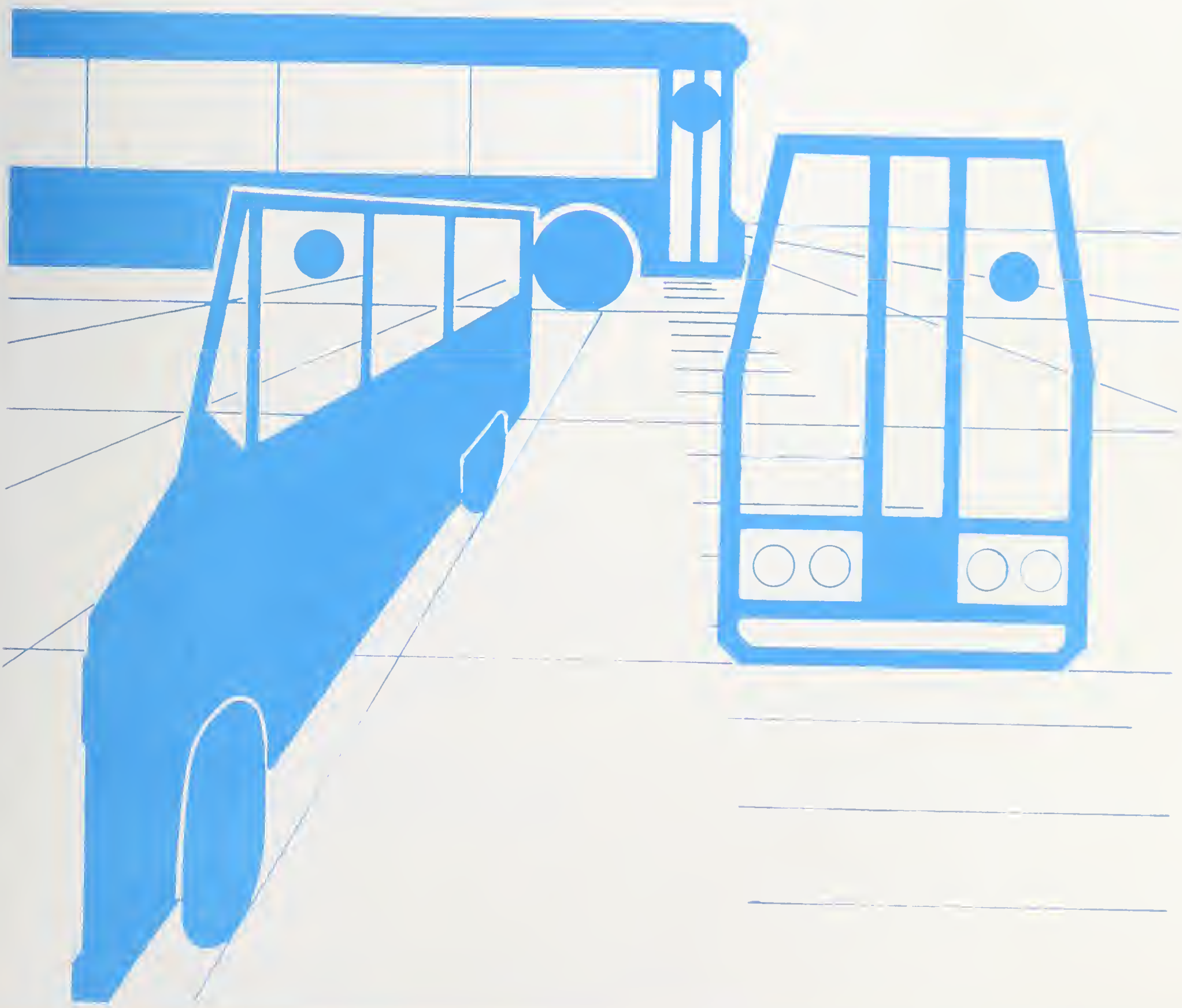
U.S. Department of Transportation

# TOP DOG

## Transit Operator Manpower Planning Model

August 1987



UMTA Technical Assistance Program

# TOP DOG
## Transit Operator Manpower Planning Model

Final Report
August 1987

Prepared by
MacDorman and Associates
4808 North 29th Street
Arlington, Virginia 22207

Prepared for
Office of Methods and Support
Urban Mass Transportation Administration
U.S. Department of Transportation
400 Seventh Street SW
Washington, D.C. 20590

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The author bears full responsibility for any errors or oversights reported herein. However, the author does not take responsibility for the results produced by TOPDOG since results are dependent on the assumptions of and information prepared by users.

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## I. INTRODUCTION

This document describes the application of Transit Operator Planning, Diagnostic, and Optimization Guidelines (TOPDOG), a model that can assist transit managers in planning and analyzing their vehicle operator requirements.

### TOPDOG OBJECTIVE AND USE

The objective of TOPDOG is to provide information that aids in determining the most cost-effective number of full-time and part-time operators (FTOs and PTOs) to employ based on service schedules and operator work assignments.[1] The model considers in this determination:

- o operator absenteeism;
- o operator wages and fringe benefits;
- o labor agreement provisions and work rules that affect operator utilization and compensation; and
- o policies or constraints that may limit the amount of operator overtime.

TOPDOG has two principal uses. The first use is to estimate the least costly work force size and composition, based on a set of scheduled runcuts. The term "optimization" is used for this manpower planning function. The second use is to estimate the cost of a specified work force size and composition for a given set of scheduled runcuts. This function is referred to as "forecasting." In both cases, detailed cost estimates are prepared for scheduled and unscheduled pay as well as for operator fringe benefits.

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1 Operator work assignments for scheduled service are typically developed through a process called "runcutting." TOPDOG uses the results of runcut-ting as a principal source of information for input to the model.

TOPDOG may also be used to:

- o estimate the costs associated with factors affecting labor productivity such as:

  - level of work (e.g., schedule changes);

  - level of operator absence;

  - use of part-time operators;

  - labor agreement provisions and work rules.

- o assist in preparing budget requirements.

- o estimate overtime labor requirements.

- o estimate the cost of special assignments such as operator training.

- o estimate personnel requirements, including operator hiring and layoffs.

TOPDOG allows an operator work force to be evaluated over two time periods:

- o a single service period, which may be defined either by a season of the year or by the work selection period for vehicle operators. The work selection period may be defined by a transit system's labor agreement or management practices.

- o multiple service periods, which may consist of up to six consecutive single service periods. Operator work force evaluation conducted over multiple service periods, for example, totaling one year, allows the user to develop optimal vacation scheduling of the operator work force.

## ORGANIZATION OF THIS GUIDE

The remainder of this document includes the following sections and appendices:

- **II.** **Summary Description**. Provides background on traditional operator work force planning objectives, key factors affecting the size and composition of the operator work force, and how TOPDOG works to improve planning procedures.

- **III.** **Getting Started with TOPDOG**. Describes the operating environment for using TOPDOG, including hardware and peripheral requirements, how to load and activate the TOPDOG program, and fundamental key strokes or entries used to navigate through the model system.

- **IV.** **Main Menu**. Presents TOPDOG's main menu and the choices available on it, and provides examples of each choice.

- **V.** **Data Base Utilities**. Provides an overview of the data structure for assistance in managing TOPDOG data, describes the types and uses of data, and presents examples of how data are stored and files updated or modified when desired.

- **VI.** **Single Period Optimization**. Describes the use of single period optimization procedures, and includes discussion of the available options supported by examples.

- **VII.** **Multiple Period Optimization**. Describes the use of multiple period optimization procedures, including discussion of the available options supported by examples.

- **VIII.** **Single Period Forecast**. Describes the use of single period forecast procedures, and discussion of the available options supported by examples.

- IX. Multiple Period Forecast. Describes the use of multiple period forecast procedures, and includes discussion of available options supported by examples.

- Appendix A. Terms and Definitions. Defines the terms and abbreviations used in this document.

- Appendix B. TOPDOG Reports. Describes the reports produced using TOPDOG.

- Appendix C. TOPDOG Methodology. Provides a description of the model design and describes how various model components operate and interact.

# II. SUMMARY DESCRIPTION

This chapter presents background information on operator work force planning objectives, key factors affecting the size and composition of the operator work force, and how TOPDOG works to improve planning procedures.

## WORK FORCE PLANNING OBJECTIVES

The objectives of operator work force planning are to retain sufficient vehicle operator resources:

- to ensure that no scheduled service is missed; and

- to minimize the payment of:

  - wages and fringe benefits when no work is available to perform (guarantees); and

  - overtime (premium) wages when there is more work to perform than operators available at regular hourly rates.

Managers responsible for planning the transit operator work force have generally relied on experience and intuitively appealing methods, such as factoring up the number of regular run operators developed through runcutting to cover anticipated open work caused by absence and vacations, that often do not yield efficient solutions. Simplistic methods often do not provide efficient solutions because of the complexity of daily absence variability and the difficulties of addressing fixed fringe benefits as a controllable cost.

Although efficiency is important, it is not the only consideration in determining the best size and composition of the operator work force. Other equally important areas are:

- public safety;

- quality of service; and

- operator performance and well-being.

Although these considerations may lead management to choose a less efficient work force structure, it is nonetheless important for managers to have reliable information that permits comprehensive examination of the tradeoffs between cost and these other factors. TOPDOG provides flexibility that permits these tradeoffs to be evaluated.

## OPEN WORK: THE IMPETUS BEHIND OPERATOR WORK FORCE PLANNING

While transit schedule makers are principally concerned with the cost of service scheduled through runcutting procedures (i.e., minimizing scheduled vehicle operator payhours and sometimes associated fringe benefits), TOPDOG is designed to evaluate unscheduled costs (both wages and fringe benefits) that are affected by the size and composition of the operator work force. Unscheduled costs are principally caused by open work. If there was no open work, transit management could rely on regular operators, and part-time operators if applicable, to meet transit service requirements. However, many factors cause open work, and the nature and dynamics of open work influence how operator work forces are planned and managed.

### Types of Open Work

There are three general categories of open work:

- Operator absence work is the largest category of open work. Operator absence can be broadly defined as any time that operators do not report for work. This includes:

  - Sick Leave. This type of absence represents lost time reported as employee illness.

- Injury-on-duty. These absences result from injuries that occur while employees are working and for which they may receive worker's compensation.

- Contractual absence. This form of absence includes absences identified in the labor agreement for which employees are typically compensated, such as jury duty, union business, military leave, funeral leave, vacations, and holidays.

- Personal absence. This category includes diverse types of absence, which may or may not be identified in the labor agreement, and for which the employee is typically not compensated. Such absences include personal business, illness in the family, child care, excused or authorized absence, tardiness, absence without leave (AWOL), or absence that is transportation-related.

- Management-requested absence. This type of absence is caused by the suspension of employees as a disciplinary action or by withholding employees from active duty pending hearings and grievance proceedings.

o Unassigned service work is the required portion of the daily service schedule that is not preassigned to operators. Open work may occur when:

  - scheduled service assignments are not offered for selection by operators during general sign-ups because they are not built into operator schedules or runs (e.g., trippers); or

  - minor service and holiday modifications between sign-ups create additional daily service. These modifications may be permanent changes (e.g., a new route) or temporary additions (e.g., service added for the Christmas shopping season).

- Non-operating assignment work consists of work assignments that require vehicle operators to perform work other than driving a vehicle in revenue service to support transit operations. Such work may include training, instruction, administrative duties, acting supervision, bus transfers, and so on. The amount of non-operating work assigned to transit operators varies considerably from one transit agency to another.

### Nature and Dynamics of Open Work

From the perspective of operator work force planning, the cause of open work is not as important as its nature and dynamics. The nature of open work refers to its predictability and management's ability to plan for the open work. More specifically, absences resulting from employee vacation, long-term illness, or military leave can be planned for in advance while absences caused by tardiness, AWOL, or bad weather cannot be precisely predicted. The dynamics of open work refer to the variability and change in open work from one day to the next. The nature and dynamics of open work are interrelated, and together provide the setting for work force management decision-making.

## FACTORS INFLUENCING THE DESIGN OF A LEAST-COST OPERATOR WORK FORCE

On a recurring basis, five factors tend to exert the greatest influence on the size and configuration of a least-cost operator work force at most transit systems. These factors are:

- the magnitude and composition of scheduled service;
- the magnitude and daily variation of open work;
- the relationships between operator wages and fringe benefits;
- the constraints on the use of part-time operators (PTOs); and
- the selection of vacation schedules.

While other factors, such as consecutive days off, can and do influence the design of the work force, changes in these factors take place less frequently at a single transit system than those listed above and are therefore generally less important in evaluating optimal conditions.

## Magnitude and Composition of Scheduled Service

The overall size of the operator work force is primarily determined by the number of runs and trippers (i.e., scheduled work assignments) prepared by schedule makers through the runcutting process. Runs are normally considered to be a full day work assignment for regular operators, although some transit systems have less-than-full-day runs[2] scheduled for regular operators. While some transit systems have few or no trippers provided through runcutting, other systems frequently have many short, unassigned pieces of work which are either worked by extraboard operators or PTOs, if applicable. Extraboard operators are also used to cover open work caused by absences, vacations, and unscheduled service.

## Magnitude and Daily Variation of Open Work

The magnitude and variability of open work has a significant impact on the design of the least-cost operator work force. As the magnitude or average daily amount of open work increases, the size of the extraboard work force should be increased to achieve optimal cost conditions. Conversely, as the magnitude of open work decreases (i.e., as the average daily absence of operators decreases) the size of the extraboard should be decreased to obtain the least-cost work force size.

Daily variation refers to the range or difference between the least/greatest day of open work assignments and the average daily open work assignments (i.e., from the extremes to the norm). Exhibit II.1 shows an

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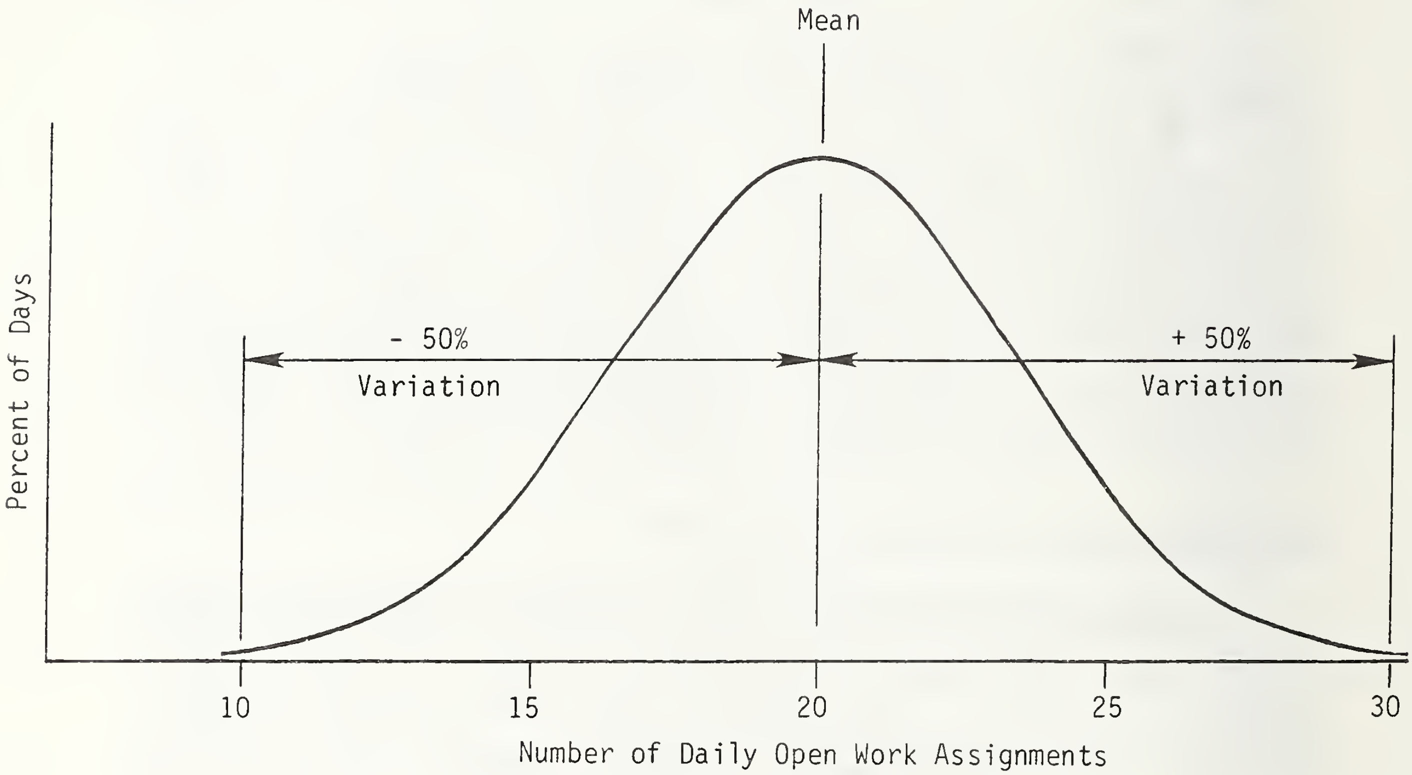
2 TOPDOG considers less-than-full-day runs as trippers.

EXHIBIT II.1

EXAMPLE OF DAILY OPEN WORK ASSIGNMENT VARIATION



example of daily open work assignment distribution where the average number of daily open work assignments is 20, the minimum is 10, and the maximum is 30. In this example, the daily open work variation is ± 50 percent.

As the absolute percentage variation of average daily open work increases, the size of the extraboard work force should be decreased and more open work assigned to overtime operators. This should be done because the greater uncertainty of open work causes the probable cost of paying overtime to be less than the probable cost of paying guarantee plus fixed fringe benefits. In other words, it is less costly under these conditions to occasionally pay overtime to a regular operator than it is to regularly pay an extraboard operator guarantee plus fixed fringe benefits.

**Relationships Between Operator Wages and Fringe Benefits**

All wages and fringe benefits directly associated with how operator labor is utilized should be considered in evaluating alternative operator configuration work force complements. In general, two types of wage payments--scheduled and unscheduled--are associated with transit operators. The amount of scheduled pay is a function of how work assignments are developed from the service plan through the scheduling and runcutting process. The operator work force size and composition do not affect scheduled pay hours but do impact unscheduled costs and fringe benefits.

The fringe benefits relevant to operator work force planning, i.e., fixed fringe benefits, are those paid to operators regardless of the number of hours they work.[3] The cost of fixed fringe benefits is determined by the number and type of operators in the work force eligible to receive such benefits. Holiday pay, vacation pay, sick pay, workers' compensation, group insurance, and uniform allowances are examples of fixed fringe benefits.

---

3 Variable fringe benefits such as FICA and often pension contributions are paid on the basis of wage earnings and are incurred whenever wage costs are incurred, including unscheduled costs.

The unscheduled costs affected by the operator work force complement can be divided into two categories: unscheduled guarantee cost and unscheduled overtime premium cost. Unscheduled guarantee cost occurs when the number of extraboard operators reporting exceeds the amount of open work that is available and wage payments for unproductive operator time are incurred. Unscheduled overtime is incurred when too few extraboard operators are available to fill open work and work must be performed by operators who are paid premium for working overtime.

The size of the operator work force largely determines its cost-effectiveness. As the number of operators increases, the cost of fixed fringe benefits and unscheduled guarantee increases, as shown in Exhibit II.2A. However, as the number of operators increases, the cost of overtime premium decreases, as shown in Exhibit II.2B. The tradeoff between hiring more operators versus using overtime labor to meet scheduled service can be addressed by summing the costs associated with the size of the operator work force. Exhibit II.2C combines the two previous exhibits to produce a total cost curve. The low point on the curve represents the least-cost operator work force size.

Exhibit II.2C also illustrates that if the relationship of operator wages to operator fringe benefits changes over time, it is likely that the optimal location shown in the exhibit will shift. In general, if fixed fringe benefits grow faster over time than operator wage rates, the number or percentage of extraboard operators will decrease under optimal conditions. The converse is also true.

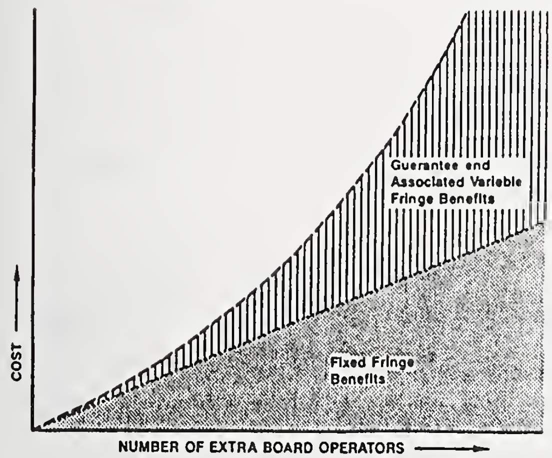
## Constraints on the Use of PTOs

The cost efficiency of the operator work force is not solely determined by its size. The mix of FTOs and PTOs must also be considered when evaluating the cost efficiency of an operator work force. PTOs are more efficient than FTOs, since they generally receive less compensation in the form of guarantees and premium pay and often receive reduced fixed fringe benefits. However, the use of PTOs is typically limited by one or

EXHIBIT II.2

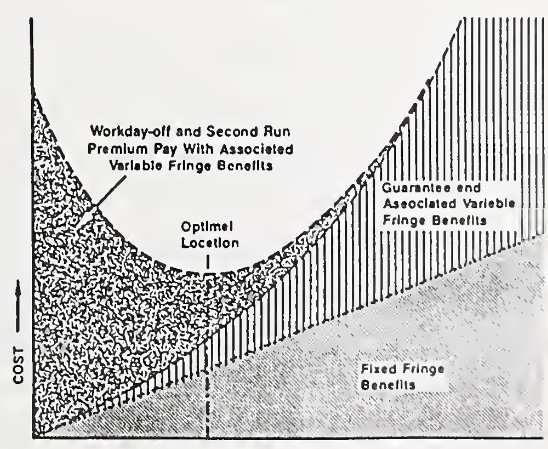
LEAST COST SIZE OF THE OPERATOR WORK FORCE

A. Cost of Extra Operators




B. Cost of Premium Pay


C. Total Unscheduled Pay



more of the following restrictions defined by a transit systems' labor agreement or management practices:

- o the number of PTOs allowed;
- o the number of weekly workdays per PTO;
- o the number of weekly work hours per PTO;
- o the number of daily work hours per PTO; and
- o the type of work that can be assigned to PTOs.

All other things being equal, the utilization of PTOs should be maximized within these constraints to maximize cost efficiency. Because the number of PTOs allowed by the labor agreement is often tied to the size of the operator work force (e.g., the number of FTOs), the size of the work force and operator mix should be addressed as a unit in evaluating the cost efficiency of the work force.

## Selection of Appropriate Vacation Schedules

Vacation time is a form of contractual absence or scheduled open work which transit managers should carefully consider when designing a least-cost operator work force. Most vehicle operators select their vacation periods once a year based on the provisions of the labor agreement and the availability of time slots throughout the year. While provisions of the labor agreement often specify a minimum percentage of vacations that should be scheduled during the summer, the scheduling of the remaining portion of vacations is the responsibility of management.

Since the magnitude of the service schedule often varies throughout the year (e.g., greater in the winter and spring, less in the summer), vacation scheduling is an opportunity to even out the size of the operator work force throughout the year and maintain a constant size work force.

As shown in Exhibit II-3, proper scheduling of vacations can "level" the manpower requirements across the year in situations where schedule requirements vary through the year. Appendix C presents a more detailed discussion of how TOPDOG may assist in planning for a uniform operator work force through vacation leveling.

## HOW DOES TOPDOG WORK FOR YOU?

TOPDOG is a menu-driven computer model designed to provide fast, accurate solutions for operator work force planning. Once the information requirements and the mechanics of navigating through the screens are understood, working with TOPDOG is fairly simple.

TOPDOG requires that certain information about the nature of scheduled service, provisions of the labor agreement, characteristics of open work, and operator wage rates and fringe benefits be input through formatted screens displayed on the video console. In addition, TOPDOG permits the amount of overtime work allowed operators to be specified as an input. Otherwise, overtime will be assigned as necessary to obtain least-cost conditions. HELP screens are available for each input item to assist the user in providing the required information. The model is designed to free the user from managing the details of a data base and includes numerous validity checks to ensure data integrity and consistency.

### TOPDOG Options

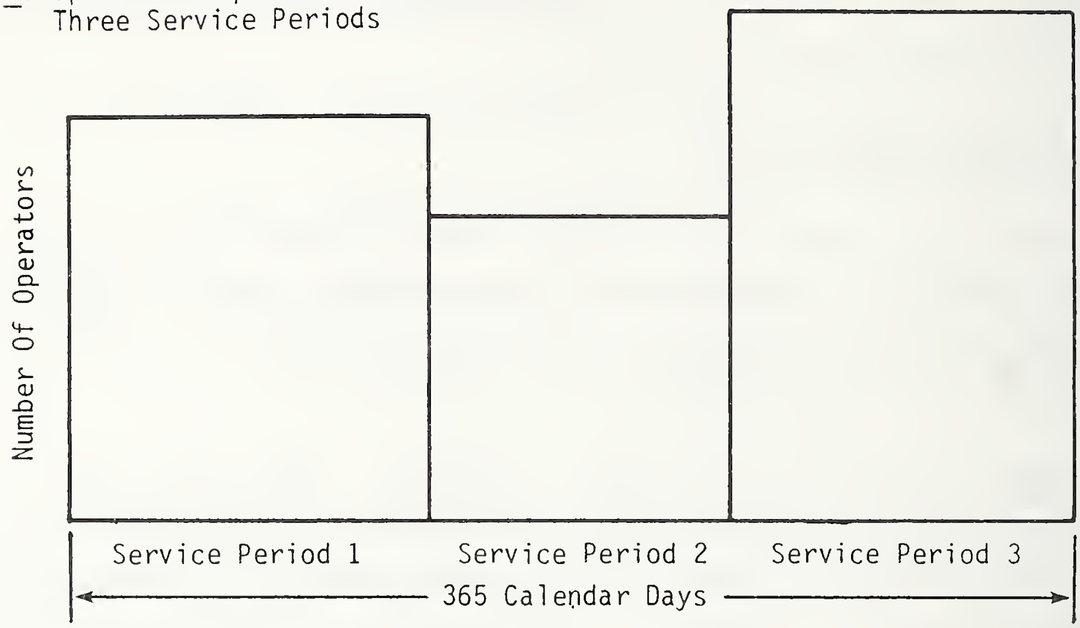
TOPDOG is programmed to permit users to evaluate an operator work force in four different ways. The choices are:

- Single Period Optimization
- Multiple Period Optimization
- Single Period Forecast
- Multiple Period Forecast

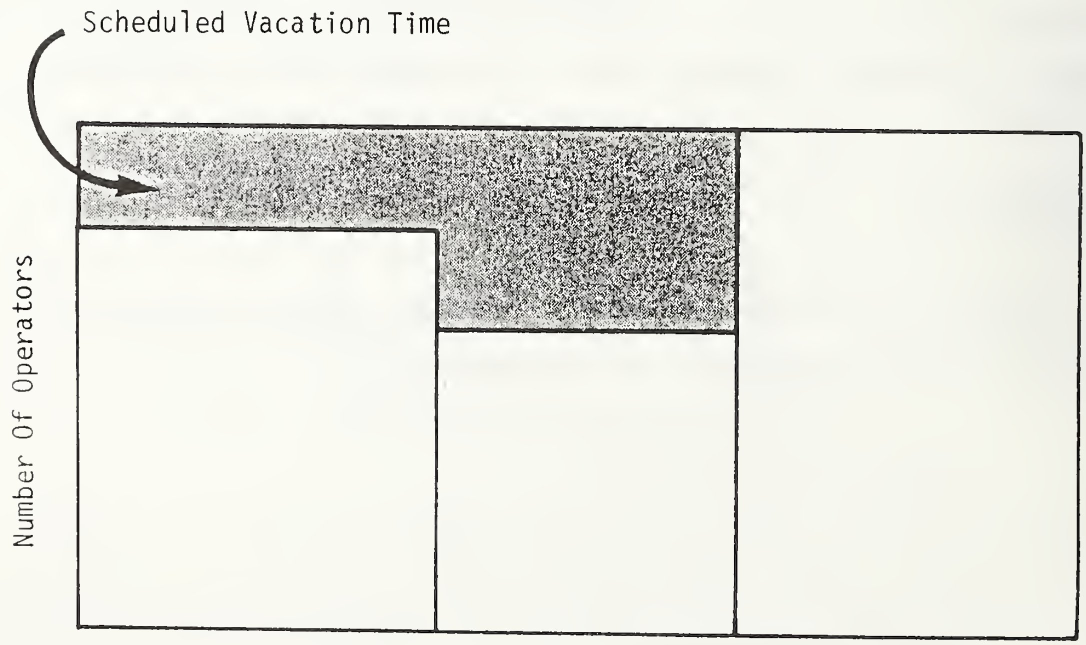
EXHIBIT II.3

OPERATOR REQUIREMENTS AND AVAILABLE VACATION TIME

A. Operator Requirements For Three Service Periods




B. Assignment of Vacation Time Using a Constant Number of Operators



Optimization refers to TOPDOG's capability to estimate the least-cost size and configuration of an operator work force given the input information described above. Forecast refers to TOPDOG's capability to estimate the cost of any work force size and configuration given certain input information. A single period is a span of time during which the service schedule generally remains constant. For some transit systems, a single period might be the duration of time defined for operator run selection or "picks" given in the labor agreement.

Multiple period refers to continuous (adjacent) combinations of single periods up to a maximum of six single periods. A good rule-of-thumb is to use the multiple period option for combinations of single periods that span one year to take advantage of the vacation leveling routine offered by the TOPDOG model.

If, for example, you were interested in estimating the least-cost operator work force size and configuration for the upcoming pick period, the Single Period Optimization option would be selected from TOPDOG's main menu. If you were interested in estimating the difference in cost between last year's actual operation (two or more pick periods) and TOPDOG's least-cost work force configuration, you would use the Multiple Period Forecast to estimate the actual costs and the Multiple Period Optimization to estimate the least cost.

## TOPDOG Output or Reports

TOPDOG produces a variety of information related to operator work force planning. A menu allows users to select from one to five reports. If you select the multiple period optimization or forecast options, the menu permits selection of a sixth report, which is a summary combination of all the single period reports contained in the multiple period output. The information contained in each report is described below.

- <u>Operator Configuration</u>. This report presents the operator configuration either generated by the model (optimization mode) or specified by the user (forecasting mode). A report, produced separately for each service period, describes the number of FTOs and PTOs scheduled to operate weekday, Saturday, and Sunday service and the number of FTOs and PTOs employed during the service period. Also provided is the percent of PTOs retained to conduct services during each service period.

- Detailed Operator Utilization. This report presents miscellaneous operator utilization information such as the estimated daily unscheduled overtime hours and average number of extra-board trippers. Reports are produced for each service period detailing information by schedule type.

- Open Work and Unassigned Trippers. This report presents information on open or unassigned work such as the expected range in the amount of daily open work. Reports are produced for each service period detailing information by type of schedule.

- Vacation Scheduling. This report presents vacation scheduling information for each service period. The report describes the number and percentage of total annual vacation days scheduled during the service period that are consistent with the optimal or user-defined operator configuration.

- Detailed Cost. This reports presents detailed cost information by schedule type for fixed fringe benefits, scheduled runs and trippers, and unscheduled guarantee and premium pay. In addition, the report contains service period information about the number of operators employed, their absences and vacations, as well as the number of unscheduled hours operators are expected to work.

- Summary Information. (For multiple periods only.) This report summarizes or combines the information from several Detailed Cost Reports into a single report for the entire multiple period of evaluation.

Examples and discussion of TOPDOG reports are provided in Appendix B.

# III. STARTING WITH TOPDOG

This chapter describes the hardware and equipment necessary to use TOPDOG; the installation of the model software, and how to activate the model and begin navigating through TOPDOG's screens with keystrokes.

## HARDWARE REQUIREMENTS

TOPDOG is designed to operate on an IBM Personal Computer (PC) or an IBM-compatible PC with 640,000 bytes of Random Access Memory (RAM),[4] a hard disk drive, and a floppy disk drive. The Disk Operating System, MS-DOS, must also be installed on the hard disk in order to use TOPDOG. In addition, you will require a monochrome video monitor[5] to view screens and input data, and a PC-compatible printer[6] to record results.

## DISK REQUIREMENTS

The TOPDOG program is written in the Turbo-Pascal software language and contains 29 files requiring almost 500k bytes of storage. Since the TOPDOG program is intended to reside on your PC's hard disk, sufficient space must be available to accommodate the program and its subdirectory.

Input data and information files reside on formatted floppy diskettes[7] in the form of a structured data base. The TOPDOG program is designed to assist you in managing the data base and automatically advises you how much of the floppy diskette's capacity is taken up by the stored data. When floppy diskettes become full, new data bases may be created using other formatted diskettes.

---

4 Some transit systems with few to moderte numbers of trippers should be able to operate successfully with 512 bytes of RAM.

5 A color video monitor is equally acceptable.

6 Dot matrix or laser printers work equally well. Reports are designed to fit on 8 1/2" x 11" paper using a 10-pitch type face.

7 Either 360k or 1.2M (Quad) floppy diskettes are suitable for data storage. However, your computer must be equipped with a 1.2M disk drive to utilize the increased capacity of the Quad diskettes.

## OBTAINING TOPDOG SOFTWARE

The TOPDOG program is provided on two diskettes which can be obtained for a nominal fee from:

TIME Support Center
Department of Civil and Environmental Engineering
Vanderbilt University
Post Office Box 1563
Station B
Nashville, Tennessee
(615) 322-3435

## LOADING TOPDOG SOFTWARE

The TOPDOG program is contained on two diskettes entitled "TOPDOG Program Files" and "TOPDOG Form Files". The files contained on these diskettes are designed to interact and therefore must be transferred onto your computer's hard disk under a separate subdirectory.

To transfer the TOPDOG files, turn on your computer and wait until the C> prompt appears on the screen of the video monitor. Create a new subdirectory on the hard disk for the TOPDOG files to reside in by typing:

```
md \topdog                    (CR)
```

Insert the TOPDOG Program Files diskette in drive A. You may now copy the TOPDOG Forms diskette onto the hard disk by typing:

```
copy a:*.* c:\topdog          (CR)
```

Repeat the process by inserting the TOPDOG Forms Files diskette in drive A and typing:

```
copy a:*.* c:\topdog          (CR)
```

Check your newly created TOPDOG directory to ensure all files were successfully transferred to the hard disk. With the C> prompt on your screen, type:

**dir** (CR)

The screen should indicate the TOPDOG directory contains 29 files, i.e., 27 TOPDOG program and form files plus 2 directory files. You may now remove the TOPDOG Forms Files diskette from drive A and together with the TOPDOG Program Files diskette, store them for possible use in installing the TOPDOG software on another computer hard disk.

## INITIALIZING TOPDOG

Before we can start to explore TOPDOG, you will need to insert a formatted floppy diskette into drive A to create a data base file for storing transit system data and information.

If your computer is not switched on, you will need to do so. With the C> prompt on the screen, type the following to gain access to the TOPDOG subdirectory:

**cd \topdog** (CR)

You are now in the TOPDOG subdirectory. With the C> prompt on the screen, you can now bring TOPDOG's Main Menu onto your video screen by typing:

**topdog** (CR)

Your screen should appear as shown in Exhibit III.1, except the date will be the current date. If the date is incorrect, you will need to enter the correct date. You should become familiar with how to change dates, when necessary, because the same keystroke procedures are used throughout TOPDOG's screen navigation and data entry processes.

## EXHIBIT III.1
## MAIN MENU SCREEN

```
                          TOPDOG MAIN MENU
Current Date: 8/15/87                          Data Base:

                 1. Set Current Date
                 2. Select/Change Data Base
                 3. Allocate New Data Base
                 4. Data Base Utilities

                 5. Single Period Optimization
                 6. Multiple Period Optimization
                 7. Single Period Forecast
                 8. Multiple Period Forecast

                 9. Quit TOPDOG

                    Enter Choice:1

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

When you first enter TOPDOG, the cursor on the Main Menu screen will be pulsing under the numeric value 9 shown next to **Enter Choice** (the Enter Choice field). If you want to change or enter a date on the Main Menu, you will need to enter 1 for **Choice 1, Set Current Date**, in the field.

Let's change the current date shown on the Main Menu by typing the numeric value one (1). Go ahead and strike the key:

**1 (CR)**

The screen's cursor has now moved to the field position where it will accept the month, day, and year in numeric format as now shown in the lower left corner of your video screen. Practice making date changes by typing in the date for September 5, 1988 as 09 05 88. After each month, day, and year entry, you must strike either the Enter key or the Carriage Return **(CR)** key as follows:

**09(CR)05(CR)88(CR)**

For TOPDOG to accept the date and return the cursor to the Main Menu Enter **Choice** field, you must strike the **F1** key after the last **CR**. Go ahead and strike the key:

F1

The cursor should now be pulsing at the **Enter Choice** field on the Main Menu. Try changing the date to other dates until you feel comfortable with the keystroke entry procedure.

The next step is to name your data base. TOPDOG requires you to establish a name for your data base that will be contained on the formatted diskette now inserted in drive A. Once you establish a name on the diskette, it will automatically appear next to Data Base in the Main Menu when the Main Menu appears in any future sessions in which you use the diskette. To name the data base, you will need to type in the numeric value three (3) corresponding to **Allocate New Data Base** on the Main Menu. Go ahead and strike the key:

**3** **(CR)**

The screen's cursor is now positioned to accept any name you wish to use as long as it does not exceed 16 characters in length. Let's select a data base name, for example, TRANS1. Go ahead and type:

**a:trans1** **(CR)** **F1**

TOPDOG has structured the diskette to accept data and information under the data base name TRANS1. You may choose any name you wish for the data base name. (You may create a second data base name on the same diskette; the procedure for doing this is described in Chapter 4.

SCREEN NAVIGATION

Before discussing other Main Menu choices or selections, it is useful to understand the basic tools and procedures available to assist you in navigating or maneuvering through TOPDOG's screens and data entry fields. At the bottom of the Main Menu screen there is an instruction line that lists a series of keys that are meaningful to TOPDOG. You have already had some experience with the **F1** and **CR** keys. The following is an explanation of the listed keys.

**F1** - Accept & Quit: This keystroke is required after data/information are entered and accepted on TOPDOG's screens for acceptance into the data base. The striking of the **F1** key must be preceded by the striking of the **CR** key and will always return the cursor to the previous menu selection position.

**F3** - Default: Striking this key will insert TOPDOG's default value into a data entry cell, if applicable. The default value which appears after striking the F3 key may be changed by typing in any other valid TOPDOG value desired.

**F10** - Help: Striking this key will bring up a screen that is designed to help you better understand the meaning of the requested data. The contents of all HELP screens are given in Appendix A.

**ESC** - Quit & Reset: Striking this key takes the cursor back to its previous menu selection position without accepting any data entries or modifications made before the key was struck.

**CR** - Clear/Accept Entry: The Enter or Return keystroke is required after data entry for the data to be accepted in the field. This keystroke may also be used to clear existing data in a field.

-->: The right arrow keystroke is used to move the screen cursor through data cell positions in a field from left to right and/or from top to bottom.

<--: The left arrow keystroke is used to move the screen cursor through data cell positions in a field from right to left and/or from bottom to top.

Now that you know about the hardware requirements, loading the software, activating the model, and some basic keystroke instructions used to navigate TOPDOG's screens, we can begin to explore the options in the Main Menu and when to use them.

## EXITING TOPDOG

To shut down your PC, strike Main Menu Choice 9, Quit TOPDOG, to return to a C> prompt on the screen. This is extremely important to remember because failure to do so will damage the files contained in your floppy diskette data base. As you build larger data bases over time, it is highly recommended you make back-up copies of diskettes in the event you fail to remember the shut down procedures.

# IV. MAIN MENU

The main menu is the central control point for all TOPDOG programs--the place where all activities begin and end. This chapter of the User's Guide discusses Main Menu choices and gives examples of how each is used to either manage data or evaluate operator work forces. The nine sections that follow correspond to the nine choices presented on the Main Menu.

If your PC is not turned on, do so at this time and wait until the C> prompt appears on your video monitor screen. Insert your floppy diskette containing your data base file TRANS1 into drive A and type the following:

**cd\topdog** **(CR)**

You should now be in the TOPDOG subdirectory. Type the following to bring the Main Menu on your monitor screen:

**topdog** **(CR)**

Your screen should look like Exhibit IV.1.

## 1. SET CURRENT DATE

**Choice 1, Set Current Date,** is required to proceed beyond TOPDOG's Main Menu. Under normal circumstances, the current date should automatically appear at the same time your Main Menu appears on your monitor screen. If the current date is shown, proceed to Choice 2. If it does not or if you wish to change the date, strike the numeric key:

**1**

The screen's cursor will move to the field where it will accept the month, day and year in numeric format now shown in the lower left corner of the monitor screen as mm/dd/yy. Remember, as previously discussed in Chapter II, each month, day and year entry must be followed by striking either the

EXHIBIT IV.1

MAIN MENU SCREEN DATA BASE A: TRANS1

TOPDOG MAIN MENU

Current Date: 8/15/87 Data Base:a:trans1

1. Set Current Date
2. Select/Change Data Base
3. Allocate New Data Base
4. Data Base Utilities

5. Single Period Optimization
6. Multiple Period Optimization
7. Single Period Forecast
8. Multiple Period Forecast

9. Quit TOPDOG

Enter Choice:1

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->

Carriage Return **(CR)** or the Enter key. Striking the F1 key after the last **(CR)** permits TOPDOG to accept the date and return the cursor to the Main Menu **Enter Choice** position. If your cursor is positioned to enter the date, but you choose not to change the date, you may return the cursor to the Main Menu **Enter Choice** position by striking the F1 key.

The date that appears or is entered on the monitor screen will also appear on all other screens as well as all output reports produced by TOPDOG. After working with TOPDOG, you will find the date feature useful in managing data and evaluations of the operator work force.

## 2. SELECT/CHANGE DATA BASE

**Choice 2, Select/Change Data Base,** permits TOPDOG to work with many data sets that may be stored in files contained on one or more floppy diskettes. In Chapter III, you named the data base contained on the diskette now residing in drive A, TRANS1. This name should have appeared automatically next to Data Base: in the upper right corner of your monitor screen, as shown in Exhibit IV.1, when the Main Menu first appeared.

TOPDOG requires both **Choice 1, Set Current Date,** and **Choice 2, Select/Change Data Base,** to be completed before you may proceed with using the model. If your floppy diskette for storing data is inserted into drive A and no name appears in the Data Base: field, either:

1. TOPDOG failed to read the name on the diskette; or

2. No name has been entered on the diskette that TOPDOG understands (i.e., no valid name).

Assuming the data base name TRANS1 was entered as described in Chapter III, try striking the numeric key:

**2**

The screen's cursor should now be positioned to accept the data base name by typing:

**a:trans1 (CR)**

followed by the **F1** key. TOPDOG will either recognize and enter the date base name, returning the cursor to the **Enter Choice** position, or send you a message in the lower left corner of the monitor screen, as shown in Exhibit IV.2, that the data base (is) not available. The cursor will not return to the **Enter Choice** position until you strike **Esc** key. If TOPDOG does not recognize the data base name or you wish to create a second data base on the same floppy diskette, select **Choice 3, Allocate New Data Base**.

## 3. <u>ALLOCATE NEW DATA BASE</u>

**Choice 3, Allocate New Data Base**, must be used to establish a new data base for storing input data on floppy diskettes. TOPDOG permits the use of two separate data bases on the same diskette. Therefore, to make maximum use of diskette storage capacity, two different data base names should be used.

In the discussion of **Choice 2, Select/Change Data Base**, above, you may have been unsuccessful in communicating your data base name to TOPDOG.

EXHIBIT IV.2

MAIN MENU SCREEN, DATA BASE NOT AVAILABLE

```
                         TOPDOG MAIN MENU
Current Date: 8/15/87                               Data Base:transl

                 1. Set Current Date
                 2. Select/Change Data Base
                 3. Allocate New Data Base
                 4. Data Base Utilities

                 5. Single Period Optimization
                 6. Multiple Period Optimization
                 7. Single Period Forecast
                 8. Multiple Period Forecast

                 9. Quit TOPDOG

                    Enter Choice:2

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Data base not available
```

If so, you can now create the data base name TRANS1 by striking the numeric key:

**3**

The screen's cursor should now be in position to enter the data base name. With your formatted floppy diskette in drive A, type the following:

**a:trans1 (CR)**

followed by the **F1** key. The message in the lower left corner of the monitor screen should indicate that TOPDOG is formatting space on the diskette to accept the TRANS1 data base. When TOPDOG is finished allocating or formatting, the screen's cursor should return to the **Enter Choice** location on the Main Menu. Your screen should then appear as shown in Exhibit IV.1.

Now that a data base, TRANS1, has been established, you have the option of creating a second data base on the same diskette or, alternatively, waiting until the first data base, TRANS1, is full or at capacity. If you wish to create the second data base, which could be called TRANS2, repeat the same steps you took to create the TRANS1 data base. Strike the numeric key:

**3**

and type the following:

**a:trans2 (CR)**

followed by the **F1** key. Again, the message in the lower left corner of your monitor screen will indicate that TOPDOG is formatting space on the floppy diskette for the data base. When the formatting is completed, your cursor should return to the **Enter Choice** field on the Main Menu and your screen should appear as shown in Exhibit IV.3.

## EXHIBIT IV.3

## MAIN MENU SCREEN, DATA BASE A: TRANS2

```
                         TOPDOG MAIN MENU
Current Date: 8/15/87                               Data Base:a:trans2

                   1. Set Current Date
                   2. Select/Change Data Base
                   3. Allocate New Data Base
                   4. Data Base Utilities

                   5. Single Period Optimization
                   6. Multiple Period Optimization
                   7. Single Period Forecast
                   8. Multiple Period Forecast

                   9. Quit TOPDOG

                      Enter Choice:3

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

Before moving on to the next Main Menu choice, practice changing the data base name by selecting Choice 2 and entering the name of the first data base created, TRANS1. Strike the numeric key:

**2**

and type the following:

**a:trans1 (CR)**

followed by the **F1** key. Your monitor screen should appear as shown in Exhibit IV.2.

Remember that if you decide to stop work and turn off the power of your PC, first strike Main Menu **Choice 9, Quit TOPDOG,** to return to a C> prompt on the screen. Failure to follow this procedure whenever you decide to shut down your PC may result in permanent damage to your floppy diskette files.

## 4. DATA BASE UTILITIES

**Choice 4, Data Base Utilities,** provides you with the capability to effectively manage the input data and information used in the TOPDOG model. Essentially, Data Base Utilities is a tool for data housekeeping. You may view the Data Base Utilities (DBU) Menu by striking the numeric key:

**4**

Your monitor screen should appear as shown in Exhibit IV.4. The DBU Menu screen tells you the current date, the data base name, and how much storage space has been used by "packets" and "components." Packets and components are names used by TOPDOG for groupings of input data that will be discussed in greater detail, along with a full exploration of the DBU Menu choices, in Chapter V, DATA BASE UTILITIES. In summary, the DBU Menu permits you to view the content and/or delete groups or all of the data contained in the indicated data base.

## EXHIBIT IV.4

## DATA BASE UTILITIES MENU SCREEN

```
                              DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl           consists of  0 Packets and   0 Components
                            and uses  2% of Capacity

Current Packet:                                   Current Component:

                   1. Copy Data Base (to) Data Base
                   2. Delete Data Base

                   3. View Packet Names
                   4. View Packet Description
                   5. Delete Packet

                   6. View Component Names
                   7. View Component Content
                   8. Delete Component

                   9. Exit to Main Menu

                      Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

Strike the numeric key:

**9**

to exit or return to the Main Menu.

## 5. SINGLE PERIOD OPTIMIZATION

**Choice 5, Single Period Optimization (SPO),** may be used to estimate the least-cost number of operators for one service period.[8] Choice 5 is typically used to estimate the least-cost operator work force size in the upcoming service period after the scheduling department performs the runcutting process. It may also be used for research purposes to compare theoretically optimal conditions with the actual results of known single service periods. In all cases, you must be able to estimate the percentage of annual operator vacation days that will be (or were) used during the service period.

After setting the current date and selecting or allocating a data base, it is recommended that you select Choice 5 to familiarize yourself with TOPDOG. To view the SPO Menu on your monitor screen, strike the numeric key:

**5**

Your screen should appear as shown in Exhibit IV.5. The SPO Menu provides ten choices as well as descriptive information for housekeeping purposes. **Choice 5, Single Period Optimization,** is discussed in detail in Chapter VI of this guide.

---

8 A service period is defined as a span of time when the number of scheduled work assignments (i.e., runs and trippers) remain relatively constant. At many transit systems, a service period coincides with the work assignment selection or pick period specified by labor agreement provisions.

## EXHIBIT IV.5

## SINGLE PERIOD OPTIMIZATION MENU SCREEN

```
Current Date: 8/15/87         SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                           Report Destination:lst:
Packet Name:
Service Period is from   / /   to   / /
Description:


                            Component                             Exist  Latest Changes
                              Names    Complete  Consistent  in DB       Saved
         Global Data
 Service Period Data
      OT Constraints

              1. Set Packet Name              6. Modify Service Period Data
              2. Set Packet Description       7. Modify OT Constraints
              3. Set Component Names          8. Optimize
              4. Set Service Period           9. Save Package/Component Data
              5. Modify Global Data           0. Exit to Main Menu

                                   Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

To return to the Main Menu, strike the numeric key:

**0**

## 6. MULTIPLE PERIOD OPTIMIZATION

**Choice 6, Multiple Period Optimization (MPO),** may be used to estimate the least-cost number of operators for more than one but not greater than six (6) service periods. Choice 6 is frequently used to estimate the least-cost operator work force over future periods of time (e.g., one year). MPO's principal advantage over SPO (Choice 5) is its ability to "level" manpower requirements across the year through careful scheduling of vacations in situations where service period operator requirements[9] are different. Multiple Period Optimization for the next year is best used just before operators select their annual vacations to assist management in determining the optimal schedule of operator vacation slots. Multiple Period Optimization is also useful for projecting future operator requirements and costs (e.g., personnel and budgeting functions).

The MPO Menu and screens are similar to those used by SPO. To view the MPO Menu on your monitor screen, strike the numeric key:

**6**

Your screen should appear as shown in Exhibit IV.6. The MPO Menu provides ten choices as well as descriptive information for housekeeping purposes. **Choice 6, Multiple Period Optimization,** is discussed in detail in Chapter VII of this guide.

---

9 Differences in service period operator requirements are typically the result of differences in scheduled runs and trippers, absence rates, and nonscheduled work assignments.

## EXHIBIT IV.6

## MULTIPLE PERIOD OPTIMIZATION MENU SCREEN

```
Current Date: 8/15/87        MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:                                                    Period
There are   Service Periods starting   / /      / /      / /    End Date
                                       / /      / /      / /      / /
Description:


                        Component                           Exist  Latest Changes
                          Names    Complete  Consistent  in DB      Saved
        Global Data
 Service Period Data
     OT Constraints

          1. Set Packet Name             6. Modify Service Period Data
          2. Set Packet Description      7. Modify OT Constraints
          3. Set Component Names         8. Optimize
          4. Set Service Periods         9. Save Package/Component Data
          5. Modify Global Data          0. Exit to Main Menu

                              Enter Choice:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

To return to the Main Menu, strike the numeric key:

**0**

7. SINGLE PERIOD FORECAST

**Choice 7, Single Period Forecast (SPF),** may be used to estimate the cost of a given number of operators for one service period. Choice 7 is often used to compare the cost of an existing operator work force against the cost estimated by Single Period Optimization (Choice 5) for the same period. If the same number of operators determined by the Single Period Optimization process are input into the Single Period Forecast, under the same service schedule and operating conditions, the resulting cost estimates each produces will be equal.

To view the SPF Menu on your monitor screen, strike the numeric key:

**7**

Your screen should appear as shown in Exhibit IV.7. Except for the menu title and some of the data entry labels, the SPF Menu appears the same as the SPO Menu shown in Exhibit IV.5. **Choice 7, Single Period Forecast,** is discussed in detail in Chapter VIII of this guide.

To return to the Main Menu, strike the numeric key:

**0**

8. MULTIPLE PERIOD FORECAST

**Choice 8, Multiple Period Forecast (MPF),** may be used to estimate the cost of a given operator work force for more than one but not greater than six (6) service periods. Choice 8 is most often used to compare the cost of a given operator work force against the cost of the least-cost operator work force estimated by Multiple Period Optimization (Choice 6) for the same annual period. MPF may also be used to help plan for personnel

EXHIBIT IV.7

SINGLE PERIOD FORECAST MENU SCREEN

```
Current Date: 8/15/87         SINGLE PERIOD FORECAST
Data Base:a:transl                          Report Destination:lst:
Packet Name:
Service Period is from   / /   to   / /
Description:


                           Component                            Exist  Latest Changes
                             Names    Complete  Consistent  in DB       Saved
           Global Data
   Service Period Data
Operator Configuration

          1. Set Packet Name              6. Modify Service Period Data
          2. Set Packet Description       7. Modify Operator Configuration
          3. Set Component Names          8. Forecast
          4. Set Service Period           9. Save Package/Component Data
          5. Modify Global Data           0. Exit to Main Menu

                             Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

changes over future periods of time as well as to provide important information for annual budgets.

To view the MPF Menu on your monitor screen, strike the numeric key:

**8**

Your screen should appear the same as shown in Exhibit IV.8. Except for the menu title and some of the data entry labels, the MPF Menu appears the same as the MPO Menu shown in Exhibit IV.6. **Choice 8, Multiple Period Forecast,** is discussed in detail in Chapter IX of this guide.

To return to the Main Menu, strike the numeric key:

**0**

9. <u>QUIT TOPDOG</u>

**Choice 9, Quit TOPDOG,** must always be used before removing floppy diskettes from the drives and/or shutting down the power of your PC. Failure to do so will result in irreparable damage to your data base files. It is always good practice to make back-up copies of your data base diskettes after each session with TOPDOG. The procedures for copying diskettes are discussed in Chapter III of this guide.

EXHIBIT IV.8

MULTIPLE PERIOD FORECAST MENU SCREEN

```
Current Date: 8/15/87        MULTIPLE PERIOD FORECAST
Data Base:a:transl                       Report Destination:lst:
Packet Name:                                                    Period
There are   Service Periods starting   / /     / /     / /    End Date
                                       / /     / /     / /      / /
Description:


                        Component                          Exist  Latest Changes
                          Names    Complete  Consistent   in DB       Saved
           Global Data
   Service Period Data
Operator Configuration

         1. Set Packet Name           6. Modify Service Period Data
         2. Set Packet Description    7. Modify Operator Configuration
         3. Set Component Names       8. Forecast
         4. Set Service Periods       9. Save Package/Component Data
         5. Modify Global Data        0. Exit to Main Menu

                             Enter Choice:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

# V. DATA BASE UTILITIES

This chapter describes the contents and uses of Main Menu Choice 4, **Data Base Utilities.** The purpose of Data Base Utilities is to assist TOPDOG users in managing the data that will naturally accrue over time while using the model. The chapter begins with an explanation of why input data are structured into groups called components and packets. This is followed by a discussion of component data screens and how component data are combined into packets to evaluate the operator work force. Lastly, the Data Base Utilities menu choices or options are discussed with examples of how each is used to manage information.

## DATA STRUCTURE OVERVIEW

Transit systems normally operate service from one or more geographic locations called divisions.[10] Larger transit systems may operate motor-bus service from certain divisions and rail service from others. TOPDOG is designed to treat each division independently for purposes of evaluating the operator work force size and configuration. This was done so that TOPDOG would be sensitive to the existing differences among divisions in service characteristics and operating performance.[11] There are generally no differences, however, among divisions in labor agreement provisions and work rules; the same labor agreement provisions and work rules almost always apply across divisions operating the same mode of service. Therefore, TOPDOG uses the same information on labor agreement provisions and work rules for each division.

TOPDOG has been structured to accept data and information into groups or compartments called components to minimize the repetition of input data when evaluating many alternative work force conditions. Labor agreement

---

10 Divisions are sometimes called garages, stations, depots, bases, etc.

11 Only those instances where there is a common extraboard for two or more divisions is TOPDOG capable of providing a reliable evaluation of more than one location at a time.

provisions and work rules are input into a single component that is used in the analysis of all divisions and periods. Division data, on the other hand, are input into separate division components. When an analysis is made of a division, TOPDOG uses the specific division's data components along with the single labor agreement component.

## COMPONENTS

TOPDOG's program options for evaluating operator work forces were briefly described in Chapter IV and are selected from the Main Menu screen as:

- **Choice 5--Single Period Optimization (SPO)**
- **Choice 6--Multiple Period Optimization (MPO)**
- **Choice 7--Single Period Forecast (SPF)**
- **Choice 8--Multiple Period Forecast (MPF)**

Each of these Main Menu choices contains a series of component screens for entering data into data components. These components are named:

- Global Data
- Service Period Data
- Overtime Constraints Data
- Operator Configuration Data

Global Data and Service Period Data components are used by all four TOPDOG work force evaluation programs selected through Main Menu Choices 5 through 8 (i.e., SPO, MPO, SPF and MPF). The Overtime Constraints Data component is used only by TOPDOG optimization programs SPO and MPO (Choices 5 and 6) while the Operator Configuration Data component is used only by TOPDOG forecasting programs SPF and MPF (Choices 7 and 8). TOPDOG requires each component data set to be named with up to eight alphabetic and/or numeric characters. Good management and data housekeeping practices dictate that a logical identification system be used, though this will not be discussed at this introductory stage of learning about TOPDOG.

The four data components were designed to permit an easy exchange of the common data used to evaluate alternative work forces. The four components are described in the following paragraphs.

## Global Data

Global Data are data and information that are common across all transit system divisions operating the same mode of service. The data pertain to full-time operator (FTO) and part-time operator (PTO) labor agreement provisions, work rules, wage rates, and fringe benefits. Exhibit V.1 shows the Global Data screen (without data) common to the SPO, MPO, SPF, and MPF programs. The screen is horizontally divided into two parts for FTOs and PTOs. Details concerning specific data requirements are given in Chapters VI through IX. Definitions of the terms used in the screen are provided in Appendix A.

## Service Period Data

Service Period Data are data and information that are division-oriented, i.e., data that apply only to a single fixed route and schedule mode operating period from a single location. The information entered into this component must be consistent with the runcutting information produced by your transit system's scheduling department.

Exhibit V.2 shows a Service Period Data screen, without input data, used for the SPO and SPF. The only differences between the screen shown in Exhibit V.2 and the ones used in MPO and MPF are the title of the screen and the number of screens corresponding to the number of service periods under evaluation (a maximum of six service periods and screens).

The data and information required to complete the Service Period Data screen may be divided into as many as three types corresponding to service schedules named Weekday, Saturday and Sunday. Each entry field must be completed for TOPDOG to accept the entire screen of information. Service that differs from the three service schedules, e.g., general holidays or school holidays, must be included in the schedule column that comes closest to matching the regular service schedule. Special service types

EXHIBIT V.1

GLOBAL DATA SCREEN

```
Current Date: 8/15/87                 GLOBAL DATA
Component Name:ABCGD       PART 1 - FULL TIME OPERATORS

        Minimum Hours for a Run:  :     ---------- Averages ----------
  Minimum Pay Hours for Trippers:  :              Hourly Wage Rate:
         Minimum % Bid Trippers:        Variable Fringe Benefit Rate:
 Effective Daily Guarantee Hours:  :    Annual Fixed Fringe Benefits:
Regular Weekly Scheduled Days Off:              Annual Vacation Days:
Must Days Off be Consecutive (Y/N)?:
------------------------------------------------------------------------------
                           PART 2 - PART TIME OPERATORS

               Max Allowed PTOS:        ---------- Averages ----------
  Max Allowed Daily Work Hours:   :              Hourly Wage Rate:
  Max Allowed Weekly Work Days:         Variable Fringe Benefit Rate:
 Max Allowed Weekly Work Hours:   :     Annual Fixed Fringe Benefits:
  Max Allowed % as a % of FTOS:                 Annual Vacation Days:
Max Allowed % as a % of FTOS + PTOS:
 Minimum Pay Hours for Trippers:   :

         Can PTOS Work Split Assignments (Y/N)?
          Can PTOS Work Sat/Sun Schedule (Y/N)?
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

EXHIBIT V.2

SINGLE PERIOD DATA SCREEN

```
                    SINGLE PERIOD DATA for Component ABCSP
                     Service Period from  1/ 5/86 to  6/14/86

     Current Date: 8/15/87                 Weekday     Saturday    Sunday
                                           -------     --------    ------
                Number Days Operated:
                         Number Runs:
                Number A.M. Trippers:
                Minimum A.M. Tripper:         :           :           :
                Maximum A.M. Tripper:         :           :           :
                Number P.M. Trippers:
                Minimum P.M. Tripper:         :           :           :
                Maximum P.M. Tripper:         :           :           :
  Average Number Nonscheduled Assigns:
            FTO Absence Rate Percent:
            PTO Absence Rate Percent:
         Open Work Variation (+/- %):
Average FTO Full Day Assignment Hours:        :           :           :
       Percent No-Work-Available Paid:
  Total Daily Scheduled Run Pay Hours:

      % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

may also be entered into columns where there is no service. For example, if your transit system offered no scheduled Sunday service, but the scheduled holiday service was unlike Weekday and Saturday scheduled service, then the holiday service data may be entered into the Sunday service column.

Information required to complete the Service Period Data screen includes:

- o number of days during the service period when each type of schedule is operated;
- o number of scheduled runs operated under each schedule type;
- o number of scheduled A.M. and P.M. trippers operated under each schedule type;
- o clock time span of the minimum and maximum length A.M. and P.M. scheduled tripper;
- o number of full-day nonscheduled work appointments;
- o average absence rates of FTOs and PTOs;
- o percentage maximum daily variation of the average absence rate;
- o average clock time length of FTO work assignments;
- o average percentage of time that daily guarantee payments are made to FTOs when no work assignments are available;
- o total run pay hours for each schedule type, taken directly from the scheduling department's runcut for the service period; and
- o percentage FTO annual vacation days scheduled during the service period.

Percentage of annual vacation days is an optional data entry requirement for MPO depending on the transit systems labor agreement provisions or management policies.

### Overtime Constraints Data

The Overtime Constraints Data component allows you the option of constraining the use of FTO overtime using either the SPO or MPO programs. As shown by the Overtime Constraints Data screen in Exhibit V.3, constraints may be imposed on the percentage of unscheduled overtime, the percentage of work day-off assignments, the percentage of unscheduled overtime, or combinations of these three by schedule type. While you can conduct either SPO or MPO without restricting FTO overtime, the results of unconstrained overtime may be unacceptable to transit system management.

### Operator Configuration Data

The Operator Configuration Data component is required when using either the SPF or MPF programs. When using either forecast program, TOPDOG's cost estimating routines will evaluate the number of operators scheduled to report, by service schedule type (i.e., weekday, Saturday and Sunday), against the data entered into the Global and Service Period screens. As shown by the SPF screen in Exhibit V.4, the number of FTOs (including all extraboard operators) and PTOs scheduled to report for each service schedule type must be complete for TOPDOG to estimate the costs of the given operator configuration.

## PACKETS

A packet is the name given to a set of data and information consisting of three (3) components that must include:

- global data;

EXHIBIT V.3

SINGLE PERIOD OPTIMIZATION OVERTIME

CONSTRAINTS DATA SCREEN

```
        SINGLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA for
              Service Period from  1/ 5/86 to  6/14/86
     Current Date: 8/15/87                Component Name:ABCOT
          Maximum Average Daily     Weekday     Saturday     Sunday
          ---------------------     -------     --------     -------
   % Unscheduled Overtime Hours:
                % WDO Assignments:
 % Unscheduled Overtime Trippers:




F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

EXHIBIT V.4
SINGLE PERIOD FORECASTING OPERATION
CONFIGURATION DATA SCREEN

```
        SINGLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for
                Service Period from  1/ 5/86 to  6/14/86
       Current Date: 8/15/87            Component Name:ABCOC
                           OPERATORS SCHEDULED
                     Weekday     Saturday     Sunday
                     -------     --------     ------

         Full Time:
         Part Time:



F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

- service period data; and
- either:
  - overtime constraint data for optimization (SPO and MPO), or
  - operator configuration data for forecasts (SPF and MPF).

TOPDOG requires each packet to be named with up to eight alphabetic and/or numeric characters. The packet name cannot be the same as any component name nor can any component name within the same packet be the same. Packet names can only be used once--that is, their composition of components and associated data must be unique.[12] Conversely, any component may be used as many times as necessary in different packets. Exhibit V.5 presents an illustration of how the same Global and Overtime Constraint Data components may be used to evaluate operator work for three divisions at a transit system using SPO.

Exhibit V.6 shows how one transit system division's present operator work force may be compared to the least-cost operator work force using the same Global and Service Period Data components. Exhibit V.7 illustrates how the same Global and Service Period Data may be used to evaluate the cost of three different operator configurations at one transit system division.

## DATA BASE UTILITIES MENU

Before discussing the Data Base Utilities (DBU) Menu, first bring the menu up on the monitor screen with the data base TRANS1 contained on the floppy diskette inserted into drive A. You may refer to Chapter IV, Main Menu, of this guide for the procedures used to bring the DBU Menu to the monitor screen. Your monitor screen should appear the same as shown in Exhibit V.8.

---

[12] While it is possible to designate the same three components with different packet names, it is not efficient to do so.

EXHIBIT V.5
COMPONENT DATA SETS FOR SPO
OF THREE TRANSIT SYSTEM DIVISIONS

| | COMPONENTS | | |
|---|---|---|---|
| DIVISION/ PACKET NAME | GLOBAL DATA NAME | SERVICE PERIOD DATA NAME | OVERTIME CONSTRAINT DATA NAME |
| Red Division/ AFP | A | F | P |
| Blue Division/ AGP | A | G | P |
| Green Division/ AHP | A | H | P |

EXHIBIT V.6
COMPONENT DATA SETS FOR
SPO VS. SPF OF ONE
TRANSIT SYSTEM DIVISION

| | COMPONENTS | | | |
|---|---|---|---|---|
| DIVISION/ PACKET NAME | GLOBAL DATA NAME | SERVICE PERIOD DATA NAME | OVERTIME CONSTRAINT DATA NAME | OPERATOR CONFIGURATION DATA NAME |
| Red Division Optimization/ AFP | A | F | P | — |
| Red Division Forecast/ AFX | A | F | — | X |

EXHIBIT V.7
COMPONENT DATA SETS FOR SPF
OF THREE ALTERNATIVE
OPERATOR CONFIGURATIONS AT THE
SAME TRANSIT SYSTEM DIVISION

| | COMPONENTS | | |
|---|---|---|---|
| DIVISION/ PACKET NAME | GLOBAL DATA NAME | SERVICE PERIOD DATA NAME | OPERATOR CONFIGURATION DATA NAME |
| Red Division/ AFX | $\boxed{A}$ | $\boxed{F}$ | $\boxed{X}$ |
| Red Division/ AFY | $\boxed{A}$ | $\boxed{F}$ | $\boxed{Y}$ |
| Red Division/ AFZ | $\boxed{A}$ | $\boxed{F}$ | $\boxed{Z}$ |

EXHIBIT V.8

DATA BASE UTILITIES MENU SCREEN

DATA BASE UTILITIES MENU

Current Date: 8/15/87
Data Base a:transl consists of 0 Packets and 0 Components
and uses 2% of Capacity

Current Packet: Current Component:

1. Copy Data Base (to) Data Base
2. Delete Data Base

3. View Packet Names
4. View Packet Description
5. Delete Packet

6. View Component Names
7. View Component Content
8. Delete Component

9. Exit to Main Menu

Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->

The nine sections that follow correspond to the nine choices presented on the DBU Menu.

### 1. Copy Data Base (to) Data Base

**Choice 1, Copy Data Base (to) Data Base,** allows you to copy the current data base shown in the upper left corner of the DBU Menu screen to another data base. If, for example, you wish to transfer the contents of TRANS1 to a data base named TRANS3, you would need to select the drive (and subdirectory, if necessary) where TRANS3 will reside, as described in Chapter 3.

After having selected the drive, go ahead and strike the numeric key:

**1**

Your cursor should now be located to the right of **Choice 1, Copy Data Base (to) Data Base,** and the monitor screen should appear as shown in Exhibit V.9 with the message **Enter data base name** highlighted in the lower left corner. Type:

**c:\topdog\trans3 (CR)**

The monitor screen should now appear as shown in Exhibit V.10. Now strike the **F1** key. TOPDOG will transfer the contents of the TRANS1 data base contained on the topdog diskette in drive A to the TRANS3 data base contained in the subdirectory topdog on drive C. Copying will take approximately one minute.

After the data base is copied, the cursor will return to the DBU Menu **Enter Choice** field and the monitor screen should appear as shown in Exhibit V.11 with a message in the lower left corner indicating the data base was successfully copied.

EXHIBIT V.9

DATA BASE UTILITIES MENU SCREEN,

CHOICE 1, COPY DATA BASE

```
                              DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl             consists of  0 Packets and   0 Components
                              and uses  2% of Capacity

Current Packet:                                        Current Component:

                        1. Copy Data Base (to) Data Base
                        2. Delete Data Base

                        3. View Packet Names
                        4. View Packet Description
                        5. Delete Packet

                        6. View Component Names
                        7. View Component Content
                        8. Delete Component

                        9. Exit to Main Menu

                           Enter Choice:1

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter data base name; then hit F1, ESC to ignore.
```

EXHIBIT V.10

DATA BASE UTILITIES MENU SCREEN

WITH COPY DATA BASE TO TRANS3

```
                        DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:trans1          consists of  0 Packets and   0 Components
                           and uses  2% of Capacity

Current Packet:                                  Current Component:

                     1. Copy Data Base (to) Data Base c:\topdog\trans3
                     2. Delete Data Base

                     3. View Packet Names
                     4. View Packet Description
                     5. Delete Packet

                     6. View Component Names
                     7. View Component Content
                     8. Delete Component

                     9. Exit to Main Menu

                        Enter Choice:1

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter data base name; then hit F1, ESC to ignore.
```

EXHIBIT V.11

DATA BASE UTILITIES MENU SCREEN,
DATA BASE COPIED SUCCESSFULLY

```
                                 DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl          consists of  0 Packets and   0 Components
                           and uses  2% of Capacity

Current Packet:                                  Current Component:

                  1. Copy Data Base (to) Data Base c:\topdog\trans3
                  2. Delete Data Base

                  3. View Packet Names
                  4. View Packet Description
                  5. Delete Packet

                  6. View Component Names
                  7. View Component Content
                  8. Delete Component

                  9. Exit to Main Menu

                     Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Data base copied successfully
```

2. <u>Delete Data Base</u>

**Choice 2, Delete Data Base,** allows you to remove an entire data base including all component and packet data it contains. The current data base, TRANS1, shown in the upper left corner of the monitor, is the only data base that may be deleted by Choice 2. If you wnated to delete data base TRANS2, you must return to TOPDOG's Main Menu, change the data base to TRANS2 using Choice 2, and then return to the DBU Menu using Choice 4.

Go ahead and strike the numeric key:

**2**

The monitor screen should appear as shown in Exhibit V.12 with the message **Delete current data base - Are you sure? (Y/N)=** highlighted in the lower left corner. If you type **Y (Yes)**, the TRANS1 data base will be deleted and the cursor will return to the Main Menu. Go ahead and strike the letter key:

**N**

Your monitor screen should appear as previously shown in Exhibit V.8.

3. <u>View Packet Names</u>

**Choice 3, View Packet Names,** allows you to view the names of all packets, along with other information, contained in the current data base shown in the upper left corner of the DBU Menu screen. As shown in Exhibit V.13, packet names appear in alphabetical and/or numerical order along with the type of packet, i.e., SPO, SPF, MPO, or MPF. The next column shows the number of service periods associated with each packet. The next two columns show the date the packet was originally created and the date of the most recent update of the packet or any of its components. The last three columns provide the names of each component contained in the packet.

EXHIBIT V.12

DATA BASE UTILITIES MENU SCREEN,

CHOICE 2, DELETE DATA BASE

```
                          DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl       consists of  0 Packets and   0 Components
                        and uses  2% of Capacity

Current Packet:                                 Current Component:

                   1. Copy Data Base (to) Data Base
                   2. Delete Data Base

                   3. View Packet Names
                   4. View Packet Description
                   5. Delete Packet

                   6. View Component Names
                   7. View Component Content
                   8. Delete Component

                   9. Exit to Main Menu

                      Enter Choice:2

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Delete current data base - Are you sure? (Y/N):
```

EXHIBIT V.13

DATA BASE UTILITIES,

CHOICE 3, VIEW PACKET NAMES SCREEN

```
                                VIEW PACKET NAMES
Data Base a:transl            consists of  2 Packets
Current Date: 8/15/87                                  ------- Components -------
                     Number of   Date     Date                     Constraints/
     Name    Type   Periods     Created  Updated   Global   Period   Config
     ----    ----   -------     -------- --------  -------- -------- --------
  1 ABCF     SPF       1         8/15/87  8/15/87  ABCGD    ABCSP    ABCOC
  2 ABCO     SPO       1         8/15/87  8/15/87  ABCGD    ABCSP    ABCOT
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /
                                  /  /     /  /

TYPE LEGEND - (S)ingle/(M)ultiple Period (O)ptimization/(F)orecast
Type RETURN to continue
```

## 4. View Packet Description

**Choice 4, View Packet Description,** allows you to view the formatted screen description of any packet contained in the current data base shown in the upper left corner of the DBU Menu screen.[13] It does not allow you change or modify data. Changes to data are only permitted under Main Menu Choices 5 through 8. As presented in Exhibit V.14, the example packet named ABCO shows:

- o The type of packet (e.g., SPO, SPF, MPO, or MPF);
- o The service period beginning and ending date; and
- o The names of the packet components and the status of each component, such as whether:
  - -- the component actually exists in the data base (i.e., have data been entered?);
  - -- the component contains sufficient data for TOPDOG to execute its program; and
  - -- the name of the component is consistent with TOPDOG's rules (i.e., no component has the same name as another conflicting component).

---

13 Selecting this choice requires that packets and components be named, which has not been described thus far in this User's Guide. Screens shown in exhibits in this section are taken from Chapter VI where more detail about packets and components is provided in a discussion of SPO.

EXHIBIT V.14

DATA BASE UTILITIES,

CHOICE 4, VIEW PACKET DESCRIPTION SCREEN

```
Current Date: 8/15/87        VIEW PACKET DESCRIPTION
Data Base:a:transl
Packet Name:ABCO     Packet Type:Single Period Optimization
Service Period is from  1/ 5/86 to  6/14/86
Description:


                           -------------  Components  ------------
                             Name     Exist   Complete  Consistent
         Global Data       ABCGD        Y         N          Y
  Service Period Data      ABCSP        Y         N          Y
     OT Constraints        ABCOT        Y         Y          Y

                        1. View Global Data
                        2. View Service Period Data
                        3. View OT Constraints/Operator Configuration Data
                        4. Exit to Data Base Utilities

                           Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

Following the packet description is a short menu of four choices,which allows you to view each component screen contained in the packet. **Choice 1, View Global Data,** allows you to view the Global Data screen named ABCGD shown in the example in Exhibit V.15. **Choice 2, View Service Period Data,** allows you to view the Service Period Data screen named ABCSP shown in Exhibit V.16. **Choice 3, View Overtime Constraints** (or **Operator Configuration** in the case of SPF or MPF), allows you to view the Overtime Constraints Data screen named ABCOT shown in Exhibit V.17.

Definitions and discussion of the data required to complete the fields shown in the Global Data, Service Period Data, and Overtime Constraints/Operator Configuration Data screens are found in Chapters V through VIII. You may also refer to Appendix A, TERMS AND DEFINITIONS, or strike key **F10** to receive on-screen assistance.

5. Delete Packet

**Choice 5, Delete Packet,** allows you to delete any packet contained in the current data base shown in the upper left corner of the DBU Menu screen. Strike the numeric key:

**5**

A message will appear highlighted in the lower left corner of the monitor screen, as shown in Exhibit V.18, requesting you to enter the packet name and then strike the F1 key. If, for example, you wish to delete Packet ABCO by striking the F1 key, TOPDOG would indicate the deletion by a highlighted message in the lower left corner of the monitor screen as shown in Exhibit V.19. Since no packets are yet named in your TRANS1 data base, strike the F1 key to return the cursor to the DBU Menu **Enter Choice** field.

EXHIBIT V.15

VIEW PACKET DESCRIPTION,

CHOICE 1, VIEW GLOBAL DATA

```
   Current Date: 8/15/87                 GLOBAL DATA
   Component Name:ABCGD         PART 1 - FULL TIME OPERATORS

           Minimum Hours for a Run:  :      ---------- Averages ----------
      Minimum Pay Hours for Trippers:  :                Hourly Wage Rate:
             Minimum % Bid Trippers:        Variable Fringe Benefit Rate:
    Effective Daily Guarantee Hours:  :     Annual Fixed Fringe Benefits:
     Regular Weekly Scheduled Days Off:             Annual Vacation Days:
Must Days Off be Consecutive (Y/N)?:
--------------------------------------------------------------------------------
                                PART 2 - PART TIME OPERATORS

                  Max Allowed PTOS:         ---------- Averages ----------
        Max Allowed Daily Work Hours:   :               Hourly Wage Rate:
        Max Allowed Weekly Work Days:       Variable Fringe Benefit Rate:
       Max Allowed Weekly Work Hours:   :   Annual Fixed Fringe Benefits:
        Max Allowed % as a % of FTOS:               Annual Vacation Days:
Max Allowed % as a % of FTOS + PTOS:
      Minimum Pay Hours for Trippers:   :

             Can PTOS Work Split Assignments (Y/N)?
              Can PTOS Work Sat/Sun Schedule (Y/N)?

Type RETURN to continue
```

EXHIBIT V.16

VIEW PACKET DESCRIPTION,

CHOICE 2, VIEW SERVICE PERIOD DATA

```
                    SINGLE PERIOD DATA for Component ABCSP
                     Service Period from  1/ 5/86 to  6/14/86

     Current Date: 8/15/87                  Weekday     Saturday    Sunday
                                            -------     --------    ------
                 Number Days Operated:
                          Number Runs:
                Number A.M. Trippers:
                 Minimum A.M. Tripper:         :            :           :
                 Maximum A.M. Tripper:         :            :           :
                 Number P.M. Trippers:
                 Minimum P.M. Tripper:         :            :           :
                 Maximum P.M. Tripper:         :            :           :
   Average Number Nonscheduled Assigns:
           FTO Absence Rate Percent:
           PTO Absence Rate Percent:
         Open Work Variation (+/- %):
  Average FTO Full Day Assignment Hours:       :            :           :
        Percent No-Work-Available Paid:
   Total Daily Scheduled Run Pay Hours:

      % Total Annual Vacation Days Scheduled This Service Period:

Type RETURN to continue
```

EXHIBIT V.17

VIEW PACKET DESCRIPTION, CHOICE 3,

VIEW OT CONSTRAINTS/OPERATOR CONFIGURATION DATA

```
        SINGLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA for

                 Service Period from  1/ 5/86 to  6/14/86

      Current Date: 8/15/87                   Component Name:ABCOT

         Maximum Average Daily      Weekday     Saturday      Sunday
         ---------------------      -------     --------      -------
  % Unscheduled Overtime Hours:
             % WDO Assignments:
% Unscheduled Overtime Trippers:




Type RETURN to continue
```

EXHIBIT V.18

DATA BASE UTILITIES,

CHOICE 5, DELETE PACKET

```
                        DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl            consists of  2 Packets and   4 Components
                             and uses  3% of Capacity

Current Packet:                                      Current Component:

                    1. Copy Data Base (to) Data Base
                    2. Delete Data Base

                    3. View Packet Names
                    4. View Packet Description
                    5. Delete Packet

                    6. View Component Names
                    7. View Component Content
                    8. Delete Component

                    9. Exit to Main Menu

                       Enter Choice:5

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter Packet name; then hit F1, ESC to ignore.
```

EXHIBIT V.19

DATA BASE UTILITIES MENU,

CHOICE 5, ABCO PACKET SUCCESSFULLY DELETED

```
                              DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl           consists of  1 Packets and   3 Components
                            and uses  3% of Capacity

Current Packet:                                   Current Component:

                    1. Copy Data Base (to) Data Base
                    2. Delete Data Base

                    3. View Packet Names
                    4. View Packet Description
                    5. Delete Packet

                    6. View Component Names
                    7. View Component Content
                    8. Delete Component

                    9. Exit to Main Menu

                       Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
ABCO successfully deleted
```

### 6. View Component Names

**Choice 6, View Component Names**, allows you to view the names of all components along with other information about the components contained in the current data base shown in the upper left corner of the DBU Menu screen.[14] As shown in Exhibit V.20, component names appear in alphabetical and/or numerical order along with the type of component, e.g., Global, Operator Configuration, Overtime Constraint, or Service Period. The number of periods indicates the number of service periods associated with each component.[15] The last two columns on the right side of the screen show the date the component was originally created and the date of the latest update of data in the component.

### 7. View Component Content

**Choice 7, View Component Content**, allows you to view each component screen contained in the data base shown in the upper left corner of the DBU Menu screen.[16] Striking the numeric key 7 will cause TOPDOG to request the name of the component to be viewed, in the lower left corner of the monitor as shown by Exhibit V.21 screen. Typing the component name (ABCGD in this example) and striking the **F1** key will cause the screen (previously shown in Exhibit V.15) to appear. After viewing the component screen, strike the **(CR)** key to return the cursor to the DBU Menu **Enter Choice** field.

---

[14] Selecting this Choice requires that packets and components be named, which has not been described thus far in this User's Guide. Screens shown in the exhibits in this section are taken from Chapter VI where more detail about packets and components is provided in a discussion of SPO.

[15] No number of service periods are given with Global Data since Global Data components may be used with different packets having different numbers of service periods.

[16] Selecting this choice requires that components be named, which has not been described thus far in this User's Guide. Screens shown in the exhibits in this section are taken from Chapter VI where more detail about components is provided in a discussion of SPO.

EXHIBIT V.20

VIEW COMPONENT NAMES MENU SCREEN

VIEW COMPONENT NAMES

Current Date: 8/15/87

Data Base a:transl consists of 4 Components

| | Name | Type | Number of Periods | Date Created | Date Updated |
|---|---|---|---|---|---|
| 1 | ABCGD | GLOB | | 8/15/87 | 8/15/87 |
| 2 | ABCOC | SOPC | 1 | 8/15/87 | 8/15/87 |
| 3 | ABCOT | SOTC | 1 | 8/15/87 | 8/15/87 |
| 4 | ABCSP | SSPD | 1 | 8/15/87 | 8/15/87 |
| | | | | / / | / / |
| | | | | / / | / / |
| | | | | / / | / / |
| | | | | / / | / / |
| | | | | / / | / / |
| | | | | / / | / / |

.......................... LEGEND ..........................

(S)ingle/(M)ultiple Period GLOB - Global Data

SPD - Service Period Data

OPC - Operator Configuration Data for Forecasting Models

OTC - Overtime Constraints Data for Optimizing Models

Type RETURN to continue

EXHIBIT V.21

DATA BASE UTILITIES MENU,

CHOICE 7, VIEW COMPONENT CONTENT

```
                          DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl          consists of  2 Packets and   4 Components
                           and uses  3% of Capacity

Current Packet:                                  Current Component:

                  1. Copy Data Base (to) Data Base
                  2. Delete Data Base

                  3. View Packet Names
                  4. View Packet Description
                  5. Delete Packet

                  6. View Component Names
                  7. View Component Content
                  8. Delete Component

                  9. Exit to Main Menu

                     Enter Choice:7

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter Component name; then hit F1, ESC to ignore.
```

## 8. Delete Component

**Choice 8, Delete Component,** allows you to delete any component contained in the current data base shown in the upper left corner of the DBU Menu screen. Strike the numeric key:

**8**

and a message will appear highlighted in the lower left corner of the screen, as shown in Exhibit V.22, requesting you to enter the component name and then strike the **F1** key. For example, if you want to delete component ABCGD by striking the **F1** key, TOPDOG would indicate the deletion by a highlighted message in the lower left corner of the screen, as shown in Exhibit V.23. Since no components are yet named in your TRANS1 data base, strike the key:

**F1**

to return the cursor to the DBU Menu **Enter Choice** field.

## 9. Exit to Main Menu

**Choice 9, Exit to Main Menu,** allows you to exit the DBU Menu and return to TOPDOG's Main Menu. Strike the numeric key:

**9**

to return to the Main Menu.

## EXHIBIT V.22

## DATA BASE UTILITIES MENU,

## CHOICE 8, DELETE COMPONENT

```
                          DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl         consists of  2 Packets and   4 Components
                         and uses  3% of Capacity

Current Packet:                                Current Component:

                  1. Copy Data Base (to) Data Base
                  2. Delete Data Base

                  3. View Packet Names
                  4. View Packet Description
                  5. Delete Packet

                  6. View Component Names
                  7. View Component Content
                  8. Delete Component

                  9. Exit to Main Menu

                     Enter Choice:8

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter Component name; then hit F1, ESC to ignore.
```

EXHIBIT V.23

DATA BASE UTILITIES MENU,

CHOICE 8, ABCGD COMPONENT SUCCESSFULLY DELETED

```
                          DATA BASE UTILITIES MENU
Current Date: 8/15/87
Data Base a:transl         consists of  2 Packets and   3 Components
                          and uses  3% of Capacity

Current Packet:                                   Current Component:

                     1. Copy Data Base (to) Data Base
                     2. Delete Data Base

                     3. View Packet Names
                     4. View Packet Description
                     5. Delete Packet

                     6. View Component Names
                     7. View Component Content
                     8. Delete Component

                     9. Exit to Main Menu

                        Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
ABCGD successfully deleted
```

# VI. SINGLE PERIOD OPTIMIZATION

This chapter describes the use of Main Menu Choice 5, Single Period **Optimization** (SPO). SPO is used to estimate the least cost number of operators for one service period. In this chapter, you will learn by examining a case study how to complete packet and component screens using example data for estimating the optimal size and configuration of an operator work force.

The chapter begins with a description of the case study data for a service period of a transit system division named ABC. Following the description are instructions for entering the data in the data base through the packet and component screens. Lastly, when input data are complete, procedures are provided showing how to instruct TOPDOG to conduct a single period optimization of the ABC example and print the results.

## CASE STUDY: ABCO

ABC is Motorbus Division C of the AB Transit System. The service period selected for evaluation corresponds to an operator work selection or pick period beginning on January 5, 1986, and ending on June 14, 1986, the last day public schools were in session. The following data and information are presented by component screen for easy reference when you follow the data entry instructions presented later in the chapter.

### Global Data

Examination of the labor agreement and work rules, coupled with the assistance of AB Transit System's Finance Department, provided the following information for completing the Global Data component screen:

- o Full-Time Operators (FTOs)

  -- No coupling provision or work rule requiring certain trippers to be combined into a run.

-- No minimum pay requirements for operating trippers.

-- No provisions reserving specified numbers of trippers for bid by FTOs.

-- Daily pay guarantee of 8 hours.

-- Two non-consecutive weekly days off guaranteed but not required to be scheduled consecutively.

-- Average FTO wage rate during the period of $12.00 per hour.

-- Average FTO variable fringe benefit rate or wage rate multiplier for the period of 1.186.

-- Average annualized FTO fixed fringe benefit cost of $7,500.

-- Average annualized number of vacation days per FTO of 16.0.

o <u>Part-Time Operators (PTOs)</u>

-- PTOs limited in number to 10 percent of the number of FTOs.

-- PTOs may work up to 30 weekly hours, with no restrictions on the number of daily hours or days of the week that work may be performed.

-- No minimum pay requirements for operating trippers.

-- Average PTO wage rate during the period of $9.50 per hour.

-- Average PTO variable fringe benefit rate or wage rate multiplier for the period of 1.073.

- -- Average annualized PTO fixed fringe benefit cost of $1,500.

- -- PTOs receive no paid vacation days.

- -- PTOs may work more than one daily assignment or tripper.

- -- PTOs may work weekends.

## Service Period Data

The Service Period Data screen requires information from various sources within the AB Transit System. This information may be divided into schedule data, open work data, nonscheduled and nonoperating work, dispatching practices, and vacation data.

## Schedule Data

AB Transit System's Scheduling Department provided the following information about scheduled service during the service period:

- o <u>Number of Days During the Service Period Each Schedule Operated</u>

| | |
|---|---|
| - Weekday | 112 |
| - Saturday | 23 |
| - Sunday | 26 |

- o <u>Number of Runs Operated in Each Schedule</u>

| | |
|---|---|
| - Weekday | 246 |
| - Saturday | 133 |
| - Sunday | 82 |

- <u>Number of Scheduled A.M. Trippers</u>

  - Weekday 26
  - Saturday 16
  - Sunday 7

- <u>Number of Scheduled P.M. Trippers</u>

  - Weekday 33
  - Saturday 15
  - Sunday 3

- <u>Minimum Clock Time Lengths of A.M. Trippers</u>

  - Weekday 0:51
  - Saturday 2:39
  - Sunday 2:30

- <u>Maximum Clock Time Length of A.M. Trippers</u>

  - Weekday 3:56
  - Saturday 4:00
  - Sunday 4:11

- <u>Minimum Clock Time Length of P.M. Trippers</u>

  - Weekday 1:07
  - Saturday 3:40
  - Sunday 3:02

- <u>Maximum Clock Time Length of P.M. Trippers</u>

  - Weekday 4:38
  - Saturday 4:45
  - Sunday 4:39

- **Average Daily Work Hours per FTO**

  The Scheduling Department estimated the average daily work hours per FTO by dividing the total scheduled pay hours by the total number of scheduled runs as follows:

  - Weekday 8:20
  - Saturday 8:30
  - Sunday 8:30

- **Total Schedule Run Pay Hours**

  For runs only (no trippers):

  - Weekday 2,050
  - Saturday 1,131
  - Sunday 697

**Open Work Data**

AB Transit System's Personnel Department maintained a complete record of operator absence.[17] Some analysis of their information resulted in the following data about operator absenteeism:

- **FTO Absence Rate**

  - Weekday 10.0%
  - Saturday 12.5%
  - Sunday 14.0%

- **PTO Absence Rate**

  - Weekday 5.0%
  - Saturday 6.0%
  - Sunday 7.0

---

17 At some transit systems, operator absence information is kept in the Transportation or Operations Department.

There was some discussion of daily open work assignments in Chapter II, with an example shown in Exhibit II.1. An estimate of the percentage of variation in the daily open work force is required for TOPDOG to appropriately evaluate the operator work force. Using FTO absence data available from AB Transit's Personnel Department, it was estimated that the variation in the amount of open work due to absence during the service period was +/- 30 percent. This was found to be true for weekdays, Saturdays and Sundays.

## Nonscheduled and Nonoperating Work

TOPDOG requires an estimate of the amount of nonschedule and nonoperating work conducted by FTOs during the service period. This estimate should be made in terms of average equivalent number of FTO daily work assignments for each service schedule. For example, if the total number of nonscheduled and nonoperating operator work hours for a weekday service schedule for the service period was 3,405, and the number of days a weekday schedule was operated in the service period was 112, then the average number of FTO nonscheduled and nonoperating work hours for a weekday schedule would be 3,405 divided by 112, or 30.4 hours. To estimate the average equivalent number of FTO weekday nonscheduled and nonoperating work assignments, divide 30.4 hours by the effective daily guarantee of 8 hours. The result is 3.8 equivalent weekday work assignments. Some transit systems may record FTO nonoperating work as absence from operating work, and therefore a portion or all of the nonscheduled and nonoperating work may be reflected in the percentage of operator absence.

AB Transit System's Transportation Department researched its daily records of operator work assignments and found that no nonscheduled work such as charters or special events service was conducted during the period by Division C FTOs. In addition, the AB Transit System labor agreement provides that operators shall not perform any nonoperating work assignments such as acting as supervisor or training new operators. Remedial training of operators was considered open work and was therefore included in the previous estimate of operator absence. Consequently, Division C operators of the AB Transit System conducted no nonscheduled and nonoperating work during the service period considered.

## Dispatching Practices

Sometimes transit systems can avoid paying extraboard operators their daily guarantee when no work is available. They accomplish this by means of an informal agreement between dispatchers and operators where operators suffer no disciplinary or other pay penalties for taking a "management-approved" day off with no pay. In the case of AB Transit System, management stated that daily guarantee was paid 100 percent of the time.[18]

## Vacation Data

In the Global Data screen, AB Transit System estimated that FTOs averaged about 16 days of vacation a year based on information taken from personnel records. They also estimated that about 7 days of vacation per FTO was taken during this service period. These estimates were converted to show that 44.23 percent of annual FTO vacation days were taken during this service period.

## Overtime Constraints Data

Under all cases of Single Period Optimization, TOPDOG allows you to limit the amount of overtime that FTOs might work. In this case study, AB Transit System elected not to have TOPDOG constrain FTO overtime, but to analyze the results of this alternative first before making any decision about limitations.

---

18 If your transit system is occasionally able to avoid paying daily guarantee to extraboard operators, you should estimate the percentage of time you believe the guarantee is paid, e.g., 80 percent.

## ENTERING SCREEN DATA

If you have not completed the case studies in Chapters VII, VIII or IX, you have now arrived at the point that data will be entered into the TOPDOG model and results printed for your review. If your PC is not turned on, please do so and bring up TOPDOG's Main Menu on the monitor screen. The first page of Chapter IV, MAIN MENU, contains instructions for doing this.

The case study in this chapter is for Single Period Optimization (SPO). At this time, select the SPO option from the Main Menu by striking the numerical key:

**5**

The monitor screen should appear as shown in Exhibit VI.1. The SPO Menu provides ten choices. Enter the name of the packet by striking the numerical key:

**1**

The cursor should now be positioned to accept the packet name. Now type the following:

**abco** **(CR)**

followed by the F1 key. Your monitor screen should now appear as shown in Exhibit VI.2 and the cursor should be at the **Enter Choice** field. Enter a brief description of the packet by striking the numerical key:

**2**

The cursor should now be positioned to accept up to 180 characters of descriptive material on three lines. TOPDOG does not require that you complete this entry, but over time the descriptive material you provide will assist you in remembering the background and nature of the

EXHIBIT VI.1

SINGLE PERIOD OPTIMIZATION MENU SCREEN

```
Current Date: 8/15/87       SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:
Service Period is from   / /   to   / /
Description:


                           Component                             Exist  Latest Changes
                             Names    Complete  Consistent  in DB        Saved
          Global Data
 Service Period Data
      OT Constraints

             1. Set Packet Name           6. Modify Service Period Data
             2. Set Packet Description    7. Modify OT Constraints
             3. Set Component Names       8. Optimize
             4. Set Service Period        9. Save Package/Component Data
             5. Modify Global Data        0. Exit to Main Menu

                               Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VI.2

SINGLE PERIOD OPTIMIZATION MENU SCREEN WITH PACKET NAME

```
Current Date: 8/15/87        SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:abco
Service Period is from   / /   to   / /
Description:


                         Component                             Exist  Latest Changes
                           Names    Complete  Consistent  in DB       Saved
       Global Data
 Service Period Data
     OT Constraints

           1. Set Packet Name              6. Modify Service Period Data
           2. Set Packet Description       7. Modify OT Constraints
           3. Set Component Names          8. Optimize
           4. Set Service Period           9. Save Package/Component Data
           5. Modify Global Data           0. Exit to Main Menu

                              Enter Choice:1

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

evaluation. In this case, some narrative concerning ABCO PTO and FTO labor agreement provisions has been inserted. Type the following on three lines:

**PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly (CR)**
**FTOs: May work as much OT as necessary, but no unscheduled (CR)**
**work (CR)**

followed by the **F1** key. Your monitor screen should now appear as shown in Exhibit VI.3 and the cursor should be at the **Enter Choice** field. Enter the names of the packet components by striking the numerical key:

**3**

The cursor should now be positioned to accept the Global Data name. Now type the following:

**abcgd (CR)**

The cursor should now be positioned to accept the Service Period Data name. Type the following:

**abcsp (CR)**

The cursor should now be positioned to accept the Overtime Constraints Data name. Type the following:

**abcot (CR)**

All component names have now been entered unless you wish to make changes. If you do, you may use the --> key to move the cursor forward to the location where you wish to make a change. After any necessary changes have been made, strike the **F1** key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit VI.4. To enter the beginning and ending dates of the service period,

EXHIBIT VI.3

SINGLE PERIOD OPTIMIZATION MENU SCREEN WITH PACKET DESCRIPTION

```
Current Date: 8/15/87       SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                         Report Destination:lst:
Packet Name:abco
Service Period is from   / /   to   / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                          Exist  Latest Changes
                           Names    Complete  Consistent  in DB       Saved
        Global Data
 Service Period Data
     OT Constraints

          1. Set Packet Name              6. Modify Service Period Data
          2. Set Packet Description       7. Modify OT Constraints
          3. Set Component Names          8. Optimize
          4. Set Service Period           9. Save Package/Component Data
          5. Modify Global Data           0. Exit to Main Menu

                              Enter Choice:2

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VI.4

SINGLE PERIOD OPTIMIZATION MENU SCREEN WITH COMPONENT NAMES

```
Current Date: 8/15/87       SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                         Report Destination:lst:
Packet Name:ABCO
Service Period is from   / /   to   / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                          Component                        Exist  Latest Changes
                            Names    Complete  Consistent  in DB      Saved
         Global Data      ABCGD         N          Y        N
 Service Period Data      ABCSP         N          Y        N
      OT Constraints      ABCOT         N          Y        N

           1. Set Packet Name            6. Modify Service Period Data
           2. Set Packet Description     7. Modify OT Constraints
           3. Set Component Names        8. Optimize
           4. Set Service Period         9. Save Package/Component Data
           5. Modify Global Data         0. Exit to Main Menu

                              Enter Choice:3

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

strike the numerical key:

**4**

The cursor should now be positioned to accept the beginning month of the service period. The service period used for evaluation in this case study began on January 5, 1986, and ended on June 14, 1986. Type the following, remembering that after the numerical entry for each day, month and year, you must strike the **(CR)** key:

**1(CR)5(CR)86(CR)6(CR)14(CR)86(CR)**

Once all the numbers and **(CR)**s have been entered, strike the **F1** key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit VI.5.

TOPDOG is now ready to receive component data. To enter Global Data, strike the numerical key:

**5**

and your monitor screen should appear as shown in Exhibit VI.6. The cursor is presently located at the bottom of the monitor screen following the highlighted message: **Enter component name to copy--RETURN for none.** This message always appears at the bottom of any new component screen when it first appears on the monitor. If you want to use or modify another previously created screen saved in the data base, type in the component name, then strike the **F1** key. In this case, however, you have not previously created another Global Data screen, so simply strike the ENTER key:

**(CR)**

The cursor should now be located at the first Global Data entry field on the monitor screen. Using the information provided by the ABCO case study description, complete the screen, striking the **F10** key whenever you

EXHIBIT VI.5

SINGLE PERIOD OPTIMIZATION MENU SCREEN WITH SERVICE PERIOD DATES

```
Current Date: 8/15/87       SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                         Report Destination:lst:
Packet Name:ABCO
Service Period is from  1/ 5/86 to  6/14/86
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                       Exist  Latest Changes
                           Names    Complete  Consistent  in DB      Saved
         Global Data     ABCGD         N          Y        N
 Service Period Data     ABCSP         N          Y        N
      OT Constraints     ABCOT         N          Y        N

           1. Set Packet Name            6. Modify Service Period Data
           2. Set Packet Description     7. Modify OT Constraints
           3. Set Component Names        8. Optimize
           4. Set Service Period         9. Save Package/Component Data
           5. Modify Global Data         0. Exit to Main Menu

                              Enter Choice:4

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VI.6

SINGLE PERIOD OPTIMIZATION GLOBAL DATA SCREEN

```
    Current Date: 8/15/87                GLOBAL DATA
    Component Name:ABCGD         PART 1 - FULL TIME OPERATORS

            Minimum Hours for a Run:  :     ---------- Averages ----------
       Minimum Pay Hours for Trippers:  :              Hourly Wage Rate:
             Minimum % Bid Trippers:        Variable Fringe Benefit Rate:
    Effective Daily Guarantee Hours:  :     Annual Fixed Fringe Benefits:
  Regular Weekly Scheduled Days Off:                Annual Vacation Days:
Must Days Off be Consecutive (Y/N)?:
--------------------------------------------------------------------------------
                                 PART 2 - PART TIME OPERATORS

                   Max Allowed PTOS:        ---------- Averages ----------
      Max Allowed Daily Work Hours:   :                Hourly Wage Rate:
      Max Allowed Weekly Work Days:         Variable Fringe Benefit Rate:
     Max Allowed Weekly Work Hours:   :     Annual Fixed Fringe Benefits:
      Max Allowed % as a % of FTOS:                 Annual Vacation Days:
Max Allowed % as a % of FTOS + PTOS:
     Minimum Pay Hours for Trippers:  :

             Can PTOS Work Split Assignments (Y/N)?
              Can PTOS Work Sat/Sun Schedule (Y/N)?
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

require assistance. When you have finished entering data on the Global Data screen, compare the results with Exhibit VI.7. If there are differences, attempt to find out why using the **F10** (Help) key.

When you are satisfied that your data entry is correct and matches Exhibit VI.7, strike the **F1** key. The cursor should return to the SPO Menu at the **Enter Choice** field. To enter Service Period data, strike the numerical key:

**6**

and your monitor screen should appear as shown in Exhibit VI.8. Since you have not previously created Service Period data that you can use or modify, strike the ENTER key:

**(CR)**

The cursor should now be located at the first Service Period Data entry field on the monitor screen. Using the information provided in the ABCO case study description, complete the screen, striking the **F10** (Help) key whenever you require assistance. When you have finished entering data on the Service Period screen, compare the results with Exhibit VI.9. Make changes and modifications, if necessary, using the --> and <-- keys to move around the screen. When you are satisfied that the data you entered is correct and matches Exhibit VI.9, strike the F1 key.

The cursor should return to the SPO Menu at the Enter Choice field. To enter Overtime Constraints data, strike the numerical key:

**7**

and your monitor screen should appear as shown in Exhibit VI.10. Since AB Transit System Management elected not to constrain FTO overtime in this example, you can either complete each field with the numeric value 100 or leave the data entry fields blank, in which case TOPDOG will fill in default values of 100. For practice, complete the screen by striking (CR)

EXHIBIT VI.7

SINGLE PERIOD OPTIMIZATION GLOBAL DATA SCREEN COMPLETED

```
Current Date: 8/15/87                  GLOBAL DATA
Component Name:ABCGD       PART 1 - FULL TIME OPERATORS

        Minimum Hours for a Run:  :     ---------- Averages ----------
  Minimum Pay Hours for Trippers:  :               Hourly Wage Rate:12.00
          Minimum % Bid Trippers:       Variable Fringe Benefit Rate:1.186
   Effective Daily Guarantee Hours: 8: 0  Annual Fixed Fringe Benefits: 7500
 Regular Weekly Scheduled Days Off:    2         Annual Vacation Days:16.00
Must Days Off be Consecutive (Y/N)?:   N
-------------------------------------------------------------------------------
                           PART 2 - PART TIME OPERATORS

               Max Allowed PTOS:        ---------- Averages ----------
    Max Allowed Daily Work Hours:   :              Hourly Wage Rate: 9.50
    Max Allowed Weekly Work Days:       Variable Fringe Benefit Rate:1.073
   Max Allowed Weekly Work Hours: 30: 0  Annual Fixed Fringe Benefits: 1500
    Max Allowed % as a % of FTOS:  10.0         Annual Vacation Days:    0
Max Allowed % as a % of FTOS + PTOS:
  Minimum Pay Hours for Trippers:   :

         Can PTOS Work Split Assignments (Y/N)? Y
          Can PTOS Work Sat/Sun Schedule (Y/N)? Y
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

EXHIBIT VI.8

SINGLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN

```
                    SINGLE PERIOD DATA for Component ABCSP
                     Service Period from  1/ 5/86 to  6/14/86

      Current Date: 8/15/87                  Weekday     Saturday    Sunday
                                             -------     --------    ------
                  Number Days Operated:
                           Number Runs:
                 Number A.M. Trippers:
                  Minimum A.M. Tripper:         :            :           :
                  Maximum A.M. Tripper:         :            :           :
                 Number P.M. Trippers:
                  Minimum P.M. Tripper:         :            :           :
                  Maximum P.M. Tripper:         :            :           :
  Average Number Nonscheduled Assigns:
              FTO Absence Rate Percent:
              PTO Absence Rate Percent:
           Open Work Variation (+/- %):
Average FTO Full Day Assignment Hours:          :            :           :
        Percent No-Work-Available Paid:
  Total Daily Scheduled Run Pay Hours:

       % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT VI.9

SINGLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN COMPLETED

SINGLE PERIOD DATA for Component ABCSP
Service Period from 1/ 5/86 to 6/14/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 112 | 23 | 26 |
| Number Runs: | 246 | 133 | 82 |
| Number A.M. Trippers: | 26 | 16 | 7 |
| Minimum A.M. Tripper: | 0:51 | 2:39 | 2:30 |
| Maximum A.M. Tripper: | 3:56 | 4: 0 | 4:11 |
| Number P.M. Trippers: | 33 | 15 | 3 |
| Minimum P.M. Tripper: | 1: 7 | 3:40 | 3: 2 |
| Maximum P.M. Tripper: | 4:38 | 4:45 | 4:39 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 10.0 | 12.5 | 14.0 |
| PTO Absence Rate Percent: | 5.0 | 6.0 | 7.0 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2050 | 1131 | 697 |

% Total Annual Vacation Days Scheduled This Service Period: 44.23
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT VI.10

SINGLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA SCREEN

```
              SINGLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA for
                      Service Period from  1/ 5/86 to  6/14/86
        Current Date: 8/15/87               Component Name:ABCOT
             Maximum Average Daily     Weekday     Saturday     Sunday
             ---------------------     -------     --------     -------
   % Unscheduled Overtime Hours:
              % WDO Assignments:
 % Unscheduled Overtime Trippers:




F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

and entering the value 100 in each of the nine fields. Your completed screen should appear as shown in Exhibit VI.11. Strike the **F1 key** to return the cursor to the SPO Menu **Enter Choice** field.

At this point, all component screens are complete. You may assure yourself that the component screens are complete by checking the column labeled **Complete** on the table just above the SPO Menu on the monitor screen. You can also check that the names of the components are consistent among those names contained in the data base and are considered valid by TOPDOG by looking in the column labeled **Consistent** on the table. The next two column headings, labeled **Exist in DB (Data Base)** and **Latest Changes Saved**, both show a series of Ns, meaning that the component screen entries have not been saved nor do they exist in the TRANS1 data base. To save the data to the TRANS1 data base, strike the numeric key:

**9**

The message appearing in the lower corner of the monitor screen asks: **Save Packet (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save Global Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save Service Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save**

EXHIBIT VI.11

SINGLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA SCREEN COMPLETED

SINGLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA for

Service Period from 1/ 5/86 to 6/14/86

Current Date: 8/15/87 Component Name:ABCOT

| Maximum Average Daily | Weekday | Saturday | Sunday |
|---|---|---|---|
| % Unscheduled Overtime Hours: | 100.0 | 100.0 | 100.0 |
| % WDO Assignments: | 100.0 | 100.0 | 100.0 |
| % Unscheduled Overtime Trippers: | 100.0 | 100.0 | 100.0 |

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

**Overtime Constraint Data (Y/N)?** Strike the key:

**Y**

After saving this data, the cursor should return to the SPO Menu **Enter Choice** field. Your screen should now appear as shown in Exhibit VI.12. Had you answered any of the previous questions **NO**, TOPDOG would have continued to ask whether to save the remaining component screens that were entered or modified.

TOPDOG has now received and stored complete and consistent component data grouped under the Packet name ABCO in the data base TRANS1. You could continue to form other packets containing new component data, or form combinations of new and existing component data. For example, a new packet could be formed with Global Data ABCGD and Service Period Data ABCSP with a new Overtime Constraint Data component reflecting some constraint on the use of overtime by FTOs. For the present, however, proceed to complete this case study with TOPDOG.

## EVALUATING THE OPERATOR WORK FORCE

TOPDOG is now ready to estimate the least-cost size and configuration of the operator work force for Division C of the AB Transit System for the service period January 5, 1986, through June 14, 1986. To perform this task a printer must be connected with the PC and turned on ready to print. Printer requirements were briefly described on the first page of Chapter III. To initiate the analysis, strike the numerical key:

**8**

The cursor has now moved to the Report Destination entry field and the message highlighted in the lower left corner of the screen requests you to enter output file name; the default (if you enter nothing) is the printer. TOPDOG allows you to specify that you want to save output files to floppy diskettes or to the hard disk for later printing. You should proceed to prepare TOPDOG for immediate printing of the reports by striking the F1 key.

EXHIBIT VI.12

SINGLE PERIOD OPTIMIZATION MENU SCREEN, DATA COMPLETE AND SAVED

```
Current Date: 8/15/87       SINGLE PERIOD OPTIMIZATION
Data Base:a:transl                        Report Destination:lst:
Packet Name:ABCO
Service Period is from  1/ 5/86 to  6/14/86
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work.

                         Component                        Exist  Latest Changes
                           Names    Complete  Consistent  in DB      Saved
        Global Data      ABCGD         Y          Y         Y          Y
 Service Period Data     ABCSP         Y          Y         Y          Y
      OT Constraints     ABCOT         Y          Y         Y          Y

           1. Set Packet Name             6. Modify Service Period Data
           2. Set Packet Description      7. Modify OT Constraints
           3. Set Component Names         8. Optimize
           4. Set Service Period          9. Save Package/Component Data
           5. Modify Global Data          0. Exit to Main Menu

                              Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

Your monitor screen should then appear as shown in Exhibit VI.13. TOPDOG has just completed an edit check of all input data to ensure its consistency. Had TOPDOG found a data input or consistency error, one or more error messages would have appeared on the monitor screen. In that case, you must strike the **(CR)** key to return to the SPO Menu for corrections. TOPDOG now asks the question: **want satisfying condition?** Strike the key:

**Y (CR)**

TOPDOG then begins its algorithmic routines; during this time, all you will see is a series of dots (.....) appearing on the monitor screen. Many of the cases you will try will take several minutes for TOPDOG to analyze and process. The growing series of dots that appear on the screen simply let you know TOPDOG is hard at work.

When TOPDOG is finished, the monitor screen should appear as shown in Exhibit VI.14, displaying a menu for choosing one or more output reports. To omit printing any reports you don't need, simply use the --> key to move the cursor to that field and strike the letter N. Practice moving the cursor around and changing entries from Y to N and back to Y. When you have completed your exercise with the options, strike the F1 key.

The monitor screen should then appear as shown in Exhibit IV.15. Turn your printer on, align the paper in your printer as necessary and strike the ENTER key:

**(CR)**

The monitor screen will inform you of TOPDOG's progress in preparing and printing the reports you selected. When report printing is completed, TOPDOG returns you to the SPO Menu screen and awaits further instructions. TOPDOG report outputs are described in Appendix B.

EXHIBIT VI.13

DATA EDIT CHECK SCREEN

```
Optimization beginning
--CHECKING GLOBAL DATA
--CHECKING SERVICE PERIOD DATA
   PERIOD 1
want satis cond?
```

EXHIBIT VI.14

REPORT SELECTION MENU SCREEN

```
                        REPORT SELECTION MENU

        Current Date: 8/15/87
           Data Base:a:transl
         Packet Name:ABCO

                              Report Selections (Y/N)

           Operator Configuration Report: Y
             Operator Utilization Report: Y
    Open Work and Unassigned Tripper Report: Y
              Vacation Scheduling Report: Y
                    Detailed Cost Report: Y
              Summary Information Report: N   (Multiple Periods Only)



F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Select desired reports; Press F1 to print, ESC to abort
```

EXHIBIT VI.15

PRINTER PREPARATION AND PRINT EXECUTION SCREEN

```
Getting ready to print reports
Please prepare your printer; Press RETURN when ready
```

If you want to stop at this point, remember to strike the numeric key:

**0**

to exit to the Main Menu and then strike the numeric key:

**9**

to return to a C> prompt on the monitor screen.

# VII. MULTIPLE PERIOD OPTIMIZATION

This chapter describes the use of Main Menu **Choice 6, Multiple Period Optimization** (MPO). MPO is used to estimate the least cost number of operators for two to six service periods. In this chapter, you will learn by examining a case study how to complete packet and component screens using example data for estimating the optimal size and configuration of an operator work force.

The chapter begins with a description of the case study data for four service periods of a transit system division named XYZ. Following the description are instructions for entering the data through the packet and component screens. Lastly, when input data are complete, procedures are provided showing how to instruct TOPDOG to conduct a multiple period optimization of the XYZ example and print the results.

## CASE STUDY: XYZO

XYZ is Motorbus Division Z of the XY Transit System. The four service periods selected for evaluation correspond to operator work selection or pick periods beginning on January 5, 1986; June 15, 1986; September 7, 1986; and November 23, 1986. The fourth service period ended on January 3, 1987. The following data and information are presented by component screen for easy reference when you follow the data entry instructions presented later in the chapter.

## Global Data

Examination of the labor agreement and work rules, coupled with the assistance of XY Transit System's Finance Department, provided the following information for completing the Global Data component screen:

- Full-Time Operators (FTOs)

  -- No coupling provision or work rule requiring certain trippers to be combined into a run.

-- No minimum pay requirements for operating trippers.

-- No provisions reserving specified numbers of trippers for bid by FTOs.

-- Daily pay guarantee of 8 hours.

-- Two weekly days off guaranteed but not required to be scheduled consecutively.

-- Average FTO wage rate during the period of $12.00 per hour.

-- Average FTO variable fringe benefit rate or wage rate multiplier for the period of 1.186.

-- Average annualized FTO fixed fringe benefit cost of $7,500.

-- Average annualized number of vacation days per FTO of 16.0.

o <u>Part-Time Operators (PTOs)</u>

-- PTOs limited in number to 10 percent of the number of FTOs.

-- PTOs may work up to 30 weekly hours, with no restrictions on the number of daily hours or days of the week that work may be performed.

-- No minimum pay requirements for operating trippers.

-- Average PTO wage rate during the period of $9.50 per hour.

-- Average PTO variable fringe benefit rate or wage rate multiplier for the period of 1.073.

-- Average annualized PTO fixed fringe benefit cost of $1,500.

-- PTOs receive no paid vacation days.

-- PTOs may work split assignments: i.e., more than one daily assignment or tripper.

-- PTOs may work weekends.

## Service Period Data

The Service Period Data screens require information from various sources within the XY Transit System. This information may be divided into schedule data, open work data, nonscheduled and nonoperating work, dispatching practices, and vacation data.

## Schedule Data

XY Transit System's Scheduling Department provided the following information about scheduled service during the service periods:

o **Number of Days During the Service Period Each Schedule Operated**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 112 | 58 | 54 | 27 |
| - Saturday | 23 | 12 | 11 | 6 |
| - Sunday | 26 | 14 | 12 | 9 |

o **Number of Runs Operated in Each Schedule**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 246 | 240 | 246 | 254 |
| - Saturday | 133 | 130 | 133 | 145 |
| - Sunday | 82 | 80 | 82 | 90 |

o **Number of Scheduled A.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 26 | 21 | 26 | 23 |
| - Saturday | 16 | 15 | 16 | 18 |
| - Sunday | 7 | 6 | 7 | 8 |

o **Number of Scheduled P.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 33 | 24 | 33 | 26 |
| - Saturday | 15 | 14 | 15 | 20 |
| - Sunday | 3 | 3 | 3 | 4 |

o **Minimum Clock Time Length of A.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 0:51 | 1:32 | 0:51 | 2:14 |
| - Saturday | 2:39 | 2:45 | 2:39 | 3:30 |
| - Sunday | 2:30 | 2:37 | 2:30 | 2:21 |

o **Maximum Clock Time Length of A.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 3:56 | 4:17 | 3:56 | 4:15 |
| - Saturday | 4:00 | 4:05 | 4:00 | 5:10 |
| - Sunday | 4:11 | 4:11 | 4:11 | 4:23 |

o **Minimum Clock Time Length of P.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 1:07 | 2:23 | 1:07 | 2:20 |
| - Saturday | 3:40 | 3:42 | 3:40 | 2:47 |
| - Sunday | 3:02 | 3:28 | 3:02 | 3:13 |

o **Maximum Clock Time Length of P.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 4:38 | 4:01 | 4:38 | 4:13 |
| - Saturday | 4:45 | 4:40 | 4:45 | 5:02 |
| - Sunday | 4:39 | 4:12 | 4:39 | 4:44 |

o **Average Daily Work Hours per FTO**

The Scheduling Department estimated the average daily work hours per FTO by dividing the total scheduled pay hours by the total number of scheduled runs as follows:

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 8:20 | 8:20 | 8:20 | 8:20 |
| - Saturday | 8:30 | 8:30 | 8:30 | 8:30 |
| - Sunday | 8:30 | 8:30 | 8:30 | 8:30 |

o **Total Schedule Run Pay Hours**

For runs only (no trippers):

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 2,050 | 2,000 | 2,050 | 2,117 |
| - Saturday | 1,131 | 1,105 | 1,131 | 1,233 |
| - Sunday | 697 | 680 | 697 | 765 |

**Open Work Data**

XY Transit System's Personnel Department maintained a complete record of operator absence.[19] Some analysis of their information resulted in the following data about operator absenteeism :

o **FTO Absence Rate**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 10.0% | 11.5% | 10.0% | 9.8% |
| - Saturday | 12.5% | 13.2% | 12.5% | 12.3% |
| - Sunday | 14.0% | 15.6% | 14.0% | 15.2% |

o **PTO Absence Rate**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 5.0% | 5.2% | 5.0% | 4.4% |
| - Saturday | 6.0% | 6.1% | 6.0% | 5.5% |
| - Sunday | 7.0% | 7.3% | 7.0% | 6.3% |

---

19 At some transit systems, operator absence information is kept in the Transportation or Operations Department.

There was some discussion of daily open work assignments in Chapter II, with an example shown in Exhibit II.1. An estimate of the percentage of variation in the daily open work force is required for TOPDOG to appropriately evaluate the operator work force. Using FTO absence data available from XY Transit's Personnel Department, it was estimated that the variations in the amount of open work due to absence during the four service periods were +/- 30 percent. This was found to be true for weekdays, Saturdays and Sundays.

## Nonscheduled and Nonoperating Work

TOPDOG requires an estimate of the amount of nonscheduled and nonoperating work conducted by FTOs during each service period. This estimate should be made in terms of average equivalent number of FTO daily work assignments for each service schedule. For example, if the total number of nonscheduled and nonoperating operator work hours for a weekday service schedule for a service period was 3,405, and the number of days a weekday schedule was operated in the service period was 112, then the average number of FTO nonscheduled and non-operating work hours for a weekday schedule would be 3,405 divided by 112, or 30.4 hours. To estimate the average equivalent number of FTO weekday nonscheduled and nonoperating work assignments, divide 30.4 hours by the effective daily guarantee of 8 hours. The result is 3.8 equivalent weekday work assignments. Some transit systems may record FTO nonoperating work as absence from operating work, and therefore a portion or all of the nonscheduled and nonoperating work may be reflected in the percentage of operator absence.

The XY System's Transportation Department researched its daily records of operator work assignments and found that no nonscheduled work such as charters or special events service was conducted during these periods by Division Z FTOs. In addition, the XY Transit system labor agreement provides that operators shall not perform any nonoperating work assignments such as acting as supervisor or training new operators.

Remedial training of operators was considered open work and was therefore included in the previous estimates of operator absence. Consequently, Division Z operators of the XY Transit System conducted no nonscheduled and nonoperating work during the service period.

## Dispatching Practices

Sometimes transit systems can avoid paying extraboard operators their daily guarantee when no work is available. They accomplish this by means of an informal agreement between dispatchers and operators where operators suffer no disciplinary or other pay penalties for taking a "management-approved" day off with no pay. In the case of XY Transit System, management stated that daily guarantee was paid 100 percent of the time.[20]

## Vacation Data

In the Global Data screen, XY Transit System estimated that FTOs averaged about 16 days of vacation a year based on information taken from personnel records. No minimum or maximum amount of vacation was specified by the labor agreement to be taken during any of the service periods.

## Overtime Constraints Data

Under all cases of Multiple Period Optimization, TOPDOG allows you to limit the amount of overtime that FTOs might work. In this case study, XY Transit System elected not to have TOPDOG constrain FTO overtime, but to analyze the results of this alternative first before making any decision about limitations.

---

20 If your transit system is occasionally able to avoid paying daily guarantee to extraboard operators, you should estimate the percentage of time you believe the guarantee is paid, e.g., 80 percent.

## ENTERING SCREEN DATA

If you have not completed the case studies in Chapters VI, VIII, or IX, you have now arrived at the point that data will be entered into the TOPDOG model and results printed for your review. If your PC is not turned on, please do so and bring up TOPDOG's Main Menu on the monitor screen. The first page of Chapter IV, MAIN MENU, contains instructions for doing this.

The case study in this chapter is for Multiple Period Optimization (MPO). At this time, select the MPO option from the Main Menu by striking the numerical key:

**6**

The monitor screen should appear as shown in Exhibit VII.1. The MPO Menu provides ten choices. Enter the name of the packet by striking the numerical key:

**1**

The cursor should now be positioned to accept the packet name. Now type the following:

**xyzo (CR)**

followed by the **F1** key. Your monitor screen should now appear as shown in Exhibit VII.2 and the cursor should be at the **Enter Choice** field. Enter a brief description of the packet by striking the numerical key:

**2**

The cursor should now be positioned to accept up to 180 characters of descriptive material on three lines. TOPDOG does not require that you complete this entry, but over time the descriptive material you provide

EXHIBIT VII.1

MULTIPLE PERIOD OPTIMIZATION MENU SCREEN

```
Current Date: 8/15/87        MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                              Report Destination:lst:
Packet Name:                                                     Period
There are   Service Periods starting  / /       / /       / /    End Date
                                      / /       / /       / /      / /
Description:


                        Component                          Exist  Latest Changes
                          Names    Complete  Consistent   in DB       Saved
        Global Data
 Service Period Data
     OT Constraints

           1. Set Packet Name              6. Modify Service Period Data
           2. Set Packet Description       7. Modify OT Constraints
           3. Set Component Names          8. Optimize
           4. Set Service Periods          9. Save Package/Component Data
           5. Modify Global Data           0. Exit to Main Menu

                             Enter Choice:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VII.2

MULTIPLE PERIOD OPTIMIZATION MENU SCREEN WITH PACKET NAME

```
Current Date: 8/15/87        MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:xyzo                                                   Period
There are   Service Periods starting   / /      / /      / /     End Date
                                       / /      / /      / /       / /
Description:


                         Component                            Exist  Latest Changes
                           Names    Complete   Consistent    in DB       Saved
         Global Data
 Service Period Data
     OT Constraints

           1. Set Packet Name             6. Modify Service Period Data
           2. Set Packet Description      7. Modify OT Constraints
           3. Set Component Names         8. Optimize
           4. Set Service Periods         9. Save Package/Component Data
           5. Modify Global Data          0. Exit to Main Menu

                              Enter Choice:1
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

will assist you in remembering the background and nature of the evaluation. In this case, some narrative concerning XYZO PTO and FTO labor agreement provisions has been inserted. Type the following on three lines:

**PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly (CR)**

**FTOs: May work as much OT as necessary, but no unscheduled (CR)**
**work (CR)**

followed by the F1 key. Your monitor screen should now appear as shown in Exhibit VII.3 and the cursor should be at the **Enter Choice** field. Enter the names of the packet components by striking the numerical key:

**3**

The cursor should now be positioned to accept the Global Data name. Now type the following:

**xyzgd (CR)**

The cursor should now be positioned to accept the Service Period Data name. Type the following:

**xyzsp (CR)**

The cursor should now be positioned to accept the Overtime Constraints Data name. Type the following:

**xyzot (CR)**

All component names have now been entered unless you wish to make changes. If you do, you may use the --> key to move the cursor forward to the location where you wish to make a change. After any necessary changes have been made, strike the F1 key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit VII.4. To enter the beginning and ending dates of the service period,

EXHIBIT VII.3

MULTIPLE PERIOD OPTIMIZATION MENU SCREEN WITH PACKET DESCRIPTION

```
Current Date: 8/15/87        MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:xyzo                                                     Period
There are   Service Periods starting   / /      / /      / /    End Date
                                       / /      / /      / /      / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work  as much OT as necessary, but no unscheduled
                   work

                         Component                           Exist  Latest Changes
                           Names    Complete  Consistent  in DB       Saved
        Global Data
 Service Period Data
      OT Constraints

            1. Set Packet Name            6. Modify Service Period Data
            2. Set Packet Description     7. Modify OT Constraints
            3. Set Component Names        8. Optimize
            4. Set Service Periods        9. Save Package/Component Data
            5. Modify Global Data         0. Exit to Main Menu

                              Enter Choice:2
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VII.4

MULTIPLE PERIOD OPTIMIZATION MENU SCREEN WITH COMPONENT NAMES

```
Current Date: 8/15/87       MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                         Report Destination:lst:
Packet Name:XYZO                                                  Period
There are   Service Periods starting  / /     / /     / /   End Date
                                       / /     / /     / /      / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work  as much OT as necessary, but no unscheduled
                   work

                         Component                         Exist  Latest Changes
                           Names    Complete  Consistent  in DB      Saved
         Global Data     XYZGD         N          Y        N
 Service Period Data     XYZSP         N          Y        N
      OT Constraints     XYZOT         N          Y        N

           1. Set Packet Name              6. Modify Service Period Data
           2. Set Packet Description       7. Modify OT Constraints
           3. Set Component Names          8. Optimize
           4. Set Service Periods          9. Save Package/Component Data
           5. Modify Global Data           0. Exit to Main Menu

                             Enter Choice:3
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

strike the numerical key:

**4**

The cursor should now be positioned to accept the number of service periods to be analyzed. Strike the numerical key:

**4**

The cursor should now be positioned to accept the beginning month of the first service period. The four service periods used for evaluation in this case study began on January 5, 1986, and ended on January 3, 1987. Type the following, remembering that after the numerical entry for each day, month and year you must strike the **(CR)** key:

**1(CR)5(CR)86(CR)6(CR)15(CR)86(CR)9(CR)7(CR)86**

**(CR)11(CR)23(CR)86(CR)1(CR)3(CR)87(CR)**

Once all the numbers and **(CR)**s have been entered, strike the **F1** key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit VII.5.

TOPDOG is now ready to receive component data. To enter Global Data, strike the numerical key:

**5**

and your monitor screen should appear as shown in Exhibit VII.6. The cursor is presently located at the bottom of the monitor screen following the highlighted message: **Enter component name to copy--RETURN for none.** This message always appears at the bottom of any new component screen when it first appears on the monitor. If you want to use or modify another previously created screen saved in the data base, type in the component

EXHIBIT VII.5

MULTIPLE PERIOD OPTIMIZATION MENU SCREEN WITH SERVICE PERIOD DATES

```
Current Date: 8/15/87        MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:XYZO                                              Period 4
There are 4 Service Periods starting  1/ 5/86   6/15/86   9/ 7/86  End Date
                                     11/23/86    / /       / /      1/ 3/87
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work  as much OT as necessary, but no unscheduled
                   work

                         Component                          Exist  Latest Changes
                           Names    Complete  Consistent   in DB       Saved
       Global Data       XYZGD         N           Y          N
 Service Period Data     XYZSP         N           Y          N
      OT Constraints     XYZOT         N           Y          N

         1. Set Packet Name             6. Modify Service Period Data
         2. Set Packet Description      7. Modify OT Constraints
         3. Set Component Names         8. Optimize
         4. Set Service Periods         9. Save Package/Component Data
         5. Modify Global Data          0. Exit to Main Menu

                              Enter Choice:4
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VII.6

MULTIPLE PERIOD OPTIMIZATION GLOBAL DATA SCREEN

```
    Current Date: 8/15/87                   GLOBAL DATA
    Component Name:XYZGD         PART 1 - FULL TIME OPERATORS

            Minimum Hours for a Run:  :      ---------- Averages ----------
      Minimum Pay Hours for Trippers:  :                Hourly Wage Rate:
              Minimum % Bid Trippers:        Variable Fringe Benefit Rate:
     Effective Daily Guarantee Hours:  :     Annual Fixed Fringe Benefits:
   Regular Weekly Scheduled Days Off:                Annual Vacation Days:
Must Days Off be Consecutive (Y/N)?:
-------------------------------------------------------------------------------
                                 PART 2 - PART TIME OPERATORS

                   Max Allowed PTOS:         ---------- Averages ----------
       Max Allowed Daily Work Hours:   :                Hourly Wage Rate:
       Max Allowed Weekly Work Days:         Variable Fringe Benefit Rate:
      Max Allowed Weekly Work Hours:   :     Annual Fixed Fringe Benefits:
       Max Allowed % as a % of FTOS:                 Annual Vacation Days:
Max Allowed % as a % of FTOS + PTOS:
     Minimum Pay Hours for Trippers:   :

             Can PTOS Work Split Assignments (Y/N)?
              Can PTOS Work Sat/Sun Schedule (Y/N)?
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component to copy - RETURN for none
```

name, then strike the **F1** key. In this case, however, you have not previously created another Global Data screen, so simply strike the ENTER key:

**(CR)**

The cursor should now be located at the first Global Data entry field on the monitor screen. Using the information provided by the XYZO case study description, complete the screen, striking the **F10** key whenever you require assistance. When you have finished entering data on the Global Data screen, compare the results with Exhibit VII.7. If there are differences, attempt to find out why using the **F10** (help) key.

When you are satisfied that your data entry is correct and matches Exhibit VII.7, strike the **F1** key. The cursor should return to the MPO Menu at the **Enter Choice** field. To enter Service Period data, strike the numerical key:

**6**

and your monitor screen should appear as shown in Exhibit VII.8. Since you have no previously created Service Period data that you can use or modify, strike the ENTER key:

**(CR)**

The cursor should now be located at the first Service Period Data entry field on the monitor screen. Using the information provided in the XYZO case study description, complete the screen, striking the **F10** key whenever you require assistance. When you have finished entering data on the first Service Period screen, compare the results with the first page of Exhibit VII.9. Make changes and modifications, if necessary, using the --> and <-- keys to move around the screen. When you are satisfied that the data you entered is correct and matches the Exhibit, strike the **F1** key.

EXHIBIT VII.7

MULTIPLE PERIOD OPTIMIZATION GLOBAL DATA SCREEN COMPLETED

```
    Current Date: 8/15/87                GLOBAL DATA
    Component Name:XYZGD       PART 1 - FULL TIME OPERATORS

            Minimum Hours for a Run:  :      ---------- Averages ----------
     Minimum Pay Hours for Trippers:  :                 Hourly Wage Rate:12.00
             Minimum % Bid Trippers:         Variable Fringe Benefit Rate:1.186
    Effective Daily Guarantee Hours: 8: 0   Annual Fixed Fringe Benefits: 7500
  Regular Weekly Scheduled Days Off:    2           Annual Vacation Days:16.00
Must Days Off be Consecutive (Y/N)?:    N
--------------------------------------------------------------------------------
                                   PART 2 - PART TIME OPERATORS

                  Max Allowed PTOS:         ---------- Averages ----------
      Max Allowed Daily Work Hours:    :               Hourly Wage Rate: 9.50
      Max Allowed Weekly Work Days:        Variable Fringe Benefit Rate:1.073
     Max Allowed Weekly Work Hours: 30: 0  Annual Fixed Fringe Benefits: 1500
      Max Allowed % as a % of FTOS:  10.0          Annual Vacation Days:    0
Max Allowed % as a % of FTOS + PTOS:
     Minimum Pay Hours for Trippers:   :

             Can PTOS Work Split Assignments (Y/N)? Y
              Can PTOS Work Sat/Sun Schedule (Y/N)? Y
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEn
```

EXHIBIT VII.8

MULTIPLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN

```
                 MULTIPLE PERIOD DATA for Component XYZSP
                   Service Period 1 from  1/ 5/86 to  6/14/86

     Current Date: 8/15/87             Weekday    Saturday     Sunday
                                       -------    --------     ------
                 Number Days Operated:
                          Number Runs:
                 Number A.M. Trippers:
                 Minimum A.M. Tripper:      :           :           :
                 Maximum A.M. Tripper:      :           :           :
                 Number P.M. Trippers:
                 Minimum P.M. Tripper:      :           :           :
                 Maximum P.M. Tripper:      :           :           :
  Average Number Nonscheduled Assigns:
             FTO Absence Rate Percent:
             PTO Absence Rate Percent:
          Open Work Variation (+/- %):
Average FTO Full Day Assignment Hours:      :           :           :
        Percent No-Work-Available Paid:
  Total Daily Scheduled Run Pay Hours:

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component to copy - RETURN for none
```

EXHIBIT VII.9

MULTIPLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 1 from 1/ 5/86 to 6/14/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 112 | 23 | 26 |
| Number Runs: | 246 | 133 | 82 |
| Number A.M. Trippers: | 26 | 16 | 7 |
| Minimum A.M. Tripper: | 0:51 | 2:39 | 2:30 |
| Maximum A.M. Tripper: | 3:56 | 4: 0 | 4:11 |
| Number P.M. Trippers: | 33 | 15 | 3 |
| Minimum P.M. Tripper: | 1: 7 | 3:40 | 3: 2 |
| Maximum P.M. Tripper: | 4:38 | 4:45 | 4:39 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 10.0 | 12.5 | 14.0 |
| PTO Absence Rate Percent: | 5.0 | 6.0 | 7.0 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2050 | 1131 | 697 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT VII.9 (Continued)

MULTIPLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 2 from 6/15/86 to 9/ 6/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 58 | 12 | 14 |
| Number Runs: | 240 | 130 | 80 |
| Number A.M. Trippers: | 21 | 15 | 6 |
| Minimum A.M. Tripper: | 1:32 | 2:45 | 2:37 |
| Maximum A.M. Tripper: | 4:17 | 4: 5 | 4:11 |
| Number P.M. Trippers: | 24 | 14 | 3 |
| Minimum P.M. Tripper: | 2:23 | 3:42 | 3:28 |
| Maximum P.M. Tripper: | 4: 1 | 4:40 | 4:12 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 11.5 | 13.2 | 15.6 |
| PTO Absence Rate Percent: | 5.2 | 6.1 | 7.3 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2000 | 1105 | 680 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT VII.9 (Continued)

MULTIPLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 3 from 9/ 7/86 to 11/22/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 54 | 11 | 12 |
| Number Runs: | 246 | 133 | 82 |
| Number A.M. Trippers: | 26 | 16 | 7 |
| Minimum A.M. Tripper: | 0:51 | 2:39 | 2:30 |
| Maximum A.M. Tripper: | 3:56 | 4: 0 | 4:11 |
| Number P.M. Trippers: | 33 | 15 | 3 |
| Minimum P.M. Tripper: | 1: 7 | 3:40 | 3: 2 |
| Maximum P.M. Tripper: | 4:38 | 4:45 | 4:39 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 10.0 | 12.5 | 14.0 |
| PTO Absence Rate Percent: | 5.0 | 6.0 | 7.0 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2050 | 1131 | 697 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT VII.9 (Continued)

MULTIPLE PERIOD OPTIMIZATION SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 4 from 11/23/86 to 1/ 3/87

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 27 | 6 | 9 |
| Number Runs: | 254 | 145 | 90 |
| Number A.M. Trippers: | 23 | 18 | 8 |
| Minimum A.M. Tripper: | 2:14 | 3:30 | 2:21 |
| Maximum A.M. Tripper: | 4:15 | 5:10 | 4:23 |
| Number P.M. Trippers: | 26 | 20 | 4 |
| Minimum P.M. Tripper: | 2:20 | 2:47 | 3:13 |
| Maximum P.M. Tripper: | 4:13 | 5: 2 | 4:44 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 9.8 | 12.3 | 15.2 |
| PTO Absence Rate Percent: | 4.4 | 5.5 | 6.3 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2117 | 1233 | 765 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

The cursor should now be at the first data entry location on the second Service Period Data screen. Notice that the data you entered in the first Service Period Data screen also appear here. When entering the second period data, you only have to enter data that are different from the first period data. Enter data on the screen for the second service period until it is completed; then compare your results with the second page of Exhibit VII.9. When you are satisfied that your data entries are correct, strike the **F1** key.

The cursor should now be at the first data entry field on the third Service Period Data screen. Just as before, the data from the previous screen--the second period--appear here. Continue entering data on the third screen and the fourth screen until all entries are complete and match those given in Exhibit VII.9. When you have completed the fourth screen, strike the **F1** key. The cursor should return to the Enter Choice field on the MPO Menu.

To enter Overtime Constraints Data, strike the numerical key:

**7**

Your monitor screen should appear as shown in Exhibit VII.10. Since XY Transit System elected not to constrain FTO overtime in this example, you can either complete each field with the numeric value 100 or leave the data entry fields blank, in which case TOPDOG will fill in default values of 100. At this time, let TOPDOG use default values by striking **(CR)** and then the **F1** key after each of the four service period screens appear. The cursor should then return to the **Enter Choice** field on the MPO Menu.

At this point, all component screens are complete. You may assure yourself that the component screens are complete by checking the column labeled **Complete** on the table just above the MPO Menu on the monitor screen. You can also check that the names of the components are consistent among those names contained in the data base and are considered valid by TOPDOG by looking in the column labeled **Consistent** on the table. The next two column headings, labeled **Exist in DB (Data Base)** and Latest

EXHIBIT VII.10

MULTIPLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA SCREEN

```
         MULTIPLE PERIOD OPTIMIZATION OVERTIME CONSTRAINTS DATA for
                 Service Period 1 from  1/ 5/86 to  6/14/86
    Current Date: 8/15/87                      Component Name:XYZOT
         Maximum Average Daily      Weekday     Saturday      Sunday
         ---------------------      -------     --------      -------
  % Unscheduled Overtime Hours:
              % WDO Assignments:
% Unscheduled Overtime Trippers:






F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component to copy - RETURN for none
```

**Changes Saved**, both show a series of Ns, meaning that the component screen entries have not been saved nor do they exist in the TRANS1 data base.

To save the data to the TRANS1 data base, strike the numeric key:

**9**

The message appearing in the lower corner of the monitor screen asks: **Save Packet (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: Save **Global Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: Save **Service Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: Save **Overtime Constraint Data (Y/N)?** Strike the key:

**Y**

After saving this data, the cursor should return to the MPO Menu **Enter Choice** field. Your screen should now appear as shown in Exhibit VII.11. Had you answered any of the previous questions **NO**, TOPDOG would have continued to ask whether to save the remaining component screens that were entered or modified.

TOPDOG has now received and stored complete and consistent component data grouped under the Packet name XYZO in the data base TRANS1. You could continue to form other packets containing new component data, or form combinations of new and existing component data. For example, a new

EXHIBIT VII.11

MULTIPLE PERIOD OPTIMIZATION MENU SCREEN, DATA COMPLETE AND SAVED

```
Current Date: 8/15/87        MULTIPLE PERIOD OPTIMIZATION
Data Base:a:transl                          Report Destination:lst:
Packet Name:XYZO                                              Period 4
There are 4 Service Periods starting  1/ 5/86   6/15/86   9/ 7/86  End Date
                                     11/23/86    / /       / /      1/ 3/87
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no nonscheduled
                   work.

                         Component                        Exist  Latest Changes
                           Names    Complete  Consistent  in DB      Saved
        Global Data      XYZGD         Y          Y         Y          Y
 Service Period Data     XYZSP         Y          Y         Y          Y
      OT Constraints     XYZOT         Y          Y         Y          Y

           1. Set Packet Name              6. Modify Service Period Data
           2. Set Packet Description       7. Modify OT Constraints
           3. Set Component Names          8. Optimize
           4. Set Service Periods          9. Save Package/Component Data
           5. Modify Global Data           0. Exit to Main Menu

                             Enter Choice:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

packet could be formed with Global Data XYZGD and Service Period Data XYZSP with a new Overtime Constraint Data component reflecting some constraint on the use of overtime by FTOs. For the present, however, proceed to complete this case study with TOPDOG.

## EVALUATING THE OPERATOR WORK FORCE

TOPDOG is now ready to estimate the least-cost size and configuration of the operator work force for Division Z of the XY Transit System for the multiple service period January 5, 1986, through January 3, 1987. To perform this task a printer must be connected with the PC and turned on ready to print. Printer requirements were briefly described on the first page of Chapter III. To initiate the analysis, strike the numerical key:

**8**

The cursor has now moved to the Report Destination entry field and the message highlighted in the lower left corner of the screen requests you to enter output file name; the default (if you enter nothing) is the printer. TOPDOG allows you to specify that you want to save output files to floppy diskettes or to the hard disk for later printing. You should proceed to prepare TOPDOG for immediate printing of the reports by striking the F1 key.

Your monitor screen should then appear as shown in Exhibit VII.12. TOPDOG has just completed an edit check of all input data to ensure its consistency. Had there been a data input or consistency error, one or more error messages would have appeared on the monitor screen. In that case, you must strike the **(CR)** key to return to the MPO Menu for corrections. TOPDOG now asks the question: **want satisfying condition?** Strike the key:

**Y (CR)**

TOPDOG then begins its algorithmic routines; during this time, all you will see is a series of dots (.....) appearing on the monitor screen.

EXHIBIT VII.12

DATA EDIT CHECK SCREEN

```
 Optimization beginning
--CHECKING GLOBAL DATA
--CHECKING SERVICE PERIOD DATA
   PERIOD 1
   PERIOD 2
   PERIOD 3
   PERIOD 4
want satis cond?
```

Many of the cases you will try will take several minutes for TOPDOG to analyze and process. The growing series of dots that appear on the screen simply let you know TOPDOG is hard at work.

When TOPDOG is finished the monitor screen should appear as shown in Exhibit VII.13, displaying a menu for choosing one or more output reports. To omit printing any reports you don't need, simply use the --> key to move the cursor to that field and strike the letter N. Practice moving the cursor around and changing entries from Y to N and back to Y. When you have completed your exercise with the options, strike the F1 key. The monitor screen should then appear as shown in Exhibit VII.14. Turn your printer on, align the paper in your printer as necessary, and strike the ENTER key:

**(CR)**

The monitor screen will inform you of TOPDOG's progress in preparing and printing the reports you selected. When report printing is completed, TOPDOG returns you to the SPO Menu screen and awaits further instructions. TOPDOG report outputs are described in Appendix B.

If you want to stop at this point, remember to strike the numeric key:

**0**

to exit to the Main Menu and then strike the numeric key:

**9**

to return to a C> prompt on the monitor screen.

EXHIBIT VII.13

REPORT SELECTION MENU SCREEN

```
                         REPORT SELECTION MENU

          Current Date: 8/15/87
             Data Base:a:transl
           Packet Name:XYZO

                                 Report Selections (Y/N)

             Operator Configuration Report: Y
               Operator Utilization Report: Y
        Open Work and Unassigned Tripper Report: Y
                  Vacation Scheduling Report: Y
                        Detailed Cost Report: Y
                  Summary Information Report: Y   (Multiple Periods Only)



F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Select desired reports; Press F1 to print, ESC to abort
```

EXHIBIT VII.14

PRINTER PREPARATION AND PRINT EXECUTION SCREEN

```
Getting ready to print reports
Please prepare your printer; Press RETURN when ready
```

# VIII. SINGLE PERIOD FORECAST

This chapter describes the use of Main Menu Choice 7, Single Period Forecast (SPF). SPF is used to estimate the cost of a given number of operators for two to six service periods. In this chapter, you will learn by examining a case study how to complete packet and component screens using example data for estimating the cost of a given operator work force.

The chapter begins with a description of the case study data for a service period of a transit system division named ABC. Following the description are instructions for entering the data in the data base through the component screens. Lastly, when input data are complete, procedures are provided showing how to instruct TOPDOG to conduct a single period forecast of the ABC example and print the results.

## CASE STUDY: ABCF

ABC is Motorbus Division C of the AB Transit System. The service period selected for evaluation corresponds to the operator work selection or pick period beginning on January 5, 1986, and ending on June 14, 1986, the last day public schools were in session. The following data and information are presented by component screen for easy reference when you follow the data entry instructions presented later in the chapter.

### Global Data

Examination of the labor agreement and work rules, coupled with the assistance of AB Transit System's Finance Department, provided the following information for completing the Global Data component screen:

- Full-Time Operators (FTOs)

  -- No coupling provision or work rule requiring certain trippers to be combined into a run.

- -- No minimum pay requirements for operating trippers.

- -- No provisions reserving specified numbers of trippers for bid by FTOs.

- -- Daily pay guarantee of 8 hours.

- -- Two non-consecutive weekly days off guaranteed but not required to be scheduled consecutively.

- -- Average FTO wage rate during the period of $12.00 per hour.

- -- Average FTO variable fringe benefit rate or wage rate multiplier for the period of 1.186.

- -- Average annualized FTO fixed fringe benefit cost of $7,500.

- -- Average annualized number of vacation days per FTO of 16.0.

o <u>Part-Time Operators (PTOs)</u>

- -- PTOs limited in number to 10 percent of the number of FTOs.

- -- PTOs may work up to 30 weekly hours, with no restrictions on the number of daily hours or days of the week that work may be performed.

- -- No minimum pay requirements for operating trippers.

- -- Average PTO wage rate during the period of $9.50 per hour.

- -- Average PTO variable fringe benefit rate or wage rate multiplier for the period of 1.073.

-- Average annualized PTO fixed fringe benefit cost of $1,500.

-- PTOs receive no paid vacation days.

-- PTOs may work split assignments, i.e., more than one daily assignment or tripper.

-- PTOs may work weekends.

## Service Period Data

The Service Period Data screen requires information from various sources within AB Transit System. This information may be divided into schedule data, open work data, nonscheduled and nonoperating work, dispatching practices, and vacation data.

## Schedule Data

AB Transit System's Scheduling Department provided the following information about scheduled service during the service periods:

o <u>Number of Days During the Service Period Each Schedule Operated</u>

| | | |
|---|---|---|
| - | Weekday | 112 |
| - | Saturday | 23 |
| - | Sunday | 26 |

o <u>Number of Runs Operated in Each Schedule</u>

| | | |
|---|---|---|
| - | Weekday | 246 |
| - | Saturday | 133 |
| - | Sunday | 82 |

- Number of Scheduled A.M. Trippers

  - Weekday 26
  - Saturday 16
  - Sunday 7

- Number of Scheduled P.M. Trippers

  - Weekday 33
  - Saturday 15
  - Sunday 3

- Minimum Clock Time Length of A.M. Trippers

  - Weekday 0:51
  - Saturday 2:39
  - Sunday 2:30

- Maximum Clock Time Length of A.M. Trippers

  - Weekday 3:56
  - Saturday 4:00
  - Sunday 4:11

- Minimum Clock Time Length of P.M. Trippers

  - Weekday 1:07
  - Saturday 3:40
  - Sunday 3:02

- Maximum Clock Time Length of P.M. Trippers

  - Weekday 4:38
  - Saturday 4:45
  - Sunday 4:39

- **Average Daily Work Hours per FTO**

  The Scheduling Department estimated the average daily work hours per FTO by dividing the total scheduled pay hours by the total number of scheduled runs as follows:

  - Weekday 8:20
  - Saturday 8:30
  - Sunday 8:30

- **Total Schedule Run Pay Hours**

  For runs only (no trippers):

  - Weekday 2,050
  - Saturday 1,131
  - Sunday 697

**Open Work Data**

AB Transit System's Personnel Department maintained a complete record of operator absence.[21] Some analysis of their information resulted in the following data about operator absenteeism:

- **FTO Absence Rate**

  - Weekday 10.0%
  - Saturday 12.5%
  - Sunday 14.0%

- **PTO Absence Rate**

  - Weekday 5.0%
  - Saturday 6.0%
  - Sunday 7.0%

---

21 At some transit systems, operator absence information is kept in the Transportation or Operations Department.

There was some discussion of daily open work assignments in Chapter II with an example shown in Exhibit II.1. An estimate of the percentage of variation in the daily open work force is required for TOPDOG to appropriately evaluate the operator work force. Using FTO absence data available from XY Transit's Personnel Department, it was estimated that the variations in the amount of open work due to absence during the service period was +/-30 percent. This was found to be true for weekdays, Saturdays and Sundays.

## Nonscheduled and Nonoperating Work

TOPDOG requires an estimate of the amount of nonscheduled and nonoperating work conducted by FTOs during the service period. This estimate should be made in terms of the average equivalent number of FTO daily work assignments for each service schedule. For example, if the total number of nonscheduled and nonoperating operator work hours for a weekday service schedule for the service period was 3,405, and the number of days that a weekday schedule was operated in the service period was 112, then the average number of FTO nonscheduled and nonoperating work hours for a weekday schedule would be equal to 3,405 divided by 112, or 30.4 hours. To estimate the average equivalent number of FTO weekday nonscheduled and nonoperating work assignments, divide 30.4 hours by the effective daily guarantee of 8 hours. The result is 3.8 equivalent weekday work assignments. Some transit systems may record FTO nonoperating work as absence from operating work, and therefore a portion or all of the nonscheduled and nonoperating work may be reflected in the percentage of operator absence.

The AB Transit System's Transportation Department researched its daily records of operator work assignments and found that no nonscheduled work such as charters or special events service was conducted during the period by Division C FTOs. In addition, the AB Transit System labor agreement provides that operators shall not perform any nonoperating work assignments such as acting as supervisor or training new operators. Remedial training of operators was considered open work and was therefore included in the previous estimate of operator absence. Consequently, Division C operators of the AB Transit System conducted no nonscheduled and nonoperating work during the service period considered.

## Dispatching Practices

Sometimes transit systems can avoid paying extraboard operators their daily guarantee when no work is available. They accomplish this by means of an informal agreement between dispatchers and operators where operators suffer no disciplinary or other pay penalties for taking a "management-approved" day off with no pay. In the case of XY Transit System, management stated that daily guarantee was paid 100 percent of the time.[22]

## Vacation Data

In the Global Data screen, AB Transit System estimated that FTOs averaged about 16 days of vacation a year based on information taken from personnel records. They also estimated that about 7 days of vacation per FTO was taken during this service period. These estimates were converted to show 44.23 percent of annual FTO vacation days were taken during this service period.

## Operator Configuration Data

Under all cases of Single Period Forecasts, TOPDOG needs to know the number of FTOs and PTOs scheduled to report for duty for each schedule type during the service period. FTOs include regular operators and extraboard operators used to fill open work due to absence, vacations and so forth.

---

22 If your transit system is occasionally able to avoid paying daily guarantee to extraboard operators, you should estimate the percentage of time you believe the guarantee is paid, e.g., 80 percent.

Based on AB Transit System's records, it was estimated that the following FTOs and PTOs were scheduled to report to work.

- Full-Time Operators

  - Weekday 269
  - Saturday 150
  - Sunday 93

- Part-Time Operators

  - Weekday 33
  - Saturday 16
  - Sunday 7

ENTERING SCREEN DATA

If you have not completed the case studies in Chapters VI, VII or IX, you have now arrived at the point that data will be entered into the TOPDOG model and results printed for your review. If your PC is not turned on, please do so and bring up TOPDOG's Main Menu on the monitor screen. The first page of Chapter IV, MAIN MENU, contains instructions for doing this.

The case study in this chapter is for Single Period Forecasting (SPF). At this time, select the SPF option from the Main Menu by striking the numerical key:

7

The monitor screen should appear as shown in Exhibit VIII.1. The SPF Menu

EXHIBIT VIII.1

SINGLE PERIOD FORECAST MENU SCREEN

```
Current Date: 8/15/87        SINGLE PERIOD FORECAST
Data Base:a:transl                         Report Destination:lst:
Packet Name:
Service Period is from   / /   to   / /
Description:

                          Component                          Exist   Latest Changes
                            Names    Complete  Consistent    in DB       Saved
          Global Data
   Service Period Data
Operator Configuration

          1. Set Packet Name             6. Modify Service Period Data
          2. Set Packet Description      7. Modify Operator Configuration
          3. Set Component Names         8. Forecast
          4. Set Service Period          9. Save Package/Component Data
          5. Modify Global Data          0. Exit to Main Menu

                            Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

provides ten choices. Enter the name of the packet by striking the numerical key:

1

The cursor should now be positioned to accept the packet name. Now type the following:

abcf (CR)

followed by the F1 key. Your monitor screen should now appear as shown in Exhibit VIII.2 and the cursor should be at the **Enter Choice** field. Enter a brief description of the packet by striking the numerical key:

2

The cursor should now be positioned to accept up to 180 characters of descriptive material on three lines. TOPDOG does not require that you complete this entry, but over time the descriptive material you provide will assist you in remembering the background and nature of the evaluation. In this case, some narrative concerning ABCF PTO and FTO labor agreement provisions has been inserted. Type the following on three lines:

**PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly CR**

**FTOs: May work as much OT as necessary, but no unscheduled (CR)**
**work (CR)**

followed by the F1 key. Your monitor screen should now appear as shown in Exhibit VIII.3 and the cursor should be at the **Enter Choice** field. Enter

EXHIBIT VIII.2

SINGLE PERIOD FORECAST MENU SCREEN WITH PACKET NAME

```
Current Date: 8/15/87        SINGLE PERIOD FORECAST
Data Base:a:transl                        Report Destination:lst:
Packet Name:abcf
Service Period is from   / /   to   / /
Description:


                           Component                             Exist  Latest Changes
                             Names    Complete  Consistent  in DB      Saved
           Global Data
   Service Period Data
Operator Configuration

          1. Set Packet Name           6. Modify Service Period Data
          2. Set Packet Description    7. Modify Operator Configuration
          3. Set Component Names       8. Forecast
          4. Set Service Period        9. Save Package/Component Data
          5. Modify Global Data        0. Exit to Main Menu

                             Enter Choice:1

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VIII.3

SINGLE PERIOD FORECAST MENU SCREEN WITH DESCRIPTION

```
Current Date: 8/15/87        SINGLE PERIOD FORECAST
Data Base:a:transl                         Report Destination:lst:
Packet Name:abcf
Service Period is from   / /   to   / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                          Component                           Exist  Latest Changes
                            Names    Complete  Consistent  in DB      Saved
           Global Data
   Service Period Data
Operator Configuration

          1. Set Packet Name              6. Modify Service Period Data
          2. Set Packet Description       7. Modify Operator Configuration
          3. Set Component Names          8. Forecast
          4. Set Service Period           9. Save Package/Component Data
          5. Modify Global Data           0. Exit to Main Menu

                            Enter Choice:2

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

the names of the packet components by striking the numerical key:

**3**

The cursor should now be positioned to accept the Global Data name. Now type the following:

**abcgd** **(CR)**

The cursor should now be positioned to accept the Service Period Data name. Type the following:

**abcsp** **(CR)**

The cursor should now be positioned to accept the Overtime Constraints Data name. Type the following:

**abcoc** **(CR)**

All component names have now been entered unless you wish to make changes. If you do, you may use the --> key to move the cursor forward to the location where you wish to make a change. After any necessary changes have been made, strike the **F1** key. The cursor should now be at the Enter **Choice** field and the monitor screen should appear as shown in Exhibit VIII.4. To enter the beginning and ending dates of the service period, strike the numerical key:

**4**

The cursor should now be positioned to accept the beginning month of the service period. The service period used for evaluation in this case study began on January 5, 1986, and ended on June 14, 1986. Type the following, remembering that after the numerical entry for each day, month and year, you must strike the (CR) key:

**1(CR)5(CR)86(CR)6(CR)14(CR)86(CR)**

EXHIBIT VIII.4

SINGLE PERIOD FORECAST MENU SCREEN WITH COMPONENT NAMES

```
Current Date: 8/15/87         SINGLE PERIOD FORECAST
Data Base:a:transl                          Report Destination:lst:
Packet Name:ABCF
Service Period is from   / /   to   / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                            Exist  Latest Changes
                           Names    Complete   Consistent   in DB       Saved
           Global Data   ABCGD         N           Y          N
   Service Period Data   ABCSP         N           Y          N
Operator Configuration   ABCOC         N           Y          N

          1. Set Packet Name                6. Modify Service Period Data
          2. Set Packet Description         7. Modify Operator Configuration
          3. Set Component Names            8. Forecast
          4. Set Service Period             9. Save Package/Component Data
          5. Modify Global Data             0. Exit to Main Menu

                         Enter Choice:3

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

Once all the numbers and **(CR)**s have been entered, strike the F1 key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit VIII.5.

TOPDOG is, now ready to receive component data. To enter Global Data, strike the numerical key:

**5**

and your monitor screen should appear as shown in Exhibit VIII.6.[23] The cursor is presently located at the bottom of the monitor screen following the highlighted message: **Enter component name to copy--RETURN for none.** This message always appears at the bottom of any new component screen when it first appears on the monitor. If you want to use or modify another previously created screen saved in the data base, type in the component name, then strike the F1 key. In this case, however, you have not previously created another Global Data screen, so simply strike the ENTER key:

**(CR)**

The cursor should now be located at the first Global Data entry field on the monitor screen. Using the information provided by the ABCF case study description, complete the screen, striking the F10 key whenever you require assistance. When you have finished entering data on the Global Data screen, compare the results with Exhibit VIII.7. If there are differences, attempt to find out why using the F10 (Help) key.

When you are satisfied that your data entry is correct and matches Exhibit VIII.7, strike the F1 key.

---

23 If you previously completed the SPO case study, ABCO, in Chapter VI, the Global Data Component ABCGD was completed and saved in the TRANS1 data base. Therefore, your monitor screen should appear as shown in Exhibit VIII.7. Strike the Esc key to return to the SPF Menu.

EXHIBIT VIII.5

SINGLE PERIOD FORECAST MENU SCREEN WITH SERVICE PERIOD DATE

```
Current Date: 8/15/87          SINGLE PERIOD FORECAST
Data Base:a:transl                                 Report Destination:lst:
Packet Name:ABCF
Service Period is from  1/ 5/86 to  6/14/86
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                              Component                          Exist  Latest Changes
                                Names    Complete  Consistent   in DB       Saved
           Global Data        ABCGD         N          Y         N
   Service Period Data        ABCSP         N          Y         N
Operator Configuration        ABCOC         N          Y         N

          1. Set Packet Name              6. Modify Service Period Data
          2. Set Packet Description       7. Modify Operator Configuration
          3. Set Component Names          8. Forecast
          4. Set Service Period           9. Save Package/Component Data
          5. Modify Global Data           0. Exit to Main Menu

                                Enter Choice:4

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT VIII.6

SINGLE PERIOD FORECAST GLOBAL DATA SCREEN

```
   Current Date: 8/15/87                 GLOBAL DATA
   Component Name:ABCGD          PART 1 - FULL TIME OPERATORS

           Minimum Hours for a Run:  :     ---------- Averages ----------
    Minimum Pay Hours for Trippers:  :                Hourly Wage Rate:
            Minimum % Bid Trippers:        Variable Fringe Benefit Rate:
   Effective Daily Guarantee Hours:  :     Annual Fixed Fringe Benefits:
  Regular Weekly Scheduled Days Off:               Annual Vacation Days:
Must Days Off be Consecutive (Y/N)?:
-------------------------------------------------------------------------------
                                 PART 2 - PART TIME OPERATORS

                  Max Allowed PTOS:        ---------- Averages ----------
      Max Allowed Daily Work Hours:   :               Hourly Wage Rate:
      Max Allowed Weekly Work Days:        Variable Fringe Benefit Rate:
     Max Allowed Weekly Work Hours:   :    Annual Fixed Fringe Benefits:
      Max Allowed % as a % of FTOS:                Annual Vacation Days:
Max Allowed % as a % of FTOS + PTOS:
     Minimum Pay Hours for Trippers:   :

            Can PTOS Work Split Assignments (Y/N)?
             Can PTOS Work Sat/Sun Schedule (Y/N)?
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT VIII.7

SINGLE PERIOD FORECAST GLOBAL DATA SCREEN COMPLETED

```
Current Date: 8/15/87                  GLOBAL DATA
Component Name:ABCGD        PART 1 - FULL TIME OPERATORS

        Minimum Hours for a Run:  :      ---------- Averages ----------
  Minimum Pay Hours for Trippers:  :               Hourly Wage Rate:12.00
         Minimum % Bid Trippers:         Variable Fringe Benefit Rate:1.186
  Effective Daily Guarantee Hours: 8: 0   Annual Fixed Fringe Benefits: 7500
  Regular Weekly Scheduled Days Off:   2          Annual Vacation Days:16.00
Must Days Off be Consecutive (Y/N)?:   N
--------------------------------------------------------------------------------
                            PART 2 - PART TIME OPERATORS

               Max Allowed PTOS:         ---------- Averages ----------
     Max Allowed Daily Work Hours:   :             Hourly Wage Rate: 9.50
     Max Allowed Weekly Work Days:       Variable Fringe Benefit Rate:1.073
    Max Allowed Weekly Work Hours: 30: 0  Annual Fixed Fringe Benefits: 1500
    Max Allowed % as a % of FTOS:  10.0          Annual Vacation Days:    0
Max Allowed % as a % of FTOS + PTOS:
    Minimum Pay Hours for Trippers:   :

         Can PTOS Work Split Assignments (Y/N)? Y
          Can PTOS Work Sat/Sun Schedule (Y/N)? Y
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

The cursor should return to the SPF Menu at the Enter Choice field. To enter Service Period data, strike the numerical key:

**6**

and your monitor screen should appear as shown in Exhibit VIII.8.[24] Since you have not previously created Service Period data that you can use or modify, strike the ENTER key:

**(CR)**

The cursor should now be located at the first Service Period Data entry field on the monitor screen. Using the information provided in the ABCF case study description, complete the screen, striking the F10 (Help) key whenever you require assistance. When you have finished entering data on the first Service Period screen, compare the results with the first page of Exhibit VIII.9. Make changes and modifications, if necessary, using the --> and <-- keys to move around the screen. When you are satisfied that your data entry is correct and matches Exhibit VIII.9, strike the F1 key.

The cursor should return to the SPF Menu at the Enter Choice field. To enter Operator Configuration data, strike the numerical key:

**7**

and your monitor screen should appear as shown in Exhibit VIII.10. Using the information provided in the ABCF case study description, complete the screen, striking the F10 (Help) key whenever you require assistance. When you have finished entering data on the Operator Configuration screen, compare the results with Exhibit VIII.11. Strike the F1 key to return the cursor to the SPF Menu Enter Choice location.

---

[24] If you previously completed the SPO case study, ABCO, in Chapter VI the Service Period Data component ABCSP was completed and saved in the TRANS1 data base. Therefore, your monitor screen should appear as shown in Exhibit VIII.9. Strike the Esc key to return to the SPF Menu.

EXHIBIT VIII.8

SINGLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN

```
                    SINGLE PERIOD DATA for Component ABCSP
                     Service Period from  1/ 5/86 to  6/14/86

     Current Date: 8/15/87              Weekday     Saturday    Sunday
                                        -------     --------    ------
               Number Days Operated:
                        Number Runs:
               Number A.M. Trippers:
               Minimum A.M. Tripper:       :           :           :
               Maximum A.M. Tripper:       :           :           :
               Number P.M. Trippers:
               Minimum P.M. Tripper:       :           :           :
               Maximum P.M. Tripper:       :           :           :
   Average Number Nonscheduled Assigns:
            FTO Absence Rate Percent:
            PTO Absence Rate Percent:
          Open Work Variation (+/- %):
 Average FTO Full Day Assignment Hours:    :           :           :
        Percent No-Work-Available Paid:
   Total Daily Scheduled Run Pay Hours:

      % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT VIII.9

SINGLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN COMPLETED

SINGLE PERIOD DATA for Component ABCSP
Service Period from 1/ 5/86 to 6/14/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 112 | 23 | 26 |
| Number Runs: | 246 | 133 | 82 |
| Number A.M. Trippers: | 26 | 16 | 7 |
| Minimum A.M. Tripper: | 0:51 | 2:39 | 2:30 |
| Maximum A.M. Tripper: | 3:56 | 4: 0 | 4:11 |
| Number P.M. Trippers: | 33 | 15 | 3 |
| Minimum P.M. Tripper: | 1: 7 | 3:40 | 3: 2 |
| Maximum P.M. Tripper: | 4:38 | 4:45 | 4:39 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 10.0 | 12.5 | 14.0 |
| PTO Absence Rate Percent: | 5.0 | 6.0 | 7.0 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2050 | 1131 | 697 |

% Total Annual Vacation Days Scheduled This Service Period: 44.23
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT VIII.10

SINGLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN

```
      SINGLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for

               Service Period from  1/ 5/86 to  6/14/86

    Current Date: 8/15/87            Component Name:ABCOC

                           OPERATORS SCHEDULED
                       Weekday     Saturday     Sunday
                       -------     --------     ------

     Full Time:
     Part Time:




F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT VIII.11

SINGLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN COMPLETED

SINGLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for

Service Period from 1/ 5/86 to 6/14/86

Current Date: 8/15/87 Component Name:ABCOC

OPERATORS SCHEDULED

| | Weekday | Saturday | Sunday |
|---|---|---|---|
| Full Time: | 269.0 | 150.0 | 93.0 |
| Part Time: | 33.0 | 16.0 | 7.0 |

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/Ac

At this point, all component screens are complete. You may assure yourself that the component screens are complete by checking the column labeled **Complete** on the table just above the SPF Menu on the monitor. You can also check that the names of the components are consistent among those names contained in the data base and are considered valid by TOPDOG by looking in the column labeled **Consistent** on the table. The next two column headings labeled **Exist in DB (Data Base)** and **Latest Changes Saved**, both have a series of Ns, meaning that the component screen entries have not been saved nor do they exist in the TRANS1 data base.[25]

To save the data to the TRANS1 data base, strike the numeric key:

**9**

The message appearing in the lower corner of the monitor screen asks: **Save Packet (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save Global Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save Service Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save**

---

[25] If you previously created and saved Global Data ABCGD and Service Period Data ABCSP, the Ys will appear in the two columns opposite those components. In that case, TOPDOG will only ask if you want to save the Packet and Operator Configuration Data.

**Operator Configuration Data (Y/N)?** Strike the key:

**Y**

After saving this data, the cursor should return to the SPF Menu Enter **Choice** field. Your screen should now appear as shown in Exhibit VIII.12. Had you answered any of the previous questions **NO**, TOPDOG would have continued to ask whether to save the remaining component screens that were entered or modified.

TOPDOG has now received and stored complete and consistent component data grouped under the Packet name ABCF in the data base TRANS1. You could continue to form other packets containing new component data or form combinations of new and existing component data. For example, a new packet could be formed with Global Data ABCGD and Service Period Data ABCSP with a new Operator Configuration Data component reflecting a different level of FTO employment. For the present, however, proceed to complete this case study with TOPDOG.

## EVALUATING THE OPERATOR WORK FORCE

TOPDOG is now ready to estimate the cost of the operator work force for Division C of the AB Transit System for the service period January 5, 1986, through June 14, 1986. To perform this task a printer must be connected with the PC and turned on ready to print. Printer requirements were briefly described on the first page of Chapter III. To initiate the analysis, strike the numerical key:

**8**

The cursor has now moved to the Report Destination entry field and the message highlighted in the lower left corner of the screen requests you to enter output file name; the default (if you enter nothing) is the printer. TOPDOG allows you to specify that you want to save output files to floppy diskettes or to the hard disk for later printing. You should proceed to prepare TOPDOG for immediate printing of the reports by striking the F1 key.

EXHIBIT VIII.12

SINGLE PERIOD FORECAST MENU SCREEN, DATA COMPLETE AND SAVED

```
Current Date: 8/15/87          SINGLE PERIOD FORECAST
Data Base:a:transl                           Report Destination:lst:
Packet Name:ABCF
Service Period is from  1/ 5/86 to  6/14/86
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                            Exist  Latest Changes
                           Names    Complete  Consistent  in DB      Saved
           Global Data   ABCGD         Y           Y        Y          Y
    Service Period Data  ABCSP         Y           Y        Y          Y
Operator Configuration   ABCOC         Y           Y        Y          Y

          1. Set Packet Name              6. Modify Service Period Data
          2. Set Packet Description       7. Modify Operator Configuration
          3. Set Component Names          8. Forecast
          4. Set Service Period           9. Save Package/Component Data
          5. Modify Global Data           0. Exit to Main Menu

                         Enter Choice:

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

Your monitor screen should then appear as shown in Exhibit VIII.13. TOPDOG has just completed an edit check of all input data to ensure its consistency. Had TOPDOG found a data input or consistency error, one or more error messages would have appeared on the monitor screen. In that case, you must strike the **(CR)** key to return to the SPO Menu for corrections. TOPDOG now asks the question: **want** satisfying condition? Strike the key:

**Y**

TOPDOG begins its algorithmic routines; during this time, all you will see is a series of dots (.....) appearing on the monitor screen. Many of the cases you will try will take several minutes for TOPDOG to analyze and process. The growing series of dots that appear on the screen simply let you know TOPDOG is hard at work.

When TOPDOG is finished the monitor screen should appear as shown in Exhibit VIII.14 displaying for choosing one or more output reports. To omit printing any reports you don't need, simply use the --> key to move the cursor to that field and strike the letter N. Practice moving the cursor around and changing entries from Y to N and back to Y. When you have completed your exercise with the options, strike the F1 key.

The monitor screen should then appear as shown in Exhibit VIII.15. Turn your printer on, align the paper in your printer as necessary, and strike the ENTER key:

**(CR)**

The monitor screen will inform you of TOPDOG's progress in preparing and printing the reports you selected. When report printing is completed, TOPDOG returns you to the SPO Menu screen and awaits further instructions. TOPDOG report outputs are discussed in Appendix B.

EXHIBIT VIII.13

DATA EDIT CHECK SCREEN

```
 Forecast beginning
--CHECKING GLOBAL DATA
--CHECKING SERVICE PERIOD DATA
   PERIOD 1
--CHECKING OPERATOR CONFIGURATION DATA
   PERIOD 1
want satis cond?
```

EXHIBIT VIII.14

REPORT SELECTION MENU SCREEN

```
                    REPORT SELECTION MENU

      Current Date: 8/15/87
         Data Base:a:transl
       Packet Name:ABCF

                              Report Selections (Y/N)

         Operator Configuration Report: Y
           Operator Utilization Report: Y
  Open Work and Unassigned Tripper Report: Y
            Vacation Scheduling Report: Y
                  Detailed Cost Report: Y
            Summary Information Report: N   (Multiple Periods Only)


F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Select desired reports; Press F1 to print, ESC to abort
```

EXHIBIT VIII.15

PRINTER PREPARATION and PRINT EXECUTION SCREEN

```
Getting ready to print reports
Please prepare your printer; Press RETURN when ready
```

If you want to stop at this point, remember to strike the numeric key:

**0**

to exit to the Main Menu and then strike the numeric key:

**9**

to return to a C> prompt on the monitor screen.

# IX. MULTIPLE PERIOD FORECAST

This chapter describes the use of Main Menu Choice 8, **Multiple Period Forecast** (MPF). As previously discussed in Chapter IV, MPF is used to estimate the cost of a given number of operators for two to six service periods. In this chapter, you will learn by examining a case study how to complete packet and component screens using example data for estimating the cost of a given operator work force.

The chapter begins with a description of the case study data for four service periods of a transit system division named XYZ. Following the description are instructions for entering data in the packet and component screens. Lastly, when input data are complete, procedures are provided showing how to instruct TOPDOG to conduct a multiple period forecast of the XYZ example and print the results.

## CASE STUDY: XYZF

XYZ is Motorbus Division Z of the XY Transit System. The four service periods selected for evaluation correspond to operator work selection or pick periods beginning on January 5, 1986; June 15, 1986; September 7, 1986; and November 23, 1986. The fourth service period ended on January 3, 1987. The following data and information are presented by component screen for easy reference when you follow the data entry instructions presented later in the chapter.

### Global Data

Examination of the labor agreement and work rules, coupled with the assistance of XY Transit System's Finance Department, provided the following information for completing the Global Data component screen:

- Full-Time Operators (FTOs)

  -- No coupling provision or work rule requiring certain trippers to be combined into a run.

- No minimum pay requirements for operating trippers.

- No provisions reserving specified numbers of trippers for bid by FTOs.

- Daily pay guarantee of 8 hours.

- Two weekly days off guaranteed, but not required to be scheduled consecutively.

- Average FTO wage rate during the period of $12.00 per hour.

- Average FTO variable fringe benefit rate or wage rate multiplier for the period of 1.186.

- Average annualized FTO fixed fringe benefit cost of $7,500.

- Average annualized number of vacation days per FTO of 16.0.

o <u>Part-Time Operators (PTOs)</u>

- PTOs limited in number to 10 percent of the number of FTOs.

- PTOs may work up to 30 weekly hours, with no restrictions on the number of daily hours or days of the week that work may be performed.

- No minimum pay requirements for operating trippers.

- Average PTO wage rate during the period of $9.50 per hour.

- Average PTO variable fringe benefit rate or wage rate multiplier for the period of 1.073.

- Average annualized PTO fixed fringe benefit cost of $1,500.

-- PTOs receive no paid vacation days.

-- PTOs may work split assignments, i.e., more than one daily assignment or tripper.

-- PTOs may work weekends.

## Service Period Data

The Service Period Data screens require information from various sources within the XY Transit System. This information may be divided into schedule data, open work data, nonscheduled and nonoperating work, dispatching practices, and vacation data.

## Schedule Data

XY Transit System's Scheduling Department provided the following information about scheduled service during the service periods:

o **Number of Days During the Service Period Each Schedule Operated**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 112 | 58 | 54 | 27 |
| - Saturday | 23 | 12 | 11 | 6 |
| - Sunday | 26 | 14 | 12 | 9 |

o **Number of Runs Operated in Each Schedule**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 246 | 240 | 246 | 254 |
| - Saturday | 133 | 130 | 133 | 145 |
| - Sunday | 82 | 80 | 82 | 90 |

- o **Number of Scheduled A.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 26 | 21 | 26 | 23 |
| - Saturday | 16 | 15 | 16 | 18 |
| - Sunday | 7 | 6 | 7 | 8 |

- o **Number of Scheduled P.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 33 | 24 | 33 | 26 |
| - Saturday | 15 | 14 | 15 | 20 |
| - Sunday | 3 | 3 | 3 | 4 |

- o **Minimum Clock Time Length of A.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 0:51 | 1:32 | 0:51 | 2:14 |
| - Saturday | 2:39 | 2:45 | 2:39 | 3:30 |
| - Sunday | 2:30 | 2:37 | 2:30 | 2:21 |

- o **Maximum Clock Time Length of A.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 3:56 | 4:17 | 3:56 | 4:15 |
| - Saturday | 4:00 | 4:05 | 4:00 | 5:10 |
| - Sunday | 4:11 | 4:11 | 4:11 | 4:23 |

- **Minimum Clock Time Length of P.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 1:07 | 2:23 | 1:07 | 2:20 |
| - Saturday | 3:40 | 3:42 | 3:40 | 2:47 |
| - Sunday | 3:02 | 3:28 | 3:02 | 3:13 |

- **Maximum Clock Time Length of P.M. Trippers**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 4:38 | 4:01 | 4:38 | 4:13 |
| - Saturday | 4:45 | 4:40 | 4:45 | 5:02 |
| - Sunday | 4:39 | 4:12 | 4:39 | 4:44 |

- **Average Daily Work Hours per FTO**

The Scheduling Department estimated the average daily work hours per FTO by dividing the total scheduled pay hours by the total number of scheduled runs as follows:

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 8:20 | 8:20 | 8:20 | 8:20 |
| - Saturday | 8:30 | 8:30 | 8:30 | 8:30 |
| - Sunday | 8:30 | 8:30 | 8:30 | 8:30 |

- Total Schedule Run Pay Hours

For runs only (no trippers):

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 2,050 | 2,000 | 2,050 | 2,117 |
| - Saturday | 1,131 | 1,105 | 1,131 | 1,233 |
| - Sunday | 697 | 680 | 697 | 765 |

Open Work Data

XY Transit System's Personnel Department maintained a complete record of operator absence.[26] Some analysis of their information resulted in the following data about operator absenteeism:

- FTO Absence Rate

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 10.0% | 11.5% | 10.0% | 9.8% |
| - Saturday | 12.5% | 13.2% | 12.5% | 12.3% |
| - Sunday | 14.0% | 15.6% | 14.0% | 15.2% |

- PTO Absence Rate

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 5.0% | 5.2% | 5.0% | 4.4% |
| - Saturday | 6.0% | 6.1% | 6.0% | 5.5% |
| - Sunday | 7.0% | 7.3% | 7.0% | 6.3% |

26 At some transit systems, operator absence information is kept in the Transportation or Operations Department.

There was some discussion of daily open work assignments in Chapter II, with an example shown in Exhibit II.1. An estimate of the percentage of variation in the daily open work force is required for TOPDOG to appropriately evaluate the operator work force. Using FTO absence data available from XY Transit's Personnel Department, it was estimated that the variation in the amount of open work due to absence during the four service periods was +/- 30 percent from the average operator absence during the four service periods. This was found to be true for weekdays, Saturdays and Sundays.

## Nonscheduled and Nonoperating Work

TOPDOG requires an estimate of the amount of nonscheduled and nonoperating work conducted by FTOs during each service period. This estimate should be made in terms of average equivalent number of FTO daily work assignments for each service schedule. For example, if the total number of nonscheduled and nonoperating operator work hours for a weekday service schedule for a service period was 3,405, and the number of days a weekday schedule was operated in the service period was 112, then the average number of FTO nonscheduled and nonoperating work hours for a weekday schedule would be 3,405 divided by 112, or 30.4 hours. To estimate the average equivalent number of FTO weekday nonscheduled and nonoperating work assignments, divide 30.4 hours by the effective daily guarantee of 8 hours. The result is 3.8 equivalent weekday work assignments. Some transit systems may record FTO nonoperating work as absence from operating work, and therefore a portion or all of the nonscheduled and nonoperating work may be reflected in the percentage of operator absence.

The XY Transit System's Transportation Department researched its daily records of operator work assignments and found that no nonscheduled work such as charters or special events service was conducted during these periods by Division Z FTOs. In addition, the XY Transit System labor agreement provides that operators shall not perform any nonoperating work assignments such as acting as supervisor or training new operators. Remedial training of operators was considered open work and was therefore included in the previous estimate of operator absence. Consequently, Division Z operators of the XY Transit System conducted no nonscheduled or nonoperating work during the service periods considered.

## Dispatching Practices

Sometimes transit systems can avoid paying extraboard operators their daily guarantee when no work is available. They accomplish this by means of an informal agreement between dispatchers and operators where operators suffer no disciplinary or other pay penalties for taking a "management-approved" day off with no pay. In the case of XY Transit System, management stated that daily guarantee was paid 100 percent of the time.[27]

## Vacation Data

In the Global Data screen, XY Transit System estimated that FTOs averaged about 16 days of vacation a year based on information taken from personnel records. No minimum or maximum amount of vacation was specified by the labor agreement to be taken during any of the service periods.

## Operator Configuration Data

Under all cases of Multiple Period Forecasts, TOPDOG needs to know the number of FTOs and PTOs scheduled to report for duty for each schedule type during each service period. FTOs include regular operators and extraboard operators used to fill open work due to absence, vacations and so forth.

---

[27] If your transit system is occasionally able to avoid paying daily guarantee to extraboard operators, you should estimate the percentage of time you believe the guarantee is paid, e.g., 80 percent.

Based on XY Transit System's records, it was estimated that the following FTOs and PTOs were scheduled to report to work.

- **Full-time Operators**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 269 | 266 | 269 | 277 |
| - Saturday | 148 | 146 | 148 | 162 |
| - Sunday | 93 | 92 | 93 | 104 |

- **Part-Time Operators**

| | Service Period 1 | Service Period 2 | Service Period 3 | Service Period 4 |
|---|---|---|---|---|
| - Weekday | 33 | 24 | 33 | 26 |
| - Saturday | 16 | 15 | 16 | 20 |
| - Sunday | 7 | 6 | 7 | 5 |

## ENTERING SCREEN DATA

If you have not completed the case studies in Chapters VI, VII or VIII, you have now arrived at the point that data will be entered into the TOPDOG model and results printed for your review. If your PC is not turned on, please do so and bring up TOPDOG's Main Menu on the monitor screen. The first page of Chapter IV, MAIN MENU, contains instructions for doing this.

The case study in this chapter is for Multiple Period Forecasting (MPF). At this time, select the MPF option from the Main Menu by striking the numerical key:

**8**

The monitor screen should appear as shown in Exhibit IX.1. The MPF Menu

EXHIBIT IX.1

MULTIPLE PERIOD FORECAST MENU SCREEN

```
Current Date: 8/15/87         MULTIPLE PERIOD FORECAST
Data Base:a:transl                          Report Destination:lst:
Packet Name:                                                        Period
There are   Service Periods starting   / /       / /       / /     End Date
                                       / /       / /       / /       / /
Description:


                         Component                           Exist  Latest Changes
                           Names    Complete  Consistent   in DB       Saved
           Global Data
   Service Period Data
Operator Configuration

         1. Set Packet Name             6. Modify Service Period Data
         2. Set Packet Description      7. Modify Operator Configuration
         3. Set Component Names         8. Forecast
         4. Set Service Periods         9. Save Package/Component Data
         5. Modify Global Data          0. Exit to Main Menu

                               Enter Choice:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

provides ten choices. Enter the name of the packet by striking the numerical key:

**1**

The cursor should now be positioned to accept the packet name. Now type the following:

**xyzf (CR)**

followed by the **F1** key. Your monitor screen should now appear as shown in Exhibit IX.2 and the cursor should be at the **Enter Choice** field. Enter a brief description of the packet by striking the numerical key:

**2**

The cursor should now be positioned to accept up to 180 characters of descriptive material on three lines. TOPDOG does not require that you complete this entry, but over time the descriptive material you provide will assist you in remembering the background and nature of the evaluation. In this case, some narrative concerning XYZF PTO and FTO labor agreement provisions has been inserted. Type the following on three lines:

**PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly (CR)**

**FTOs: May work as much OT as necessary, but no unscheduled (CR)**
**work (CR)**

followed by the **F1** key. Your monitor screen should now appear as shown in Exhibit IX.3 and the cursor should be at the **Enter Choice** field. Enter

EXHIBIT IX.2

MULTIPLE PERIOD FORECAST MENU SCREEN WITH PACKET NAME

```
Current Date: 8/15/87          MULTIPLE PERIOD FORECAST
Data Base:a:transl                           Report Destination:lst:
Packet Name:xyzf                                                        Period
There are   Service Periods starting  / /      / /      / /    End Date
                                      / /      / /      / /      / /
Description:


                         Component                          Exist  Latest Changes
                           Names    Complete  Consistent   in DB       Saved
           Global Data
   Service Period Data
Operator Configuration

         1. Set Packet Name              6. Modify Service Period Data
         2. Set Packet Description       7. Modify Operator Configuration
         3. Set Component Names          8. Forecast
         4. Set Service Periods          9. Save Package/Component Data
         5. Modify Global Data           0. Exit to Main Menu

                                 Enter Choice:1
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

EXHIBIT IX.3

MULTIPLE PERIOD FORECAST MENU SCREEN WITH PACKET DESCRIPTION

```
Current Date: 8/15/87        MULTIPLE PERIOD FORECAST
Data Base:a:transl                         Report Destination:lst:
Packet Name:xyzf                                                    Period
There are   Service Periods starting  / /      / /      / /    End Date
                                       / /      / /      / /      / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                          Exist  Latest Changes
                           Names    Complete  Consistent    in DB      Saved
           Global Data
   Service Period Data
Operator Configuration

          1. Set Packet Name          6. Modify Service Period Data
          2. Set Packet Description   7. Modify Operator Configuration
          3. Set Component Names      8. Forecast
          4. Set Service Periods      9. Save Package/Component Data
          5. Modify Global Data       0. Exit to Main Menu

                             Enter Choice:2
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

the names of the packet components by striking the numerical key:

**3**

The cursor should now be positioned to accept the Global Data name. Now type the following:

**xyzgd (CR)**

The cursor should now be positioned to accept the Service Period Data name. Type the following:

**xyzsp (CR)**

The cursor should now be positioned to accept the Overtime Constraints Data name. Type the following:

**xyzoc (CR)**

All component names have now been entered unless you wish to make changes. If you do, you may use the --> key to move the cursor forward to the location where you wish to make a change. After any necessary changes have been made, strike the F1 key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit IX.4. To enter the beginning and ending dates of the service period, strike the numerical key:

**4**

The cursor should now be positioned to accept the number of service periods to be analyzed. Strike the numerical key:

**4**

The cursor should now be positioned to accept the first service period beginning month. The four service periods used for evaluation in this

EXHIBIT IX.4

MULTIPLE PERIOD FORECAST MENU SCREEN WITH COMPONENT NAMES

```
Current Date: 8/15/87        MULTIPLE PERIOD FORECAST
Data Base:a:transl                       Report Destination:lst:
Packet Name:XYZF                                                 Period
There are   Service Periods starting   / /      / /      / /    End Date
                                       / /      / /      / /      / /
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                          Exist  Latest Changes
                           Names    Complete  Consistent   in DB       Saved
           Global Data   XYZGD         N          Y          N
   Service Period Data   XYZSP         N          Y          N
Operator Configuration   XYZOC         N          Y          N

         1. Set Packet Name            6. Modify Service Period Data
         2. Set Packet Description     7. Modify Operator Configuration
         3. Set Component Names        8. Forecast
         4. Set Service Periods        9. Save Package/Component Data
         5. Modify Global Data         0. Exit to Main Menu

                             Enter Choice:3
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

case study began on January 5, 1986, and ended on January 3, 1987. Type the following, remembering that after the numerical entry for each day, month and year you must strike the **(CR)** key:

**1(CR)5(CR)86(CR)6(CR)15(CR)86(CR)**
**9(CR)7(CR)86(CR)11(CR)23(CR)86(CR)1(CR)3(CR)87(CR)**

After all the numbers and **(CR)**s have been entered, strike the **F1** key. The cursor should now be at the **Enter Choice** field and the monitor screen should appear as shown in Exhibit IX.5.

TOPDOG is now ready to receive component data. To enter Global Data, strike the numerical key:

**5**

and your monitor screen should appear as shown in Exhibit IX.6.[28] The cursor is presently located at the bottom of the monitor screen following the highlighted message: **Enter component name to copy--RETURN for none.** This message always appears at the bottom of any new component screen when it first appears up on the monitor. If you want to use or modify another previously created screen saved in the data base, type in the component name, then strike the **F1** key. In this case, however, you have not previously created another Global Data screen, so simply strike the ENTER key:

**(CR)**

The cursor should now be located at the first Global Data entry field on the monitor screen. Using the information provided by the XYZF case study description, complete the screen, striking the **F10** key whenever you require assistance. When you have finished entering data on the Global Data screen, compare the results with Exhibit IX.7. If there are differences, attempt to find out why using the **F10** (Help) key.

---

28 If you previously completed the MPO case study, XYZO, in Chapter VII the Global Data component XYZGD was completed and saved in the TRANS1 data base. Therefore, your monitor screen should appear as shown in Exhibit IX.7. Strike the Esc key to return to the MPF Menu.

EXHIBIT IX.5

MULTIPLE PERIOD FORECAST MENU SCREEN WITH SERVICE PERIOD DATES

```
Current Date: 8/15/87        MULTIPLE PERIOD FORECAST
Data Base:a:transl                     Report Destination:lst:
Packet Name:XYZF                                            Period 4
There are 4 Service Periods starting  1/ 5/86   6/15/86   9/ 7/86  End Date
                                     11/23/86    /  /      /  /     1/ 3/87
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                           Exist  Latest Changes
                           Names    Complete  Consistent     in DB      Saved
           Global Data   XYZGD         N          Y          N
   Service Period Data   XYZSP         N          Y          N
Operator Configuration   XYZOC         N          Y          N

         1. Set Packet Name             6. Modify Service Period Data
         2. Set Packet Description      7. Modify Operator Configuration
         3. Set Component Names         8. Forecast
         4. Set Service Periods         9. Save Package/Component Data
         5. Modify Global Data          0. Exit to Main Menu

                             Enter Choice
```

EXHIBIT IX.6

MULTIPLE PERIOD FORECAST GLOBAL DATA SCREEN

```
    Current Date: 8/15/87                GLOBAL DATA
    Component Name:XYZGD        PART 1 - FULL TIME OPERATORS

            Minimum Hours for a Run:  :     ---------- Averages ----------
      Minimum Pay Hours for Trippers:  :                Hourly Wage Rate:
             Minimum % Bid Trippers:        Variable Fringe Benefit Rate:
    Effective Daily Guarantee Hours:  :     Annual Fixed Fringe Benefits:
  Regular Weekly Scheduled Days Off:                Annual Vacation Days:
Must Days Off be Consecutive (Y/N)?:
-------------------------------------------------------------------------------
                                PART 2 - PART TIME OPERATORS

                   Max Allowed PTOS:        ---------- Averages ----------
       Max Allowed Daily Work Hours:   :                Hourly Wage Rate:
        Max Allowed Weekly Work Days:       Variable Fringe Benefit Rate:
      Max Allowed Weekly Work Hours:   :    Annual Fixed Fringe Benefits:
       Max Allowed % as a % of FTOS:                Annual Vacation Days:
Max Allowed % as a % of FTOS + PTOS:
     Minimum Pay Hours for Trippers:   :

            Can PTOS Work Split Assignments (Y/N)?
             Can PTOS Work Sat/Sun Schedule (Y/N)?
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT IX.7

MULTIPLE PERIOD FORECAST GLOBAL DATA SCREEN COMPLETED

```
    Current Date: 8/15/87                GLOBAL DATA
    Component Name:XYZGD       PART 1 - FULL TIME OPERATORS

            Minimum Hours for a Run:  :     ---------- Averages ----------
       Minimum Pay Hours for Trippers:  :              Hourly Wage Rate:12.00
             Minimum % Bid Trippers:        Variable Fringe Benefit Rate:1.186
    Effective Daily Guarantee Hours: 8: 0   Annual Fixed Fringe Benefits: 7500
  Regular Weekly Scheduled Days Off:    2           Annual Vacation Days:16.00
Must Days Off be Consecutive (Y/N)?:    N
--------------------------------------------------------------------------------
                              PART 2 - PART TIME OPERATORS

                   Max Allowed PTOS:        ---------- Averages ----------
         Max Allowed Daily Work Hours:   :             Hourly Wage Rate: 9.50
         Max Allowed Weekly Work Days:      Variable Fringe Benefit Rate:1.073
      Max Allowed Weekly Work Hours: 30: 0  Annual Fixed Fringe Benefits: 1500
       Max Allowed % as a % of FTOS:  10.0          Annual Vacation Days:    0
Max Allowed % as a % of FTOS + PTOS:
     Minimum Pay Hours for Trippers:   :

             Can PTOS Work Split Assignments (Y/N)? Y
              Can PTOS Work Sat/Sun Schedule (Y/N)? Y
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

When you are satisfied that your data entry is correct and matches Exhibit IX.7, strike the F1 key. The cursor should return to the MPF Menu at the **Enter Choice** field. To enter Service Period data, strike the numerical key:

**6**

and your monitor screen should appear as shown in Exhibit IX.8.[29] Since you have not previously created Service Period data that you can use or modify, strike the ENTER key:

**(CR)**

The cursor should now be located at the first Service Period Data entry field on the monitor screen. Using the information provided in the XYZF case study description, complete the screen, striking the F10 key whenever you require assistance. When you have finished entering data on the first Service Period screen, compare your screen with the first page of Exhibit IX.9. Make changes and modifications, if necessary, using the --> and <-- keys to move around the screen. When you are satisfied that the data you entered is correct and matches the exhibit, strike the F1 key. The cursor should now be at the first data entry field on the second Service Period Data screen. Notice that the data you entered in the first Service Period Data screen also appear here. When entering the second period data, you only have to enter data that are different from the first period data. Entering data on the screen for the second service period until it is complete, then compare your results with the second page of Exhibit IX.9. When you are satisfied that your data entries are correct, strike the F1 key. The cursor should now be at the first data entry field on the third Service Period Data screen. Just as before, the data from the previous screen--the second period--appear here. Continue entering data on the third screen then the fourth screen until all entries are complete and match those given in Exhibit IX.9. When you have completed the fourth

---

[29] If you previously completed the MPO case study, XYZO, in Chapter VII the Service Period Data component XYZSP was completed and saved in the TRANS1 data base. Therefore, your monitor screen should appear as shown in Exhibit IX.9. Strike the Esc key to return to the MPF Menu.

EXHIBIT IX.8

MULTIPLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN

```
              MULTIPLE PERIOD DATA for Component XYZSP
                Service Period 1 from  1/ 5/86 to  6/14/86

    Current Date: 8/15/87                Weekday    Saturday     Sunday
                                         -------    --------     ------
                  Number Days Operated:
                           Number Runs:
                  Number A.M. Trippers:
                  Minimum A.M. Tripper:     :           :           :
                  Maximum A.M. Tripper:     :           :           :
                  Number P.M. Trippers:
                  Minimum P.M. Tripper:     :           :           :
                  Maximum P.M. Tripper:     :           :           :
  Average Number Nonscheduled Assigns:
              FTO Absence Rate Percent:
              PTO Absence Rate Percent:
           Open Work Variation (+/- %):
 Average FTO Full Day Assignment Hours:     :           :           :
         Percent No-Work-Available Paid:
   Total Daily Scheduled Run Pay Hours:

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT IX.9

MULTIPLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 1 from 1/ 5/86 to 6/14/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 112 | 23 | 26 |
| Number Runs: | 246 | 133 | 82 |
| Number A.M. Trippers: | 26 | 16 | 7 |
| Minimum A.M. Tripper: | 0:51 | 2:39 | 2:30 |
| Maximum A.M. Tripper: | 3:56 | 4: 0 | 4:11 |
| Number P.M. Trippers: | 33 | 15 | 3 |
| Minimum P.M. Tripper: | 1: 7 | 3:40 | 3: 2 |
| Maximum P.M. Tripper: | 4:38 | 4:45 | 4:39 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 10.0 | 12.5 | 14.0 |
| PTO Absence Rate Percent: | 5.0 | 6.0 | 7.0 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2050 | 1131 | 697 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT IX.9 (Continued)

MULTIPLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 2 from 6/15/86 to 9/ 6/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 58 | 12 | 14 |
| Number Runs: | 240 | 130 | 80 |
| Number A.M. Trippers: | 21 | 15 | 6 |
| Minimum A.M. Tripper: | 1:32 | 2:45 | 2:37 |
| Maximum A.M. Tripper: | 4:17 | 4: 5 | 4:11 |
| Number P.M. Trippers: | 24 | 14 | 3 |
| Minimum P.M. Tripper: | 2:23 | 3:42 | 3:28 |
| Maximum P.M. Tripper: | 4: 1 | 4:40 | 4:12 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 11.5 | 13.2 | 15.6 |
| PTO Absence Rate Percent: | 5.2 | 6.1 | 7.3 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2000 | 1105 | 680 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT IX.9 (Continued)

MULTIPLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 3 from 9/ 7/86 to 11/22/86

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 54 | 11 | 12 |
| Number Runs: | 246 | 133 | 82 |
| Number A.M. Trippers: | 26 | 16 | 7 |
| Minimum A.M. Tripper: | 0:51 | 2:39 | 2:30 |
| Maximum A.M. Tripper: | 3:56 | 4: 0 | 4:11 |
| Number P.M. Trippers: | 33 | 15 | 3 |
| Minimum P.M. Tripper: | 1: 7 | 3:40 | 3: 2 |
| Maximum P.M. Tripper: | 4:38 | 4:45 | 4:39 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 10.0 | 12.5 | 14.0 |
| PTO Absence Rate Percent: | 5.0 | 6.0 | 7.0 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2050 | 1131 | 697 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT IX.9 (Continued)

MULTIPLE PERIOD FORECAST SERVICE PERIOD DATA SCREEN COMPLETED

MULTIPLE PERIOD DATA for Component XYZSP
Service Period 4 from 11/23/86 to 1/ 3/87

| Current Date: 8/15/87 | Weekday | Saturday | Sunday |
|---|---|---|---|
| Number Days Operated: | 27 | 6 | 9 |
| Number Runs: | 254 | 145 | 90 |
| Number A.M. Trippers: | 23 | 18 | 8 |
| Minimum A.M. Tripper: | 2:14 | 3:30 | 2:21 |
| Maximum A.M. Tripper: | 4:15 | 5:10 | 4:23 |
| Number P.M. Trippers: | 26 | 20 | 4 |
| Minimum P.M. Tripper: | 2:20 | 2:47 | 3:13 |
| Maximum P.M. Tripper: | 4:13 | 5: 2 | 4:44 |
| Average Number Nonscheduled Assigns: | 0 | 0 | 0 |
| FTO Absence Rate Percent: | 9.8 | 12.3 | 15.2 |
| PTO Absence Rate Percent: | 4.4 | 5.5 | 6.3 |
| Open Work Variation (+/- %): | 30.0 | 30.0 | 30.0 |
| Average FTO Full Day Assignment Hours: | 8:20 | 8:30 | 8:30 |
| Percent No-Work-Available Paid: | 100.0 | 100.0 | 100.0 |
| Total Daily Scheduled Run Pay Hours: | 2117 | 1233 | 765 |

Minimum % Total Annual Vacation Days Scheduled This Service Period:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

screen, strike the **F1** key. The cursor should return to the **Enter Choice** field on the MPO Menu.

To enter Operator Configuration Data, strike the numerical key:

**7**

Your monitor screen should appear as shown in Exhibit IX.10. Using the information provided in the XYZF case study description, complete the first service period screen by first striking the **(CR)** key and then entering the data. When you have completed the screen, compare the results with the first page of Exhibit IX.11. Make changes, if necessary, and then strike the **F1** key.

The cursor should now be at the first data entry field on the second Operator Configuration Data screen. Notice that the data from the first Operator Configuration Data screen appear here. When entering the second period data, you only have to enter data that are different from the first period data. Continue entering data on the screen for the second service period until it is complete. Compare the results with the second page of Exhibit IX.11. When you are satisfied that your data entries are correct, strike the **F1** key.

The cursor should now be at the first data entry field on the third Operator Configuration Data screen. Just as before, the data from previous screen--the second period--appear here. Continue entering data on the third screen and, subsequently, the fourth screen, until all entries are complete and match those given in Exhibit IX.11. When you have completed the fourth screen, strike the F1 key. The cursor should return to the **Enter Choice** field on the MPF Menu.

At this point, all component screens are complete. You may assure yourself that the component screens are complete by checking the column labeled **Complete** on the table just above the MPF Menu on the monitor screen. You can also check that the names of the components are consistent among those names contained in the data base and are considered valid by TOPDOG by looking in the column labeled **Consistent** on the table. The

EXHIBIT IX.10

MULTIPLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN

```
        MULTIPLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for

                Service Period 1 from  1/ 5/86 to  6/14/86

   Current Date: 8/15/87                       Component Name:XYZOC

                              OPERATORS SCHEDULED
                        Weekday      Saturday      Sunday
                        -------      --------      ------

       Full Time:
       Part Time:



F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter component name to copy - RETURN for none
```

EXHIBIT IX.11

MULTIPLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN COMPLETED

MULTIPLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for

Service Period 1 from 1/ 5/86 to 6/14/86

Current Date: 8/15/87 Component Name:XYZOC

OPERATORS SCHEDULED

| | Weekday | Saturday | Sunday |
|---|---|---|---|
| Full Time: | 269.0 | 148.0 | 93.0 |
| Part Time: | 33.0 | 16.0 | 7.0 |

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT IX.11 (Continued)

MULTIPLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN COMPLETED

MULTIPLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for

Service Period 2 from 6/15/86 to 9/ 6/86

Current Date: 8/15/87 Component Name:XYZOC

OPERATORS SCHEDULED

| | Weekday | Saturday | Sunday |
|---|---|---|---|
| Full Time: | 266.0 | 146.0 | 92.0 |
| Part Time: | 24.0 | 15.0 | 6.0 |

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT IX.11 (Continued)

MULTIPLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN COMPLETED

MULTIPLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for

Service Period 3 from 9/ 7/86 to 11/22/86

Current Date: 8/15/87 Component Name:XYZOC

OPERATORS SCHEDULED

| | Weekday | Saturday | Sunday |
|---|---|---|---|
| Full Time: | 269.0 | 148.0 | 93.0 |
| Part Time: | 33.0 | 16.0 | 7.0 |

F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change

EXHIBIT IX.11 (Continued)

MULTIPLE PERIOD FORECAST OPERATOR CONFIGURATION DATA SCREEN COMPLETED

```
        MULTIPLE PERIOD FORECASTING OPERATOR CONFIGURATION DATA for
                 Service Period 4 from 11/23/86 to  1/ 3/87
Current Date: 8/15/87                      Component Name:XYZOC

                          OPERATORS SCHEDULED
                     Weekday     Saturday     Sunday
                     -------     --------     ------

     Full Time:       277.0        162.0       104.0
     Part Time:        26.0         20.0         5.0



F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Enter modifications - then F1; ESC if no change
```

next two column headings, labeled **Exist in DB (Data Base)** and **Latest Changes Saved**, both show a series of Ns, meaning that the component screen entries have not been saved nor do they exist in the TRANS1 data base.[30] To save the data to the TRANS1 data base, strike the numeric key:

**9**

The message appearing in the lower corner of the monitor screen asks: **Save Packet (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen changes to: **Save Global Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen then changes to: **Save Service Data (Y/N)?** Strike the key:

**Y**

The message in the lower left corner of the screen then changes to: **Save Operator Configuration Data (Y/N)?** Strike the key:

**Y**

After saving this data, the cursor should return to the MPF Menu **Enter Choice** field. Your screen should now appear as shown in Exhibit IX.12. Had you answered any of the previous questions **NO**, TOPDOG would have continued to ask whether to save the remaining component screens that were entered or modified. TOPDOG has now received and stored complete and

---

30 If you previously created and saved Global Data XYZGD and Service Period Data XYZSP, the Ys will appear in the two columns opposite those components. In that case, TOPDOG will only ask if you want to save the Packet and Operator Configuration Data.

## EXHIBIT IX.12

## MULTIPLE PERIOD FORECAST MENU SCREEN, DATA COMPLETE AND SAVED

```
Current Date: 8/15/87        MULTIPLE PERIOD FORECAST
Data Base:a:transl                        Report Destination:lst:
Packet Name:XYZF                                                Period 4
There are 4 Service Periods starting  1/ 5/86   6/15/86   9/ 7/86  End Date
                                      11/23/86    /  /      /  /     1/ 3/87
Description: PTOs: Limit of 10% of FTOs & may work up to 30 hours weekly
             FTOs: May work as much OT as necessary, but no unscheduled
                   work

                         Component                          Exist  Latest Changes
                           Names    Complete  Consistent  in DB       Saved
           Global Data   XYZGD         Y          Y         Y           Y
   Service Period Data   XYZSP         Y          Y         Y           Y
Operator Configuration   XYZOC         Y          Y         Y           Y

         1. Set Packet Name              6. Modify Service Period Data
         2. Set Packet Description       7. Modify Operator Configuration
         3. Set Component Names          8. Forecast
         4. Set Service Periods          9. Save Package/Component Data
         5. Modify Global Data           0. Exit to Main Menu

                             Enter Choice:
F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
```

consistent component data grouped under the Packet name XYZF in the data base TRANS1.

EVALUATING THE OPERATOR WORK FORCE

TOPDOG is now ready to estimate the cost size and configuration of the operator work force for Division Z of the XY Transit System for the multiple service period January 5, 1986, through January 3, 1987. To perform this task, a printer must be connected with the PC and turned on ready to print. Printer requirements were briefly described on the first page of Chapter III. To initiate the analysis, strike the numerical key:

**8**

The cursor has now moved to the Report Destination entry field and the message highlighted in the lower left corner of the screen requests you to enter output file name; the default (if you enter nothing) is the printer. TOPDOG allows you to specify that you want to save output files to floppy diskettes or to the hard disk for later printing. You should proceed to prepare TOPDOG for immediate printing of the reports by striking the F1 key.

Your monitor screen should then appear as shown in Exhibit IX.13. This means that TOPDOG has just completed an edit check of all input data to ensure its consistency. Had TOPDOG found a data input or consistency error, one or more error messages would have appeared on the monitor screen. In that case, you must strike the **(CR)** key to return to the SPO Menu for corrections. TOPDOG now asks the question: **want satisfying condition?** Strike the key:

**Y (CR)**

TOPDOG then begins its algorithmic routines; during this time all you will see is a series of dots (.....) appearing on the monitor screen. Many of the cases you will try will take several minutes for TOPDOG to analyze and process. The growing series of dots that appear on the screen simply let you know TOPDOG is hard at work.

EXHIBIT IX.13

DATA EDIT CHECK SCREEN

```
 Forecast beginning
--CHECKING GLOBAL DATA
--CHECKING SERVICE PERIOD DATA
   PERIOD 1
   PERIOD 2
   PERIOD 3
   PERIOD 4
--CHECKING OPERATOR CONFIGURATION DATA
   PERIOD 1
   PERIOD 2
   PERIOD 3
   PERIOD 4
want satis cond?
```

When TOPDOG is finished, the monitor screen should appear as shown in Exhibit IX.14, displaying a menu for choosing one or more output reports. To omit printing any reports you don't need, simply use the --> key to move the cursor to that field and strike the letter N. Practice moving the cursor around and changing entries from Y to N and back to Y. When you have completed your exercise with the options, strike the F1 key.

The monitor screen should then appear as shown in Exhibit IX.15. Align the paper in your printer as necessary and strike the ENTER key:

**(CR)**

The monitor screen will inform you of TOPDOG's progress in preparing and printing the reports you selected. When report printing is completed, TOPDOG returns you to the SPO Menu screen and awaits further instructions. TOPDOG report outputs are described in Appendix B.

If you want to stop at this point, remember to strike the numeric key:

**0**

to exit to the Main Menu and then strike the numeric key:

**9**

to exit TOPDOG and return to a C> prompt on the monitor screen.

EXHIBIT IX.14

REPORT SELECTION MENU SCREEN

```
                          REPORT SELECTION MENU

   Current Date: 8/15/87
      Data Base:a:transl
    Packet Name:XYZF

                                Report Selections (Y/N)

      Operator Configuration Report: Y
        Operator Utilization Report: Y
Open Work and Unassigned Tripper Report: Y
          Vacation Scheduling Report: Y
                Detailed Cost Report: Y
          Summary Information Report: Y   (Multiple Periods Only)



F1-Accept&Quit,F3-Default,F10-Help,ESC-Quit&Reset,CR-Clear/AcceptEntry,<--,-->
Select desired reports; Press F1 to print, ESC to abort
```

EXHIBIT IX.15

PRINTER PREPARATION AND PRINT EXECUTION SCREEN

```
Getting ready to print reports
Please prepare your printer; Press RETURN when ready
```

# APPENDIX A

## TERMS AND DEFINITIONS

Managers throughout the mass transit industry use a variety of terms that have similar meanings and often the same term with somewhat different meanings. The purpose of this appendix is not to suggest changing managers' definitions but to better understand the terms and phrases presented in this User's Guide.

This appendix is divided into three sections. The first section, TERMS & PHRASES, presents definitions of terms and phrases used throughout the text of this document. The second section of this document, ABBREVIATIONS, provides the full names of acronyms and letter combinations commonly used throughout the text, but principally found in Appendix C, TOPDOG Methodology. The last section, HELP SCREENS, presents the messages available to assist you in completing the data input requirements of TOPDOG using the F10 keystroke.

### TERMS AND PHRASES

**Component:** Data grouped by category and stored in data base files under user-selected names. TOPDOG uses four categories of components: Global Data, Service Period Data, Overtime Constraint Data, and Operator Configuration Data.

**Coupling:** The joining of pieces of work, i.e., trippers, into a single daily operator work assignment. Labor agreements sometime require that an a.m. tripper and a p.m. tripper, whose total payhours exceed a specified amount, be made into a run eligible for operator selection.

**Cursor:** The symbol - showing on the video monitor screen indicating your computer is ready to receive information or instructions at the indicated location.

**Data Base:** An addressable location for storing and retrieving data. This User's Guide refers only to floppy diskettes as the location for data bases; however, hard disks are equally suitable.

**Extraboard:** A term for the listing of unfilled work and the operators assigned to conduct such work. The term spareboard is often used instead of extraboard.

**Fixed Fringe Benefits:** Benefits that accrue or are paid to operators regardless of the number of hours they work. Holiday pay, vacation pay, workers' compensation, group insurance and uniform allowances are examples of fixed fringe benefits.

**Forecast:** The algorithmic process used by TOPDOG to estimate the costs associated with a given work force size and composition based on a set of scheduled work assignments and other factors which may affect the results.

**Frag:** See Tripper.

**HELP Screen:** A definition, instruction, or example designed to assist TOPDOG users answer questions and clarify data input requirements. Help messages may be made to appear on the monitor screen by striking the F10 key.

**Keystroke:** The striking of a key on the PC keyboard.

**Menu:** A format presented on the video monitor screen that allows choices to be made, usually by a single key stroke.

**Nonoperating Work:** At many transit systems, operators are periodically assigned duties other than driving or operating vehicles. These duties may include training, temporary assignment in a supervisory capacity, and so on.

**Open Work:** Unfilled work assignments. Open work is the basis for the need or demand for available manpower. It may fluctuate daily according to service additions and deletions, nonoperating work requirements and operators' absence.

**Optimization:** The algorithmic process used by TOPDOG to estimate the least-cost work force size and composition based on a set of scheduled work assignments and other factors which may affect the results.

**Packet:** Groups of data made up of components, which are combined for convenient use in evaluating operator work forces. Packets always consist of three components, two of which must be Global Data and Service Period Data.

**Pick:** Work assignment selection. Labor agreement provisions or management policies often designate times when operators select work assignments based on their seniority for upcoming periods of time, which are referred to as pick or service periods.

**Run:** A full-day's work assignment for a vehicle operator, usually paying about 8 hours or more in wages.

**Runcutting:** A process used by transit systems for dividing scheduled service into operator work assignments or runs. The process often uses criteria that will minimize cost or payhours in the development of work assignments.

**Service Schedule:** The published directions for conducting and using public transportation service. The service schedule results from a process that attempts to economically translate management service goals and objectives into vehicle and operator requirements. The process is often referred to as runcutting, and directions to operators are sometimes called paddles. Service schedules resulting from the process are normally published for public use as timetables.

**Tripper:** Pieces of work that cannot be matched to achieve a full-day's work assignment, i.e., a run. In the transit industry, terms such as minimum or frag are often used instead of tripper.

**Vacation Leveling:** A TOPDOG procedure that attempts to provide the same number of operators over several service periods by allocating vacation slots that recognize differences in manpower requirements due to scheduled service, absenteeism, nonscheduled work and so forth.

**Variable Fringe Benefits:** Benefits that accrue and are paid to operators based on the number of hours they work. Variable fringe benefits such as FICA and often pension contributions are paid on the basis of wage earnings.

## ABBREVIATIONS

**Assign:** Assignment
**Comprate:** Full-time operator hourly compensation rate
**CR:** Carriage return
**DBU:** Data Base Utilities
**DG:** Effective daily guarantee hours
**DOS:** Disk operating system
**EB:** Number of extra operators scheduled
**FD:** Full-day
**FTO:** Full-time operators
**LP:** Linear program
**Max:** Maximum number of open work assignments
**Min:** Minimum number of open work assignments
**MNT:** Minimum unassigned tripper assignment length
**MPF:** Multiple period forecast
**MPO:** Multiple period optimization
**MXT:** Maximum unassigned tripper assignments
**NT:** Number of unassigned tripper assignments
**NWA:** No work available
**OTpremrate:** Overtime premium rate

**OT:** Overtime

**PC:** Personal Computer

**PTO:** Part-time operators

**Sched:** Scheduled

**RAM:** Random Access Memory

**SP:** Service Period

**SPF:** Single period forecast

**SPO:** Single period optimization

**TG:** Tripper guarantee

**TOPDOG:** Transit Operator Productivity, Diagnostic & Optimization Guidelines

**TP:** Tripper premium

**TRANS1:** The name of an example data base used in this document

**TRANS2:** The name of an example data base used in this document

**TSlope:** Unassigned tripper work length distribution slope

**WDO:** Work-day-off

---: The symbol shown on the monitor screen indicating your computer is ready to receive instructions.

## HELP SCREENS

The following information may be used to assist TOPDOG users in completing the data requirements for evaluating the operator work force when using Single Period Optimization (SPO), Multiple Period Optimization (MPO), Single Period Forecast (SPF), or Multiple Period Forecast (MPF). Terms or phrases are arranged in the same order in which they appear on the Global Data, Service Period Data, and Overtime Constraints Data Screens. This same information is also available on the monitor screen by striking the **F10** key when the screen cursor is positioned at a data entry field.

GLOBAL DATA (Applicable to SPO, MPO, SPF, and MPF)

Part I: Full-Time Operators

**MINIMUM HOURS FOR A RUN:** Many transit labor agreements provide that any pieces of work which may be coupled together (e.g., an AM tripper or frag and a PM tripper or frag) exceeding a specified number of total daily hours of work or pay must be made into a run. EXAMPLE PROVISION: "Two pieces totaling seven hours or more must be made into a regular run for bid." The Minimum Hours For A Run in the example = 7:00. If you do NOT have such a provision in your labor agreement or work rules, do NOT enter any value.

**MINIMUM PAY HOURS FOR TRIPPERS:** Some labor agreements provide a minimum guarantee for the conduct of tripper work or frags by full-time operators. If your labor agreement or work rules contain such a provision, enter the minimum pay hours for a tripper conducted by a full-time operator, e.g., 2:00. If you do NOT have such a provision, do NOT enter any value.

**MINIMUM % BID TRIPPERS:** Some labor agreements require that a certain percentage of trippers or frags be reserved for full-time operators to bid as an additional daily overtime assignment. If your labor agreement or work rules contain such a provision, enter the minimum percentage of total trippers that are to be reserved for bid for full-time operators. If you do NOT have such a provision, do NOT enter any value.

**EFFECTIVE DAILY GUARANTEE HOURS:** This value defines the effective number of daily payhours guaranteed to full-time operators specified in the labor agreement or work rules. Generally this value is eight hours. In many cases, weekly, bi-weekly payhour guarantees are specified in addition to or used in lieu of daily guarantees. You should provide the value corresponding to the largest effective daily guarantee. EXAMPLE: A labor agreement guarantees full-time operators 8 hours a day and 45 hours a week if the operator incurred no absence. Operators are scheduled to work 5 days a week so the daily guarantee is effectively 45/5 = 9 hours (on average) which is the largest effective daily guarantee. If you do NOT have such a provision, do NOT enter any value.

**REGULAR WEEKLY SCHEDULED DAYS OFF:** Full-time operators are normally provided two days off per work week by transit labor agreements or work rules. Enter the value 2 unless your labor agreement or work rules provides for a different number.

**MUST DAYS OFF BE CONSECUTIVE (Y/N):** If your labor agreement or work rules provide full-time operators with consecutive days off each work week (e.g., Saturday-Sunday, Wednesday-Thursday, etc.) enter Y. Otherwise, enter N.

**HOURLY WAGE RATE:** This value defines the average full-time operator (FTO) hourly wage rate during the period of analysis. The average hourly wage rate is a weighted mean that considers operator pay progression and the number of operators at each wage step. The average FTO hourly wage rate is estimated by dividing the total FTO payroll wages by the total number of FTO equivalent pay hours for some representative period. Alternatively, multiplying the top wage rate by 0.95 may provide a suitable estimate.

**VARIABLE FRINGE BENEFIT RATE:** Variable fringe benefits are those employer contributions that are a direct function of operator pay-hours. Such contributions normally include FICA and may include pension fund payments, for full-time operators (FTOs) that can be estimated using the formula: 1+[Total FTO Variable Fringe Benefit Cost/Total FTO Wage Earnings]. Normally, this factor should be between 1.07 ad 1.30.

**ANNUAL FIXED FRINGE BENEFITS:** Annual Fixed Fringe Benefits are those costs incurred by transit systems which are not a direct function of operator payhours. Fixed fringe benefits often include: health benefits plan, life insurance, disability insurance, workers' compensation premiums and supplemental payments, sick-leave pay, vacation pay, holiday pay (but not for working a holiday), other paid absence (e.g., jury duty, military leave, court time, bereavement, etc.), uniform allowance, allocated training, and other fixed fringe benefits. The average annual full-time operator fixed fringe benefits may be estimated by dividing the total annual FTO fixed fringe benefit cost by the average number of FTOs employed. Typically, annual fixed fringe benefits for FTOs range from $5,000 to $10,000.

**ANNUAL VACATION DAYS:** The average annual vacation days per full-time operator is a weighted mean which takes into account vacation progression and the number of operators at each step. One method of estimating this value is to use a seniority roster to determine the number of vacation days provided for each full-time operator (FTO) in accordance with the labor agreement. Divide the total number of FTO vacation days by the number of FTOs on the roster to estimate the average annual vacation days per full-time operator. An alternative estimate may be obtained by dividing total annual gross FTO vacation payroll wages by the product: [average FTO hour wage rate * 8 hours a day * the average number of FTOs employed].

## PART II: PART-TIME OPERATORS

**MAX ALLOWED PTOS:** This value defines the total number of part-time operators (PTOs) that may be employed at any one time as specified in the labor agreement. If your transit system is not allowed PTOs, enter zero (0). If your labor agreement allows PTOs but does not limit the number of PTOs based on a specific number, do NOT enter any value. The number of PTOs may still be limited as a maximum percentage of full-time operators (FTOs) or as a maximum percentage of full-time operators (FTOs) or as a maximum percentage of total operators. The limits should either be entered as % of FTOs, or as a % of (FTOs + PTOs).

**MAX ALLOWED DAILY WORK HOURS:** This value defines the maximum number of daily hours that a part-time operator (PTO) is permitted to work as specified by the labor agreement, e.g., no more than 5 hours a day. If your labor agreement contains a DAILY work hour restriction for PTOs enter the upper limit. If your labor agreement has no such restrictions, e.g., only limits PTOs on the basis of WEEKLY work hours, do NOT enter any value.

**MAX ALLOWED WEEKLY WORK DAYS:** If your labor agreement provides that part-time operators (PTOs) may only work a certain number of days per week, enter the maximum number of weekly work days permitted. Some transit labor agreements permit PTOs to work only five (5) days per week. If your labor agreement has no restrictions on the number of days that PTOs may work do NOT enter any value.

**MAX ALLOWED WEEKLY WORK HOURS:** If your labor agreement or work rules limit part-time operators (PTOs) to a certain number of weekly work hours, this number should be entered. For example, a labor agreement may restrict PTOs to a maximum of 30 hour per week. In this case 30 should be entered. If your labor agreement contains no PTO weekly work hour restrictions, e.g., limits PTO work hours strictly on a daily basis, do NOT enter any value.,

**MAX ALLOWED % AS A % OF FTOS:** This value defines the maximum of part-time operators (PTOs) that may be employed as a percentage of the number of full-time operators (FTOs/PTOs employed, e.g., 10%). Labor agreements may state such a limitation on a division by division basis, on a systemwide basis, or a combination of the two. Because TOPDOG is intended to analyze divisions independently, you must decide how to apportion PTOs if a systemwide limitation is applicable, e.g., if PTOs are limited to 10% total operators systemwide and 15% by division you may wish to limit PTOs to 8% at one division and 12% at another. If your labor agreement contains NO such restrictions, e.g., PTOs are instead limited on the basis of TOTAL operators, do NOT enter any value.

**MAX ALLOWED % AS A % OF FTOS + PTOS:** Some transit labor agreements or work rules contain a provision restricting the number of part-time operators (PTOs) that may be employed based on a percentage of total operators (FTOs + PTOs), e.g. 10%. Labor agreements may state such a limitation on a division by division basis, on a systemwide basis, or a combination of the two. Because TOPDOG is intended to analyze divisions independently, you must decide how to apportion PTOs if a systemwide limitation is applicable, e.g., if PTOs are limited to 10% total operators systemwide and 15% by division you may wish to limit PTOs to 8% at one division and 12% at another. If your labor agreement contains NO such restrictions, e.g., PTOs are instead limited on the basis of just FTOs, do NOT enter any value.

**MINIMUM PAY HOURS FOR TRIPPERS:** Some labor agreements provide a minimum guarantee for the conduct of tripper work or frags by part-time operators. If your labor agreement or work rules contains such a provision, enter the minimum pay hours for a tripper conducted by a part-time operator, e.g., 2:00. If you do NOT have such a provision do NOT enter any value.

**HOURLY WAGE RATE:** This value defines the average part-time operator (PTO) hourly wage rate during the period for analysis. The average hourly wage rate is a weighted mean that considers operator pay progression (if applicable for PTOs) and the number of operators at each wage step. The average PTO hourly wage rate is estimated by dividing the total gross PTO payroll wages by the total number of PTO equivalent pay hours for some representative period.

**VARIABLE FRINGE BENEFIT RATE:** Variable fringe benefits are those employer contributions that are a direct function of operator pay-hours. Such contributions normally include FICA and may include unemployment payments and other costs. The variable fringe benefit rate for part-time operators (PTOs) can be estimated using the formula: 1+[Total PTO Variable Fringe Benefit Cost/Total PTO Wage Earnings]. Normally, this factor should be between 1.07 and 1.30.

**ANNUAL FIXED FRINGE BENEFITS:** Annual Fixed Fringe Benefits are those costs incurred by transit systems which are not a direct function of operator payhours. Fixed fringe benefits for part-time operators (PTOs) may be limited to items such as a uniform allowance and allocated training or may represent a prorated share of many full-time operator (FTO) fixed fringe benefits. (See Average Annual FTO Fixed Fringe Benefit HELP for a list.) The average annual PTO fixed fringe benefits may be estimated by dividing the total annual PTO fixed fringe benefit cost by the average number of PTOs employed.

**ANNUAL VACATION DAYS:** At many transit systems, part-time operators (PTOs) are NOT provided with any vacation benefits. At other transit systems, PTOs are provided with prorated vacation benefits. If PTOs receive NO vacation benefits at your transit system, enter zero (0). Otherwise, estimate the average annual vacation days per part-time operator and enter the value. Some methods for estimating this value are given in the Average Annual Vacation Days for Full-time Operator HELP screen. Use PTO values when using the methods described in this HELP screen.

**CAN PTOS WORK DAILY SPLIT ASSIGNMENTS (Y/N)?:** Some transit labor agreements and work rules permit part-time operators (PTOs) to work only a single, continuous assignment each work day. If your labor agreement or work rules restrict PTOs to work only a single daily piece of work on the days they report for work, you should enter N (No). If your labor agreement does not restrict PTOs to a single daily work assignment (e.g., they may work an AM tripper or frag and a PM tripper or frag), you should enter Y (Yes).

**CAN PTOS WORK SAT/SUN SCHEDULE (Y/N)?:** If your labor agreement or work rules permit part-time operators to work only weekday assignments, you should enter N (No). Otherwise, you should enter Y (Yes).

## SERVICE PERIOD DATA (APPLICABLE TO SPO, MPO, SPF, AND MPF)

**NUMBER DAYS OPERATED:** These values define the number of days the service schedule (Weekday, Saturday, Sunday) is operated during the service period. Saturday or Sunday schedules operated on a holiday in lieu of a Weekday schedule should be counted as a Saturday or Sunday schedule. If a schedule is operated during the service period that is not a Weekday, Saturday or Sunday schedule, the Weekday, Saturday, or Sunday schedule most similar to the special schedule should be substituted. If no service is operated on a Saturday or Sunday, enter a zero (0) under the appropriate day(s).

**NUMBER RUNS:** These values define the number of DAILY runs operated under each service schedule (Weekday, Saturday, Sunday). A run is a normal driving assignment approximately 8 hours in length, usually assigned to regular full-time operators. Runs paying less than approximately 8 hours (e.g., 6 hour runs) should be treated as TRIPPERS.

**NUMBER A.M. TRIPPERS:** These values define the number of DAILY a.m. trippers or frags operated during each service schedule (Weekday, Saturday, Sunday). A tripper is a short driving assignment, usually between 1 and 5 hours in length, that is not part of a regularly scheduled run.

**MINIMUM A.M. TRIPPER:** These values define the shortest a.m. tripper or frag work (clock) hours for each service schedule (Weekday, Saturday, Sunday). Do not use pay hours. If no a.m. trippers are operated during the service schedule, enter zero (0).

**MAXIMUM A.M. TRIPPER:** These values define the longest a.m. tripper or frag work (clock) hours for each service schedule (Weekday, Saturday, Sunday). Do not use pay hours. If no a.m. trippers are operated during the service schedule, enter zero (0).

**NUMBER P.M. TRIPPERS:** These values define the number of DAILY p.m. trippers or frags operated during each service schedule (Weekday, Saturday, Sunday). A tripper is a short driving assignment, usually between 1 and 5 hours in length, that is not part of a regularly scheduled run.

**MINIMUM P.M. TRIPPER:** These values define the shortest p.m. tripper or frag work (clock) hours for each service schedule (Weekday, Saturday, Sunday). Do not use pay hours. If no p.m. trippers are operated during the service schedule, enter zero (0).

**MAXIMUM P.M. TRIPPER:** These values define the longest p.m. tripper or frag work (clock) hours for each service schedule (Weekday, Saturday, Sunday). Do not use pay hours. If no p.m. trippers are operated during the service schedule, enter zero (0).

**AVERAGE NUMBER NONSCHEDULED ASSIGNS:** These values define the average DAILY number of (full-day equivalent) nonscheduled work assignments for each service schedule (Weekday, Saturday, Sunday). Nonscheduled work requires operator labor but is not a regularly scheduled driving assignment. Nonscheduled work includes charters; special service, e.g. football games; and nonoperating work such as training, vehicle transfers, or operators working in a temporary supervisory capacity. The average number of nonscheduled assignments should be given in full-day equivalents, i.e., the total average daily nonscheduled workhours divided by 8 hours a day.

**FTO ABSENCE RATE PERCENT:** These values define the full-time operator (FTO) absence rate for each service schedule (Weekday, Saturday, Sunday). The absence rate should be representative of the total FTO work days lost due to absence as a percentage of the total scheduled FTO work days. Absence is defined as work time lost for any reason other than vacation, regular holiday or regular weekly scheduled days off. Reasons for absence include: paid and unpaid sick leave; injury or duty; contractual absences such as jury duty, union business, military leave, funeral leave, and personal or floating holidays; personal absence such as excused or authorized absence and absence without leave; and management-requested absence such as suspension or withholding from active duty pending hearings and grievance proceedings.

**PTO ABSENCE RATE PERCENT:** These values define the part-time operator (PTO) absence rate for each service schedule (Weekday, Saturday, Sunday). The absence rate should be representative of the total PTO work days lost due to absence as a percentage of the total scheduled PTO work days. Absence is defined as work time lost for any reason other than vacation, regular holiday or regular weekly scheduled days off. Reasons for absence include: paid and unpaid sick leave; injury on duty; contractual absences such as jury duty, union business, military leave, and personal or floating holidays; personal absence such as excused or authorized absence and absence without leave; and management-requested absence such as suspension or withholding from active duty pending hearings and grievance proceedings.

**OPEN WORK VARIATION (+/-%):** These values define the daily variation in open work for each service schedule (Weekday, Saturday, Sunday). The amount of open work due to operator absence and nonscheduled work typically varies from day to day. The daily variation is a range expressed as a percentage of the average number of open work assignments. For example, if 20 open work assignments is the weekday average, with a range between 10 on a low-absence weekday and 30 on a high-average weekday, the variation is plus or minus 50%, i.e., (10-20/20*100%) = -50% and (30-20)/20*100% = +50%.

**AVERAGE FTO FULL DAY ASSIGNMENT HOURS:** These values define the normal DAILY work hours of a full-time operator (FTO) for each service schedule (Weekday, Saturday, Sunday). Because the majority of FTOs are assigned a run, the average work hours per run can be used as a practical gauge. In most cases, this value should be approximately 8 hours.

**PERCENT NO-WORK-AVAILABLE PAID:** These values define the percentage of the time extraboard operators are paid a full daily guarantee when no work is available for each service schedule (Weekday, Saturday, Sunday). In some instances, management can avoid paying guarantee by allowing the operator to take the day off, under no guarantee obligations. If you do not enter a value, the model will assume extraboard operators are always paid their full guarantee when no work is available for assignment.

**TOTAL DAILY SCHEDULED RUN PAY HOURS:** These values define the total DAILY scheduled run pay hours for each service schedule (Weekday, Saturday, Sunday). These values are NOT actual operator pay hours obtained using payroll records but rather the SCHEDULED pay hours for RUNS as given by the scheduling department. RUNS are to be considered all work bid by operators NOT including trippers or frags. Normally, the total daily scheduled run pay hours for a service schedule, (e.g., Weekday) is somewhat greater than 8 times the number of runs scheduled for the day.

**% TOTAL ANNUAL VACATION DAYS SCHEDULED THIS SERVICE PERIOD:** This value defines the percentages of total annual operator vacation days scheduled during this service period.

**OVERTIME CONSTRAINTS DATA (APPLICABLE TO SPO AND MPO)**

**% UNSCHEDULED OVERTIME HOURS:** These values define the maximum average daily unscheduled overtime hours you may wish to establish as a percentage of the total daily scheduled payhours (runs and trippers). Unscheduled overtime is incurred when: an operator is required to work on a regularly scheduled day off to cover open work that the extraboard cannot cover; or unassigned trippers cannot be covered by the extraboard and must be covered by operators as an additional overtime assignment. If your enter a value for a particular service schedule (Weekday, Saturday, Sunday) TOPDOG will allow the overtime limit to be exceeded in its least cost search. Otherwise, optimization will not be constrained on the basis of this overtime restriction.

**% WDO ASSIGNMENTS:** These values define the maximum average daily number of workday-off (WDO) assignments you may wish to establish as a percentage of total daily scheduled runs. A WDO assignment is a full-day, e.g., an 8 hour piece of open work (normally a run), that cannot be covered by the extraboard and must be covered by an operator working on a regularly scheduled day off. If you enter a value for a particular service schedule (Weekday, Saturday, Sunday) TOPDOG will not allow the overtime limit to be exceeded in its least cost search. Otherwise, optimization will not be constrained on the basis of this overtime restriction.

**% UNSCHEDULED OVERTIME TRIPPERS:** These values define the maximum average daily number of single unscheduled overtime trippers you may wish to establish as a percentage of total daily single trippers. An unscheduled overtime tripper results when an unassigned tripper cannot be filled by the extraboard and the work must be filled as an additional overtime assignment. Note: unscheduled overtime trippers do NOT include trippers reserved as bid by full-time operators. If you enter a value for a particular service schedule (Weekday, Saturday, Sunday) TOPDOG will not allow the overtime limit to be exceeded in its least cost search. Otherwise, optimization will not be constrained on the basis of this overtime restriction.

# APPENDIX B

## TOPDOG REPORTS

This appendix describes the various reports which can be produced using TOPDOG. The exhibits presented are taken from the case studies presented in chapters 5 through 8 of this document.

TOPDOG produces the following six reports:

- o Operator Configuration Report
- o Detailed Operator Utilization Report
- o Open Work and Unassigned Tripper Report
- o Vacation Scheduling Report
- o Period Detailed Cost Report
- o Summary Information Report

The first five reports are available under any optimization or forecast condition. The sixth report is available only for multiple period optimizations or forecasts. These reports are described below.

### OPERATOR CONFIGURATION REPORT

This report presents the operator configuration generated by TOPDOG (Optimization) or defined by the user (Forecast). A separate report is generated for each service period. If the configuration is generated for a multiple period, the model produces one report for each service period in the multiple period. If the configuration is generated for a single service period, only one report is produced. The report is shown, with sample numerical outputs, in Exhibit B.1. The operator configuration information appearing in the report is described below.

- o Service Period and Service Period Dates. These items define the service period number and the applicable beginning and ending dates of the service period.

## EXHIBIT B.1

# T O P D O G   M U L T I P L E   P E R I O D   O P T I M I Z A T I O N

## OPERATOR CONFIGURATION REPORT

Data Base: a:transl                                          Packet Name: XYZO
Service Period:1 from 1/ 5/86 to 6/14/86          Current Date: 8/15/87

| ------------------Operators Scheduled------------------ | Weekday | Saturday | Sunday | ---Total Operators--- Employed | |
|---|---|---|---|---|---|
| Regular Full Time | 246 | 133 | 82 | Full Time | 338 |
| Extra Full Time | 23 | 16 | 11 | | |
| | | | | Part Time | 33 |
| Total Full Time | 269 | 149 | 93 | | |
| Total Part Time | 33 | 16 | 7 | | |

% Part Time / Full Time 9.75
% Part Time / Total 8.89

- Regular FTOs Scheduled. These items define the total regular operators assigned for each service schedule during the service period (weekday, Saturday, Sunday). Regular operators are assigned regularly scheduled runs.

- Extra FTOs Scheduled. These items define the total extra operators assigned for each service schedule during the service period (weekday, Saturday, Sunday). Extra operators include vacation operators, and are also used to cover open work due to operator absence, nonscheduled work and unassigned trippers.

- Total FTOs Scheduled. These items define the total FTOs assigned to report for each service schedule in the service period (weekday, Saturday, Sunday). FTOs include regular, extra, and vacation operators.

- Total PTOs Scheduled. These output items define the total PTOs assigned to report for each service schedule in the service period (weekday, Saturday, Sunday).

- Total FTOs Employed. This item defines the number of FTOs that must be employed during the service period.

- Total PTOs Employed. This item defines the number of PTOs that must be employed during the service period.

- % Part Time/Full Time. This item shows the percentage that the total number of PTOs represent of the total number of FTOs.

- % Part Time/Total. This item shows the percentage that the total number of PTOs represent of the total number of operators, i.e., FTOs plus PTOs.

## DETAILED OPERATOR UTILIZATION REPORT

This report provides the operator utilization information associated with the operator configuration considered by the model. A separate report is generated for each service period. If the configuration is generated for a multiple period, the model produces one report for each service period in the multiple period. If the configuration is generated for a single service period, only one report is produced. The report is shown, with sample numerical outputs, in Exhibit B.2. The operator utilization information appearing in the report is described below.

- Service Period and Service Period Dates. These items define the service period number and the applicable beginning and ending dates of the service period.

- Unscheduled Overtime Hours. These items define the average daily unscheduled overtime hours for each service schedule (weekday, Saturday, Sunday).

- Unscheduled Guarantee Hours. These items define the average daily unscheduled guarantee hours for each service schedule (weekday, Saturday, Sunday).

- Extraboard Tripper Hours. These items define the average daily tripper hours covered by extraboard operators for each service schedule (weekday, Saturday, Sunday).

- 2nd Assignment Tripper Overtime Hours. These items define the total average daily tripper hours covered by FTOs at overtime pay rates for each service schedule (weekday, Saturday, Sunday). These hours include both bid trippers and trippers not scheduled for overtime.

- 2nd Bid Tripper Hours. These items define the average daily tripper hours bid and operated by regular FTOs at overtime pay rates for each service schedule (weekday, Saturday, Sunday).

EXHIBIT B.2

TOPDOG MULTIPLE PERIOD OPTIMIZATION

DETAILED OPERATOR UTILIZATION REPORT

Data Base: a:transl                                          Packet Name: XYZO
Service Period:1 from 1/ 5/86 to 6/14/86          Current Date: 8/15/87

DAILY AVERAGES

| -----Total Hours----- | Weekday | Saturday | Sunday |
|---|---|---|---|
| Unscheduled Overtime | 43.49 | 31.35 | 21.16 |
| Unscheduled Guarantee | 2.96 | 1.87 | 1.43 |
| --------Tripper-------- | | | |
| Extraboard | 1.19 | 1.12 | 0.38 |
| 2nd Assignment Overtime | 6.66 | 5.86 | 2.06 |
| 2nd Bid | 0.00 | 0.00 | 0.00 |
| 2nd Unscheduled | 6.66 | 5.86 | 2.06 |
| Part Time Operator | 149.21 | 109.35 | 32.47 |
| --Total Assignments-- | | | |
| No Work Available | 0.20 | 0.19 | 0.15 |
| Paid No Work Available | 0.20 | 0.19 | 0.15 |
| Work-Day-Off | 4.42 | 3.00 | 2.25 |
| --------Tripper-------- | | | |
| Extraboard | 0.32 | 0.19 | 0.08 |
| 2nd Assignment Overtime | 2.51 | 1.56 | 0.59 |
| 2nd Bid | 0 | 0 | 0 |
| 2nd Unscheduled | 2.51 | 1.56 | 0.59 |
| Part Time Operator | 31.35 | 15.04 | 6.51 |

Part Time Operator Average Weekly Work Hours 28.38

- 2nd Unscheduled Tripper Hours. These items define the average daily scheduled tripper hours covered by external operators at overtime pay rates for each service schedule (weekday, Saturday, Sunday).

- Part Time Operator Tripper Hours. These items define the average daily tripper hours covered by PTOs for each service schedule (weekday, Saturday, Sunday).

- NWA Assignments. These items define the average daily number of No Work Available (NWA) assignments for each service schedule (weekday, Saturday, Sunday). An NWA assignment is an extraboard operator with no work available.

- Paid NWA Assignments. These items define the average daily number of paid NWA assignments for each service schedule (weekday, Saturday, Sunday). In some instances management may avoid paying guarantees to all extraboard operators when no work is available by allowing operators to take the day off with no guarantee pay obligations.

- Extraboard Tripper Assignments. These items define the average daily number of tripper assignments (single or combination) covered by extraboard operators for each service schedule (weekday, Saturday, Sunday).

- 2nd Assignment of Trippers. These items define the total average daily number of single trippers covered by FTOs in addition to their regularly scheduled assignment for each service schedule (weekday, Saturday, Sunday).

- 2nd Bid Tripper Assignments. These items define the average daily number of trippers bid and operated by regular FTOs at overtime pay rates for each service schedule (weekday, Saturday, Sunday).

- 2nd Unscheduled Tripper Assignments. These items define the average daily scheduled tripper assignments covered by extraboard operators at overtime pay rates for each service schedule (weekday, Saturday, Sunday).

- Part-Time Operator Tripper Assignments. These items define the average daily number of trippers covered by PTOs for each service schedule (weekday, Saturday, Sunday). The values take into account PTO absence.

- Part-Time Operator Average Weekly Work Hours. This item defines the average weekly work hours per PTO during the service period.

## OPEN WORK AND UNASSIGNED TRIPPER REPORT

This report presents the open work and unassigned tripper information associated with the operator configuration considered by the model. A separate report is generated for each service period. If the configuration is generated for a multiple period, the model produces one report for each service period in the multiple period. If the configuration is generated for a single service period, only one report is produced.

The report is shown, with sample numerical outputs, in Exhibit B.3. The open work and unassigned tripper information represents daily figures with output items given by individual service schedule (weekday, Saturday, Sunday).

- Service Period and Service Period Dates. These items define the service period number and applicable beginning and ending dates of the service period.

- Average FTO Absences. These items define the average daily number of FTO absences for each service schedule (weekday, Saturday, Sunday). These absences contribute to the number of open work assignments.

EXHIBIT B.3

T O P D O G   M U L T I P L E   P E R I O D   O P T I M I Z A T I O N

OPEN WORK AND UNASSIGNED TRIPPER REPORT

Data Base: a:transl                                                    Packet Name: XYZ0
Service Period:1 from 1/ 5/86 to 6/14/86          Current Date: 8/15/87

DAILY ASSIGNMENTS

| | Weekday | Saturday | Sunday |
|---|---|---|---|
| --------Open Work------- | | | |
| Average FTO Absences | 26.90 | 18.62 | 13.02 |
| Average FDE Nonscheduled | 0.00 | 0.00 | 0.00 |
| Average FDE Open Work | 26.90 | 18.62 | 13.02 |
| Minimum FDE Open Work | 18.83 | 13.04 | 9.11 |
| Maximum FDE Open Work | 34.97 | 24.21 | 16.93 |
| ----Tripper Assignments---- | | | |
| Not Scheduled to Part Time | 0.61 | 0.25 | 0.00 |
| Average PT Operator Absences | 1.65 | 0.96 | 0.49 |
| Average PT Operator Vacation | 0.00 | 0.00 | 0.00 |
| Average Unassigned Trippers | 2.26 | 1.21 | 0.49 |
| Average Split | 0.69 | 0.65 | 0.21 |
| Average Single | 1.58 | 0.55 | 0.28 |

- Average FDE Nonscheduled Assigns. These items define the average daily number of full-day equivalent nonscheduled work assignments for each service schedule (weekday, Saturday, Sunday) as specified by the user. Nonscheduled work also contributes to the number of open work assignments.

- Average FDE Open Work Assigns. These items define the total average daily number of full-day equivalent open work assignments for each service schedule (weekday, Saturday, Sunday). This open work is created by operator absence and nonscheduled work assignments and does not include open work resulting from operator vacation or unassigned trippers.

- Minimum FDE Open Work Assigns. These items define the minimum daily number of full-day equivalent open work assignments that might occur under normal circumstances for each service schedule (weekday, Saturday, Sunday). This open work is created by operator absence and nonscheduled work assignments and does not include open work resulting from operator vacations or unassigned trippers. The model assumes that the amount of open work may be even less than the given value five percent of the time.

- Maximum FDE Open Work Assigns. These items define the maximum daily number of full-day equivalent open work assignments that might occur under normal circumstances for each service schedule (weekday, Saturday, Sunday). This open work is created by operator absence and nonscheduled work assignments and does not include open work resulting from operator vacations or unassigned trippers. The model assumes that the amount of open work may be even greater than the given value five percent of the time.

- Not Scheduled to PTOs. These items define the number of tripper assignments not scheduled to PTOs for each service schedule (weekday, Saturday, Sunday).

- Average PTO Absence. These items define the number of tripper assignments not scheduled to PTOs for each service schedule (weekday, Saturday, Sunday). The absences contribute to the number of unassigned trippers.

- Average PTOs Vacation. These items define the average daily number of PTOs on vacation for each service schedule (weekday, Saturday, Sunday). These vacations contribute to the number of unassigned trippers.

- Average Unassigned Tripper Assigns. These items define the average daily number of unassigned tripper assignments (single or combination) for each service schedule (weekday, Saturday, Sunday). A tripper assignment is unassigned if it is not scheduled to a PTO, results from a PTO absence, or results from PTO vacations.

- Average Split Tripper Assigns. These items define the average daily number of unassigned split, i.e., combination trippers, for each service schedule (weekday, Saturday, Sunday).

- Average Single Tripper Assigns. These items define the average daily number of unassigned single trippers for each service schedule (weekday, Saturday, Sunday).

## VACATION SCHEDULING REPORT

This report provides vacation scheduling information associated with the operator configuration considered by the model. A separate report is generated for each service period. If the configuration is generated for a multiple period, the model produces one report for each service period in the multiple period. If the configuration is generated for a single service period, only one report is produced. The report is shown with illustrative numerical outputs in Exhibit B.4. The vacation scheduling information appearing in the report is described below. The information includes service period figures.

EXHIBIT B.4

T O P D O G   M U L T I P L E   P E R I O D   O P T I M I Z A T I O N

VACATION SCHEDULING REPORT

Data Base: a:transl
Service Period:1 from 1/ 5/86 to 6/14/86

Packet Name: XYZO
Current Date: 8/15/87

| --Operators-- | % Annual Vacation Days Scheduled | Scheduled Vacation Days |
|---|---|---|
| Full Time | 44.47 | 2407.17 |
| Part Time | N/A | 0.00 |

| | Average Operators on Vacation |
|---|---|
| Full Time | 20.93 |
| Part Time | N/A |

- Service Period and Service Period Dates. These items define the service period number and applicable beginning and ending dates of the service period.

- % Annual FTO Vacation Days Scheduled. This item defines the percentage of total FTO annual vacation days scheduled during the service period.

- FTO Scheduled Vacation Days. This item defines the number of vacation days scheduled during the service period.

- % Annual PTO Vacation Days Scheduled. This item defines the percentage of total annual vacation days scheduled during the service period.

- PTO Scheduled Vacation Days. This item defines the number of PTO vacation days scheduled during the service period.

- Average FTOs on Vacation. This item defines the average number of FTOs scheduled for vacation during the service period.

- Average PTOs on Vacation. This item defines the average number of PTOs scheduled for vacation during the service period.

## PERIOD DETAIL COST REPORT

This report provides cost information associated with the operator configuration considered by the model. A separate report is generated for each service period. If the configuration is generated for a multiple period, the model produces one report for each service period in the multiple period. If the configuration is generated for a single service period, only one report is produced. The report is shown, with sample numerical outputs, in Exhibit B.5. With the exception of the first item below, the output items represent service period costs. They are the aggregate complements of their individual service schedule costs--weekday, Saturday and Sunday, respectively.

EXHIBIT B.5

TOPDOG MULTIPLE PERIOD OPTIMIZATION

PERIOD DETAILED COST REPORT

Data Base: a:transl — Packet Name: XYZO
Service Period:1 from 1/ 5/86 to 6/14/86 — Current Date: 8/15/87

| | Weekday | Saturday | Sunday | Total |
|---|---|---|---|---|
| ----Fixed Fringe Costs---- | | | | |
| Full Time Operators | 936771.30 | 106555.87 | 75182.99 | 1118510.16 |
| Part Time Operators | 18992.97 | 1891.07 | 935.26 | 21819.30 |
| Total | 955764.27 | 108446.94 | 76118.25 | 1140329.46 |
| ----Scheduled Run Costs---- | | | | |
| Full Time Operators | 3267667.20 | 370217.02 | 257912.30 | 3895796.52 |
| --Scheduled Tripper Costs-- | | | | |
| Full Time Operators | 12517.42 | 2284.64 | 904.42 | 15706.49 |
| FTO Straight Time | 12517.42 | 2284.64 | 904.42 | 15706.49 |
| FTO Bid Premium | 0.00 | 0.00 | 0.00 | 0.00 |
| Part Time Operators | 170343.65 | 25636.11 | 8606.22 | 204585.97 |
| Total | 182861.07 | 27920.75 | 9510.64 | 220292.46 |
| -----Unscheduled Costs----- | | | | |
| No Work Available Guarantee | 2577.59 | 487.90 | 447.22 | 3512.70 |
| Tripper Guarantee | 2144.76 | 125.41 | 81.21 | 2351.39 |
| Subtotal Guarantee | 4722.35 | 613.31 | 528.43 | 5864.09 |
| Work-Day-Off OT Premium | 29349.55 | 4172.47 | 3532.99 | 37055.01 |
| Tripper Overtime Premium | 5310.47 | 958.98 | 381.12 | 6650.56 |
| Subtotal Premium | 34660.02 | 5131.44 | 3914.10 | 43705.57 |
| Total | 39382.37 | 5744.75 | 4442.53 | 49569.65 |
| Total Operator Cost | 4445674.91 | 512329.46 | 347983.72 | 5305988.09 |

----------------------Operator Utilization Information----------------------

| | Full Time | Part Time |
|---|---|---|
| Number Employed | 338.33 | 33 |
| Average Annual Days Absent-Per Operator | 25.34 | 15.10 |
| Total Number of Absences | 3779.69 | 219.62 |
| Average Annual Operator Vacation Days | 16.00 | 0.00 |
| Total Number of Vacation Days | 2407.17 | 0.00 |

| -------Unscheduled Hours------- | |
|---|---|
| Total Overtime | 6141.87 |
| Total Guarantee | 412.04 |

- Service Period and Service Period Dates. These items define the service period number and the applicable beginning and ending dates of the service period.

- FTO Fixed Fringe Costs. These items define the estimated FTO fixed fringe benefit costs for each service schedule (week-day, Saturday, Sunday).

- PTO Fixed Fringe Costs. These items define the estimated PTO fixed fringe benefit costs for each service schedule (weekday, Saturday, Sunday).

- Total Fixed Fringe Costs. These items define the estimated total FTO and PTO fixed fringe benefit costs for each service schedule (weekday, Saturday, Sunday).

- FTO Scheduled Run Cost. These items define the estimated cost of scheduled runs only for each service schedule (weekday, Saturday, Sunday).

- FTO Scheduled Tripper Cost. These items define the estimated total FTO scheduled tripper cost for each service schedule (weekday, Saturday, Sunday).

- FTO Straight Time Tripper Cost. These items define the estimated FTO scheduled tripper cost paid at straight time for each service schedule (weekday, Saturday, Sunday).

- FTO Bid Tripper Premium Cost. These items define the estimated FTO bid tripper premium cost for each service schedule (weekday, Saturday, Sunday).

- PTO Scheduled Tripper Cost. These items define the estimated PTOs scheduled tripper cost for each service schedule (weekday, Saturday, Sunday).

- Total Scheduled Tripper Cost. These items define the estimated total FTO and PTO scheduled tripper cost for each service schedule (weekday, Saturday, Sunday).

- No Work Available Guarantee Cost. These items define the estimated NWA guarantee cost for each service schedule (weekday, Saturday, Sunday). This cost is incurred when there is no work assignment available for an extraboard operator.

- Tripper Guarantee Cost. These items define the estimated tripper guarantee cost for each service schedule (weekday, Saturday, Sunday). This cost is incurred when an extraboard operator works a tripper assignment (single or combination) that results in less pay time than the effective daily guarantee pay required by the labor agreement.

- Subtotal Guarantee Cost. These items are the sum of NWA and Tripper Guarantee costs for each service schedule (weekday, Saturday, Sunday).

- Work-Day-Off Overtime Premium Cost. These items define the estimated WDO overtime premium cost for each service schedule (weekday, Saturday, Sunday). This cost is incurred when the amount of open work exceeds the number of extraboard operators scheduled and a FTO is called in to work on a scheduled day off.

- Tripper OT Premium Cost. These items define the estimated tripper overtime premium cost for each service schedule (weekday, Saturday, Sunday). Tripper assignments not covered by extraboard operators or PTOs are assumed to be worked by FTOs as second daily assignments, resulting in tripper overtime premium pay.

- Subtotal Premium Costs. These items are the sum of WDO and Tripper Premium costs for each service schedule (weekday, Saturday, Sunday).

- Total Unscheduled Costs. These items define the estimated total unscheduled costs for each service schedule (weekday, Saturday, Sunday).

- Total Operator Costs. These items define the total FTO and PTO costs for each service schedule (weekday, Saturday, Sunday). It consists of estimated fixed fringe benefit costs, scheduled run costs, scheduled tripper costs and unscheduled costs. Unscheduled costs do not include the cost for late pull-ins or unscheduled spread penalty premiums. Unscheduled spread cost is generally a function of the schedule or how operator dispatchers combine open work for assignment to operators.

- Number of FTOs and PTOs Employed. These items define the number of FTOs and PTOs estimated to be employed during the service period.

- Average Annual Days Absent-Per Operator. These items define the annualized absence rate for FTOs and PTOs in terms of days per year based on the percentage of absence during the service period.

- Total Number of Absences. These items define the total number of lost work days due to the absence of FTOs and PTOs during the service period.

- Average Annual Operator Vacation Days. These items define the average number of annual vacation days per FTO and PTO.

- Total Number of Vacation Days. These items define the total number of FTO and PTO vacation days during the service period.

- Total Unscheduled Overtime Hours. This item defines the total number of unscheduled work hours during the service period when FTOs were paid at premium rates.

- Total-Unscheduled Guarantee Hours. This item defines the total number of unscheduled hours during the service period when FTOs were paid though no work was available.

## SUMMARY INFORMATION REPORT

This report is available only when generating multiple period optimizations and forecasts. The report is shown, with illustrative numerical outputs, in Exhibit B.6. The report represents the sum of all the Period Detailed Costs Reports generated for multiple periods. The only exception is that both the minimum and maximum numbers of FTOs and PTOs employed are presented.

EXHIBIT B.6

# TOPDOG MULTIPLE PERIOD OPTIMIZATION

## SUMMARY INFORMATION REPORT

Data Base: a:transl
Period: 1/ 5/86 to 1/ 3/87

Packet Name: XYZ0
Current Date: 8/15/87

----------------------Operator Utilization Information----------------------

| | Full Time | Part Time |
|---|---|---|
| Minimum Number Employed | 338 | 28 |
| Maximum Number Employed | 338 | 33 |
| Average Annual Days Absent-Per Operator | 26.09 | 14.34 |
| Total Number of Absences | 8796.91 | 454.98 |
| Average Annual Operator Vacation Days | 16.00 | 0.00 |
| Total Number of Vacation Days | 5268.31 | 0.00 |

------------------------------Cost Information------------------------------

| | Weekday | Saturday | Sunday | Total |
|---|---|---|---|---|
| ----Fixed Fringe Costs---- | | | | |
| Full Time Operators | 2105950.42 | 243376.88 | 179478.28 | 2528805.58 |
| Part Time Operators | 40827.61 | 4628.22 | 2149.92 | 47605.75 |
| Total | 2146778.03 | 248005.10 | 181628.20 | 2576411.33 |
| ----Scheduled Run Costs---- | | | | |
| Full Time Operators | 7307548.49 | 841281.98 | 610424.71 | 8759255.18 |
| --Scheduled Tripper Costs-- | | | | |
| Full Time Operators | 27171.00 | 5254.79 | 3500.55 | 35926.34 |
| FTO Straight Time | 27171.00 | 5254.79 | 3500.55 | 35926.34 |
| FTO Bid Premium | 0.00 | 0.00 | 0.00 | 0.00 |
| Part Time Operators | 371771.31 | 59536.42 | 19499.86 | 450807.60 |
| Total | 398942.32 | 64791.22 | 23000.41 | 486733.94 |
| -----Unscheduled Costs----- | | | | |
| No Work Available Guarantee | 6996.63 | 1276.45 | 935.40 | 9208.48 |
| Tripper Guarantee | 3837.46 | 283.74 | 343.95 | 4465.15 |
| Subtotal Guarantee | 10834.09 | 1560.19 | 1279.35 | 13673.63 |
| Work-Day-Off OT Premium | 68629.07 | 9202.91 | 8556.39 | 86388.37 |
| Tripper Overtime Premium | 11501.83 | 2168.58 | 1507.53 | 15177.94 |
| Subtotal Premium | 80130.90 | 11371.49 | 10063.92 | 101566.31 |
| Total | 90964.99 | 12931.68 | 11343.27 | 115239.94 |
| Total Operator Cost | 9944233.83 | 1167009.97 | 826396.59 | 11937640.39 |

-------Unscheduled Hours-------

| | |
|---|---|
| Total Overtime | 14272.95 |
| Total Guarantee | 960.77 |

## APPENDIX C

## TOPDOG METHODOLOGY

TOPDOG uses a modular design incorporating six major modules and a model host to manage the integration and flow of the modules. The model is designed to:

- o optimize the operator work force configuration by estimating the least-cost number of FTOs and PTOs to assign each service schedule and employ each service period; and

- o forecast the cost of any user-defined operator work force configuration.

The model allows the operator work force configuration to be optimized or forecast over:

- o a single service period, which may be defined by a season or by an operator work selection period defined by management or the labor agreement; or

- o several service periods.

A time frame consistent with the interval between vacation picks is preferable since it takes advantage of the model's fullest capabilities by developing a least-cost operator work force in conjunction with optimal vacation scheduling. Single service period optimization normally does not allow the model to comprehensively address the vacation scheduling issue. This concept is addressed later in this appendix.

Exhibit C.1 presents an overview of the model. The shaded boxes identify the six TOPDOG modules described below.

- <u>PTO Assignment</u>. This module assigns trippers to PTOs to maximize their work hours within the bounds of the transit system's labor agreement provisions and work rules. A binary linear program using a branch and bound algorithm is the mechanism for PTO tripper assignment.

- <u>Unassigned Tripper Coupling</u>. This module synthesizes a representative distribution of vehicle operator work assignments which results from piecing together unassigned trippers. Unassigned trippers are those work assignments not assigned to PTOs and/or those resulting from PTO absence or vacations.

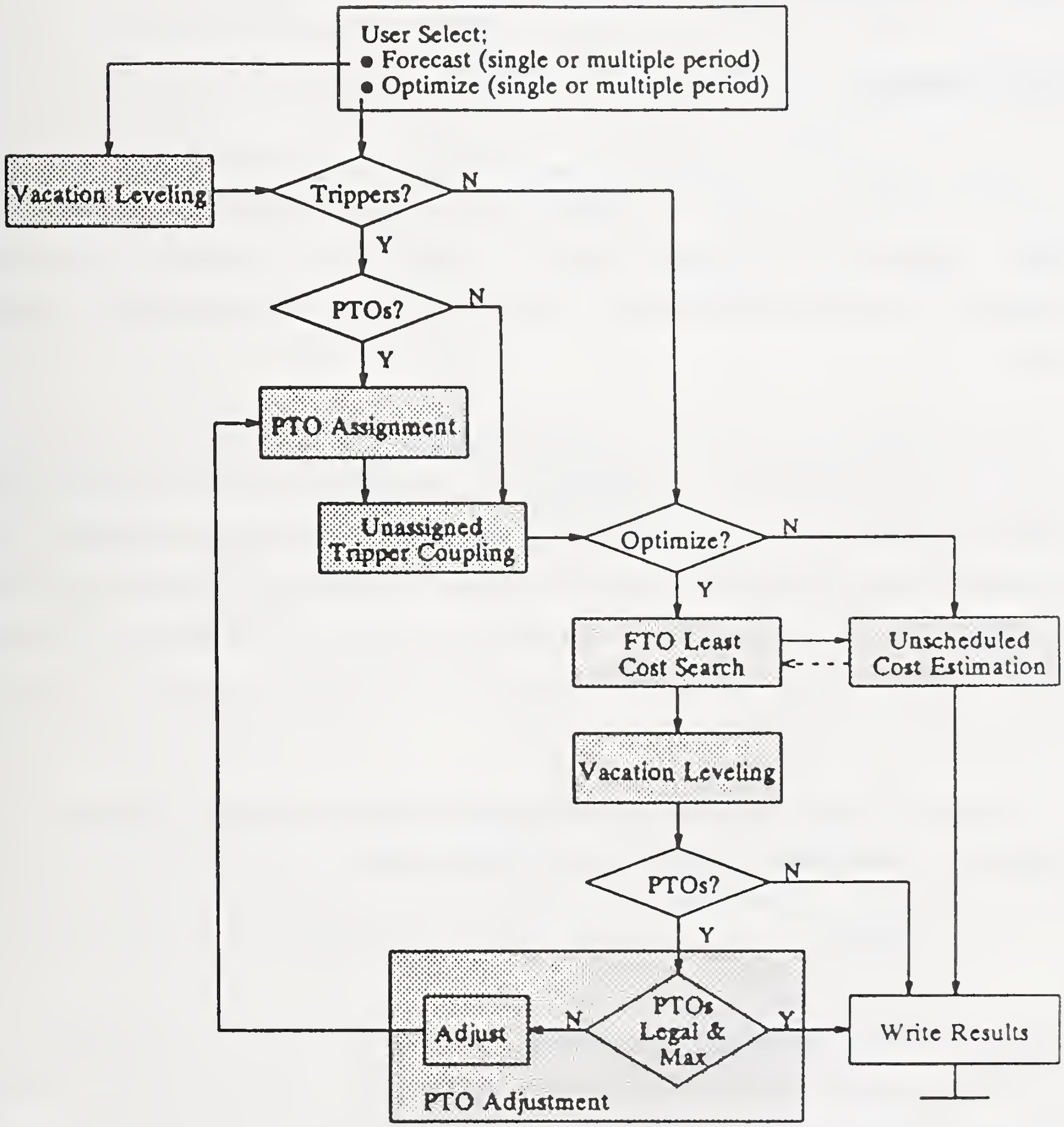
- <u>Unscheduled Cost Estimation</u>. This module estimates the unscheduled costs incurred by a user-defined or computer-generated operator configuration. Unscheduled costs are estimated using the expected value of probabilistic cost functions which incorporate the variation in daily open work levels.

- <u>FTO Least-Cost Search</u>. This optimization mode module estimates the least-cost number of FTOs to schedule by iteratively comparing the unscheduled costs and fixed fringe benefit pay of alternative operator arrangements. The module also recognizes user-defined overtime constraints and the limitations of consecutive-day-off scheduling.

- <u>Vacation Leveling</u>. This module estimates the number of FTOs that must be retained to perform the work assignments of operators who are on vacation. The module attempts to schedule operator vacations such that the number of operators employed over the planning horizon is as uniform as user-defined constraints will allow.

EXHIBIT C.1

MODEL OVERVIEW



- PTO Adjustment. This optimization mode module adjusts the number of PTOs retained if the previous model iteration does not maximize the number of PTOs that can be utilized.

Each of the TOPDOG modules is described below.

## PTO ASSIGNMENT

This module is used to assign trippers to PTOs to maximize their total work hours within the bounds established by the transit system's labor agreement provisions and work rules. The PTO work hours are maximized since part-time labor is assumed to cost less than full-time labor.

PTOs are generally more cost-effective than FTOs due to less restrictive pay provisions, e.g., guarantees, and reduced fixed fringe benefits. Maximizing the work hours of PTOs is the basis for PTO optimization and is a normalizing assumption for forecasting the cost associated with the use of PTOs. It also provides a reasonable means of developing PTO assignments without requiring detailed runcutting information such as the pull-out and pull-in times of every tripper.

The utilization of PTOs is constrained by transit systems' labor agreement provisions and work rules, which may:

- limit the number of PTOs in the work force;
- limit the weekly work days of PTOs;
- limit the daily work hours of PTOs; and
- restrict PTOs from working split assignments.

In all cases, PTOs are assumed to be restricted to tripper assignments. The module considers each of these constraints in combination with the work hour distribution of a.m. and p.m. trippers, to develop PTO assignments.

The objective of this module is to estimate the number of PTOs to schedule and the amount of tripper work covered by PTOs during each service schedule. The module handles the PTO assignment process according to the combination of applicable PTO utilization constraints defined by the user in the Global Data Form. For instance, if PTOs can only work single tripper assignments, the module will select a set of single trippers to maximize total PTO work hours. Alternatively, if PTOs are allowed to work split assignments, the module matches a.m. and p.m. trippers in addition to selecting single trippers for PTO assignment. Daily work hour limitations can be addressed by service schedule, whereas weekly work hour limitations require the module to consider weekday, Saturday and Sunday trippers simultaneously. A simple example of the PTO assignment process is given in Exhibits C.2 and C.3.

Complex scenarios require the model to break user-defined tripper distributions down to representative individual pieces and match a.m. and p.m. trippers for PTO assignment. A binary linear program using a branch and bound algorithm assigns the work to part-time operators to maximize their weekly work hours.

## UNASSIGNED TRIPPER COUPLING

This module synthesizes a representative distribution of work assignments which results from piecing together unassigned trippers. Unassigned trippers are those trippers or short pieces of work not assigned to PTOs or those resulting from PTO absence or vacations.

Unassigned trippers are generally pieced together by operator dispatchers for assignment to extraboard operators or left uncoupled for assignment to FTOs as an additional daily overtime work assignment. The trippers combined or left uncoupled often vary from day to day according to the availability of extraboard operators or the availability of full-time operators willing to work overtime. Operator availability not only varies from day to day but also varies during the course of each day, making actual tripper coupling even more unpredictable.

EXHIBIT C.2

ILLUSTRATION OF PTO ASSIGNMENT

OBJECTIVE:

ESTIMATE THE NUMBER OF PTOs scheduled and trippers covered by PTOs for a weekday schedule during the summer service period. PTO work hours should be maximized.

TRIPPER DISTRIBUTION:

The summer weekday schedule includes 40 a.m. trippers ranging in duration from 4 to 2 hours and 27 p.m. trippers ranging in duration from 4.5 to 2.25 hours. This information defines an estimated tripper distribution shown in Exhibit C.3A.

APPLICABLE LABOR AGREEMENT PROVISIONS:

The labor agreement provisions affecting PTO utilization for the example are:

- o PTOs may represent up to 10 percent of the FTO work force;
- o PTOs may work a maximum of 4 hours per day; and
- o PTOs may only work single tripper assignments.

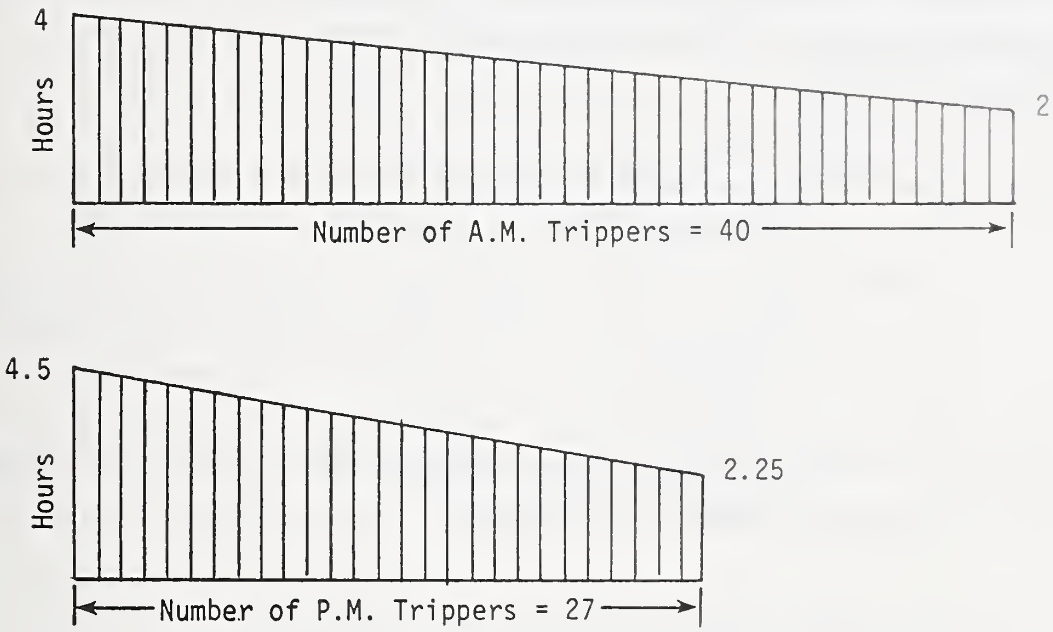
PTO ASSIGNMENT:

Based on a 10 percent limitation, the module indicates that 32 PTOs are permitted. The module will search for the longest trippers that are 4 hours or less in duration and assign this work to PTOs until either the number of available trippers or the number of PTOs is exhausted. Exhibit C.3B shows the trippers assigned to PTOs.

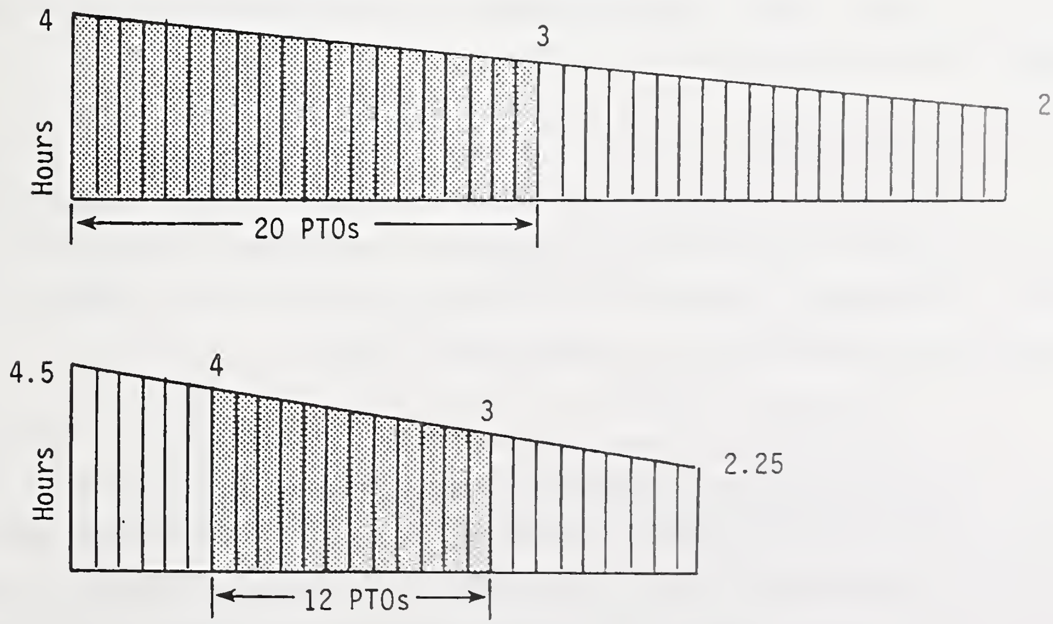
EXHIBIT C.3

EXAMPLE PTO ASSIGNMENT

A. A.M. and P.M. Trippers




B. Trippers Assigned to PTOs (shaded)



The module synthesizes an unassigned tripper distribution (combina-tions and singles) based on a best estimate of what a representative distribution might look like for the service schedule under consideration. The module defines the rough geometry of the distribution rather than trying to define exactly which tripper is combined with another tripper. The general approach for unassigned tripper coupling is described in the following example.

- o The module begins by determining how many a.m. and p.m. trippers are not assigned to PTOs and adds these numbers to the average number of a.m. and p.m. trippers left open due to PTO absences and vacations, if any. This example assumes that 20 a.m. trippers are unassigned and 15 p.m. trippers are unassigned.

- o The 15 p.m. trippers are combined with 15 of the a.m. trippers, leaving 5 single a.m. trippers.

- o The total work hours of these trippers are estimated by subtracting the tripper work hours assigned to PTOs from the total tripper work hours and adding the estimated work hours of trippers left open due to PTO absence and vacations to the difference. This example assumes the total unassigned tripper work hours equals 100.

- o The module produces a linear distribution of 20 unassigned trippers (15 combinations and 5 singles), which preserves the total unassigned tripper work hours (100) and is consistent with coupling provisions in the labor agreement that may limit the maximum combination tripper work length.

- o The tripper distribution development is initiated by identifying the shortest unassigned single tripper and solving for the maximum combination length, which preserves the total unassigned tripper work hours. This example assumes the shortest unassigned single tripper is 3 hours. The maximum combination length is calculated to be 7 hours, i.e., a trapezoid with base = 20 and heights 7 and 3 has area = 100.

- The module checks to see if the maximum combination length exceeds the allowable coupling limit. In this example, it is assumed any work greater than 7.5 hours must be made into a run. If the maximum combination length exceeded 7.5 hours, the model would convert the longer combinations back into singles such that the constraint was satisfied. However, because the maximum tripper combination length equals 7 hours, no adjustment is necessary and the final unassigned tripper distribution is a trapezoid with base = 20 (15 combinations and 5 singles), maximum height 7 hours, and minimum height 3 hours.

## UNSCHEDULED COST ESTIMATION

This module is used to estimate the unscheduled costs incurred by a user-defined (i.e., forecasting) or computer-generated (i.e., optimization) operator configuration. TOPDOG divides unscheduled costs into four main categories:

- No-Work-Available (NWA) pay. This cost is incurred when there is no work assignment available for an extraboard operator.

- Work-Day-Off (WDO) overtime premium pay. This cost is incurred when the amount of open work exceeds the number of extraboard operators scheduled and an FTO is called in to work on a regularly scheduled day off.

- Tripper bonus to make guarantee pay (TG). This cost is incurred when an extraboard operator works a tripper assignment (single or combination) that results in less pay time than the effective daily guarantee pay required by the labor agreement.

- Second assignment tripper overtime premium pay (TP). It is assumed that tripper assignments not covered by extraboard operators or PTOs are worked by FTOs as second daily assignments resulting in tripper overtime premium pay.

Unscheduled spread is not considered by the model, since this cost is generally a function of the schedule and how operator dispatchers combine open work for assignment to operators.

In addition to deriving unscheduled cost estimates, the module produces other information about operator utilization, such as the estimated required overtime hours. Estimating unscheduled costs and associated operator utilization parameters requires the use of expected value calculations to address the variability and uncertainty of open work.[1]

The module is structured to derive daily estimates for each service schedule, e.g., Service Period 1 - Weekday. The daily estimates can be multiplied by the number of days the service schedule is operated to produce service schedule totals. These values can then be aggregated to produce service period and annual period totals.

In deriving daily unscheduled costs and associated operator utilization estimates, the module simultaneously considers the open work produced by operator absence, nonscheduled work assignments and unassigned trippers.[2] The approach is presented below in a stepwise manner using examples to facilitate understanding of the most important principles used in deriving daily cost and operator utilization estimates.

## Open Work Created by Operator Absence

The amount of open work created by vehicle operator absence typically varies from day to day. The variability and uncertainty of absence often lead to an imbalance between the supply of extraboard operators and the demand for their labor. The following example describes the impact of this imbalance through a series of illustrations. The example describes the open work created by operator absence as scheduled runs. The example can be generalized to include any operator assignment, e.g., extraboard

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[1]Expected value is the numerical average associated with a probabilistic function.

[2]Operator absence does not include vacations, regular holidays or operators' regular weekly scheduled days off.

assignments, since the principal issue is the imbalance between operator supply and demand for labor.

- o <u>Framework for this example</u>. Exhibit C.4A is a graphic representation of all scheduled runs during a 24-weekday period at a transit property. In this example, 720 runs were operated each weekday. This graphic establishes the framework for the example.

- o <u>All open scheduled runs caused by absence</u>. Runs open because of absence are represented in Exhibit C.4B by shaded cells.

- o <u>Open scheduled runs aggregated</u>. In Exhibit C.5A, the shaded area represents the aggregate daily scheduled runs resulting from absence. The exhibit shows the daily variation in open runs.

- o <u>Open scheduled runs ranked from least to most</u>. The shaded portion of Exhibit C.5B also shows all the runs open due to unscheduled absence. By ranking the number of open runs, this figure describes the daily variation as a cumulative distribution.

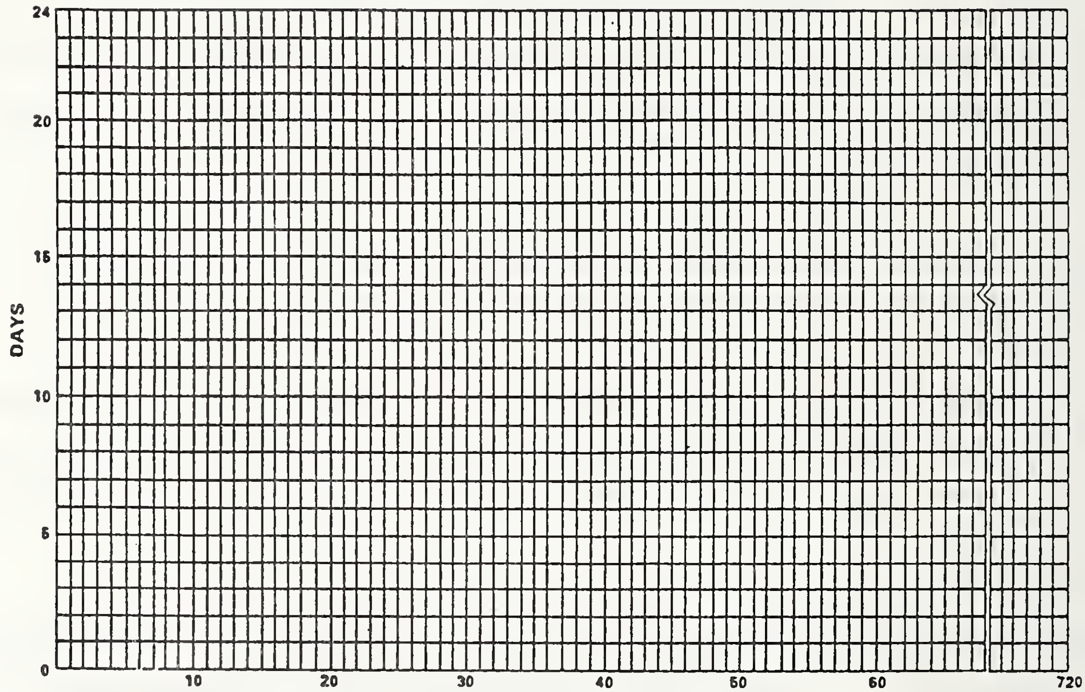
- o <u>Minimum extraboard size for open runs</u>. Exhibit C.6A identifies a minimum number of extra operators needed to cover open runs due to absence, without incurring any unscheduled guarantee pay. In this example, 16 extra opera'ors are required. The shaded area (area A) represents the open runs that must be filled by operators working on their regularly scheduled day off, i.e., at overtime.

- o <u>Maximum extraboard size for open runs</u>. Exhibit C.6B identifies a maximum number of extra operators required to cover open runs due to absence (i.e., 62 operators). In this case, no unscheduled premium (i.e., overtime) pay would be required. However, the shaded area (area B) represents runs that are already filled, for which extra operators must receive guarantee pay.

## EXHIBIT C.4

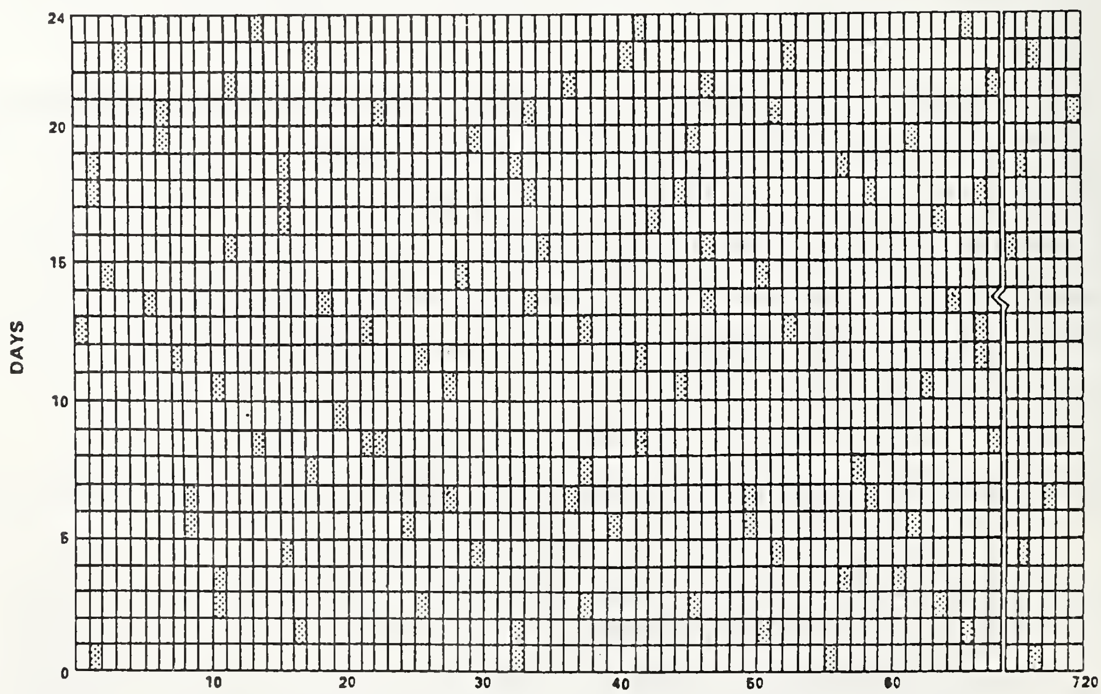
## SCHEDULED AND OPEN RUNS

A. Representation of 720 Weekday Runs Scheduled For A 24-Day Period




Scheduled Runs

B. Representation of Open Runs Due To Absence During A 24-Day Period

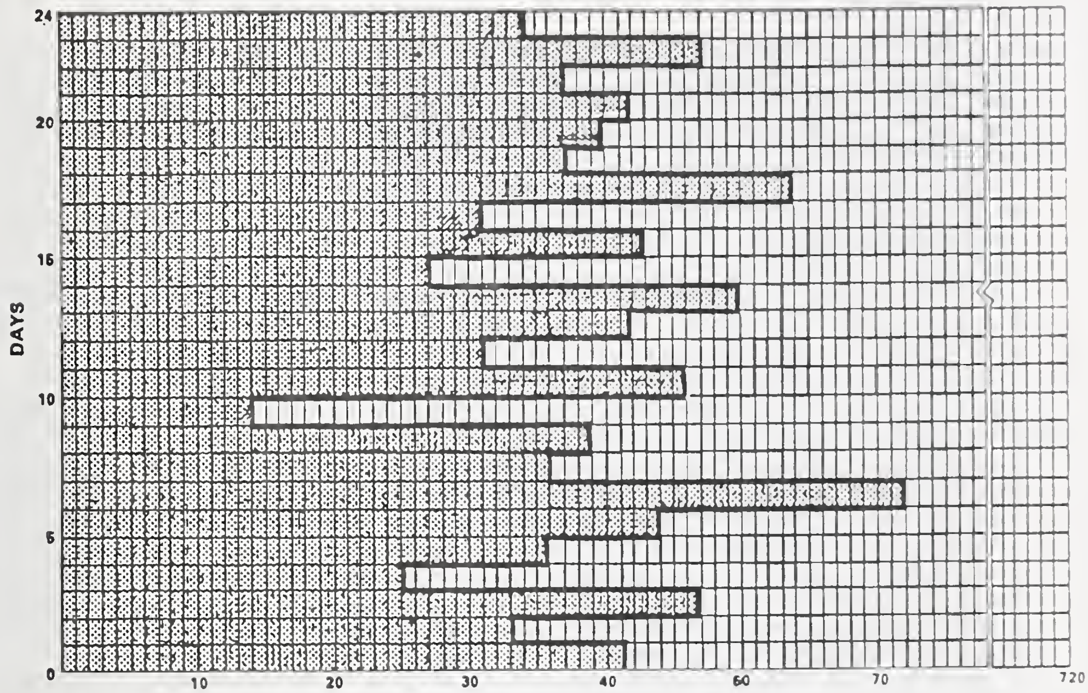



Scheduled Runs With Those Darkened To Show Open Runs Due To Absence

EXHIBIT C.5

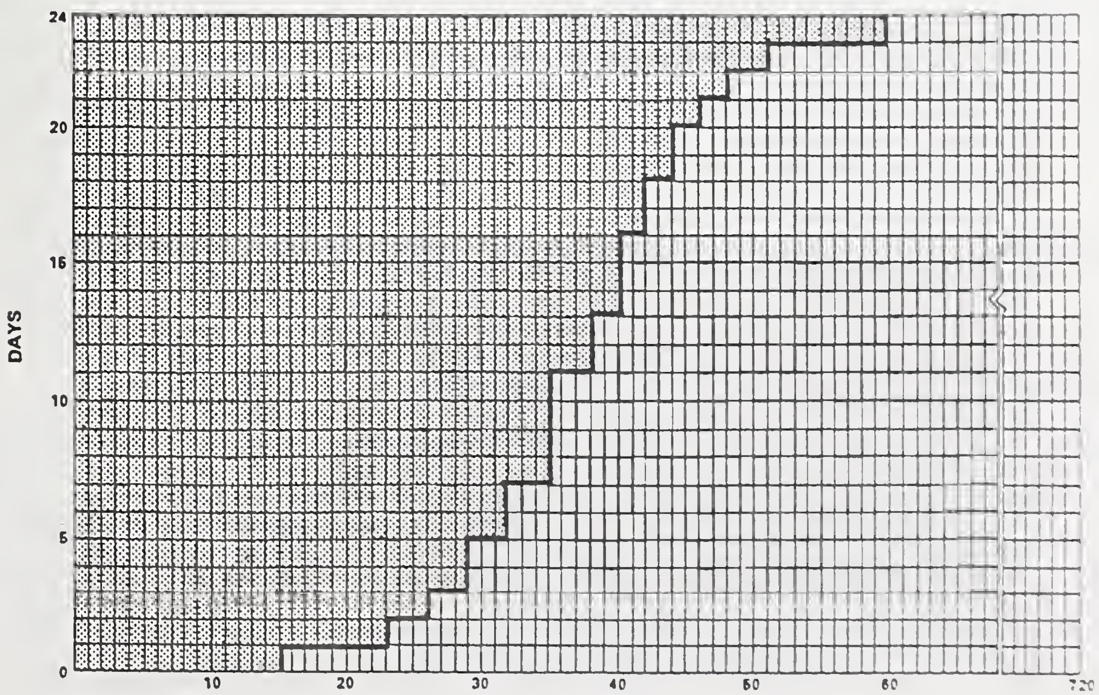
DAILY VARIATION IN OPEN RUNS

A. Representation Of Open Runs Due To Absence Aggregated During A 24-Day Period




Scheduled Runs With Those Darkened And Aggreagated To Show Open Runs Due To Absence

B. Cumulative Distribution Of Open Runs Due To Absence

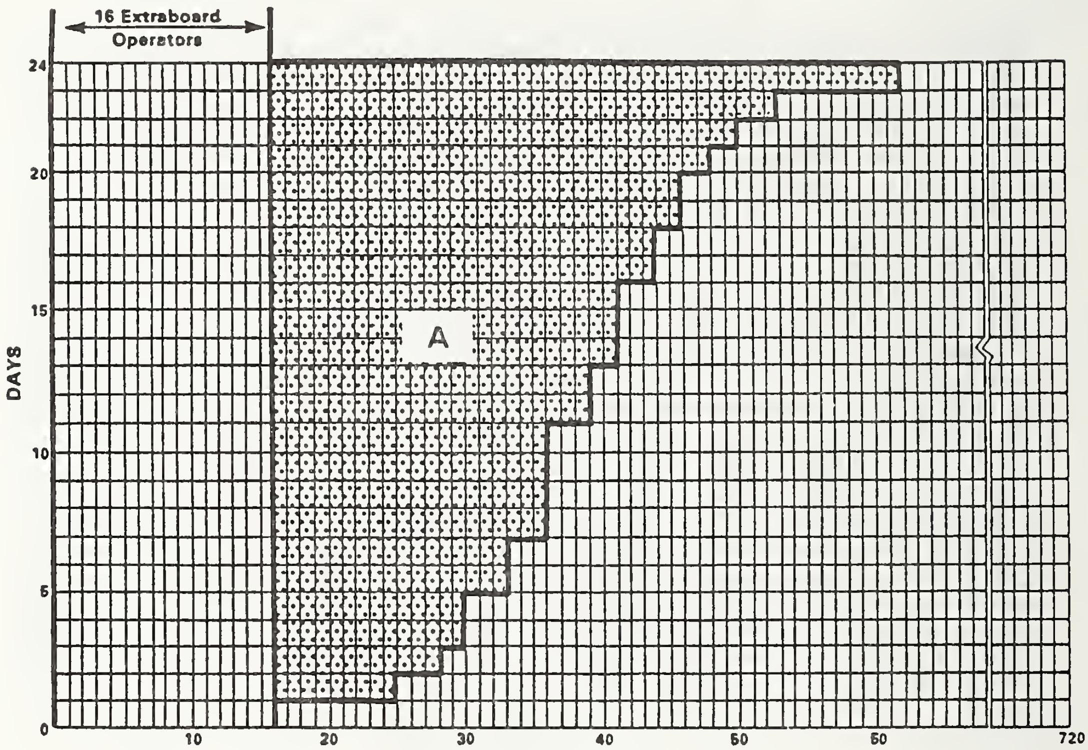



Scheduled Runs

## EXHIBIT C.6

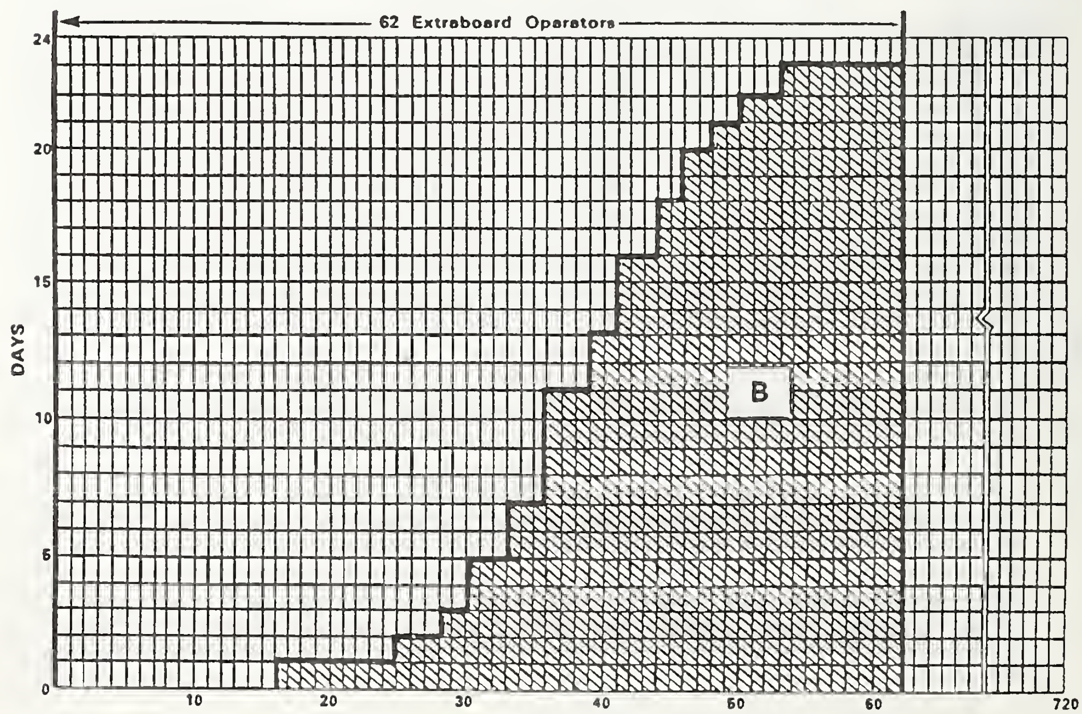
## MINIMUM AND MAXIMUM EXTRABOARD SIZE TO COVER OPEN RUNS

A. Minimum Extraboard Size To Fill Open Runs Due To Absence




Scheduled Runs

B. Maximum Extraboard Size To Fill Open Runs Due To Absence




Scheduled Runs

- o <u>Intermediate extraboard size for open runs</u>. Exhibit C.7 illustrates the case when the number of extraboard operators is somewhere between the minimum and maximum size. On days when the number of open runs exceeds the number of extraboard operators, unscheduled overtime premium is incurred, as represented by area A. On days when the number of open runs is less than the number of extraboard operators, unscheduled guarantee is incurred, as represented by area B.

## Open Work Created by Nonscheduled Work Assignments

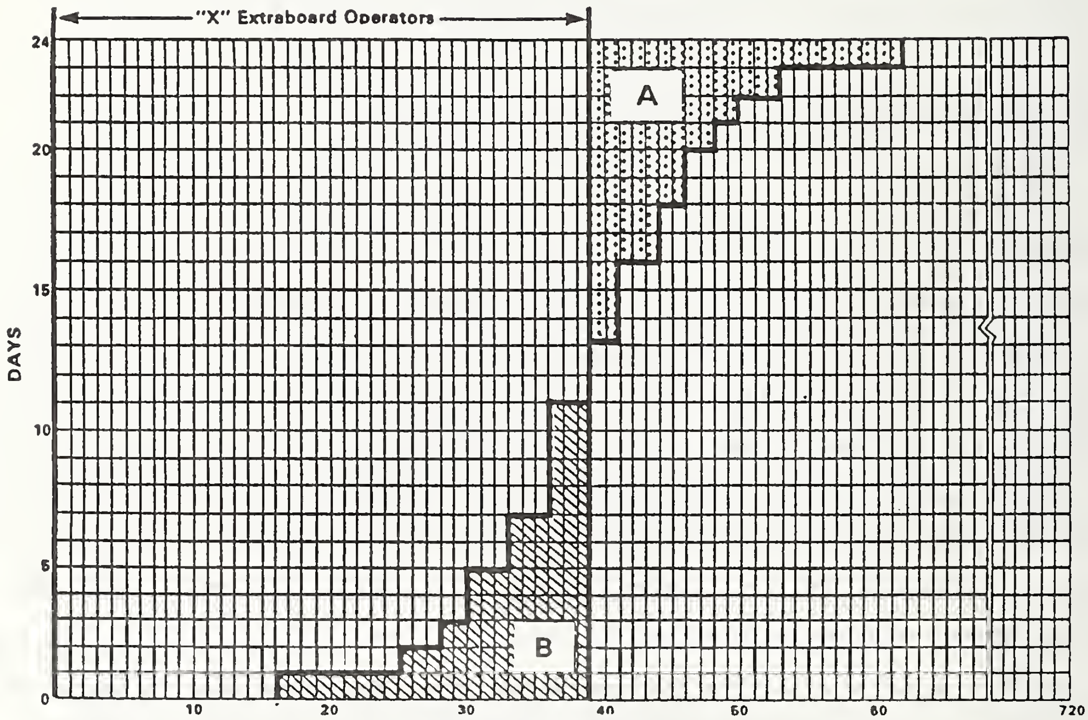
Nonscheduled work assignments are additional vehicle operator work assignments that are not part of the regular service schedule. These assignments generally result from special service demand (e.g., charters, special-event trippers, and nonoperating assignments such as training, instruction, administration and supervision). Like operator absence, nonscheduled work assignments create additional demand for operator labor and often vary from one day to the next. The open work created by nonscheduled work assignments can be combined with the open work created by operator absence. This is accomplished by summing the open work due to absence with the open work due to nonscheduled work for day 1, the open work due to absence with the open work due to nonscheduled work for day 2, and so on. A cumulative distribution of the daily variation of open work from operator absence and nonscheduled work is obtained as described in the previous example.

## Daily Variation in Open Work Due to Operator Absence and Nonscheduled Work

The cumulative open work distribution is described with a mathematical function to minimize the amount of input required to obtain unscheduled cost estimates. Rather than requiring absence and nonscheduled work data for each individual work day, the module uses an assumption about the distribution curve's general shape. The model assumes that the daily amount of open work resulting from operator absence and nonscheduled work is normally distributed. When the normal bell-shaped curve is presented

EXHIBIT C.7

INTERMEDIATE EXTRABOARD SIZE TO FILL OPEN RUNS DUE TO ABSENCE




Scheduled Runs

s a cumulative distribution, it has an S-shape. Exhibit C.8 presents an example of this curve as it would be used to estimate a cumulative distribution of open work.

Because the normal distribution is mathematically cumbersome, a logistic function is used in its place. A comparison between a standardized logistic function and a normal cumulative distribution is given in Exhibit C.9. The logistic function used to describe the daily variation in open work is described by the following equation:

$$F(x) = P\ (X <= x) = 1/(1+\exp(a+bx))$$

where:

- x is a particular number of open work assignments.

- X is a random variable representing the number of open work assignments due to operator absence and nonscheduled work.

- $P(X <= x)$ is the probability that the number of open work assignments is less than or equal to a particular number.

Although the general shape of the cumulative open work distribution curve is described by the function's equation, the average open work on a given day and the variation in daily open work amounts are based on user-defined inputs. The module uses these inputs to calibrate the function's coefficients: a and b. Once these coefficients are determined, the cumulative open work distribution curve is completely defined.

The function can be used to determine the amount of unscheduled guarantee and premium pay, as shown in Exhibit C.10. The y-axis on the graph is stated in terms of a cumulative probability, i.e., the proportion of total days rather than fixed numbers given in previous examples. This allows the distribution to be generalized beyond specific instances. The average daily number of unscheduled premium assignments is shown by area

EXHIBIT C.8

ILLUSTRATION OF A NORMAL CUMULATIVE DISTRIBUTION FITTED TO A CUMULATIVE DISTRIBUTION OF OPEN RUNS

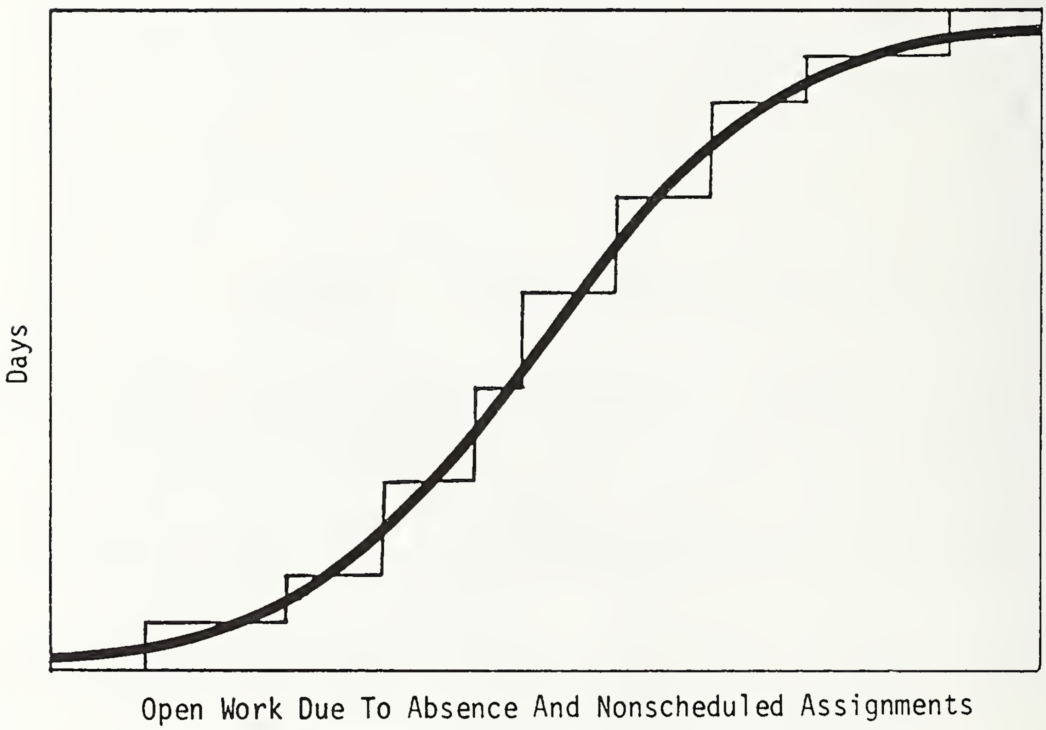
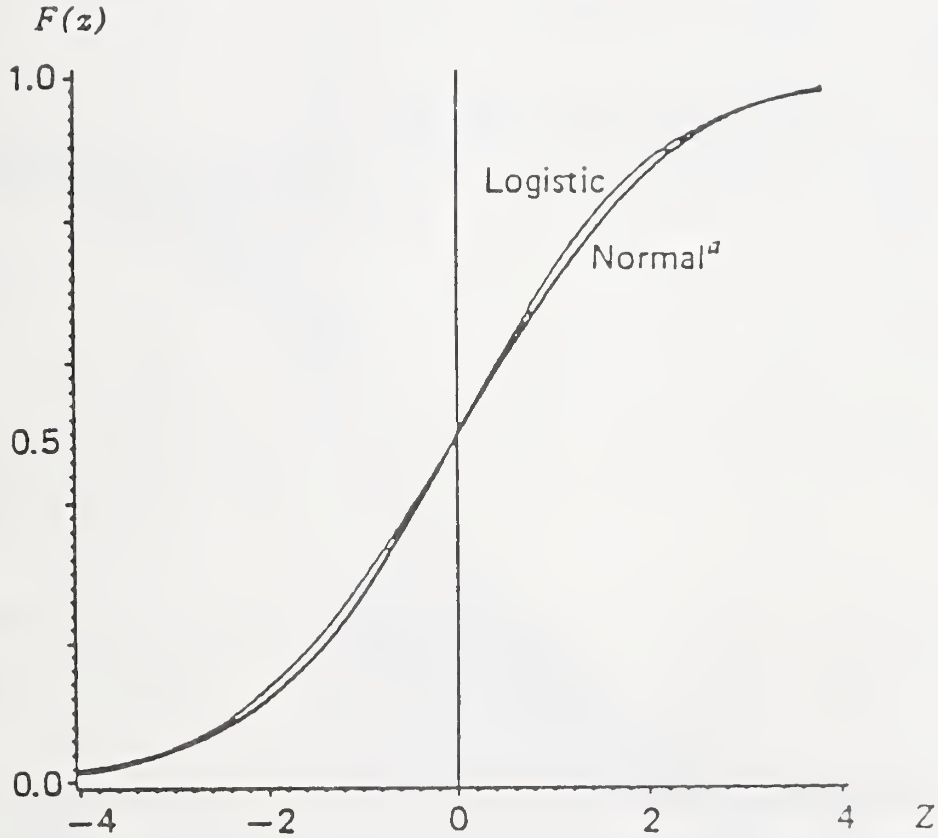


EXHIBIT C.9

LOGISTIC AND NORMAL DISTRIBUTION



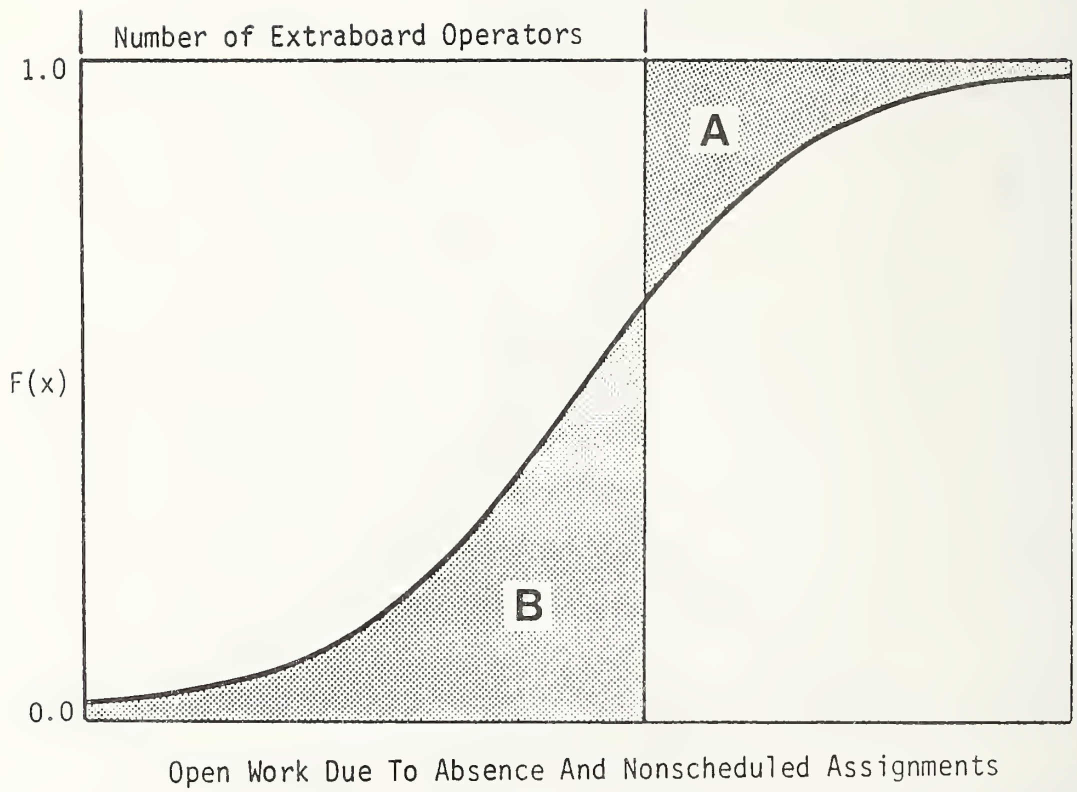

Logistic and normal cumulative probability distribution functions.
[a]$N(0, \pi^2/3)$ to match variance of standardized logistic.

[1]Source: Fox, John. Linear Statistical Models and Related Methods New York: John Wiley & Sons, 1984.

EXHIBIT C.10

LOGISTIC FUNCTION USED TO ESTIMATE

UNSCHEDULED GUARANTEE AND OVERTIME PREMIUM



A, and the average daily number of extraboard operators that may be paid unscheduled guarantees is represented by area B.[3]

<u>Unassigned Trippers: An Element of Unscheduled Cost Estimation</u>

This section describes how the Unscheduled Cost Estimation module simultaneously considers the open work produced by operator absence, nonscheduled work and the unassigned trippers. The unscheduled guarantee and premium pay estimates were described in the preceding section but did not address unassigned trippers and their impact on unscheduled costs. As stated above, trippers are short driving assignments not covered by PTOs. They are typically combined for assignment to extraboard operators or covered by FTOs at overtime in addition to the FTOs' regularly scheduled assignments. Unassigned trippers differ from open work created by operator absence and nonscheduled work because they are scheduled pieces of work that are assumed to remain constant from one day to the next within a particular service schedule.

The module assumes that extraboard operators are used to cover open work due to operator absence and nonscheduled work assignments before they are assigned to trippers, since: 1) open work due to operator absence and nonscheduled work assignments is given as full-day equivalents; and 2) extraboard operators are typically assigned a full day's work if it is available. Estimating unscheduled costs requires considering three distinct cases, described below. Any of these cases may occur on a given day.

- o <u>The number of open work assignments due to operator absence and nonscheduled work is greater than the number of extraboard operators scheduled</u>. In this case, some operators will be required to work on their regularly scheduled day off to cover the open work assignments due to operator absence and nonscheduled work

[3]In some cases, the payment of guarantee when an operator has no available work may be avoided, e.g., an operator may be willing to take the day off under no guarantee obligations.

not filled by extraboard operators. All unassigned trippers must be filled by operators working additional overtime assignments (Case 1).

- The number of open work assignments due to operator absence and nonscheduled work, plus all unassigned trippers (combination or single), is less than the number of extraboard operators scheduled. In this case, all open work and unassigned trippers can be filled by extraboard operators. The excess extraboard operators may incur unscheduled guarantee pay, since they have no work assignment and may receive tripper assignments that fall short of guaranteed pay time (Case 2).

- The number of open work assignments due to operator absence and nonscheduled work can be covered by the extraboard, but the number of extraboard operators left over is not sufficient to cover all unassigned trippers. In this case, no operators are required to work on their regularly scheduled day off and all extraboard operators can be assigned work. However, because not all unassigned trippers can be filled by extraboard operators, some FTOs will be required to cover the remaining trippers as additional overtime assignments (Case 3).

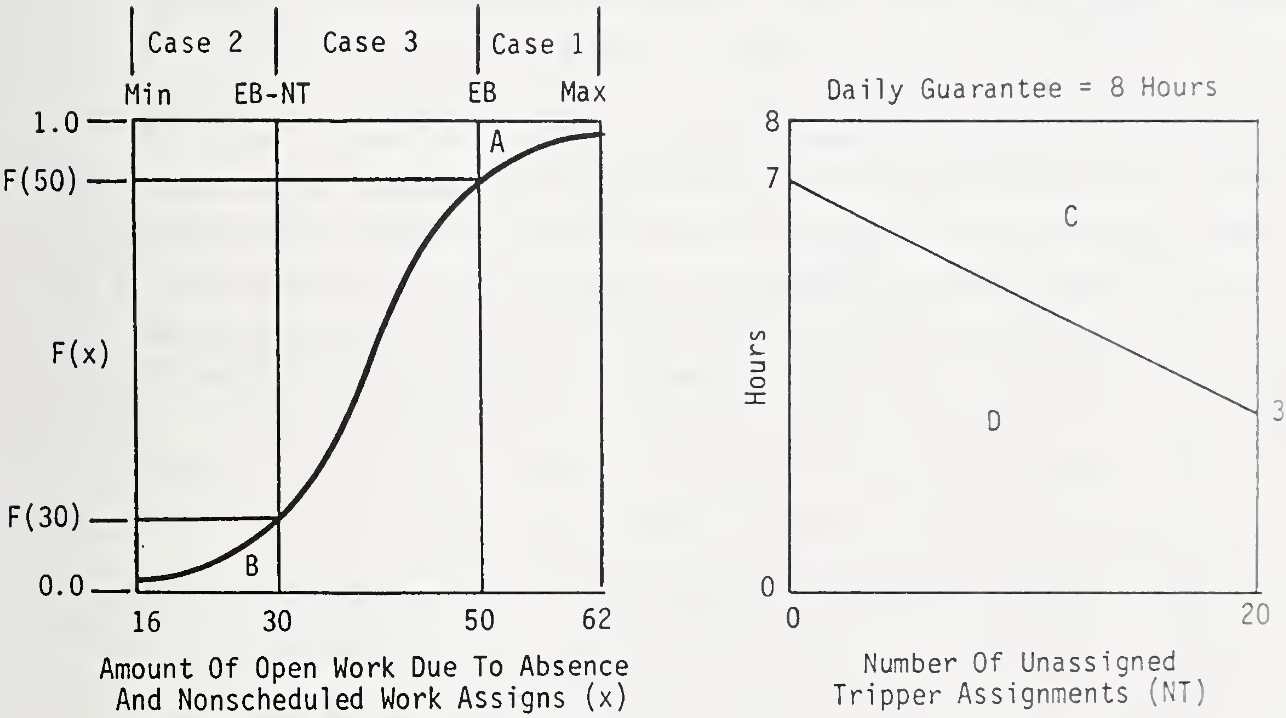
## An Illustration of Unscheduled Cost Estimation

The example discussed below and represented by the graphic in Exhibit C.11 describes the general approach used to estimate a service schedule's daily unscheduled costs. The following parameters define the example:

- The number of open work assignments due to operator absence and nonscheduled work assignments on a given day varies from a low of 16 to a high of 62. The average number of open work assignments equals 39.

EXHIBIT C.11

REPRESENTATION OF EXAMPLE FOR UNSCHEDULED COST ESTIMATES



- The number of unassigned tripper assignments (combinations and singles) equals 20. These assignments range from seven to three hours in length.

- The number of extraboard operators scheduled equals 50.

The amount of WDO overtime premium pay and NWA guarantee pay is obtained from areas A and B. Area A represents the expected daily number of WDO assignments, i.e., the number of open work assignments due to operator absence and nonscheduled work that must be covered by operators working on their regularly scheduled day off. These assignments are the result of a Case 1 scenario. Area B represents the expected daily number of NWA assignments, i.e., the number of extraboard operators stranded with no available work. These assignments are the result of a Case 2 scenario. Area A does not extend to the extraboard (EB) line since some extraboard operators that cannot be assigned open work due to absence or nonscheduled work can still be assigned trippers. Areas A and B are calculated as:

$$\text{Area A} = \int_{EB}^{Max} (1-(1/(1+\exp(a+bx))))dx = (Max-EB) - \left[ (1/b)*\ln \left[ \frac{\exp(a)+\exp(-(b*EB))}{\exp(a)+\exp(-(b*Max))} \right] \right]$$

$$\text{Area B} = \int_{Min}^{EB-NT} dx/(1+\exp(a+bx)) = (1/b)*\ln \left[ \frac{\exp(a)+\exp(-(b*Min))}{\exp(a)+\exp(-b(EB-NT))} \right]$$

where:

- EB is the number of extraboard operators scheduled (50).

- NT is the number of unassigned tripper assignments (20).

- Min is the minimum amount of open work due to operator absence and nonscheduled assignments that might occur on a given day (16).

- Max is the maximum amount of open work due to operator absence and nonscheduled assignments that might occur on a given day (62).

Estimated tripper premium and tripper guarantee requires a little more effort since the distribution of unassigned tripper work lengths must be considered in combination with the daily variation in open work. The amount of tripper premium and tripper guarantee will vary each day depending on how many extraboard operators are left over after open work due to absence and nonscheduled work is assigned.

Tripper premium results when there are not enough extraboard operators left over to cover all unassigned trippers. This happens under a Case 1 or Case 3 scenario. Tripper guarantee results when there are enough extraboard operators to cover some or all of the unassigned trippers and any of these assignments result in less pay time than the effective daily guarantee. This may happen under a Case 2 or Case 3 scenario. Each case is considered separately below.

<u>Case 1</u>. Under a Case 1 scenario, all unassigned trippers are covered by FTOs as an additional overtime assignment. The expected Case 1 tripper overtime premium, E [TP1], is calculated as:

E[TP1] = (Comprate) (OTpremrate) (total unassigned tripper hours)(probability of Case 1)

$$= (\text{Comprate})(0.5)(\text{Area D})(1-(1/(1+\exp(a+b(\text{EB})))))$$

here:

- o Comprate is the average full-time operator hourly compensation rate (wages plus variable fringe benefits, e.g., FICA).

- o OTpremrate is the overtime premium rate and is assumed in this example to equal 0.5.

- o Area D is shown in Exhibit C.12 and is calculated by solving for the area of the trapezoid.

- o Probability of Case 1 is the distance between f(50) and 1.0 shown in Exhibit C.12.

<u>Case 2</u>. Under a Case 2 scenario, all unassigned trippers are covered by extraboard operators. The expected Case 2 tripper guarantee, E[TG2], is calculated as:

E[TG2] = (Comprate)(Total tripper guarantee)(Probability of Case 2)

= (Comprate)(Area C)(1/(1+exp(a+b(EB-NT))))

where:

- o Area C is shown in Exhibit C.12 and is calculated by solving for the area of the trapezoid.

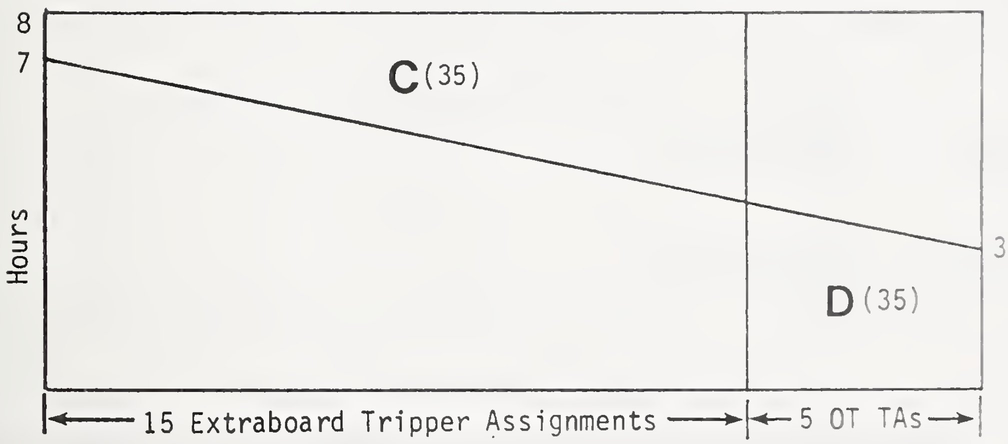
- o Probability of Case 2 is the distance between F(30) and 1.0 shown in Exhibit C.12.

<u>Case 3</u>. Under a Case 3 scenario, some unassigned trippers are covered by extraboard operators, leaving the remaining trippers to be covered at overtime rates. The number of unassigned tripper assignments that can be covered by extraboard operators will vary, as the amount of open work due to absence and unscheduled assignments varies within the interval

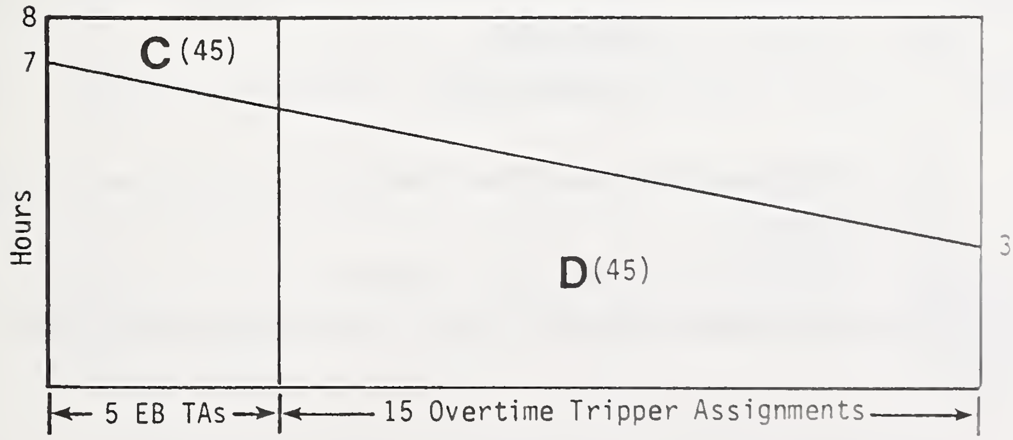
EXHIBIT C.12

TRIPPER GUARANTEE AND OVERTIME PREMIUM REPRESENTATIONS

A. Tripper Guarantee (C) and Overtime Premium (D*0.5) Hours When Number of Open Work Assignments = 35




B. Tripper Guarantee (C) and Overtime Premium (D*0.5) Hours When Number of Open Work Assignments = 45



efining a Case 3 scenario: [EB-NT, EB] = [30,50]. Exhibit C.12A describes the amount of tripper guarantee and overtime premium on a day when there are 35 open work assignments due to operator absence and non-scheduled work. Exhibit C.12B describes the amount of tripper guarantee and overtime premium on a day when there are 45 open work assignments.

The expected Case 3 tripper guarantee, E[TG3], and overtime premium, E[TP3], are based on a weighted average taking the general form:

$$E[TG3] = \int_{\alpha}^{\beta} TG3(x)f(x)dx$$

$$E[TP3] = \int_{\alpha}^{\beta} TP3(x)f(x)dx$$

where:

- o TG3(x) and TP3(x) are the tripper guarantee and overtime premium as a function of the amount of open work (x) and are calculated from the trapezoid areas shown previously in Exhibit C.12.

- o F (x) is the logistic density function.

- o $f(x) = F'(x) = \dfrac{-b * \exp(a+bx)}{(1+\exp(a+bx))^2}$

- o $\int_{\alpha}^{\beta}$ is the integral sum from the lower case 3 bound to $\alpha$ the upper case 3 bound $\beta$.

In this example, the expected Case 3 tripper guarantee, E[TG3], is calculated as:

$$E[TG3] = (\text{Comprate}/2)[[\text{TSlope} \int_{\alpha}^{\beta} x2f(x)]+$$

$$[2(\text{MXT-DG-(TSlope*EB)}) \int_{\alpha}^{\beta} xf(x)]+$$

$$[EB((2*DG)-(2*MXT)+(TSlope*EB)) \int_{\alpha}^{\beta} f(x)]]$$

and the expected Case 3 tripper overtime premium, E[TP3], as:

$$E[TP3] = (Comprate * OTpremrate/2)[[TSlope \int_{\alpha}^{\beta} x^2 f(x)]+$$

$$[2(MNT + (TSlope(NT-EB))) \int_{\alpha}^{\beta} xf(x)]+$$

$$[((NT-EB)((2*MNT)+(TSlope(NT-EB)))) \int_{\alpha}^{\beta} f(x)]]$$

where:

- o equals the number of extraboard operators scheduled (EB=50).

- o equals the number of extraboard operators scheduled minus the number of unassigned trippers (EB-NT=30).

- o DG is the effective daily guarantee hours (DG=8).

- o MXT is the maximum unassigned tripper assignment length (MXT=7).

- o MNT is the minimum unassigned tripper assignment length (MNT=3).

- o EB equals the number of extraboard operators scheduled (EB=50).

- o NT equals the number of unassigned trippers (NT=20).

- o TSlope is the absolute value of the unassigned tripper work length distribution slope and is calculated as: (MXT-MNT)/NT (TSlope = 0.2).

- o OTpremrate is the overtime premium rate and is assumed in this example to equal 0.5.

- o Comprate is the average full-time operator hourly compensation rate (wages plus variable fringe benefits, e.g., FICA).

Finally, the total expected daily tripper guarantee, E[TG], and the expected daily tripper overtime premium, E[TP], are determined by summing their respective component estimates:

$$E[TG] = E[TG2]+E[TG3]$$

$$E[TP] = E[TP1]+E[TP3]$$

FTO LEAST COST SEARCH

This module is used under an optimization mode of model execution to identify the least-cost number of FTOs to schedule each service schedule. The least-cost FTO arrangement is optimized within the bounds set by two types of restrictions:

- o user-defined constraints that limit the amount of unscheduled overtime; and
- o special scheduling considerations that arise if the labor agreement requires that FTOs' regular weekly scheduled days off fall consecutively, e.g., Saturday-Sunday, Tuesday-Wednesday.

The module begins by finding an unbound optimal solution, i.e., no restrictions are initially considered. If overtime or special scheduling restrictions exist, the module then adjusts the unbound solution to meet these constraints.

The routine uses the following iterative process to develop the unbound optimal solution:

- o An initial number of FTOs needed to operate the service schedule is developed based on the number of runs and average number of open work assignments.
- o The unscheduled Cost Estimation Module estimates the total unscheduled cost associated with the number of FTOs. The

unscheduled cost is added to the fixed-fringe-benefit cost associated with the number of FTOs to estimate the value used for cost comparisons.

- The number of FTOs is increased by one operator.

- The unscheduled cost and fixed-fringe-benefit cost of the new number of FTOs are estimated.

- If the second cost estimate is less than the first cost estimate, the number of FTOs is increased again.

The iterative process continues until the costs no longer decrease. Conversely, if the first cost estimate is less than the second estimate, the number of FTOs is adjusted downward until the costs no longer decrease.

The module next determines if the unbound optimal solution falls within the bounds set by user-defined unscheduled overtime restrictions. The parameters that restrict the amount of unscheduled overtime are:

- the maximum allowed average daily unscheduled overtime hours as a percentage of total daily scheduled payhours;

- the maximum allowed average daily number of WDO assignments as a percentage of total daily scheduled runs;

- the maximum allowed average daily number of single overtime trippers as a percentage of total daily single trippers; and

- any combination of the above.

The Unscheduled Cost Estimation Module determines the required unscheduled overtime estimates associated with the unbound optimal number of FTOs. If any of the unscheduled overtime constraints is not satisfied, the number of FTOs is increased iteratively until all constraints are met.

If the labor agreement does not require FTOs' regular weekly scheduled days off to be consecutive, no further adjustments are necessary. Otherwise, the module checks to see if the current number of FTOs satisfies special scheduling constraints that arise under such a provision. Briefly stated, the numbers of operators scheduled on weekdays, Saturdays and Sundays must bear certain relationships to each other to ensure the feasibility of consecutive day off scheduling. For instance, if the number of operators scheduled on a Sunday is less than the number scheduled for Saturday, the following constraint must be satisfied:

Number of Sunday operators $\geq$ (2/3) (Number of Saturday operators)

If all such constraints are not met, the module adjusts the number of operators scheduled on weekdays, Saturdays and Sundays until consecutive day off scheduling is feasible. The adjustments are made to minimize the total costs of the schedules involved while ensuring that unscheduled overtime constraints are not violated. The procedure is similar to those described above, i.e., it is iterative in nature.

## VACATION LEVELING

This module estimates the number of FTOs required for each service schedule to perform the work assignments of vehicle operators who are on vacation. The number of operators needed to fill open work resulting from vacations depends on two factors:

- o the vacation benefits of operators according to labor agreement provisions; and
- o the different numbers of operators required in different service periods.

The operators' vacation benefits, specified in the labor agreement, generally provide an established number of annual vacation days as a function of service seniority. The module uses a user-defined estimate of the average number of annual vacation days per operator to estimate the total vacation requirements for a particular operator configuration.

To effectively plan for operator vacations, it is necessary to recognize the differences in operator requirements by service period. The operator requirements are the number of operators that must be retained each service period to supply the number of operators needed for each service schedule. These requirements must consider the number of regular weekly scheduled days off allotted to operators. If operator requirements do not differ between service periods, vacations should be spread continuously and as evenly as possible throughout the year to obtain optimal cost conditions.

However, many transit systems reduce service during the summer months to accommodate reduced travel demand. Consequently, fewer operators are needed. Operator vacations should then be scheduled in the summer or in other periods when fewer operators are required to meet scheduled service.

The following example summarizes the general approach to vacation leveling using a series of illustrations. The example is presented from a multi-period optimization perspective.

- <u>Operator requirements for three service periods</u>. Exhibit C.13A graphically represents operator requirements for three different service periods in the year. The requirements include regular operators for regularly scheduled runs and extra operators to cover open work due to absence and nonscheduled work.

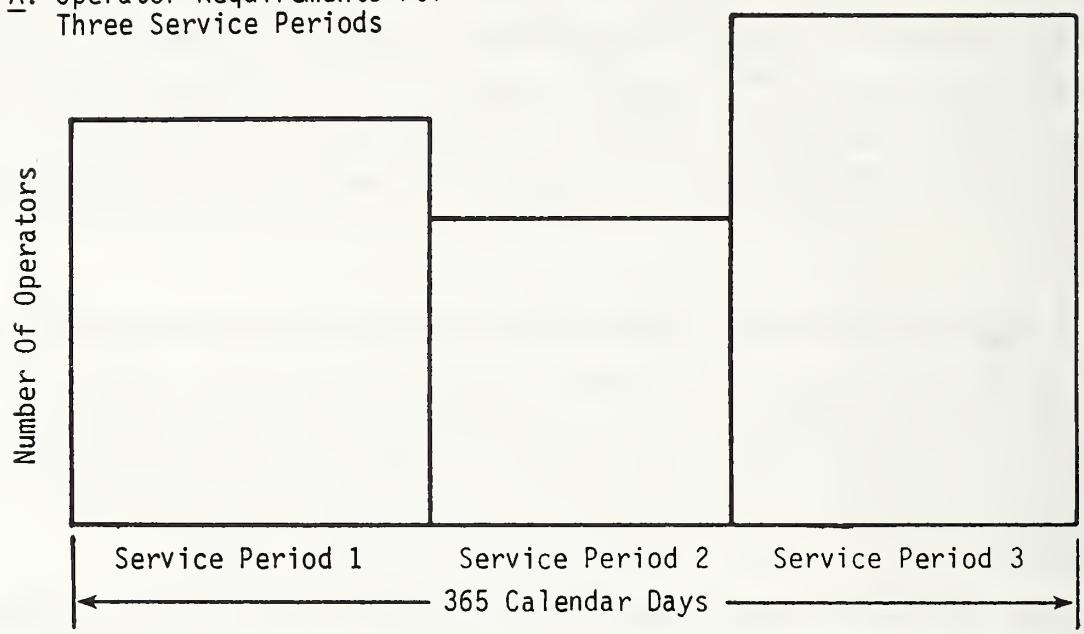
- <u>Available vacation time with a constant number of operators</u>. The shaded area in Exhibit C.13B shows the time available for vacations, assuming that the number of operators employed is held constant throughout the year. The time is available for vacations because of the different numbers of operators required in different service periods.

- <u>Optimal operator work force size when the available time exceeds the vacation requirements</u>. In Exhibit C.14A, the required time

EXHIBIT C.13

OPERATOR REQUIREMENTS AND AVAILABLE VACATION TIME

A. Operator Requirements For Three Service Periods




B. Available Vacation Time Using A Constant Number Of Operators

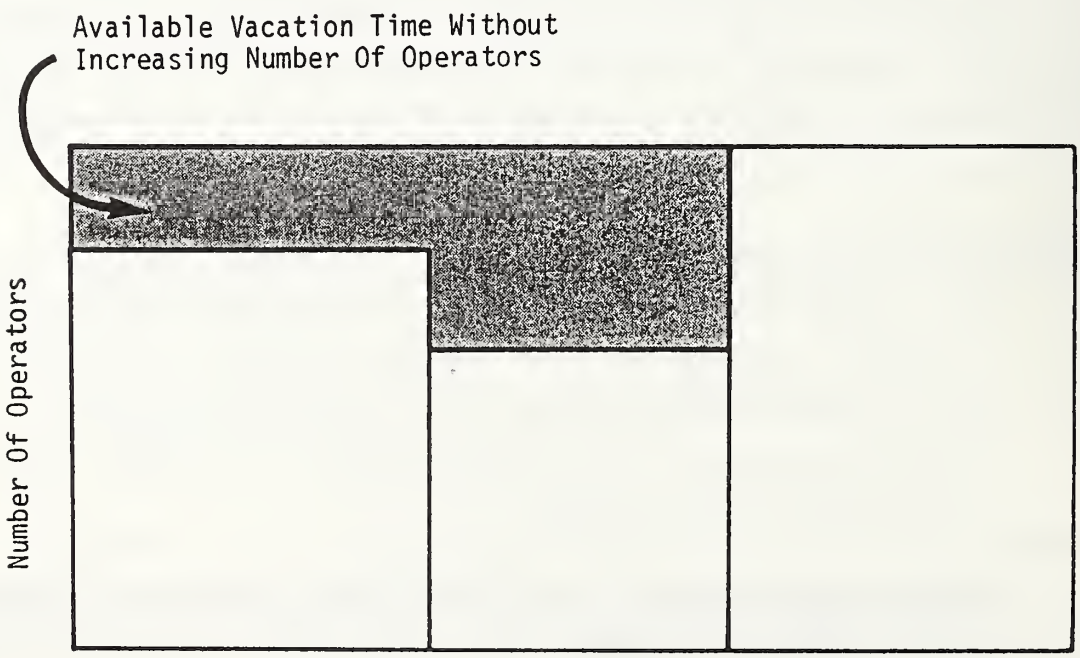
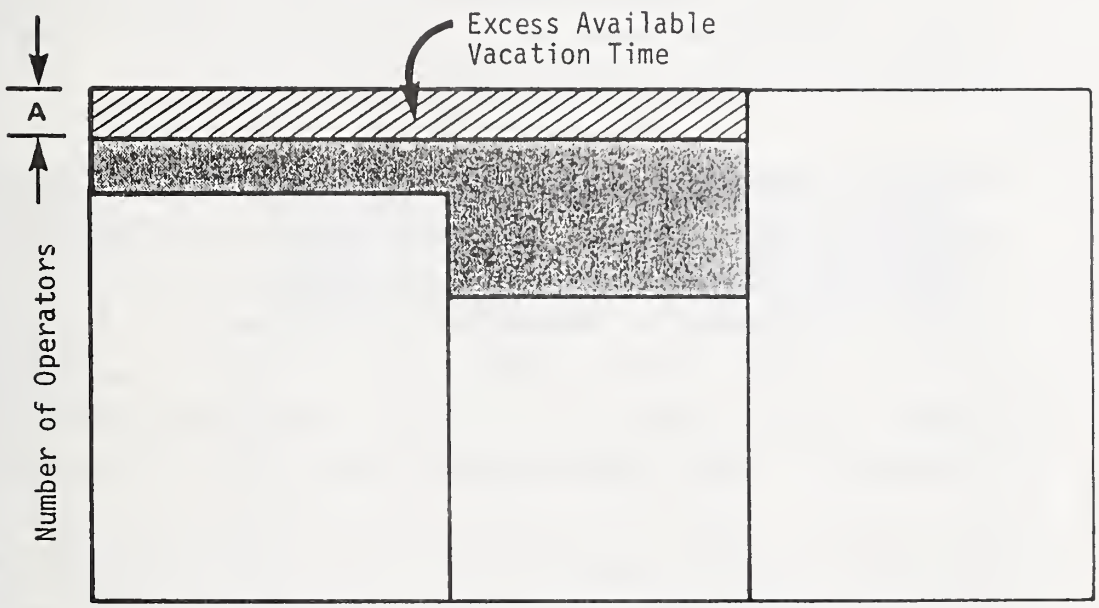


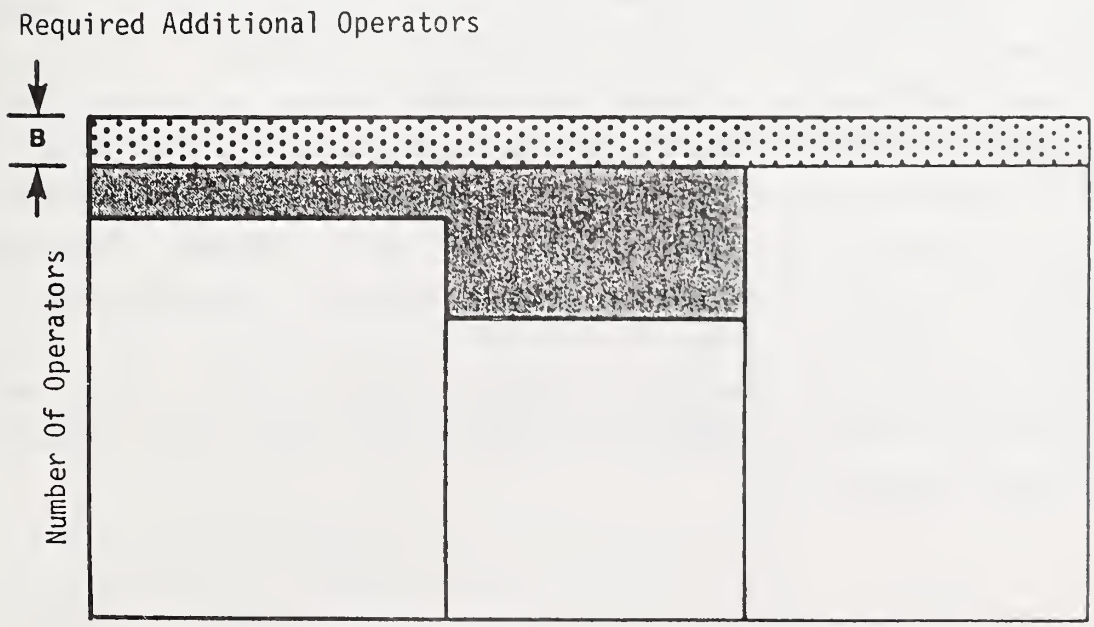
EXHIBIT C.14

MULTI-PERIOD VACATION LEVELING

A. Optimizing Operators Employed When Available Time Is Greater Than The Vacation Requirements




B. Optimizing Operators Employed When The Vacation Requirements Are Greater Than The Available Time



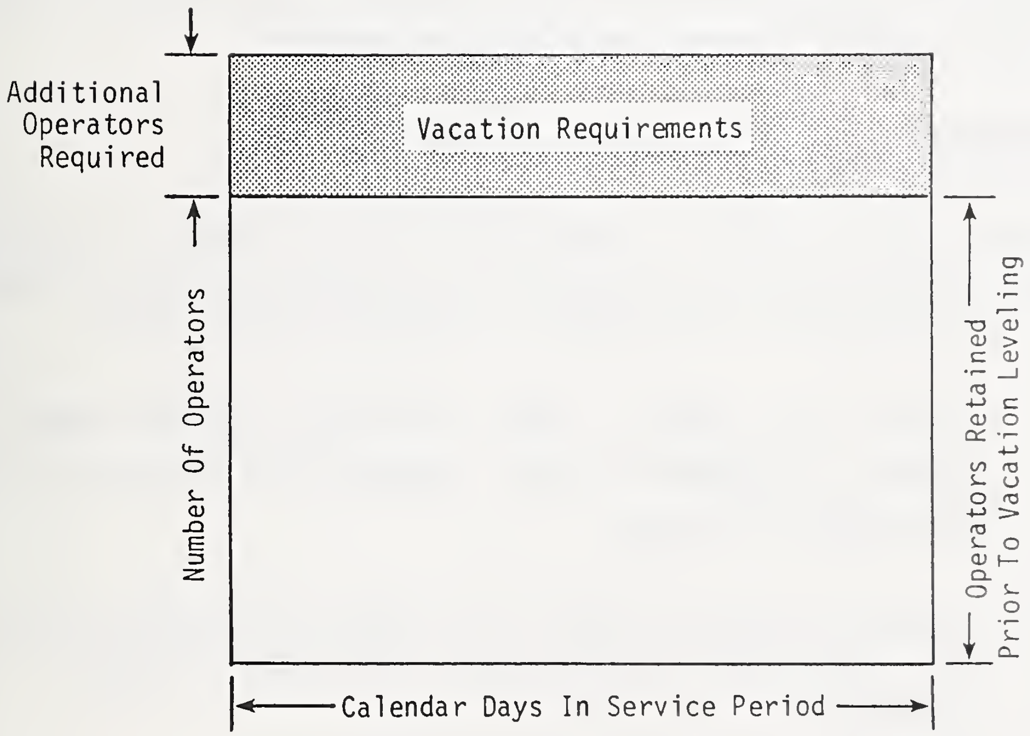
for vacations is shown by the shaded area. The number of operators required for service period 1 and service period 2 is less than for service period 3, even if all vacations are scheduled during service periods 1 and 2. Consequently, if the operator work force size is based on the requirements for service period 3, the number of operators during the other two periods will exceed optimal cost conditions. The excess operators (see A) should be laid off to achieve optimal cost conditions.

- <u>Additional operators needed when vacation requirements exceed available time</u>. Exhibit C.14B shows a case in which additional operators are needed to meet vacation requirements. This situation exists because the vacation benefits exceed the available time resulting from the differences in operator requirements between service periods. The vacation benefit time needed is represented by both the shaded and dotted areas, and the available time is shown only by the shaded area. The number of additional operators required to fill open work resulting from vacations under optimal conditions is shown as B on this exhibit.

When the Vacation Leveling Module is used under a single service period optimization mode of model execution, the difference in operator requirements between service periods cannot be addressed. Therefore, the operator configuration developed under single service period optimization may not be consistent with optimal vacation scheduling. The module assumes that the operator requirements of each service period are the same, i.e., there are no available vacation days due to operator requirement differences and all vacation days must be covered by employing additional operators. The user is asked to estimate the percentage of total annual vacation days to be scheduled during the service period. The module estimates the number of additional operators to satisfy this requirement as shown in Exhibit C.15.

EXHIBIT C.15

SINGLE SERVICE PERIOD VACATION LEVELING



The Vacation Leveling Module also considers special vacation scheduling provisions in deriving operator employment estimates. This allows the user to specify the minimum percentage of total annual vacation days to be scheduled each service period when operated in a multi-period mode of model execution. The model ensures that these constraints are satisfied in determining operator employment estimates. The special vacation scheduling constraints can be used to ensure that vacation scheduling provisions contained in the labor agreement are satisfied and are used in combination with optimization to develop an operator configuration consistent with a customized vacation scheduling arrangement.

PTO ADJUSTMENT

This module is used in an optimization mode of model execution to compare the number of FTOs and PTOs for the least-cost operator configuration. It is essentially a monitoring and adjustment routine that:

- ensures the number of PTOs is maximized given the number of tripper assignments and labor agreement provisions that limit the number of PTOs; and

- adjusts the number of PTOs if the number of PTOs does not satisfy labor agreement provisions or the number of PTOs is not maximized.

If an adjustment to the number of PTOs is required, program control is returned to the PTO Assignment Module and the optimization process is reiterated.



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