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Final Report

Dynamic Delivery of the
National Transit Database
Sampling Manual
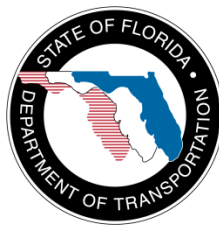
February 2013

Dynamic Delivery of the *National Transit Database Sampling Manual*

FDOT BDK85 977-28

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Final Report

February 2013

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The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

Metric Conversion

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft³	cubic feet	0.028	cubic meters	m³
yd³	cubic yards	0.765	cubic meters	m³
NOTE: volumes greater than 1000 L shall be shown in m³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

Technical Report Documentation

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.		
4. Title and Subtitle *Dynamic Delivery of the National Transit Database Sampling Manual*		**5. Report Date** *February 2013*		
		6. Performing Organization Code		
7. Author(s) *Xuehao Chu*		**8. Performing Organization Report No.** *NCTR 77933/FDOT BDK85 977-28*		
9. Performing Organization Name and Address *National Center for Transit Research Center for Urban Transportation Research University of South Florida 4202 East Fowler Avenue, CUT100, Tampa, FL 33620*		**10. Work Unit No. (TRAIS)**		
11. Contract or Grant No. *FDOT BDK85 977-28/U.S. DOT DTRS98-G-0032*				
12. Sponsoring Agency Name and Address *Research and Innovative Technology Administration U.S. Department of Transportation, Mail Code RDT-30 1200 New Jersey Ave., SE, Room E33, Washington, DC 20590* *Florida Department of Transportation, Research Center 605 Suwannee Street, MS 30, Tallahassee, FL 32399*		**13. Type of Report and Period Covered** *Final Report January 2011–February 2013*		
		14. Sponsoring Agency Code		
15. Supplementary Notes *Supported by a grant from the Florida Department of Transportation and the U.S. Department of Transportation*				

16. Abstract

This project improves the National Transit Database (NTD) Sampling Manual *and develops an Internet-based, WordPress-powered interactive Web tool to deliver the new* NTD Sampling Manual *dynamically. The new manual adds guidance and a tool for transit agencies to develop sampling plans customized to their conditions but similar to those in Circular 2710.1A. Additionally, the manual adds requirements for a minimum sample size of 50 for all new NTD sampling plans and for the sample data to be used for developing new NTD sampling plans. The new manual is included in this report as an appendix. The Web tool can deliver the portion of the new manual relevant to the special circumstances of individual agencies that they specify through the user interface of this tool. Agencies can also use the tool to browse the manual in terms of its sections, subsections, and individual pairs of questions/answers. Agencies can search the new manual with keywords as well. The tool currently can be found at http://ntd.transitgis.org/ and is planned to be taken over by the official NTD website at http://www.ntdprogram.gov/ntdprogram/. In addition to an introduction and a conclusion section, this report covers the following three aspects of the research project:*

1. *Enhancements to the* Sampling Manual *– discusses both enhancements that were implemented and those not implemented because their shortcomings are expected to outweigh their potential benefits.*
2. *Alternative Content Management Systems – considers different content management systems for building the Internet-based interactive tool and selects WordPress as the final approach for this project.*
3. *Dynamic Delivery through WordPress – describes the different aspects of the implementation and the final Web tool for dynamic delivery of the new sampling manual and includes guides to use and update the tool.*

The enhancements to the manual help improve the reliability of NTD sampling plans and give transit agencies more options to identify the best sampling plans for their special circumstances. The Internet-based tool greatly condenses and simplifies the comprehensive full manual for many transit agencies and their special circumstances, particularly small- and mid-size agencies.

17. Key Words	18. Distribution Statement			
National Transit Database (NTD), Unlinked Passenger Trips, Passenger Miles Traveled, Sampling Manual, Sampling Plans, Dynamic Delivery, WordPress	*Available to the public through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650, http://www.ntis.gov, and through the NCTR website at http://www.nctr.usf.edu/*			
19. Security Classification (of this report) *Unclassified*	**20. Security Classification (of this page)** *Unclassified*	**21. No. of Pages** *138*	**22. Price**	

Acknowledgments

Executive Summary

Background

In Spring 2010, the Federal Transit Administration (FTA) officially released the *National Transit Database (NTD) Sampling Manual*, which was developed by the National Center for Transit Research (NCTR) and sponsored by the Florida Department of Transportation (FDOT) in response to an FTA request. The manual consists of guidance for individual transit agencies to get sampling plans, collect sample data, and estimate annual totals of unlinked passenger trips and passenger miles traveled that meet FTA requirements. For three decades, FTA has provided guidance for transit agencies in Circulars 2710.1A and 2710.2A. However, these current circulars cover only two modes—bus and demand response; they do not reflect the operating conditions of individual agencies, and they do not take advantage of modern sampling techniques. The *NTD Sampling Manual* overcomes the shortcomings of the current circulars and is expected to reduce reporting burdens significantly for a wide range of transit agencies in Florida and across the nation. The experiences since the Spring 2010 release have been mostly positive and confirm this expectation.

The current manual was designed to be comprehensive to cover all modes, service types, units of measurement, methods of sampling and estimation, steps of data collection and estimation, etc. Being comprehensive, however, also comes with a price—only a small portion of the guidance is directly relevant to any one specific application. Some guidance is common to all applications, but other guidance is unique to one or more applications. Because this manual is in the traditional static format, it is not practical to separate the guidance for all possible applications. As a result, agencies need to look for the relevant guidance for each application in this format. This is common to the traditional model of static content delivery, which pushes technical documents that cover many options and variations to an audience with varying needs.

Objectives

The primary objective of this project was to move the *NTD Sampling Manual* from its current static delivery format to a dynamic delivery format. This was accomplished by developing an Internet-based interactive tool where the full content of the manual is stored in terms of individual topics, but only the relevant topics are dynamically assembled and presented to a user once the user specifies the profile of a specific application.

Another important objective of this project was to make enhancements to the current version of the *NTD Sampling Manual*. The experiences since the Spring 2010 release of the current version and changes in FTA's reporting requirements for NTD also prompted the desire to improve the manual in the following ways:

- Ensure that the sampling plans developed from the NTD Sampling Template are based on robust and precise sample data
- Provide more options to transit agencies in developing sampling plans

- Further reduce the reporting burden to transit agencies, particularly for small- and medium-size agencies
- Simplify procedures that are relatively complex.

Findings and Conclusions

This project successfully revised the *NTD Sampling Manual* to incorporate a number of enhancements to the existing version. To ensure quality data for developing sampling plans, for example, the new manual requires a minimum sample size of 50 for all new sampling plans and for all sample data to be used in developing new sampling plans. To give transit agencies more options to seek the best sampling plans for them, as another example, the new manual provides guidance and a tool for transit agencies to develop sampling plans that are customized to their conditions and have a structure similar to those in Circular 2710.1A. Furthermore, the new manual simplifies guidance for transit agencies to determine whether they should revise their previously-developed sampling plans.

Researchers on this project also investigated several potential enhancements and ultimately decided not to incorporate them into the new manual. These potential enhancements had been suggested by FTA to reduce the likely negative impact on transit agencies as a result of the recent split in NTD of the traditional single mode of bus services into three modes—regular bus, commuter bus, and bus rapid transit. One suggestion was to allow combined sampling across these three bus modes. Another was to waive the newly-added minimum sample size of 50 for certain services.

Researchers also successfully developed a Web tool for the new *NTD Sampling Manual* to be delivered to its users in a range of options. Users can download the entire manual and the Sampling Template. In addition, users can browse the manual by its major sections, subsections, or even individual pairs of questions/answers. Users also can specify what they need in terms of four profiling questions (e.g., What is your mode of service?) and their various options (e.g., vanpool), and the Web tool, in turn, can deliver the relevant content of the manual. The tool currently is located at http://ntd.transitgis.org/ and will be taken over by the NTD website at http://www.ntdprogram.gov/ntdprogram/.

However, the new Web tool does not always dynamically deliver contents that are relevant only to the profile specified. Some questions cover guidance for one mode of service in one part of the answer but for another mode of service in other parts of the answer. These pairs of questions/answers were not restructured in the new version to avoid having too many questions and to avoid appearing significantly different from its existing version. This shortcoming also brings forth a lesson for future efforts of developing Web-based dynamic content delivery tools—the full content document should be prepared from the very beginning in such a way that each of its individual topics does not include content for more than one option of any given profiling question.

Benefits

The enchancements to the *NTD Sampling Manual* help improve the reliability of NTD sampling plans and the resulting rideship data reported and give transit agencies more options to search for the best sampling plans for their special circumstances. The Web tool greatly condenses and simplifies the comprehensive full manual for many transit agencies and their special circumstances, particularly small- and mid-size agencies.

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Chapter 1 – Introduction

In Spring 2010, the Federal Transit Administration (FTA) officially released the first version of the *National Transit Database (NTD) Sampling Manual*, which was developed by the National Center for Transit Research (NCTR) in response to an FTA request. This manual consists of guidance for individual transit agencies to get sampling plans, collect sample data, and estimate annual total ridership that meets FTA's statistical requirements. For three decades, FTA has provided guidance for transit agencies in Circulars 2710.1A and 2710.2A. But these current circulars cover only two modes—bus and demand response; they do not reflect the operating conditions of individual agencies, and they do not take advantage of modern sampling techniques. The *NTD Sampling Manual* overcomes the shortcomings of the current circulars and is expected to reduce reporting burdens significantly for a wide range of transit agencies. User experiences since the Spring 2010 release have been mostly positive and confirm this expectation. To serve transit agencies even better, however, FTA has identified from these experiences a number of enhancements to the first version and to the delivery of the manual.

The *NTD Sampling Manual* was designed to be comprehensive to cover all modes, service types, units of measurement, methods of sampling and estimation, steps of data collection and estimation, etc. Being comprehensive, however, also comes with a price—only a small portion of the guidance is directly relevant to any one specific application. Some guidance is common to all applications, but other guidance is unique to one or more applications. Because the current manual is in the traditional static document-based format, it is not practical to separate the guidance for all possible applications. As a result, agencies need to look for the relevant guidance for each application in this format. This is common to the traditional model of static content delivery, which pushes technical documents that cover many options and variations to an audience with varying needs.

One identified improvement was to deliver the *NTD Sampling Manual* not only in its current static format but also in a dynamic delivery format. Instead of pushing an entire manual of many possible applications to the audience, a dynamic delivery format allows a user to pull the specific content that is relevant to a specific application. This would be accomplished by developing an Internet-based interactive Web tool where the full content of the *NTD Sampling Manual* would be stored in terms of individual topics, but only the relevant topics would be dynamically assembled and presented to a user once the user specifies the profile of a specific application. The manual consists of a large number of pairs of questions/answers; therefore, the individual pairs of questions/answers would be a natural unit of presentation for the topics in the Web tool.

In addition to improving the delivery of the *NTD Sampling Manual*, FTA also wanted to make enhancements to the existing manual. Some of these were motivated by the desire to ensure that the sampling plans developed from the NTD Sampling Template are based on robust and precise sample data; some were motivated by the desire to give more options to transit agencies in developing sampling plans; and others were motivated by the desire to further reduce the reporting burden on transit agencies, particularly for small- and mid-size agencies.

The objectives of this project include the following:

1. To investigate and implement the most feasible and beneficial enhancements to the *NTD Sampling Manual* and the NTD Sampling Template
2. To search for and implement the most appropriate approach to dynamic delivery of the *NTD Sampling Manual*.

The remainder of this report documents the project and is organized into four chapters and one appendix. Chapter 2 presents all potential enhancements identified by FTA and discusses separately those enhancements that were implemented and those that were not. Chapter 3 discusses alternative approaches to implementing dynamic delivery of the manual. Chapter 4 presents the implementation of the chosen approach to dynamic delivery and describes the resulting Web tool. Chapter 5 concludes the report. Finally, the appendix includes the new version of the full *NTD Sampling Manual*.

Chapter 2 – Enhancements to the Sampling Manual

In addition to improving how the *NTD Sampling Manual* is delivered, FTA identified a number of enhancements to the manual that would serve NTD reporters even better. This section first lists all of the enhancements identified and then describes the enhancements that were implemented and those that were not. The revised new *NTD Sampling Manual* is included in the appendix.

Enhancements Identified

Identified enhancements to the manual are listed below. These enhancements are grouped into categories in terms of their primary motivation:

- To ensure that new NTD sampling plans are based on robust and precise sample data:
    - Adding the requirement of minimum sample size of 50 for new sampling plans and for sample data used to develop new sampling plans
    - Adding guidance on identifying and correcting errors in sample data for developing new sampling plans

- To provide more options to transit agencies in developing sampling plans:
    - Adding the option of developing interval-based sampling plans
    - Adding guidance for alternative sampling plans
    - Adding the new modes recently recognized by the NTD

- To further reduce the reporting burden to transit agencies, particularly for small- and medium-size agencies:
    - Condensing and simplifying guidance through dynamic delivery
    - Adding small-system waivers. These waivers allow small systems to continue using ready-to-use sampling plans and give small systems the option of not reporting passenger miles traveled.
    - Allowing combined sampling for different types of service for a given mode
    - Allowing combined sampling for different bus modes for a given type of service

- To simplify the *NTD Sampling Manual* for all users. Specifically, the current version has a rather involved procedure for updating sampling plans over time.

The current project investigated each of these potential enhancements in terms of their feasibility and their pros and cons. Most of these enhancements were implemented, but several were not. In deciding which identified enhancement was to be implemented, the main criterion was how the potential benefits of an enhancement compared to its potential shortcomings.

Enhancements Implemented

Most of the above-identified enhancements have been implemented into the new *NTD Sampling Manual*. Each is discussed below separately.

New NTD Modes

The NTD recently made several changes to the individual modes recognized for NTD reporting purposes; therefore, the new manual includes these new modes. A description of each new mode is listed below:

- A special form of demand response services is now recognized and called Demand Response–Taxi (DT). This mode is operated through taxicab providers and is always treated as purchased transportation in terms of service type.
- The traditional single motorbus mode is split into three separate bus modes: regular bus (MB), commuter bus (CB), and bus rapid transit (RB).
- The traditional light rail mode is split into streetcar rail (SR) and light rail (LR).
- The traditional monorail and automated guideway modes are combined into a single Monorail/Automated Guideway (MG) mode.
- Hybrid Rail (YR) is recognized as a new mode, which is for rail transit systems primarily operating entire routes on the National system of railroads, but not operating with the characteristics of commuter rail. This service typically operates light rail-type vehicles as diesel multiple-unit trains.

Small System Waivers

The NTD recently added the option of allowing small agencies with 30 or fewer vehicles operated in maximum service (VOMS) for all modes combined not to report passenger miles traveled to the NTD for any of their modes of service. This small-system waiver has been added to the manual.

In addition, the new manual also has added the option of allowing these small systems to continually use ready-to-use sampling plans as long as they remain small systems (i.e., VOMS for all modes combined<=30).

Condensed and Simplified Guidance

The NTD includes a large number of small- and mid-size transit systems, typically comprised of a few buses and a demand-response operation. These systems often find the whole sampling process, as well as *NTD Sampling Manual*, to be overwhelming. FTA felt that finding ways to condense and simplify the sampling guidance for these systems could be especially useful.

In terms of the manual itself, dynamic delivery, once implemented, will condense and simplify the manual for specific applications to all agencies. This is particularly effective for

small agencies. Their operations are typically limited to regular bus service and demand response. As a result, they do not have to sift through non-applicable information.

In terms of the whole sampling process, however, it would be difficult to shorten or simplify it until FTA loosens some of its basic NTD statistical requirements for small agencies.

Alternative Sampling Plans

To meet FTA's statistical requirements to estimate unlinked passenger trips and passenger miles traveled, agencies have three options in terms of sampling plans:

- Ready-to-use sampling plans from the *NTD Sampling Manual* for those agencies that do not have previous NTD sample data.
- Template sampling plans that transit agencies can develop with their own NTD sample data using the NTD Sampling Template.
- Alternative sampling plans that transit agencies can ask qualified statisticians to develop and certify using the NTD sample data from these agencies.

Alternative sampling plans are unique in that they must be certified by a qualified statistician to meet FTA's statistical requirements. Ready-to-use sampling plans and template sampling plans are certified as long as transit agencies follow the guidance in the manual. To ensure the basic statistical quality of template sampling plans, they must meet the following five requirements:

1. A 25% margin of safety is built into any template sampling plans. If a given set of sample data results in an initial annual sample size of 100, for example, the final sample size must be increased by at least 25% to a total of 125.
2. The annual total sample size must be at least 50 for any new template sampling plan.
3. The sample data to be used to develop template sampling plans must have at least 50 samples.
4. Template sampling plans must be periodically checked for the need for revision based on information built into the *NTD Sampling Manual*.
5. Agencies must follow the guidance in the *NTD Sampling Manual* for sampling, collecting sample data, identifying and correcting errors in the sample data, and estimating annual totals from the corrected sample data.

The new manual has added a section of guidance to require alternative sampling plans to meet the first three requirements. The last two requirements are not explicitly included in the added section because they should be considered by the qualified statisticians during their certification process.

Simplified Procedure for Revision of Template Sampling Plans

The automatic certification of template sampling plans developed from the Sampling Template is conditional on the sampling plans being periodically checked for the need for

revision due to a changed operating environment. The current manual includes a procedure for transit agencies to do that. However, the current procedure requires transit agencies to perform additional calculations beyond entering their sample data into the Sampling Template. At the same time, the guidance in the manual to help transit agencies follow this procedure is somewhat lengthy and complex. One reason for this rather involved and complex procedure is that it is based on determining whether the degree of statistical variation in the use of services has changed over time.

The new manual and its template have replaced this procedure with a simple one that does not involve calculations by transit agencies. The related guidance is brief and simple. The new procedure is based on an index calculated automatically by the Sampling Template once a set of sample data are entered.

Guidance on Errors in Sample Data for Developing Sampling Plans

The *NTD Sampling Manual* already includes guidance on identifying and correcting non-sampling errors in the sample data for estimating annual totals of unlinked passenger trips and passenger miles traveled but not for developing new sampling plans. Experience in working with transit agencies for developing new sampling plans using their own sample data shows that serious errors frequently occur in such sample data. In addition, many of these serious errors can be easily identified through simple checks. Once they are identified, transit agencies can go back to the original field data and make corrections. Experience also indicates that such serious errors typically lead to larger variances in the data. These inflated variances have several undesirable consequences:

- Transit agencies unnecessarily may be asked to revise their existing sampling plans.
- The suggested minimum sample size in a new sampling plan is significantly greater than what would be required.
- The stability in the annual minimum sample size is lost due to the minimum sample sizes for new sampling plans over time fluctuating significantly.

While these negative consequences do not result in FTA's statistical requirements not being satisfied, they unnecessarily increase the reporting burden of transit agencies.

Option for Developing Interval-Based Sampling Plans

The current *NTD Sampling Manual* provides guidance for transit agencies to develop sampling plans that require them to sample on random days during each week, month, or quarter and these days vary across weeks, months, or quarters. In contrast, the sampling plans in Circular 2710.1A for bus modes follow a structured interval pattern: every day, every other day, every third day, every fourth day, every sixth day, and every seventh day. In addition, these sample days are known to the transit agencies in advance for an entire report year. A third advantage is that transit agencies can choose samples with larger intervals (e.g., every sixth day) to reduce the number of sample days during a report year. Finally, many bus operators have been using these circular sampling plans for years. As a

result, FTA wants to add the option of developing such structured sampling plans to the manual.

This project investigated the feasibility of adding this option, particularly to the Sampling Template. One issue was how to avoid creating confusion with two types of sampling plans that both are customized to agency conditions. The sampling plans developed from the current version of the Sampling Template are called "period-based sampling plans" and the newly-added structured sampling plans are called "interval-based sampling plans."

Another issue was how to determine the sample size requirement for each sampling interval from a set of sampling data entered into the Sampling Template. Facilitated by the work from a previous NCTR project on an investigation of the sampling plans in Circular 2710.1A, adding the option of developing interval-based sampling plans proved to be feasible. There are two limitations, however, to this option in terms of their applicability:

- Unlike period-based sampling plans, developing interval-based sampling plans requires at least two samples for every sample day in the sample data.

- Transit agencies can consider a wide range of efficiency options in developing period-based sampling plans. One of these is to take advantage of the fact that the average passenger trip length (APTL) almost always varies significantly less than passenger miles traveled across vehicle trips. This efficiency option is called the "APTL option." Another efficiency option for period-based sampling plans is to sample separately for different parts of a service. One typical example for bus services is to group long routes separately from shorter routes. This is called the "grouping option." Transit agencies that want to use interval-based sampling plans would not be able to take advantage of the grouping option. The new NTD Sampling Template does not include the grouping option for interval-based sampling plans because interval-based sampling plans are day-based, and the grouping option would not help reduce sample size requirements.

Minimum Sample Size of 50

The current manual can produce period-based sampling plans whose annual sample size can be below 50 for some cases with 100% unlinked passenger trips being reported to the NTD. The annual sample size can be very small, even with the required 25% margin of safety. Commuter rail and commuter bus services are two examples of such cases. While these small sample sizes may be adequate to meet FTA's statistical requirements for estimating annual totals of passenger miles traveled for some situations, they may not produce estimates of the degree of variation in the resulting sample data that are precise enough with adequate confidence. The degree of variation in the sample data collected from a current sampling plan determines the sample size in future sampling plans. If this degree of variation does not have adequate precision and confidence levels, the resulting new sampling plans may not produce estimates of annual totals of passenger miles traveled that meet FTA's statistical requirements. FTA wanted a minimum annual sample size to be determined and implemented in the new manual.

A literature search was conducted to determine the sample size for estimating variance to meet certain confidence and precision levels. This search identified equation (2.3) by Gupta and Gupta (1987) and was used to determine the required sample size for estimating variance to meet certain confidence and precision levels. The following shows the required sample size for two levels of precision and confidence for variance estimation:

Precision of Variance	Confidence of Variance	
	95%	**90%**
10%	194	137
20%	50	35

If the requirements imposed on annual totals of unlinked passenger trips and passenger miles traveled also apply to estimates of variance, the required minimum sample size would be 194. Experience indicates that the annual sample size for estimated annual totals to meet the 95% confidence and 10% precision levels can be much smaller than 194 for many transit agencies. If the precision level is reduced to 20% at the same 95% confidence level, the required minimum sample size would be just 50.

FTA feels that this combination of 20% precision with 95% confidence is adequate. As a result, the new manual has implemented a minimum sample size of 50 for all period-based sampling plans, including ready-to-use sampling plans, template sampling plans, and alternative sampling plans. Because interval-based sampling plans are highly structured, with the longest sampling interval being limited to 7 days, the annual sample size will always be greater than 50 for all cases.

In addition to requiring all period-based sampling plans to have a minimum sample size of 50, the new manual also imposes this minimum sample size on the sample data being used in developing sampling plans of any type, including both period-based and interval-based as well as template and alternative sampling plans. If a transit agency wants to develop new sampling plans but does not have adequate sample size in its own sample data, it will need to use a ready-to-use sampling plan for one year and use the sample data from the ready-to-use sampling plan to develop new template sampling plans for future years.

The requirement for a minimum sample size of 50 ensures that more reliable and accurate estimates of variance are used in developing new sampling plans (alternative or template).

Enhancements Not Implemented

Combined Sampling

Recent changes to the NTD reporting rules split the single motorbus mode into three separate bus modes: regular bus (MB), commuter bus (CB), and bus rapid transit (RB). Under current NTD rules, separate sampling is required for each combination of mode and service type (directly operated or purchased). FTA was concerned that this split may increase the reporting burden on some agencies, especially if they have all three of these

bus modes and they provide these services both directly and indirectly through purchased transportation contracts. Allowing combined sampling for all three modes of a given service type or combined sampling of different service types of a given bus mode may lessen the potential increase in reporting burdens.

Potential Effects. The extent of this potential increase in reporting burden may be not as big as might be expected. Needing six separate sampling plans for bus services may occur, but is likely to be rare. In addition, the statistical variation in APTL is likely much smaller for CB and RB, particularly for CB. Consequently, the burden of data collection for these new modes is not likely to be close to the same magnitude as the base bus service in most cases. Separate sampling for each of these modes might mean additional work in creating sampling frames in the number of times sampling is done and in estimation. But if an agency has RB and CB, it may group its overall bus service and treat RB and CB as separate groups. If this is the case, splitting the bus modes results in some extra data collection burden but no extra sampling burden.

If combined sampling across service type or across bus modes is an option, not a requirement, agencies may choose not to use the option if it is too much trouble, if they have good data from automatic passenger counters (APCs) for RB, etc. If that occurs frequently, combined sampling would benefit far fewer transit agencies than the full potential.

The burden of three separate bus modes for a given service type is acceptable for the vast majority of agencies. These transit agencies collect and report 100% counts of unlinked passenger trips (UPT) for all bus modes. The share of these agencies will continue to increase in the future. The main basis for the burden being acceptable for these agencies is that the combined total of annual sample sizes for all three bus modes of a given service type is likely not to exceed those in Circular 2710.1A or is likely not to exceed them by much if greater than those in Circular 2710.1A.

However, the burden of three bus modes may not be acceptable for other transit agencies that sample, estimate, and report both unlinked passenger trips and passenger miles traveled. This assessment is based on the fact that the combined total of annual sample sizes for all three bus modes of a given service type is likely to exceed those in Circular 2710.1A considerably. The exact additional burden depends on each specific case and would increase with the number of bus modes for a given service type.

Based on these assessments, combined sampling across bus modes or across service types is not needed for transit agencies that report 100% UPT counts.

The question is what to do with agencies that do not report 100% UPT counts. Based on the increased burden from three bus modes, combined sampling should be allowed. On other hand, it should not be allowed because this contradicts FTA's desire of 100% counts of UPT being reported and implies that FTA does not take its statistical requirements of 10% precision and 95% confidence levels seriously. Also, the share of

these agencies is expected to decrease over time and the requirements should be kept as simple as possible.

Shortcomings. Combined sampling has several shortcomings, one of which is the loss of data. Indicators involving data items required for directly operated services but not for purchased services would no longer be available. Similarly, data on unlinked passenger trips and passenger miles traveled would not be available separately for each of the new bus modes, defeating some of the benefit of splitting the traditional bus mode into three bus modes. In addition, managing the process and sampling and data collection can become significantly more difficult with combined sampling across service types because different service types are usually operated separately, potentially defeating the benefit of an overall smaller sample size from combining sampling. Combined sampling also may complicate contracts for purchased services in matters related to NTD.

Waiver for the Minimum Sample Size of 50

FTA sought to find ways to reduce the potential increase in reporting burdens as a result of the recent split of the traditional motorbus mode into three separate bus modes. One identified way was to waive the minimum sample size of 50 for some circumstances. However, investigation of the potential benefits and shortcomings of this proposed improvement resulted in not implementing it in the new manual for the following reasons:

- The number of qualifying agencies is likely to be small. Experience with sample data from a range of modes and agencies indicates that such a waiver is applicable mostly to commuter rail and commuter bus services that report 100% counts of unlinked passenger trips.

- The benefit of this waiver is extremely small in absolute terms for any qualifying agency. Suppose that the actual sample size is 30; the reduction from the waiver would be 20, which would not be significant in terms of cost for data collection on an annual basis.

Chapter 3 – Alternative Content Management Systems

The Web tool needs a content management system that stores the manual and assembles and delivers the appropriate content for specific usage profiles. This chapter discusses the search for the most appropriate content management system for the project. The first sub-section summarizes key characteristics of the manual; the second and third subsections cover potential content management systems and WordPress as the chosen approach, respectively.

Characteristics of the New *NTD Sampling Manual*

Written in a question-and-answer (Q&A) format, the new manual is a comprehensive guidance document for transit agencies to meet FTA's minimum statistical requirements of 10% precision and 95% confidence levels in the annual totals of unlinked passenger trips and passenger miles traveled they estimate through random sampling. It covers:

- All modes explicitly recognized by the NTD.
- Both types of service (directly-operated and purchased).
- All scales of operation (small, medium, and large).
- All patterns of operation (weekdays only, daily, etc.).
- All steps for getting estimates of annual totals (getting a sampling plan, collecting sample data, processing sample data, and estimating annual totals).
- All reporting practices (100% counts of unlinked passenger trips, etc.).
- A wide range of options for sampling efficiency.
- Availability of previous sample data for developing sampling plans.
- Two types of structure in sampling plans (period-based and interval-based).
- A range of sampling frequency (weekly, monthly, and quarterly) for period-based sampling plans.
- A range of sampling frequency (every day, every second day, every third day, every fourth day, every fifth day, and every sixth day) for interval-based sampling plans.
- A range of sampling plans in terms of who develops and certifies them (ready-to-use sampling plans, template sampling plans, and alternative sampling plans).

For a given agency, only a subset of the elements of the full manual may be relevant. For example, for agencies that operate only demand-response and regular bus services, elements related to other modes are irrelevant. For agencies that operate only fixed-route services, elements related to non-scheduled services are irrelevant. For each application of a given agency, a still narrower set of these elements may be relevant. For example:

- 100% counts of unlinked passenger trips are reported for demand-response but not for regular bus.
- Interval-based sampling plans may be more useful for regular bus, but period-based sampling plans may be more appropriate for demand response.
- Different staff may be responsible for different steps of getting estimates of annual totals, and each person would be interested only in the relevant step.

The *NTD Sampling Manual* consists of 7 major sections, 21 subsections, 122 pairs of questions/answers, and 1 appendix. Each of these sections and pairs of questions/answers may be applicable to a range of agencies and their applications. While this is not a problem in searching for the most appropriate approach to dynamic delivery, it must be considered in designing the delivery tool. Also, each major section and subsection may cover many of the elements covered in the manual. As a result, it would not be meaningful to use these sections and subsections as the unit of dynamic delivery. Furthermore, even a single pair of question/answer may involve multiple elements for some of the pairs of questions/answers. For example, a question may cover certain guidance for non-schedule services but the answer differs slightly across different modes of non-scheduled services (i.e., demand response, vanpool, etc.).

Potential Content Management Systems

Search Criteria

The first step to searching for the most appropriate content management system was to identify the needs of the Web tool. Project researchers identified the following necessary capabilities for the Web tool:

(a) Able to assemble and present only the relevant topics of the manual to a user once he/she specifies the profile of a specific use through a user-interface within the Web tool.

(b) Able to be updated with relative ease, allowing the content of the manual to be edited within the Web tool, with changes propagating into a fully-revised manual in Word or PDF format. Alternatively, it should be easy to update the Web tool to reflect changes already made to the full manual.

(c) Able to provide users with:

(1) Access to the full version of the manual
(2) Access to and use of the Sampling Template
(3) Ability to browse the manual

(d) Able to allow users to save and print the dynamically-delivered content.

In addition to these desired capabilities, another search criterion was that the chosen content management system must be compatible with the following programming environment, indicated by FTA as compatible with the NTD website:

- PHP 4.3 (or greater; 5.0 or greater recommended)
- MySQL 4.1.2 (or greater; 5.0 or greater recommended)
- Apache with the mod_rewrite module enabled

Basic Logic behind Dynamic Delivery

Once the general needs of the Web tool were understood, the next step was to understand the basic logic behind any dynamic delivery of the *NTD Sampling Manual*. This involved several aspects.

Profiling Questions. To get the dynamically-delivered content for a specific use of the manual from the Web tool, users must answer one or more profiling questions in a user interface. The project initially identified more than 20 potential profiling questions and grouped them into three categories:

- *Pure Choice* – Users are free to choose once they have evaluated their situation. The most obvious are service grouping and sampling frequency.
- *Semi Choice* – Users are largely free to choose, but their particular situation may prevent them from choosing certain options. These would include sampling units (e.g., one-way versus round vehicle trips), sampling structure (i.e., period-based versus interval-based), 100% UPT by service group.
- *Non Choice* – Users do not have much freedom to choose among the options.

Only non-choice questions may be used as profiling questions. Among all potential profiling questions, nine of them were non-choice questions and are listed below:

1) Do you sample every year?
2) Is next year your mandatory sampling year? (Small agencies only are required to sample every third year.)
3) Have you made major changes to your service since you started using your current template sampling plan?
4) How many days of service do you provide every week?
5) Do you have 100% UPT by route?
6) What are you trying to do?
7) What is the mode of service?
8) Do you report 100% UPT?
9) You do not have own sample data?

The first five of these were not chosen for at least two reasons: 1) their different options would not affect much of the content delivered, and 2) they involve details of the process of obtaining estimates of annual totals and would not be clear to many users who are new to the NTD process. The last four of these were chosen as the profiling questions at this point and are shown in Table 1 along with their profiling options.

Unit of Topics. A natural selection of the unit of topics for dynamic delivery would be the individual pairs of questions/answers under ideal conditions. As described earlier, a single pair of question/answer may cover slightly different guidance for different options of a given profiling question, and this occurs to some pairs of questions/answers in relation to profiling by mode and by 100% UPT reporting.

Table 1. Profiling Questions, Options, and Examples

Profiling Questions	Profiling Options	Profiling Examples			
		1	2	3	4
1. What are you trying to do?	General Directions				
	Sampling Plans	√			
	Data Collection			√	√
	Estimation			√	
2. What is the mode of service?	Bus Modes			√	√
	Commuter Rail	√			
	Other Rail Modes				
	Other Scheduled Modes				
	Demand Response Modes			√	
	Commuter Vanpool		√		
	Other Non-Scheduled Modes				
3. Do you report 100% UPT?	Yes	√	√	√	
	No				
4. You do not have own sample data?	Yes		√		
	No	√			

To allow individual pairs of questions/answers to be the unit of topics, separating those questions whose answers cover more than one profiling option on mode and reporting of 100% UPT was considered. For example, for a question on non-scheduled services, one part of the answer covers guidance for demand-response (DR or DT), and the remainder covers guidance for vanpool. The answer for this original question would be separated into two pieces—one for demand-response services and one for vanpool. However, it was decided not to break these questions for two reasons: it would increase the total number of pairs of questions/answers significantly, and it would result in the new version of the manual appearing significantly different from the current version. Neither of these consequences is desirable.

As a result, the search for the best content management system treated the whole pair of question/answer as a delivery topic if the answer covers only one profiling option, but treated the different parts of the answer as different delivery topics if they cover different profiling options. For example, the guidance for a particular question in the manual may relate to agencies that report 100% counts of unlinked passenger trips in one part of its answer but to agencies that do not report 100% counts in another part of its answer. In this case, only one of these two parts of the answer would be delivered, depending on whether an agency reports 100% counts.

Profiling Logic. The profiling logic is what the Web tool will use in assembling the relevant topics of the manual in response to the particular use profile specified by the user. The profiling logic consists of the following aspects:

- A profiling question is not answered if none of its profiling options is chosen. For example, the user in profile example 2 in Table 1 did not answer profiling question 1.
- Nothing would be delivered if the user does not answer any profiling question.

- Only a portion of the manual would be delivered if the user answers just one question and the delivered content may be reduced further as the user answers more profiling questions.
- When a profiling question is answered, the amount of delivered content increases with more profiling options chosen for the given profiling question.
- Choosing all profiling options for a given profiling question is equivalent to the profiling question not being answered.

The user in profiling example 1 in Table 1 probably operates commuter rail service for the first time, knows exactly how many riders use its service, does not have previously-collected sample data because the service is new, and needs to get a sampling plan to estimate the annual total passenger miles traveled (PMT) for this new service. The user in profiling example 2, on the other hand, operates vanpool service, also knows exactly how many customers use its service every day, has sample data collected from previous years, and wants to learn all aspects of the process for getting annual total PMT for the service.

Open-Source Solutions

Once the needs of the Web tool and the profiling logic for accomplishing dynamic delivery were understood, the next step of the search was to consider off-the-shelf software, either commercial or non-commercial. Typically, content management software uses XML/database schemas to deliver dynamically-generated material. Using XML tags, the precise and relevant sections of the document can be parsed and "delivered" to a user. Based on research by CUTR's GIS group, however, these off-the-shelf products do not have the capability to dynamically deliver the *NTD Sampling Manual* under the profiling logic described above.

Without successfully identifying any off-the-shelf product for further consideration, the next step was to consider open-source products. Open-source applications are fully-developed products that can be altered and customized to meet unique needs of specific Web applications. Two potential open-source solutions were identified for further consideration.

WordPress. WordPress is a database-driven content management system (CMS) for websites. While WordPress is widely used for managing and delivering Internet content for specific websites, using it to dynamically deliver the sampling manual turned out not to be as easy as initially thought.

To develop the Web tool, the manual would need to be entered into the WordPress database (MySQL) in terms of individual pairs of questions/answers. The profiling logic described earlier would be followed to tag each pair of question/answer using a tagging system employed by the WordPress CMS. Once the eventual Web tool is complete, it can parse and dynamically deliver the individual topics in response to user profiles entered through a user interface.

One problem was that the default tagging system offered by WordPress is a simple taxonomy that can allow entire WordPress sections to be tagged. While the unit of topics for dynamic delivery can be parts of an answer for some questions in the manual, as discussed earlier, individual questions and their entire answers are the smallest sections that WordPress recognizes. As a result, the eventual Web tool based on WordPress can deliver only questions and their whole answers but not parts of their answers.

Currently, tagging parts of an answer is feasible when a related third-party plug-in is used. However, the plug-in may not be updated to support future versions of WordPress. Consequently, as WordPress evolves and changes, this third-party plug-in built into the current Web tool may stop working. This is a real possibility, as WordPress is regularly updated, and without the third-party developer continuing to support the application, the plug-in used for this project may become out of date and no longer work. If this happens, more programming might be necessary for the Web tool to work. As a result, using this plug-in was not chosen as a solution to the tagging problem.

Beyond this tagging problem for dynamically delivering sub-answers, it is relatively easy to allow the full manual to be delivered in entirety or to be browsed for individual sections, subsections, or even individual pairs of questions/answers. Updating the Web tool in response to possible future changes to the manual requires that these changes first be made to the manual in Word and modifications then be made to the database and its tags accordingly. Printing only the dynamically-delivered content is also feasible.

LimeSurvey. LimeSurvey is an open-source product for designing dynamic survey instruments on the Internet. To use it for the eventual Web tool, LimeSurvey would use question tags that reveal and hide portions of the manual based on the profiling questions and options specified by its user. LimeSurvey is similar to WordPress in that it stores and organizes its data in a MySQL database. The advantage of LimeSurvey over WordPress is that it allows sub-answers of individual questions be tagged. As a result, the topic unit for dynamic delivery would be sub-answers rather than individual questions and their entire answers. Relative to WordPress, however, LimeSurvey has a number of significant shortcomings:

- It lacks flexibility in the appearance of the user interface for profiling questions and options, as well as the appearance of the content delivered.
- It is not well-suited for browsing the manual for sections, subsections, and individual pairs of questions/answers.
- It is extremely complex to update the Web tool in response to future changes made to the manual; editing the manual content in the database and related tags requires technical skills and familiarity with LimeSurvey.
- Printing dynamically-delivered contents needs to be programmatically developed.

WordPress as the Chosen Approach

A Web tool based on LimeSurvey would be able to dynamically deliver the content of the manual as small as sub-answers of individual questions; however, using LimeSurvey to develop the Web tool requires customized programming and high levels of technical skills, not only for the dynamic delivery capability of the Web tool, but also for its other desired capabilities.

On the other hand, a Web tool based on WordPress would not be able to dynamically deliver the content of the manual as small as sub-answers. However, it is able to dynamically deliver individual questions and their entire answers as well as to provide the other desired capabilities with relative ease. These capabilities were described in the previous section as the search criteria for the best content management system.

As a result, WordPress was chosen as the content management system for developing the Web tool. This choice meant that the unit of topics for dynamic delivery had to be changed from sub-answers to entire answers for all questions in the manual. When compared to the technical complexity of using LimeSurvey for both developing and updating the eventual Web tool, this loss of detail in the unit of delivery topics was considered to be relatively small.

Chapter 4 – WordPress-Powered Dynamic Delivery

With the general content management system chosen, the next step was to develop the Web tool. This chapter presents its development, the protocol for transferring and updating the tool, and its usage. The section on usage serves as a guide to using the Web tool.

Developing the Web Tool

Design

The design of the Web tool followed the principles of inclusiveness and simplicity. Inclusiveness refers to the need for the Web tool to have a range of options for the manual to be delivered to users, including the capabilities of dynamic delivery, semi-dynamic browsing and searching, and static downloading. This range of delivery options is meant to meet different needs of users. The capability of semi-dynamic browsing includes a range of options, including browsing by whole sections, by subsections, and by individual pairs of questions/answers. Semi-dynamic searching allows the user to search the entire manual by entering desired keywords. Finally, the download capability allows the following to be downloaded:

- Full manual
- Sampling Template
- A table of random numbers (Appendix 98 in the manual)
- Each appendix of sample tables for data collection

Simplicity refers to the appearance and features of the website being as simple as possible under the condition that the desired capabilities are available.

While the final design calls for the Sampling Template being made available as a downloadable Excel file, two alternatives were considered early on: embedding the Excel file into the Web tool, and programming the functionality of the template into the Web tool. Neither alternative was chosen for various reasons:

- Embedded. Embedding an interactive Excel workbook with multiple linked worksheets has been technically feasible using a Microsoft product called Office Web Components. The advantages of an embedded Sampling Template are clear: it avoids the need to download the file, and it is accessible from anywhere with Internet access. However, Microsoft will not to release new versions of this product by 2012 and has ended its standard support of the previously-released versions. Embedding such a complex Excel workbook is still feasible, but it requires that the workbook be hosted at Microsoft's SkyDrive site.

- Programmed. Programming the functionalities of the entire Sampling Template into the Web tool is feasible and has advantages over both downloading and embedding. However, it would require resources beyond the scope of the current project.

Build

Before the design was implemented to build the Web tool using WordPress, the following tasks were completed first:

1. Select the programming environment.
2. Break the manual into individual topics for dynamic delivery.
3. Identify profiling parameters and the logic involved.
4. Link these profiling parameters to the individual topics in the manual based on the logic.

The first three tasks were done before WordPress was chosen as the content management system for building the Web tool. The individual topics are individual pairs of questions/answers. The profiling parameters are four profiling questions and a set of options for each profiling question. The logic requires the Web tool to deliver the common content when more than one profiling question is answered and to deliver the combined content when more than one profiling option is chosen for each given profiling question.

The fourth task involved linking the profiling questions and options to all individual pairs of questions/answers in the form of a matrix. Table 2 shows one part of this matrix for the questions on the ready-to-use sampling plans included in Subsection 43 of the manual. For a given manual question and a given profiling question, the primary tags differ from the filling tags as follows:

- Primary Tags. The guidance in the answer to the manual question would be selected for dynamic delivery only when at least at least one profiling option with a primary tag is selected. Consider manual question §43.01 and the profiling question of "What are you trying to do?" Its guidance would be selected if the user selects the profiling option of "Sampling Plans" but would not be selected if the user selects any other profiling option of this profiling question.

- Filling Tags. The guidance in the answer to the manual question would be selected for possible delivery regardless of which profiling option of this profiling question is selected. Consider manual question §43.01 and the profiling question of "Do you report 100% UPT?" Its guidance would be selected if the user chooses to answer this manual question, independent of the profiling option selected.

Primary tags are separately defined from filling tags only for building the Web tool. The users of the Web tool will not see the existence of any tags.

Table 2. Link between Profiling Manual Content

Profiling Questions	Profiling Options	Selected Questions from the Sampling Manual					
		§43.01	§43.03	§43.05	§43.07	§43.09	§43.11
What are you trying to do?	General Directions						
	Sampling Plans	■	■	■	■	■	■
	Data Collection						
	Estimation						
What is the mode of service?	Bus Modes		■	■			■
	Commuter Rail				■		
	Other Rail Modes					■	
	Other Scheduled Modes						
	Demand Response Modes	■					
	Commuter Vanpool	■					
	Other Non-Scheduled Modes	■					
Do you report 100% UPT?	Yes	░	░	░	░	░	░
	No	░	░	░	░	░	░
Do you have own sample data?	Yes						
	No	■	■	■	■	■	■

Notes:

■	Primary tags
░	Filling tags for manual questions with no primary tag for a particular profiling question.

§ 43.01 = What period-based sampling plans are available for non-scheduled services?

§ 43.03 = What period-based ready-to-use sampling plans are available for bus services?

§ 43.05 = How does grouping of my bus routes affect sampling and estimation procedures?

§ 43.07 = What period-based sampling plans are available for commuter rail?

§ 43.09 = What period-based sampling plans are available for other rail modes?

§ 43.11 = What interval-based ready-to-use sampling plans are available for bus services?

The following are several examples of how users of the Web tool would answer profiling questions and select profiling options based on agency needs; the examples also show which of these manual questions would be delivered accordingly. If a user is not interested in sampling plans, none of the questions in Table 2 would be selected for possible delivery. This is the case regardless of whether and how any other profiling question is answered. If a user is interested in sampling plans, on the other hand, which of these questions would be selected for possible delivery depends on whether he answers any other profiling questions and which profiling option is chosen for each profiling question answered. For examples:

- None of these questions would be selected if the user answers "yes" to the last profiling question (i.e., Do you have own sample data?).
- All of these questions would be selected if the user answers "no" to the last question but does not answer the profiling question about modes.
- Questions §43.03, §43.05, and §43.11 would be selected if the user is interested only in bus modes.
- Only question §43.01 would be selected if the user is interested only in demand-response, commuter vanpool, or other non-scheduled services.

For the Web tool to be able to dynamically deliver the manual, the individual pairs of questions/answers in the manual must be manually entered into the database of WordPress. In addition, each pair of these questions/answers in the database must be manually tagged as described above. Once the database of questions/answers was created and tagged properly in WordPress, the last step was to build the user interface for the user to answer the profiling questions and select profiling options.

Review

The review of the draft Web tool focused on how the delivered manual content appeared and on the simplicity and functionality of the tool. The manual content delivered through the draft Web tool differed quite significantly from that in the actual manual. One spacing issue was that too much vertical space existed in the delivered text and tables. This spacing issue resulted when the original manual content in Word format was copied and pasted into the WordPress database. On one hand, it is desirable to have the delivered content looking similar to what is in the actual manual. On the other hand, it is undesirable to make too much adjustment to the WordPress after the actual manual content is pasted into it because such adjustment complicates future updates to the tool if the manual is revised in the future. In the end, adjustments were made to reduce the vertical spaces.

The design of the draft Web tool was reviewed to improve simplicity and functionality. Several issues were identified and addressed. The most notable was the addition of the option to using the manual through searching by keywords.

Test

The draft Web tool was tested with two levels of testing. One level was to determine if the Web tool delivers what was designed in the tag matrix between individual manual questions/answers and the profiling questions and options. This matrix was developed before building the Web tool. The objective of this level of testing was to see if any errors were made relative to the matrix when each of the manual questions/answers was manually tagged within WordPress. Once this level of testing was complete, the tags in the WordPress database of the questions/answers were corrected when any errors were identified.

The other level of testing was to determine if any errors were made in developing the tag matrix between individual manual questions/answers and the profiling questions and options. Before conducting the second level of testing, the following two steps of preparation were taken:

1. A variety of possible scenarios of the manual guidance being used was prepared. Each scenario was represented by the specific profiling questions to be answered and the specific profiling options selected for each answered profiling question.
2. For each of these scenarios of usage, the corresponding guidance relevant for this scenario was established.

After these were prepared, the second level of testing was done in two steps:

1. Each of these scenarios of usage was entered into the Web tool through the user interface in terms of the profiling questions and options.
2. The dynamically-delivered manual content for each of the entered scenario of usage was then compared to the guidance that was thought to be relevant for this scenario.

Once these two steps were complete, the Web tool was revised again. Specifically, the tagging matrix was adjusted when any inappropriate tags were identified. The tags in the WordPress database of the manual questions/answers were revised again according to the adjusted tagging matrix.

Transferring and Updating the Web Tool

Transfer

The Web tool has been hosted at a temporary site at http://ntd.transitgis.org/ since its development. After this project ends, this temporary site will continue to be used until FTA moves it to its NTD site, at which time FTA's contractor for operating, maintaining, and developing its NTD site will transfer and take over the Web tool. As mentioned before, the Web tool has been developed within a programming environment that is compatible with the NTD website. While some level of programmatic and software skills are required to transfer the Web tool from its current site to the NTD site, it should within the FTA contractor's skills and capacity.

Updating

In the case where the new version of the manual is revised in the future, the Web tool would need to be updated accordingly if it is still active in the NTD site. FTA's contractor for NTD operation, maintenance, and development will need to carry out the update. WordPress enables users to seamlessly update its database by creating or editing questions and assigning tags. The following explains how to use these features and how to make additional changes to the NTD manual as contained in the Web tool as needed.

Creating New Questions. Follow these steps to add new questions/answers to the WordPress database:

1. Login to the NTD WordPress website: <base URL>/wp-admin/.
2. Once logged in, hover over "Posts" on the navigation bar, and click "Add New."
3. Along with the title (i.e., the question) and body (i.e., the answer), the new post can be assigned to a tag (described under Assigning Tags later). The screenshot in Figure 1 illustrates the "Add New Post" page.
4. The question will be entered into the "Enter title here" text box, and the corresponding answer can be written or copied and pasted into the large text box below the editor menu.

5. To copy a question from the Word version of the manual, copy the question title (including the section number), and paste into the "Enter title here" text box. Next, copy the answer portion from the Word document and paste it into the body text box in WordPress.
6. A completed post can then be previewed and published via the "Publish" widget located in the top-right portion of the page. "Preview" allows one to view a draft in real-time, while "Publish" makes the post live.
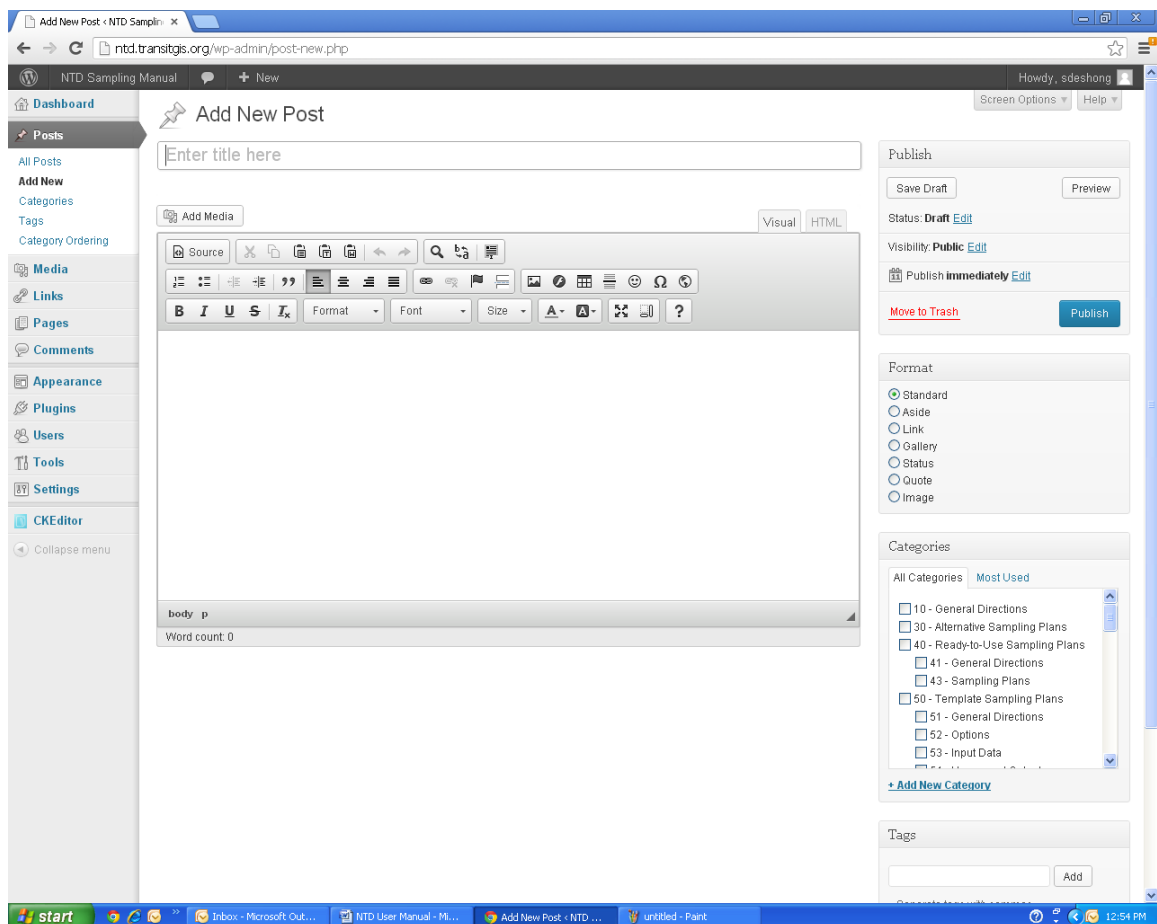
Figure 1. Creating New Questions

Editing a Question. Follow these steps to edit an existing question and its answer:

1. From the "Posts" menu, all the questions/answers previously published in WordPress can be accessed. To edit a post, hover over a title and click "Edit" ("Quick Edit" will be discussed later). The illustration in Figure 2 highlights this feature.
2. The edit feature allows for minor changes such as changing font, adding an image, or one can copy an excerpt from the NTD Manual and paste it into the WordPress editor.
3. Once finished editing a post, changes can be previewed and the post can be updated via the "Publish" widget as described under Creating New Questions.
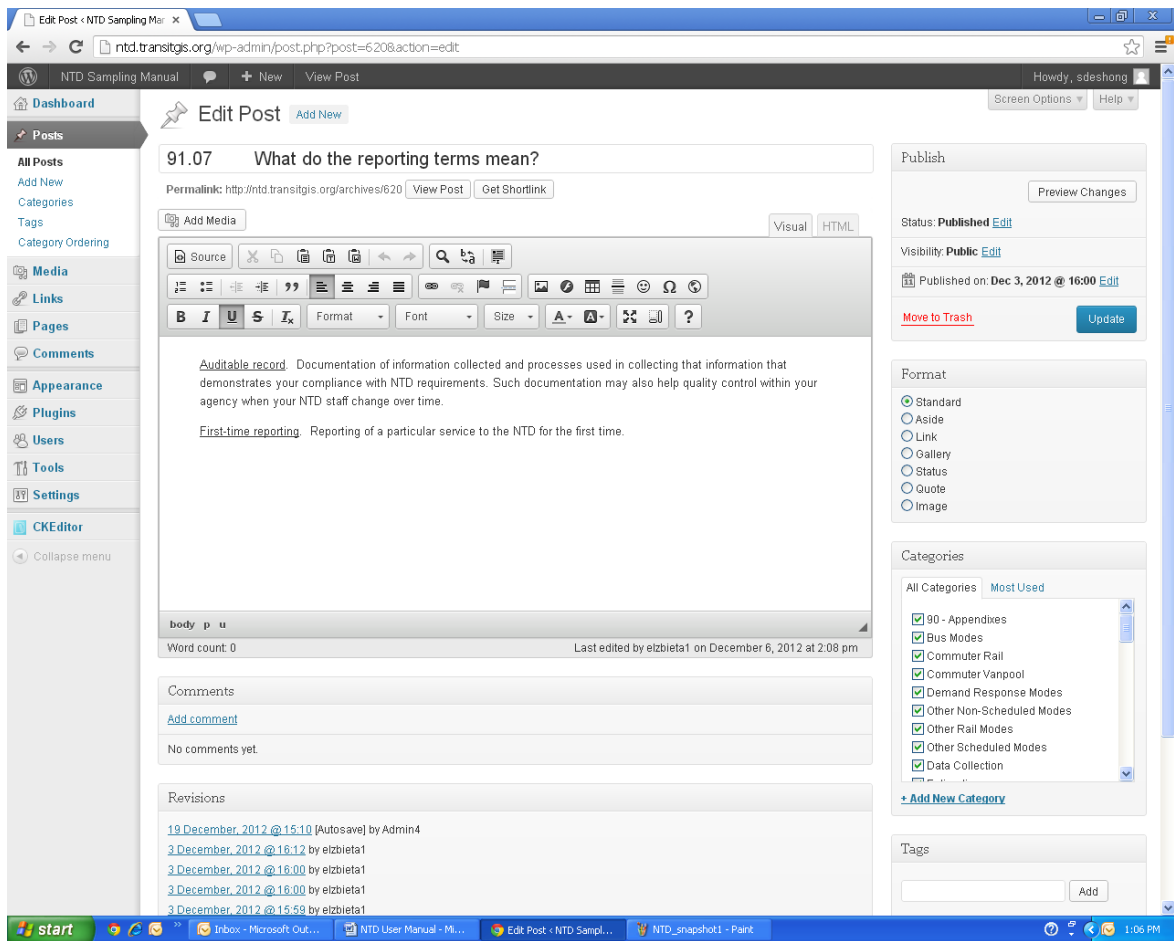
Figure 2. Editing a Question

Assigning Tags. Follow these steps to tag new or modified questions/answers:

1. In WordPress parlance, "tagging a post" means assigning it to a particular tag in the tag matrix discussed earlier. This can be done quickly and easily through the "Quick Edit" function (Figure 3).
2. From the "Posts" menu, highlight the entry that will be tagged and click "Quick Edit" below the title.
3. Click checkboxes in the "Categories" section for each section number in the NTD Manual the post corresponds. Ignore the "Tags" section.
4. Click "Update" once finished.
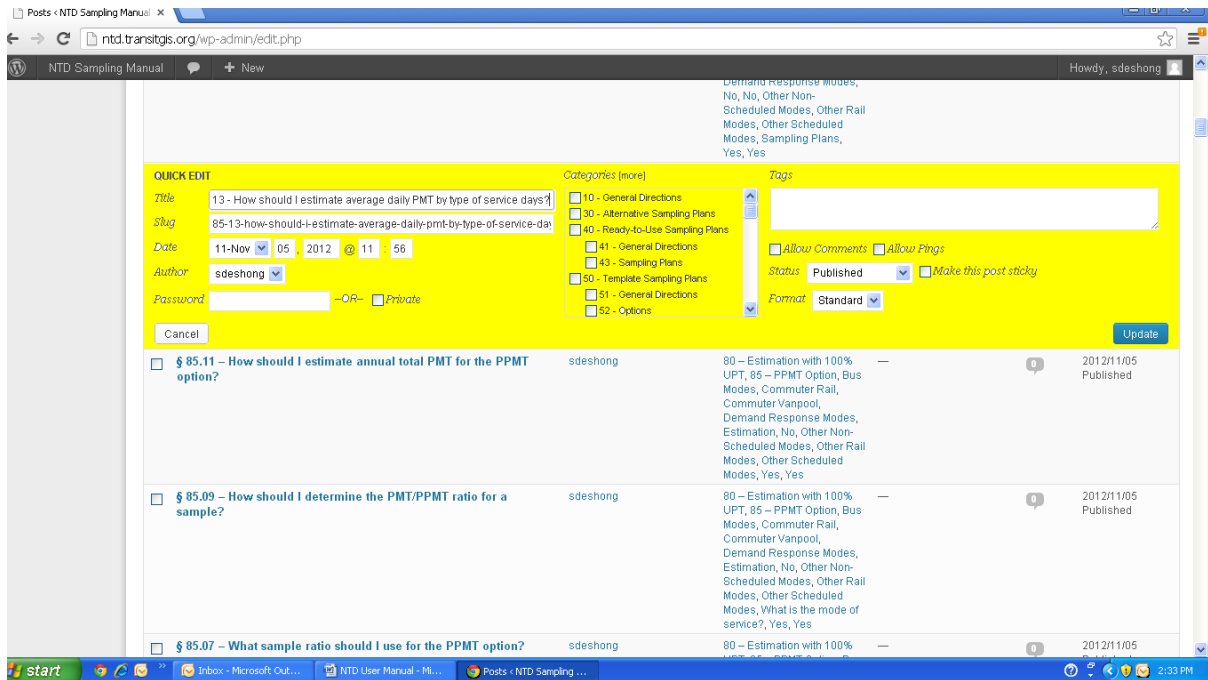
Figure 3. Assigning Tags

Deleting a Question. From the "Posts" menu, hover over a question that needs to be deleted, and click the "Trash" link below the title.

Using the Web Tool

This section is written in the form of a user guide. It also is available as a separate PDF file through the Web tool under About the Manual button.

If you need help with viewing the *NTD Sampling Manual* through this Web tool, this is the right place for you. This guide is organized into three sections:

1. Summary of the content of the manual and its main characteristics.
2. Description of the Web tool in terms of its home page and each of its options for viewing the manual.
3. Examples of using the Web tool to get exactly what you need for your specific profiles of using the manual.

Summary of the Manual

Written in a question-and-answer (Q&A) format, the *NTD Sampling Manual* is a comprehensive guidance document to assist you to meet FTA's minimum statistical requirements. The requirements entail 10% precision and 95% confidence levels in the annual totals of unlinked passenger trips and passenger miles traveled, which you estimate for the NTD through random sampling. The full manual consists of 7 major sections, 21 subsections, 122 pairs of questions/answers, and 1 appendix. It covers:

- All modes explicitly recognized by the NTD.
- Both types of service (directly-operated and purchased).
- All scales of operation (small, medium, and large).
- All patterns of operation (weekdays only, daily, etc.).
- All steps for getting estimates of annual totals (getting a sampling plan, collecting sample data, processing sample data, estimating annual totals).
- All reporting practices (100% counts of unlinked passenger trips, etc.).
- A wide range of options for sampling efficiency.
- Availability of own sample data for developing sampling plans.
- Two types of structures in sampling plans (period-based and interval-based).
- A range of sampling frequency (weekly, monthly, and quarterly) for period-based sampling plans.
- A range of sampling frequency (every day, every second day, every third day, every fourth day, every fifth day, and every sixth day) for interval-based sampling plans.
- A range of sampling plans in terms of who develops and certifies them (ready-to-use sampling plans, template sampling plans, and alternative sampling plans).

For each of you, only a subset of these elements of the full manual may be relevant. If you operate only demand-response and regular bus services, for example, those elements about other modes are irrelevant. If you operate only fixed-route services, those elements related to non-scheduled services are irrelevant. For your specific applications, a still narrower set of these elements may be relevant. For example:

- You report 100% UPT for demand-response but not for regular bus.
- Interval-based sampling plans may be more useful for your regular bus service, but period-based sampling plans may be more appropriate for your demand-response service.
- Different persons on your NTD staff may be responsible for different steps of getting estimates of annual totals, and each person would be interested only in the relevant step.

This Web tool is designed to help you select only the relevant portion of the full manual for your agency and for the specific need of each of your application.

Home Page

The home page of the Web tool is simple by design. It lists the main options of viewing the content from the manual. Figure 4 shows how the home page appears on the Internet.
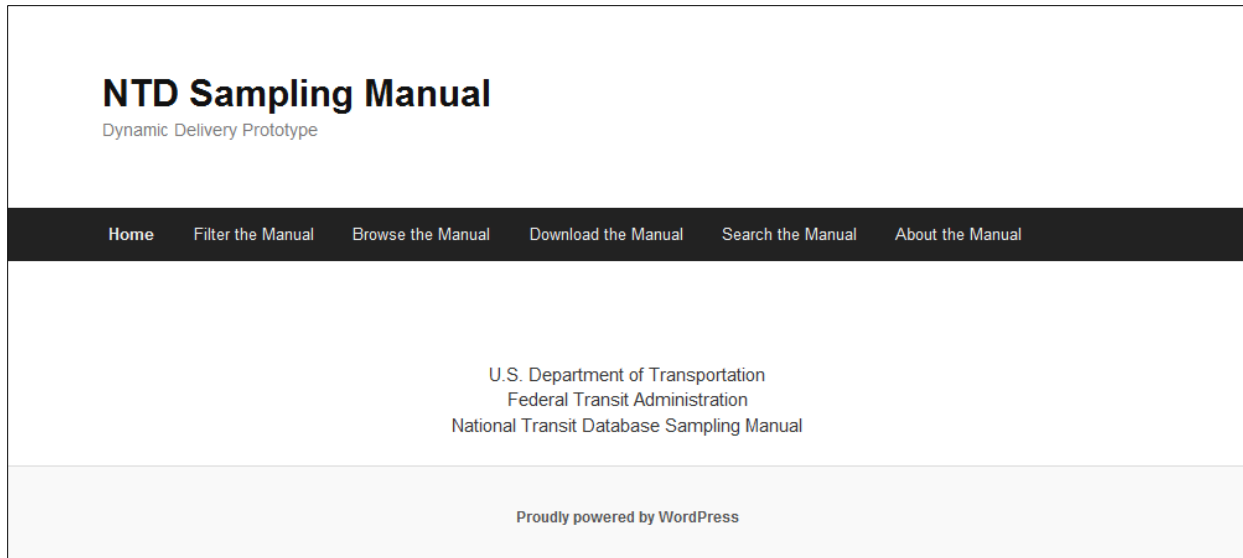
Figure 4. Home Page of the Web Tool

Filtering the Manual

The "Filter the Manual" function of the Web tool gives you the most flexible and dynamic way for viewing the manual. After clicking the "Filter the Manual" button, you get a Web page that is split into left-right columns, as shown in Figure 5. The narrower left side hosts the user interface for you to enter the specific profile. The user interface consists of four profiling questions and the profiling options for each profiling question. The wider right side shows the full content of the manual in terms of all individual questions/answers. To narrow the content delivered on the right side, you must answer at least one profiling question by selecting at least one of its profiling options.

§ 10.01 – What is the purpose of this Sampling Manual?

(a) It suggests procedures for obtaining annual data on unlinked passenger trips (UPT) and passenger miles traveled (PMT) for the National Transit Database (NTD) through random sampling according to the requirements in the *NTD Reporting Manual*.

(b) In the event of a conflict between the requirements in the *Reporting Manual* and this *Sampling Manual*, the requirements of the *Reporting Manual* are definitive.

(c) When it is possible to obtain annual UPT and PMT data according to the requirements in the *Reporting Manual* by using other methods not specified in this *Sampling Manual*, then you may do so.

§ 10.03 – What procedures does this Sampling Manual cover?

(a) Development of sampling plans with two options:
  (1) Section 40 on ready-to-use sampling plans.
  (2) Section 50 on agency-developed template sampling plans with agency sample data.
(b) Collection of sample data in Section 60.
(c) Estimation of annual service-consumed data with two options:
  (1) Both UPT and PMT if you do not report 100% counts of UPT.
  (2) PMT if you report 100% counts of UPT.
(d) Section 30 specifies several requirements for alternative sampling plans that template sampling plans must also meet.
(e) Figure 10.01 shows how these procedures and options relate to each other.

Figure 5. Filtering the Manual

Table 3 lists the profiling questions and their respective profiling options in the user interface. The last column briefly explains each profiling option. The bottom of the table describes the three types of sampling plans mentioned in explaining the profiling options.

Examples of Dynamically Delivering the Manual

Before you examine any examples shown in Table 4, it is essential for you to fully understand the logic behind the user interface and how the interface is linked to the content of the manual. This logic helps you correctly specify your usage profiles in the user interface to get what you need.

  Logic behind the User Interface. The profiling logic is what the Web tool uses in assembling the relevant topics of the manual in response to the particular use profile that you specify. The profiling logic consists of the following aspects:

- A profiling question is not answered if you do not choose any profiling option. For example, the user in profile example 5 in Table 4 did not answer question 1.

- Nothing would be delivered if you do not answer any profiling question.
- Only a portion of the manual would be delivered if you answer just one question and the delivered content is reduced further as you answer more questions.
- When a profiling question is answered, the amount of delivered content increases with more profiling options chosen for the given profiling question.
- Choosing all profiling options for a given profiling question is equivalent to the profiling question not being answered.

Table 3. Profiling Questions and Profiling Options for the User Interface

Profiling Questions	Profiling Options	Notes
1. What are you trying to do?	General Directions	Overall directions to the full manual
	Sampling Plans	These are the major steps of getting estimates of annual totals of UPT and PMT.
	Data Collection	
	Estimation	
2. What is the mode of service?	Bus Modes	MB, CB, RB, etc.
	Commuter Rail	CR
	Other Rail Modes	Heavy rail, light rail, streetcar rail, etc.
	Other Scheduled Modes	Ferryboat
	Demand Response Modes	Regular (DR) or by taxi (DT)
	Commuter Vanpool	Vanpool service for commuters
	Other Non-Scheduled Modes	Jitney services, etc.
3. Do you report 100% UPT?	Yes	You can sample far less if you report 100% UPT and only estimate PMT
	No	
4. Do you have own sample data?	Yes	Use template or alternative sampling plans
	No	Should use ready-to-use sampling plans

Notes:
1. UPT = unlinked passenger trips.
2. CR = commuter rail.
3. Template sampling plans are what you get from using your own NTD sample data from a previous report year with the Sampling Template.
4. Alternative sampling plans are what you have qualified statisticians develop and certify with your own NTD sample data from a previous report year.
5. Ready-to-use sampling plans are what the Sampling Manual provides for you to use temporally if you do not have your own NTD sample data from a previous report year for various reasons.

Examples. Table 4 summarizes examples of how you may filter the manual through the Web tool for five potential cases of using the manual:

1. You will start operating commuter rail service next year and will know exactly how many riders use the service, but you do not have previously-collected sample data because the service is new. It is a couple of months before next year starts, and you need to get a sampling plan now for estimating the annual total PMT for next year so you can plan ahead for the staffing needs of data collection.

2. You operate regular bus services only, you collect and report 100% UPT, and you have been sampling for several years; hence, you have your own sample data.

What you want is all of the content in the manual that is relevant for your operation and NTD reporting practices. As a result, you choose all steps of the overall process of obtaining estimates of annual total PMT for your bus service.

Table 4. Illustrative Examples of Filtering the Manual

Profiling Questions	Profiling Options	Examples				
		1	2	3	4	5
1. What are you trying to do?	General Directions		√			
	Sampling Plans	√	√			
	Data Collection		√			
	Estimation		√	√	√	
2. What is the mode of service?	Bus Modes		√	√	√	√
	Commuter Rail	√				
	Other Rail Modes				√	
	Other Scheduled Modes					
	Demand Response Modes			√	√	√
	Commuter Vanpool				√	
	Other Non-Scheduled Modes					
3. Do you report 100% UPT?	Yes	√	√	√	√	√
	No				√	
4. Do you have own sample data?	Yes		√			
	No	√				√

3. Your agency used template sampling plans for both of your regular bus and demand-response services during the report year that just passed. Your agency collected 100% UPT and will report it to the NTD for both modes. The staff person in charge of obtaining annual total PMT for both modes has since left. It is time to estimate the annual totals of PMT for the two modes using the sample data collected by the previous staff person from last report year. You are the new staff person in charge of preparing the estimates, and you want to learn exactly what you need to do.

4. You are part of a large transit agency that operates regular bus, commuter bus, light rail, regular demand-response, and vanpool services. You and several other colleagues are involved in the NTD process at your agency. Your agency collects and reports 100% UPT all of these modes except light rail. Your NTD-related job is to estimate annual totals of UPT and PMT for all of these modes using sample data collected by your NTD colleagues. You want to have all of the estimation-related content in the manual for all of the modes your agency operates. You do not choose an answer to the last profiling question because it is irrelevant to the estimation-related content in the manual.

5. You provide both regular bus and demand-response services, but have only 25 vehicles operated in maximum service. As a result, you qualify for the small-agency waiver—that is, you do not have to report PMT data to the NTD. In fact, you have not been sampling for several years and, hence, you do not have your

own usable sample data. But you have been asked by other transportation partners in the region to start reporting PMT data so that the region can qualify for more Section 5307 funds. As a result, you want to learn more about what would take to report PMT data before making the final decision. The good thing is that you have been collecting and reporting 100% UPT and will continue to do so in the future. You choose not to answer the first profiling question because you want guidance in the manual covering all of these steps.

Browsing the Manual

The Web tool gives you the option to browse manual for its sections, subsections, or individual pairs of questions/answers.

Sections. When you move your mouse curser over the "Browsing the Manual" button, the section numbers and titles appear as a drop-down menu, as shown in Figure 6. To view the entire content for a given section, just click the title of the section in the drop-down menu. All individual questions/answers for this section appear.
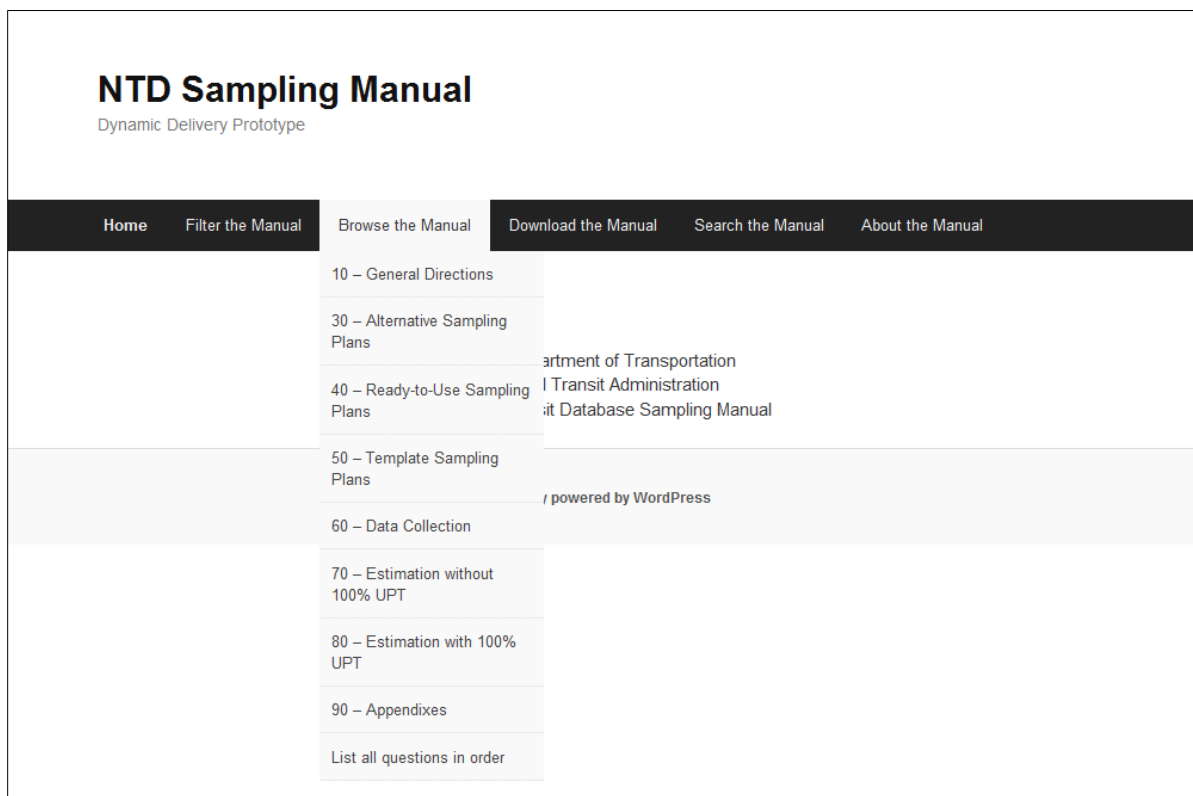
Figure 6. Browsing the Sections

Subsections. After the drop-down menu appears for the sections, you can move your cursor to a particular section title and hover over it; the subsection numbers and titles will appear to the right of the drop-down menu for sections. Figure 7 illustrates this for section 70 and its subsections. To view the entire content of any subsection, just click its title in the new drop-down menu. The full subsection appears.
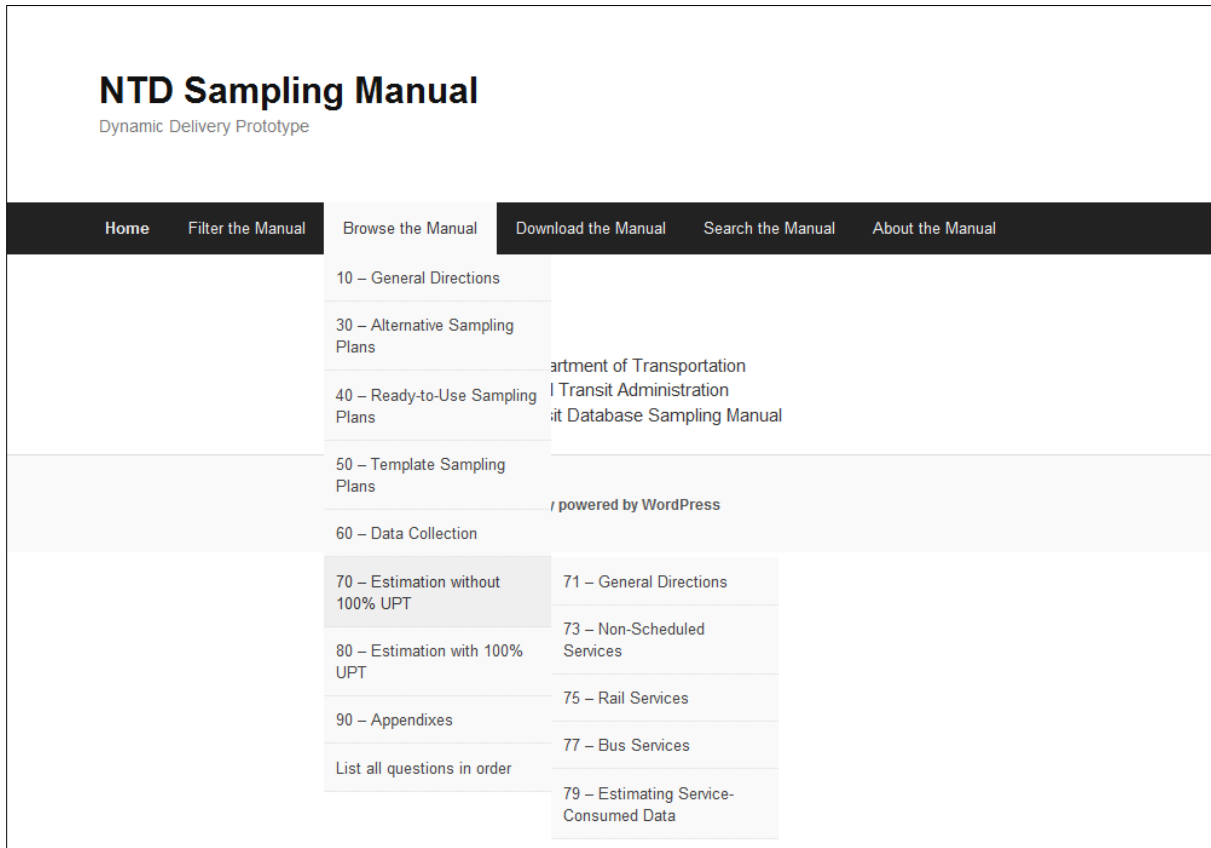
Figure 7. Browsing the Subsections

Questions. To get the clickable list of individual pairs of questions/answers for the entire manual for browsing, either directly click the "Browsing the Manual" button at the top or select "List All Questions in Order" in the pull-down menu shown in Figure 6 for sections. The hyperlinked individual pairs of questions/answers appear. Figure 8 shows how the screen appears with questions for the first three sections. The question itself and its full answer appear once the hyperlinked title of this question is clicked.

NTD Sampling Manual
Dynamic Delivery Prototype

Home   Filter the Manual   **Browse the Manual**   Download the Manual   Search the Manual   About the Manual

POSTS
- § 10.01 – What is the purpose of this Sampling Manual?
- § 10.03 – What procedures does this Sampling Manual cover?
- § 10.05 – May I continue using the sampling plans in Circulars 2710.1A and 2710.2A?
- § 30.01 – When should I consider using alternative sampling plans?
- § 30.03 – What additional requirements do alternative sampling plans should meet?
- § 41.01 – Under what conditions may I use ready-to-use sampling plans?
- § 41.03 – If I am using a ready-to-use sampling plan this year, may I use it again for my next report year?
- § 41.05 – For what modes are ready-to-use sampling plans available?
- § 41.07 – What sampling options are available?

Figure 8. Browsing by Questions

Downloading the Manual

The full manual is available for download both in a Word format and as a PDF file. In addition to the full manual, the following also are available for download:

- Sampling Template without any input data entered
- Sampling Template with input data entered as an example
- Individual appendices of example tables for data collection in Word format
- A random number table as a PDF file

Figure 9 show how the page appears after "Download the Manual" is clicked:
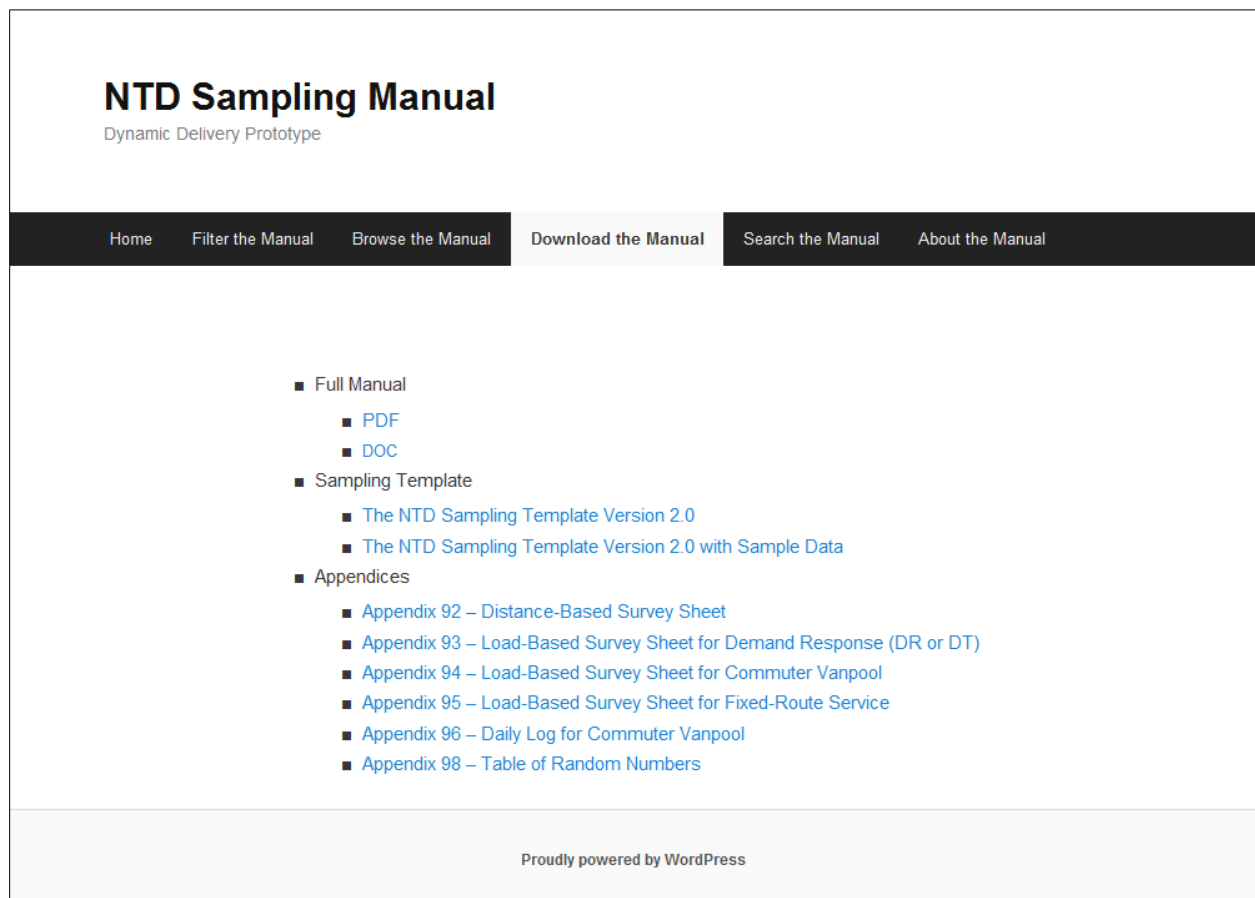
Figure 9. Download the Manual

Search the Manual

A fourth option to get to the manual is the "Search the Manual" function of the Web tool. The following appears after you click "Search the Manual" at the top:

Type search terms and hit the return key:

The Web tool delivers every pair of question/answer that contains all search terms you have used for the search. As an illustration, Figure 10 shows the search result from using "certify" as the search term.

Figure 10. Result of Searching for "Certify"

Chapter 5 – Conclusions

Summary

Enhancements to the Manual

The project has successfully revised the *NTD Sampling Manual* to incorporate a number of enhancements over the existing version in response to a request by FTA. For example, the new manual adds the requirement for a minimum sample size of 50 for all new sampling plans and for all sample data to be used in developing new sampling plans. Also, the new manual now has a simplified procedure for transit agencies to determine whether they should revise their previously-developed template sampling plans. The most significant improvement is that the new manual includes procedures for transit agencies to develop sampling plans that are similar in structure with those in Circular 2710.1A.

This study also investigated several potential enhancements suggested by FTA that eventually were not incorporated into the new manual. FTA suggested these to reduce the potential negative impact on transit agencies as a result of the recent split of the traditional single mode of bus services into three modes—regular bus, commuter bus, and bus rapid transit. One of these suggested enhancements was to allow transit agencies to estimate and report unlinked passenger trips and passenger miles traveled for these three bus modes combined for a given type of service (directly-operated or purchased). Combined sampling has its disadvantages, but the potential benefits of combined sampling are far less than initially thought. Another suggestion was to waive the newly-added minimum sample size of 50 for certain services, such as single-route services of commuter bus and commuter rail. However, the number of agencies that can benefit from this waiver is likely to be small, and its benefits in terms of the reduction in annual sample size also are small in absolute terms.

Web Tool of a Range of Delivery Options

More important, researchers for this project successfully developed a Web tool for the new *NTD Sampling Manual* to be delivered to its users in a range of options. Users can download the entire manual and the Sampling Template and can browse the manual by its sections, subsections, or even individual pairs of questions/answers. They can specify what they need in terms of four profiling questions (e.g., What is your mode of service?) and their various options (e.g., vanpool), and the Web tool can deliver the relevant content of the manual. The delivery options greatly condense and simplify the full manual to many transit agencies and their special guidance needs for obtaining annual totals of unlinked passenger trips and passenger miles traveled, particularly those small- and mid-size agencies that operate only regular bus and demand-response services with small fleets.

Lessons Learned

As a dynamic content delivery mechanism, the Web tool does not realize all its potential. Dynamic deliveries are not always executed cleanly in some situations. The previous

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version of the manual was not prepared with dynamic delivery in mind. Consequently, some of its individual pairs of questions/answers cover content that includes more than one option of a given profiling question. For example, the guidance for a particular question in the manual may relate to agencies that report 100% counts of unlinked passenger trips in one part of its answer but to agencies that do not report 100% counts in another part of its answer. As a result, both parts of the answer would be delivered for either profiling option for the profiling question of whether an agency reports 100% counts. That is, the delivered content is not clean in that it relates to both profiling options. In many such cases, one pair of question/answer may be broken into two or more pairs. This breaking of existing questions/answers was considered but not adopted for at least two reasons: it will significantly increase the number of questions in the manual, and the resulting manual will look significantly different from the existing version. Neither of these is desirable.

One lesson learned from this shortcoming of the current Web tool is that, for future efforts of developing Internet-based dynamic content delivery tools, the full content document should be prepared in such a way that each of its individual topics does not include content for more than one option for any given profiling question. The challenge is for the resulting document to be coherent among its different sections and individual topics and still to visually be as appealing as a document that is not designed for dynamic delivery.

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Appendix - NTD Sampling Manual 2.0

	NATIONAL TRANSIT DATABASE SAMPLING MANUAL
U.S. Department of Transportation **Federal Transit Administration**	
	Final, Version 2.0, February 2013

TABLE OF CONTENTS

SECTION 10 – GENERAL DIRECTIONS

§ 10.01 **What is the purpose of this *Sampling Manual*?**
    (a) It suggests procedures for obtaining annual data on unlinked passenger trips (UPT) and passenger miles traveled (PMT) for the National Transit Database (NTD) through random sampling according to the requirements in the *NTD Reporting Manual*.
    (b) In the event of a conflict between the requirements in the *Reporting Manual* and this *Sampling Manual*, the requirements of the *Reporting Manual* are definitive.
    (c) When it is possible to obtain annual UPT and PMT data according to the requirements in the *Reporting Manual* by using other methods not specified in this *Sampling Manual*, then you may do so.

§ 10.03 **What procedures does this *Sampling Manual* cover?**
    (a) Development of sampling plans with two options:
        (1) Section 40 on ready-to-use sampling plans.
        (2) Section 50 on agency-developed template sampling plans with agency sample data.
    (b) Collection of sample data in Section 60.
    (c) Estimation of annual service-consumed data with two options:
        (1) Both UPT and PMT if you do not report 100% counts of UPT.
        (2) PMT if you report 100% counts of UPT.
    (d) Section 30 specifies several requirements for alternative sampling plans that template sampling plans must also meet.
    (e) Figure 10.01 shows how these procedures and options relate to each other.

Figure 10.01. Flow Chart of Procedures and Options

§ 10.05 **May I continue using the sampling plans in Circulars 2710.1A and 2710.2A?**
    (a) You may continue using these sampling plans until they are withdrawn.

SECTION 30 – ALTERNATIVE SAMPLING PLANS

§ 30.01   When should I consider using alternative sampling plans?
   (a) An alternative sampling plan is equivalent to an alternative sampling technique as defined in the *NTD Reporting Manual*.
   (b) If the sampling options provided in the companion template of this *NTD Sampling Manual* meet your needs, it is to your advantage to use template sampling plans.
   (c) You should consider using alternative sampling plans when the companion template does not cover the best option for your specific situation. The companion template provides many options for you to explore and consider for the vast majority of possible situations, but it may not cover the best option for all situations.

§ 30.03   What additional requirements should alternative sampling plans meet?
   (a) Alternative sampling plans must meet FTA's 95% confidence and 10% precision levels.
   (b) In addition to these basic statistical requirements, alternative sampling plans should also meet the following requirements:
      (1) They are based on the conditions of your service. That means that they should be developed with sample data collected from a random sample of your service.
      (2) The sample data used for developing alternative sampling plans have a minimum sample size of 50 service units.
      (3) They contain a margin of safety of at least 25%. That is, the final sample size of an alternative sampling plan is at least 25% greater than what you would get from using the sample data directly.
      (4) The final sample size of any alternative sampling plan is at least 50.
   (c) Template sampling plans also should meet the additional requirements in (b) as specified in Section 50.

SECTION 40 – READY-TO-USE SAMPLING PLANS

Subsection 41 – General Directions

§ 41.01   Under what conditions may I use ready-to-use sampling plans?
  (a) Small Systems – If you operate no more than 30 vehicles operated in maximum service for all modes combined and if you choose to sample for determining your annual service-consumed data for any of the modes you operate.
  (b) New Mode – If you will be sampling and reporting for the first time this current report year for a particular mode that you do not already operate. For example, you would meet this condition if you will add light rail (LR) service this year, but you have not operated this service previously, or
  (c) New Type of Service – If you will be sampling and reporting this current report year for a particular type of service for the first time. For example, you would meet this condition if you previously directly operated all of your bus (MB) service, but will contract out part or all of that service to a private entity for this year, or
  (d) Major Changes of Service – You have made major changes to your service since your last sampling year, or
  (e) No Sample Data – If you have reported your service to the NTD before through random sampling, but no longer have the original sample data, or
  (f) Sample Data Not Reliable – If you have reported your service to the NTD before through random sampling, but the sample data are found to be not reliable, or
  (g) Sample Data Not Enough – if you have reported your service to the NTD before through random sampling, but the sample size is smaller than 50 service units.

§ 41.03 If I am using a ready-to-use sampling plan this year, may I use it again for my next report year?
  (a) You should not use it again if your next report year is your mandatory sampling year. After you have collected the sample data from this year, you should develop a template sampling plan with that sample data for your next report year.
  (b) You may use it again for the next report year if that year is not your mandatory sampling year.
  (c) You may use it while you operate no more than 30 vehicles operated in maximum service for all modes combined.

§ 41.05   For what modes are ready-to-use sampling plans available?
  (a) For non-scheduled services, they are available for demand response services (DR and DT) and commuter vanpool. You should not use the ready-to-use sampling plans for commuter vanpool if your vanpool service does not serve commuters exclusively.
  (b) For scheduled services, they are available for bus services (bus (MB), commuter bus (CB), bus rapid transit (RB), and trolleybus (TB)), commuter rail (CR), and other rail modes.

§ 41.07   What sampling options are available?

   (a) The available sampling options vary in:
      (1) the unit of sampling and measurement,
      (2) sampling structure,
      (3) efficiency options, and
      (4) sampling frequency.
   (b) The particular unit of sampling and measurement used in these ready-to-use sampling plans varies by mode and whether the service is scheduled (Table 41.01).
      (1) For non-scheduled services, the unit is in vehicle days.
      (2) For bus services (MB, CB, RB, and TB), separate sampling plans are available with units in one-way trips and in round trips.
      (3) For commuter rail, the unit is in one-way car trips.
      (4) For other rail modes, separate sampling plans are available in units of one-way car trips and one-way train trips.

Table 41.01. Options for Unit of Sampling and Measurement

Service	Mode	Units of Sampling and Measurement
Non-Scheduled	Demand Response (DR, DT)	Vehicle days
	Commuter Vanpool	Vehicle days
Scheduled	Bus (MB, CB, RB, TB)	One-way trips, round trips
	Commuter Rail (CR)	One-way car trips
	Other Rail Modes	One-way car trips, one-way train trips

   (c) Two options are provided for sampling structure—period-based and interval-based. Interval-based sampling plans are available for bus services only.
   (d) Three efficiency options are provided:
      (1) Base Option – you must estimate both UPT and PMT through random sampling.
      (2) APTL Option – you must report a 100% count of UPT, estimate the average passenger trip length (APTL) through random sampling, and obtain annual PMT by multiplying the 100% UPT with the estimated APTL.
      (3) Grouping Option – you must divide your bus routes into two groups by route length. The grouping option is available for period-based sampling plans only.
   (e) Three frequency options are provided for period-based sampling plans—quarterly, monthly, or weekly. You may choose whichever of these options is best suited for your agency. One factor to consider is that the annual realized sample size may be larger at a lower sampling frequency due to rounding. Another factor is that a lower sampling frequency means a larger annual number of acts for random sampling.
   (f) Up to six frequency options are provided for interval-based sampling plans—every day, every 2nd day, every 3rd day, every 4th day, every 5th day, and every 6th day. Three sets of these sampling plans are available for 7-day weekly service, 6-day weekly service, and 5-day weekly service, respectively. The sampling plans for 7-day weekly service and the base option are similar to those in Circular 2710.1A.

Subsection 43 – Sampling Plans

§ 43.01   What period-based sampling plans are available for non-scheduled services?
 (a) Table 43.01 shows the sampling plans available for demand response services (DR and DT) and commuter vanpool, respectively.
 (b) Sample size is stated in the number of vehicle days.
 (c) Separate sampling plans are available for the base option and the APTL option.
 (d) Sample size is shown for the entire year and for the relevant period for each frequency.

Table 43.01. Period-Based Ready-to-Use Sampling Plans for Non-Scheduled Services

Sampling Frequency	Sample Size	Demand Response		Commuter Vanpool	
		Reporting 100% UPT (APTL Option)	Not Reporting 100% UPT (Base Option)	Reporting 100% UPT (APTL Option)	Not Reporting 100% UPT (Base Option)
Quarterly	Vehicle Days for a Quarter	13	22	31	45
	Total Sample Size for Year	52	88	124	180
Monthly	Vehicle Days for a Month	5	8	10	15
	Total Sample Size for Year	60	96	120	180
Weekly	Vehicle Days for a Week	1	2	2	4
	Total Sample Size for Year	52	104	104	208

§ 43.03   What period-based ready-to-use sampling plans are available for bus services?
 (a) Table 43.03 shows the available ready-to-use sampling plans for bus services, including bus (MB), commuter bus (CB), bus rapid transit (RB), and trolleybus (TB).

Table 43.03. Period-Based Ready-to-Use Sampling Plans for Bus Services

Sampling Frequency	Sample Size for Period and Year	One-Way Trips			Round Trips		
		Reporting 100% UPT (APTL Option)		Not Reporting 100% UPT (Base Option)	Reporting 100% UPT (APTL Option)		Not Reporting 100% UPT (Base Option)
		With Route Grouping	Without Route Grouping		With Route Grouping	Without Route Grouping	
		(1)	(2)	(3)	(4)	(5)	(6)
Quarterly	Trips for a Quarter	52	78	138	39	59	103
	Total Sample Size for Year	208	312	552	156	236	412
Monthly	Trips for a Month	18	27	46	13	20	35
	Total Sample Size for Year	216	324	552	156	240	420
Weekly	Trips for a Week	4	6	11	3	5	8
	Total Sample Size for Year	208	312	572	156	260	416

(b) Sampling plans are provided separately for one-way trips and round trips.
(c) The number of one-way trips in a sampling plan based on round trips is about 50% greater than the number of one-way trips in a sampling plan based on one-way trips. A sampling plan based on round trips requires a larger number of one-way trips because the pair of one-way trips making up a round trip are not selected randomly or independently.
(d) If you choose the base option:
    (1) use column (3) to find the sample size in one-way trips, and
    (2) use column (6) to find the sample size in round trips.
(e) If you choose the APTL option, you may choose one of two options:
    (1) With Route Grouping – Use column (1) to find the sample size in one-way trips and column (4) to find the sample size in round trips. In using this option, you must divide your routes into two groups on the basis of route length and do sampling and estimation separately for each group. For example, if you operate 10 routes, put the 5 routes with the shortest route distances in the group of short routes and the other 5 routes in the group of long routes.
    (2) Without Route Grouping – If you prefer not to deal with grouping your routes, use column (2) to find the sample size in one-way trips and use column (5) to find the sample size in round trips.

§ 43.05 How does grouping of my bus routes affect sampling and estimation procedures?
(a) You must do your sampling and estimation separately for individual route groups. For details, refer to:
    (1) Subsection 63 on sampling.
    (2) Section 70 on estimation without 100% UPT.
    (3) Section 80 on estimation with 100% UPT.

§ 43.07 What period-based sampling plans are available for commuter rail?
(a) Table 43.05 shows the available ready-to-use sampling plans for commuter rail (CR).
(b) Sample size is in one-way car trips.
(c) Separate sampling plans are available for the base option and the APTL option.

Table 43.05. Period-Based Ready-to-Use Sampling Plans for Commuter Rail (CR)

Sampling Frequency	Sample Size for Period and Year	Reporting 100% UPT (APTL Option)	Not Reporting 100% UPT (Base Option)
Quarterly	One-Way Car Trips for a Quarter	13	80
	Total Sample Size for Year	52	320
Monthly	One-Way Car Trips for a Month	5	27
	Total Sample Size for Year	60	324
Weekly	One-Way Car Trips for a Week	1	7
	Total Sample Size for Year	52	364

§ 43.09   What period-based sampling plans are available for other rail modes?
(a) Table 43.07 shows the available ready-to-use sampling plans for other rail modes, including light rail (LR), heavy rail (HR), monorail and automated guideway (MG).
(b) Separate sampling plans are available for one-way train trips and one-way car trips.
(c) Separate sampling plans are available for the base option and for the APTL option.

Table 43.07. Period-Based Ready-to-Use Sampling Plans for Other Rail Modes

Sampling Frequency	Sample Size for Period and Year	One-Way Train Trips		One-Way Car Trips	
		Reporting 100% UPT (APTL Option)	Not Reporting 100% UPT (Base Option)	Reporting 100% UPT (APTL Option)	Not Reporting 100% UPT (Base Option)
Quarterly	Trips for a Quarter	13	45	13	72
	Total Sample Size for Year	52	180	52	288
Monthly	Trips for a Month	5	15	5	24
	Total Sample Size for Year	60	180	60	288
Weekly	Trips for a Week	1	4	1	6
	Total Sample Size for Year	52	208	52	288

§ 43.11   What interval-based ready-to-use sampling plans are available for bus services?
(a) Table 43.09 shows the available ready-to-use sampling plans for bus services, including bus (MB), commuter bus (CB), bus rapid transit (RB), and trolleybus (TB).
(b) Separate sampling plans are available for the base option and the APTL option.
(c) In determining whether using interval-based sampling plans, you should consider the tradeoff between at least two factors:
   (1) the advantage of using a sampling plan that you have been using for years, and
   (2) the potentially lost opportunity of a lower sample size.
(d) You should first determine the number of weekly operating days for your next sampling year, and choose the set of sampling plans accordingly. For example, if you will be operating 7 days a week, you should not consider any of the sets for the other weekly operating patterns.
(e) You may choose any of the above plan numbers that correspond to the weekly operating pattern of your service.

Table 43.09. Interval-Based Ready-to-Use Sampling Plans for Bus Services

Plan Number	Frequency of Sampling	Operating 7 Days a Week		Operating 6 Days a Week		Operating 5 Days a Week	
		Daily One-Way Bus Trips	Total Sample Size for Year	Daily One-Way Bus Trips	Total Sample Size for Year	Daily One-Way Bus Trips	Total Sample Size for Year
Base Option							
1	Every Day	2	730	2	624	2	520
2	Every 2nd Day	3	549	3	468	4	520
3	Every 3rd Day	5	610	6	624	7	609
4	Every 4th Day	7	644	9	702	12	780
5	Every 5th Day	10	730	13	819		
6	Every 6th Day	15	915				
APTL Option							
1	Every Day	1	365	1	312	1	260
2	Every 2nd Day	2	366	2	312	3	390
3	Every 3rd Day	3	366	4	416	5	435
4	Every 4th Day	4	368	6	468	8	520
5	Every 5th Day	6	438	8	504		
6	Every 6th Day	10	610				

SECTION 50 – TEMPLATE SAMPLING PLANS

Subsection 51 – General Directions

§ 51.01 Under what conditions should I develop a template sampling plan for next year?
  (a) If you have previously been using a ready-to-use sampling plan and the next report year is your mandatory sampling year;
  (b) If you have previously been using a sampling plan, but it is not based on the conditions of your service;
  (c) If you have previously been using a template sampling plan, but you must revise it for your next sampling year according to Subsection 56; or
  (d) If you previously have been using an alternative sampling plan, but would like to:
    (1) improve your sampling efficiency,
    (2) change the unit of sampling and measurement,
    (3) change the sampling structure, or
    (4) use a different sampling frequency.

§ 51.02 Should I consider template sampling plans if I am a small system and want to sample?
  (a) You do not have to consider template sampling plans. You may continue using ready-to-use sampling plans while you continue operate no more than 30 vehicles operated in maximum service for all modes combined.
  (b) It is likely to be in your interest to consider template sampling plans.
  (c) If the sample size requirement is considerably smaller for template sampling plans than for ready-to-use sampling plans, the benefit is likely to be much greater than your cost from considering template sampling plans.

§ 51.03 Does this *Manual* have a companion tool that I may use?
  (a) Yes, this companion tool is an Excel template, "The NTD Sampling Template.xlsm."
  (b) It is specifically designed for you to develop template sampling plans.
  (c) You may download a copy of this template from the NTD homepage at www.ntdprogram.gov.

§ 51.05 What is the scope of this template?
  (a) You may use it for any mode of transit service, such as bus (MB), that is explicitly recognized by the NTD.
  (b) You may use it for any type of service, such as directly operated (DO), that is explicitly recognized by the NTD.
  (c) You may use it with sample data in any unit of sampling and measurement.

§ 51.07 Do I need to have knowledge of statistics to use this template?
  (a) You do not need any knowledge of statistics to use this template.
  (b) You must follow the steps exactly as described.

Subsection 52 – Options

§ 52.01 What types of options does this template provide in its sampling plans?
    (a) Unit of sampling and measurement – the unit of service at which you do sampling, data collection, and estimation.
    (b) Sampling structure – period-based sampling or interval-based sampling.
    (c) Sampling frequency – how frequently you do sampling.

§ 52.03 Must I pick a specific unit of sampling and measurement to use this template?
    (a) You must pick a specific unit of sampling and measurement before you start using this template. The type of sample data you have available will often dictate your choice of a unit for sampling and measurement.
        (1) For non-scheduled services, such as demand response (DR and DT) or vanpool (VP), the unit of sampling and measurement is typically the vehicle day.
        (2) For bus services, including bus (MB), commuter bus (CB), bus rapid transit (RB), and trolley bus (TB), you must decide if the unit will be a one-way bus trip or a round-trip bus trip. It is a common practice to use a one-way bus trip as the unit of sampling and measurement.
        (3) For rail services, you must decide if the unit will be a one-way car trip, a round-trip car trip, a one-way train trip, or a round-trip train trip. It is a common practice to use one-way passenger car trip as the unit of sampling and measurement.
    (b) The sample data you enter into this template will all be in this unit.
    (c) The resulting sampling plans from this template will also be in this unit.
    (d) The expansion factors you are going to use to expand your sample will also be in this unit if you are going to estimate both UPT and PMT with your sample data.

§ 52.04 What options does this template provide on sampling structure?
    (a) Period-based sampling plans – you sample the same number of service units for each period (e.g., monthly).
    (b) Interval-based sampling plans – you sample the same number of service units one each sample day, and the interval between the sample days is constant.
    (c) In determining whether using interval-based sampling plans, you should consider their advantages and disadvantages:
        (1) the advantage of using a sampling plan that you have been using for years,
        (2) the advantage of using regular sample days throughout a year,
        (3) the disadvantage of a large number of times you need to sample during a year,
        (4) the disadvantage of not being able to consider the PPMT and grouping options, and
        (5) the disadvantage of a likely larger annual sample size due to rounding in determining the daily sample size.

§ 52.05 What options does this template provide on sampling frequency?
    (a) This template provides you with three frequency options for period-based sampling – quarterly, monthly, and weekly. For example, if weekly sampling requires 4 one-way bus trips per week, you must select at least 4 one-way bus trips at random from the full list of one-way bus trips that you expect to operate during a particular week.
    (b) This template provides you with up to 6 frequency options for interval-based sampling:

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(1) 7-day weekly service – every day, every 2nd day, every 3rd day, every 4th day, every 5th day, and every 6th day.

(2) 6-day weekly service – every day, every 2nd day, every 3rd day, every 4th day, and every 5th day.

(3) 5-day weekly service – every day, every 2nd day, every 3rd day, and every 4th day.

(c) You may choose whichever frequency option is best for your agency.

§ 52.07   What should I consider in choosing a sampling frequency?

(a) Period-based sampling plans:

(1) Your cycle of minor schedule changes during a year. For example, quarterly sampling may be appropriate if you routinely adjust your schedule every three months.

(2) The scale of your operation and the method you will be using to select a sample. For example, it may become difficult to select a sample for an entire quarter if the number of service units involved in a quarter is too large for a spreadsheet to handle.

(3) The realized annual sample size. The realized annual sample size can be larger than the initial annual sample size due to rounding in allocating the initial annual sample to each frequency level. This is particularly true for weekly sampling when the initial annual sample size is relatively small. For example, if the initial annual sample size is 55 and you choose weekly sampling, the weekly sample size would be 2 and the realized annual sample size would be 104.

(b) Interval-based sampling plans:

(1) Your staffing needs for data collection.

(2) The number of times you need to do sampling. The number of times is larger with plans of higher frequency (e.g., every vs. every 2nd day).

(3) The annual total sample size. The degree of rounding is higher with plans of higher frequency.

§ 52.09   What efficiency options does the template include?

(a) The template includes a number of options for you to consider in improving your sampling efficiency:

(1) The base option.

(2) The APTL option.

(3) The PPMT option.

(4) The grouping option.

(b) You may use the base option if you are going to estimate both UPT and PMT (i.e., you will not be using 100% counts for either UPT or PMT), and

(c) Any of the other three options has the potential to improve your sampling efficiency over the base option:

(1) Sampling plans under the APTL option are based on how APTL in absolute terms varies across your service units.

(2) Sampling plans under the PPMT option are based on how APTL relative to average route length varies across your service units.

(3) Sampling plans under the grouping option are based on the idea that relevant statistical variation may be smaller across service units within sub-segments of your service than across all service units of your entire service.

(d) Additional options become available when service grouping is combined with each of the other three efficiency options.

§ 52.11   Which of these efficiency options are available to me?

(a) All four efficiency options are available for period-based sampling. Only the first two are available for interval-based sampling.
(b) The base option is available to you if you have data on PMT from your sample. But it is not recommended in most cases if a 100% count of annual UPT is available and reliable.
(c) The APTL option is available to you if you meet the following two criteria:
   (1) you are going to report a 100% count of annual UPT, and
   (2) you have data on both UPT and PMT from your sample data.
(d) The PPMT option is available to you if you meet all of the following criteria:
   (1) you are going to report a 100% count of annual UPT,
   (2) you have data on both UPT and PMT from your sample data,
   (3) your service is a fixed-route service,
   (4) you have your 100% count of annual UPT for each route, and
   (5) you have data on annual total vehicle revenue miles and annual total vehicle revenue one-way trips for each route.
(e) The grouping option is available to you as long as you have some basis for dividing your service into two or more groups.

§ 52.13 How do I divide my scheduled service if I want to consider the grouping option?

(a) Grouping is usually by route when there is a small number of routes or by groups of routes that are similar.
(b) You are going to determine the similarity of service units on your expectations from your prior knowledge of your service.
(c) The most efficient grouping depends on other efficiency options you consider:
   (1) If your sampling plan follows the base option, define groups so that within each group, they are similar with respect to PMT per service unit. For example, you may group heavily used long routes separately from lightly used shorter routes.
   (2) If your sampling plan follows the APTL option, define your groups so that within each group they have similar APTL. For example, if your express route customers travel particularly long distances, you may separate your express and local services as two groups. As another example, if some of your local routes are particularly longer than the other local routes, you may further divide your local service into two groups.
   (3) If your sampling plan follows the PPMT option, define your groups so that the routes within each group are similar with respect to the fraction of a route's length that passengers typically ride. For example, if on some routes passengers tend to ride most of length of the route (as is the case for some express routes) while on other routes passengers tend to ride for only a small part of the route's full length, separate those routes into different groups. Consider another example. If a system has a mix of radial routes (routes with one end in the downtown), diagonal routes (routes that pass through the downtown), and crosstown routes (routes that don't pass through the downtown), the average fraction of route length that passengers ride tends to be smaller on the diagonal and crosstown routes and longer on the radial routes. In this case, radial routes could be grouped separately from diagonal and crosstown routes.

§ 52.15 How do I group my vanpool service if I serve commuters only?
   (a) You should base the grouping of your service on the registered round-trip distance of each vanpool.
   (b) In most cases you will only need two groups with the longer routes in one group and the shorter routes in another group.

§ 52.17 What should I consider in general when I consider grouping my service?
   (a) Strike a balance between the number of groups and the potential reduction in necessary sample size. In most cases, you will only want to deal with two or three groups.
   (b) You may try different ways of grouping your service and choose one particular grouping based on its efficiency improvement and your administrative convenience.
   (c) The grouping option may be used for administrative convenience alone:
      (1) You may treat your different contractors of service for a given mode as separate groups when each is responsible for sampling and collecting data.
      (2) You may treat your operational divisions as separate groups if each is responsible for sampling and collecting data.
      (3) You may treat your commuter vanpool separately from your other vanpool services.

Subsection 53 – Input Data

§ 53.01 What data must I have to use this template?
   (a) You must have a set of sample data collected recently from your service for the mode and type of service for which you would like to have a new template sampling plan.
      (1) The sample data must be at the unit of sampling and measurement you have chosen for your sampling plan. For example, if your sampling plan is in one-way bus trips, the sample data should show the UPT and PMT and other identification information for each one-way bus trip in your sample.
      (2) Follow the instructions in the template for details on data items and format required and how they should be entered into the template.
   (b) You should use your NTD sample if it is available and you have not made major changes to your service since the data were collected.
   (c) Otherwise, you may use data that have been collected for non-NTD purposes:
      (1) One good source of non-NTD sample data for scheduled services is a comprehensive operational analysis (COA). Typically, all trips or a large portion of all trips on your schedule are checked by ride-checkers or by APCs during a concentrated period.
      (2) Make sure that the non-NTD source of sample data has the required information for using this template. For example, between-stop distances often are not collected during COA ride checks, and the resulting ride check data would not be useful if you do not have predetermined between-stop distances for your entire service.
   (d) The sample size of the sample data from any source must be 50 or more service units.
   (e) If you do not have a set of sample data recently collected from your service for the mode and type of service, then you should use one of the other types of sampling plans, such as ready-to-use sampling plans.

§ 53.03 Must I identify and correct errors with my sample data before I enter them into the template?
  (a) Yes, you must identify and correct errors in your sample data for using the template.
  (b) If you are using sample data from previous report years, you should have identified and corrected such errors in developing your estimates then; make sure that you use the final version of your sample data.
  (c) Refer to Subsection 67 for identifying and correcting errors in your sampling data during the course of an entire report year as you collect sample data.
  (d) If you are using sample data from the current report year, identifying and correcting errors in the sample data now for developing sampling plans saves you from doing it when you develop your estimates later for reporting purposes.
  (e) At a minimum, you should conduct the following checks to identifying potential errors:
    (1) Overall consistency – UPT and PMT should be closely related across all sample units. For period-based sampling plans, check for errors if cell D26 in the PeriodCalculations worksheet is smaller than 0.5. For interval-based sampling plans, check for errors if cell D20 in the IntervalCalculations worksheet is smaller than 0.5.
    (2) Consistency at the level of sampling units – UPT and PMT should both be zero or both be positive. Check for errors if one is zero but the other is positive.
    (3) Comparing APTL with route length – Calculate the ratio of PMT over UPT and compare the result to the maximum length of your route. This check is not applicable to demand response services.
    (4) If you consider the PPMT option, calculate the ratio of PMT over PPMT for each sample unit; the ratio should not be greater than 1.
  (f) It is in your interest to keep your sample data free of errors. Experience indicates that sample data with errors tend to result in larger sample sizes than sample data free of errors.

§ 53.05 Do interval-based sampling plans have any special requirement for the sample data used in developing them?
  (a) Yes, the sample data must have 2 or more service units for every sample day.
  (b) If you sampled 3 one-way bus trips every 2nd day with an annual total sample of 549 trips during your last sampling year, your sample data would meet this requirement. If you have identified and corrected errors in your sample data, you may use them for developing interval-based sampling plans with the template.

§ 53.07 What other data do I need to use this template?
  (a) If you want to consider the grouping option, you must have data:
    (1) on the size of each service group in the number of service units operated during the period for which the sample data were collected, and
    (2) on the expected size of each service group for future sampling years.
    (3) Follow the instructions in the template on how you should enter the information on group size.
  (b) If you want to consider combining the grouping option with the APTL option, you must enter into the template whether you will have reliable 100% counts of UPT for each service group for estimating your annual PMT. Follow the instructions in the template on where you should enter this information. Your input affects several things:

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(1) The efficiency of your sampling plan. In general your sampling plan is more efficient if you will have reliable 100% counts of UPT by service group.

(2) How you should estimate your annual PMT. For example, you will need to estimate your annual PMT separately for each service group if you have 100% counts of UPT by service group. Refer to Subsection 83 for more guidance on estimation.

(3) The information you need to get from the template for determining whether you need to revise your template sampling plan. Refer to Subsection 56 for more guidance on revision of sampling plans.

(c) If you want to consider interval-based sampling plans, you must have information on the annual number of days of service and the daily number of trips.

§ 53.09 What sample data should I use to develop template sampling plans for next year?

(a) If you are not sampling this year, you should use the sample data from your most recent previous sampling year.

(b) If you are sampling this year, you should use the sample data from this year. It is critical that you process your sample data as they become available. The objective is that you can apply the companion template of this Manual to the cumulative sample data any time during this year. Refer to Section 60 for processing your sample data.

(1) If you are familiar with the companion template of this Manual, you should wait until a couple of weeks before the end of this year to use the template. It is fine if you miss a few service units in your annual NTD sample for this purpose. Note that you will still need to use the full sample to estimate your annual service-consumed data for NTD reporting.

(2) If you are not familiar with the companion template, you should start learning to use the companion template with your sample data from this year. Once you become familiar with the template, you should still wait until a couple of weeks before the end of this year to use the template.

§ 53.11 How does this template deal with fluctuations in sample data from one year to another for a given service?

(a) The measured statistical variation in APTL or any relevant characteristic of your service fluctuates from one year to another.

(b) Such fluctuations can occur from minor changes in your service or changes in how people use your service even if you do not adjust your service.

(c) Fluctuations can also occur due to errors in data collection as a result of sampling.

(d) This template has built in a 25% margin of safety against such fluctuations.

(e) This margin of safety is equivalent to increasing the minimum precision level from 10% to 8.94% at the same 95% confidence level.

§ 53.13 Why do such annual fluctuations in sample data require a margin of safety?

(a) FTA's 95% confidence and 10% precision levels are imposed on your estimates of annual service-consumed data.

(b) The template, on the other hand, can only impose these requirements on your template sampling plans, but not on the estimates you develop with data collected according to your template sampling plans.

(c) Whether the estimates of annual service-consumed data from the sample data collected according to the template sampling plans meet FTA's requirements depends on how the sample data fluctuate over time:
   (1) If the statistical variation is greater in the sample data used to develop your template sampling plan, your estimates will meet FTA's requirements.
   (2) If the statistical variation is smaller in the sample data used to develop your template sampling plan, your estimates may not meet FTA's requirements. The margin of safety is built in to prevent such violations from happening.

§ 53.15 How does this template ensure adequate sample size for developing template sampling plans in the future?
(a) Statistical theory shows that a minimum sample size of 50 is required to get an adequately precise estimate of how much APTL or any other relevant characteristic of your service varies across your service.
(b) This template has built in a minimum sample size of 50 for all new template sampling plans.

Subsection 54 – Usage and Output

§ 54.01   How do I use this template?
(a) You must choose **Enable Macros** upon opening the template.
(b) You must check a checkbox in the Cover Worksheet to develop interval-based sampling plans. The default is for period-based sampling plans.
(c) You must follow the instructions provided in the template.
(d) This template is illustrated with actual sample data in "The NTD Sampling Template with Sample Data.xlsm."
(e) This illustrated template is available for download at the NTD webpage: www.ntdprogram.gov.

§ 54.03 What does the template output include?
(a) The output includes a set of several sampling plans as a result of the input data you have entered.
(b) The sampling plans in this set differ in their efficiency options and sampling frequency.
(c) For period-based sampling plans, the number of sampling plans in this set varies with the efficiency options that your input data allow. It ranges from 6 sampling plans if you do not consider the PPMT and grouping options to 18 sampling plans if you consider them.
(d) For interval-based sampling plans, the number of sampling plans in this set varies with your weekly service patterns. It ranges from 8 sampling plans if you operate your service 5 days a week to 12 sampling plans if you operate 7 days a week.
(e) The set of sampling plans changes when you change your input data.

Subsection 55 – Selecting a Sampling Plan

§ 55.01   What should I consider in selecting one from the set of template sampling plans?
- (a) When your data allow, you should take the full advantage of the template by considering all possibilities, particularly both period-based and interval-based sampling plans and alternative ways of grouping your service. This exploratory use of the template is especially useful when you have not used template sampling plans before.
- (b) Once you have done the exploratory work, you should consider all five elements of a sampling plan:
  - (1) unit of sampling and measurement,
  - (2) sampling structure,
  - (3) efficiency options,
  - (4) sampling frequency, and
  - (5) annual sample size.
- (c) You should consider tradeoffs among the following characteristics of sampling plans:
  - (1) sampling cost – it is closely related to the annual sample size and to the unit of sampling and measurement.
  - (2) complexity of sampling plans – the grouping and PPMT options, for example, make sampling and estimation more complex.
  - (3) administrative convenience – how a sampling plan matches your institutional arrangements for sampling and data collection purposes.
- (d) If you want to choose an interval-based sampling plan for the current report year and want to consider interval-based sampling for future years:
  - (1) you should consider those plans that require sampling 2 or more service units per sample day. You must have sample data for 2 or more service units for each sample day in order to use the template for developing new interval-based sampling plans in the future. Or
  - (2) you may increase the daily sample size for a desired sampling frequency (e.g., every 3rd day) if the template results in a daily sample size of 1 for that frequency.

§ 55.03 Should I keep a copy of the used template that contains my sample data and my chosen template sampling plan?
- (a) Yes, you should keep a copy of the used template that contains your sample data and the final sampling plans, including the sampling plan you have chosen. It is useful later for several purposes.
- (b) You may need it for NTD requirements on record keeping.
- (c) You may also need it for the following purposes:
  - (1) Get information about the sample data for determining whether you need to revise your template sampling plan. Refer to Subsection 56 for guidance on that.
  - (2) Remind you what you have entered into the template on whether you will have reliable 100% count of UPT by service group if your template sampling plan is based on the APTL option with service grouping. Refer to Subsection 83 for guidance on estimation under the APTL option.

§ 55.05 How does my choice of efficiency options affect my choice of estimation methods?
    (a) Your choice of an efficiency option determines your method of estimation.
    (b) Follow the guidance on estimation in:
        (1) Section 70 if you choose the base option.
        (2) Subsection 83 if you choose the APTL option.
        (3) Subsection 85 if you choose the PPMT option.

§ 55.07 May I change template sampling plans from one report year to another?
    (a) Suppose that:
        (1) you have developed a set of final template sampling plans with sample data from a previous sampling year, and
        (2) you are using one of these template sampling plans this year.
    (b) The answer depends on whether you are required to revise your current sampling plan for next year. Refer to Subsection 56 on how you may determine the need for revision.
    (c) You may change to a different sampling plan from the current set of final template sampling plans if you are not required to revise your current sampling plan.
    (d) You may change to a different sampling plan from an entirely new set of template sampling plans if you choose to develop new sampling plans using your sample data from the current report year.
    (e) You must not change to a different sampling plan from the current set of template sampling plans if you are required to revise your current sampling plan.

§ 55.09 May I change sampling plans during a report year?
    (a) You should not change sampling plans during the same report year if you have not made major changes to your service.
    (b) You should increase the necessary sample size by 50% with the same template sampling plan you used during the first part of the year if you have made major changes to your service. For example, if you were sampling 4 one-way bus trips each week before the major changes, you should change to sample 8 one-way bus trips each week after those changes.
    (c) Table 55.01 shows this guidance in a tabular format.

Table 55.01. Tabular Guidance on Changing Sampling Plans in a Report year

If you	then you should	by
have not made major changes to your service	not change your sampling plan during a report year	
you have made major changes to your service	adjust your sampling plan during a report year	increasing the necessary sample size by 50%

§ 55.11 How should I implement a template sampling plan?
    (a) You must not implement a template sampling plan at a unit that is smaller than the unit used in developing the original sampling plan. For example, if your plan is to sample 3 round trips per week, you must not implement it by sampling 3 one-way trips per week.

(b) You may choose to sample and measure at a unit that is greater than the unit used in developing the original template sampling plan. For example, if your plan is to sample 4 one-way trips per week, you may implement it by sampling 4 round trips per week instead.

(c) You may only want to do (b) during the first year of implementing a template sampling plan. For example, once you have the sample data in round trips from the first year, you should use the sample data from the first year to develop a new template sampling plan in round trips for future years.

Subsection 56 – Revision

§ 56.01   When does this subsection apply to me?
(a) When you have used a template sampling plan for at least one year, or
(b) When you have been using a template sampling plan for the first time this year.

§ 56.03   Why do I need to consider revision?
(a) Your service and the traveling habits of your customers change naturally over time.
(b) To meet certification requirements:
    (1) Such service and habit changes may increase the statistical variation in key quantities (e.g., PMT, APTL) and hence require larger sample sizes.
    (2) The sampling plans produced by this template are only certified to meet FTA's requirements of 95% confidence with 10% precision for certain sampling cycles, presuming no major changes in your service.
    (3) After this time, or after major changes in your service, a new template sampling plan must be developed to maintain certification of compliance with the FTA requirements.
(c) To get more efficient sampling plans:
    (1) Such service and habit changes sometimes may reduce the statistical variation of key quantities (e.g., PMT, APTL).
    (2) You would be able to take advantage of such reduced variation by revising your template sampling plans using your most recent sample data that reflect these service and habit changes.

§ 56.05   Under what conditions should I revise my template sampling plan?
(a) If your next sampling year is your mandatory revising year, you must revise your template sampling plans. Or
(b) If you have made major changes to your service since you started using the current template sampling plan, you must consider revising your template sampling plan.

§ 56.07   How do I know if next year is a mandatory revising year for me?
(a) If you are required to sample every year, every 6th year is your mandatory revising year. For example, if you used your 2010 NTD sample to develop a template sampling plan, report year 2016 is your mandatory revising year.
(b) If you are required to sample every 3rd year, every 9th year is your mandatory revising year. For example, if you used your 2010 NTD sample to develop a template sampling plan, report year 2019 is your mandatory revising year.

(c) Follow the *Reporting Manual* to determine whether you are required to sample every year.

§ 56.09 What are considered major changes to my service?
(a) A major change is any change you make to your service that is likely to lead to major changes in the statistical variation in a relevant quantity of your service.
(b) The relevant quantity of your service varies with the sampling options you choose. It is PMT if you choose the base option, APTL if you choose the APTL option, etc.
(c) The following are examples of a major change:
   (1) Making transfers fare-free for all passengers.
   (2) Adding or cutting express routes to the base of all local service.
   (3) Expanding or contracting your service by at least 25% in vehicle revenue miles.
   (4) Service restructuring that affects at least 25% of your service in vehicle revenue miles.

§ 56.11 How do I determine if I must revise my template sampling plan after I have made major changes to my service?
(a) Enter your sample from the current report year into the companion template as if you were going to develop a new template sampling plan.
   (1) Enter your PPMT data if your current template sampling plan follows the PPMT option.
   (2) Enter the corresponding grouping data if your current template sampling plan follows the grouping option.
(b) For period-based sampling, go to the PeriodPrecision Worksheet. The index number you need depends on the efficiency option you have chosen for the current template sampling plan. For example, you must use the value in cell D6 of Part A, Figure 56.01 (=32.7) if your template sampling plan is based on the APTL option with service grouping and if you have chosen to use your 100% UPT count by group in developing your annual estimates.
(c) For interval-based sampling, go to the IntervalPrecision Worksheet. The index number you need also depends on the efficiency option you have chosen for your current template sampling plan. For example, you must use the value in cell C5 of Part B, Figure 56.01 (=31.3) if your template sampling plan is based on the APTL option.
(d) You must revise your sampling plan if the precision index is smaller than 10.0.

A. PeriodPrecision Worksheet

	A	B	C	D	E
1		**Precision Index for Period-Based Sampling**			
2					
3		Efficiency Options	No Grouping	Grouping	
4		Base Option	14.1	15.3	
5		APTL Option - 100% UPT Total	31.5	32.5	
6		APTL Option - 100% UPT by Group	N/A	32.7	
7		PPMT Option	24.3	30.9	
8		Notes:			
9		1. APTL Option - 100% UPT Total applies if cell M52 = 0 in the **PeriodInput** Worksheet.			
10		2. APTL Option - 100% UPT by Group applies otherwise.			

A. PeriodPrecision Worksheet

B. IntervalPrecision Worksheet

	A	B	C	D	E
1		**Precision Index for Interval-Based Sampling**			
2					
3		Efficiency Options	No Grouping		
4		Base Option	14.0		
5		APTL Option - 100% UPT Total	31.3		

B. IntervalPrecision Worksheet

Figure 56.01. Layout of the PeriodPrecision and IntervalPrecision Worksheets

Subsection 57 – Certification

§ 57.01 How do I certify my template sampling plan?
   (a) You must certify that that your template sampling plan meets FTA's 95% confidence and 10% precision levels through your annual reporting process.
   (b) You should follow the current *Reporting Manual* on how exactly you may do that.
   (c) This certification of your template sampling plan through the annual reporting process is conditional:
      (1) Your template sampling plan must use the 25% margin of safety according to Subsection 53.
      (2) You revise your template sampling plans over time according to Subsection 56.

SECTION 60 – DATA COLLECTION

Subsection 61 – General Directions

§ 61.01   What are the basic elements of collecting sample data?
(a) Selecting a sample at random according to your sampling plan (Subsection 63).
(b) Collecting data from the random sample (Subsection 65).
(c) Identifying and correcting any errors in the sample data (Subsection 67).

§ 61.03   What criteria does this section cover to ensure that estimates of annual service-consumed data meet FTA's 95% confidence and 10% precision levels?
(a) Your sampling process covers your entire service.
(b) You select your sample at random according to your chosen ready-to-use sampling plan or your template sampling plan.
(c) Your data-collection process is designed to avoid errors from happening.
(d) Your data-collection is designed to identify and correct errors when they occur.

Subsection 63 – Selecting a Sample at Random

§ 63.01   What are the basic elements of selecting a sample at random?
(a) Choosing a method with which you select a sample at random.
(b) Developing lists of service units that you expect to operate:
    (1) A single list of all services if your sampling plan is not based on service grouping.
    (2) One list for each service group if your sampling plan is based on service grouping.
(c) Selecting a sample at random from each list with the chosen method.

§ 63.03   What method may I use for random sampling?
(a) You may use the traditional method based on a table of random numbers.
(b) You may use any other method for random sampling as long as it meets these two criteria:
    (1) sampling under the method is random.
    (2) sampling under the method is without replacement. Without replacement means that the method will not select the same service unit more than once.

§ 63.05   What is a table of random numbers?
(a) It is a list of integers whose frequency and sequence of appearance in the list have been determined entirely by chance.
(b) For convenience and simplicity in use, published tables of random numbers usually appear in the form of separate columns of five-digit numbers. Both rows and columns may be consecutively numbered for easy reference. Table 63.01 shows an example.
(c) Appendix 98 is a comprehensive table of random numbers you may use for random sampling if you choose to use this method.

Table 63.01. Example of a Table of Random Numbers

Rows	(1)	(2)	(3)	(4)	(5)
1	10480	15011	01$536	02011	81647
2	22368	46573	25595	85393	30995
3	24130	48360	22527	97265	76393
4	42167	93093	06243	61680	07856
5	37570	39975	81837	16656	06121

§ 63.07   What is the list of all service units that I expect to operate?
(a) It is the amount of revenue service that you expect to operate.
(b) It is measured with the following characteristics:
   (1) It is in the unit of sampling and measurement of the sampling plan you have chosen.
   (2) It is for the duration corresponding to the sampling frequency that you have chosen for your sampling plan. The duration would be a day for interval-based sampling but a week, a month, or a quarter for period-based sampling.
   (3) It is for each of the service groups you have defined if your sampling plan is based on service grouping.
(c) For scheduled services, the list must include:
   (1) all service units that are listed on the schedule, and
   (2) all service units that are not on the schedule but are expected to be operated, such as trippers, shuttles, and other special operations.
(d) It would be the number of one-way bus trips you expect to operate in a week by your MB express routes, for example, if:
   (1) your sampling plan is in terms of one-way bus trips,
   (2) you have chosen weekly sampling for your MB service,
   (3) your sampling plan involves service grouping, and
   (4) you use express routes as one of the groups.

§ 63.09 How do I develop the list of all service units for using a table of random numbers?
(a) Suppose that:
   (1) you have chosen weekly sampling for your vanpool service,
   (2) your sampling plan requires 2 vanpool-days per week,
   (3) you want to select a random sample for next week, and
   (4) you have 101 vanpools and each of them is expected to operate every day next week.
(b) One way to develop the list would be to assign a serial number of four-digits to each vanpool-day for all 707 combinations of vanpools and service days. The first digit would represent the day of week with 1 for Monday and 7 for Sunday. The other three digits would represent vanpool numbers ranging from 001 through 101.
(c) The vanpool numbers may differ from what you use for your internal purposes. Make sure that you have a one-to-one list between the internal vanpool numbers and the new serial numbers if they differ.
(d) The serial numbers on a given day must be consecutive without any gaps.

(e) Write down just the first and the last for each day of week so that you will know the range of numbers. For example, the range for Monday is 1001-1101.

(f) You should summarize these serial numbers in a summary table as in Table 63.03.

Table 63.03. Example of a Summary Table of Serial Numbers

Day of Week	Range of Serial Numbers
1 (Monday)	1001-1101
2	2001-2101
3	3001-3101
4	4001-4101
5	5001-5101
6	6001-6101
7	7001-7101

§ 63.11   How do I use a table of random numbers?

(a) Suppose that:
   (1) you have 101 vanpools that you expect to operate every day of next week,
   (2) you have numbered the vanpool days for all vanpools as shown in Table 63.03, and
   (3) your sampling plan for your vanpool service requires 2 vanpool days per week.

(b) You must work with a constant length of digits from a table of random numbers for sampling. This constant length is given by the number of digits in the longest serial number you have assigned to members of the list of all service units.
   (1) This constant length would be 4 for the example in Table 63.03 because all serial numbers are four-digits long.
   (2) This constant length would be 5 if your serial numbers vary in length, ranging from one to five digits.

(c) You must combine adjacent digits from the table of random numbers as needed to obtain a two-, three-, or four-digit number, or any other length number from the table.
   (1) You may choose to work with rows or columns in combining adjacent digits. You may start with any row if you choose to work with rows. You may start with any column if you choose to work with columns. You may also choose to work from right to left or from left to right if you choose to work with rows.
   (2) If you choose to work with rows and to start with row 1, for example, the first 9 four-digit numbers from Table 63.01 would be:

1048, 0480, 4801, 8015, 0150, 1501, 5011, 0110, and 1101.

(d) You must continue forming four-digit numbers until you find two four-digit numbers from the table of random numbers that are in the summary table of serial numbers (Table 63.03). In the above example, these two numbers are 1048 and 1101. That is, you should select vanpools 48 and 101 and collect sample data from them on Monday of next week.

(e) Once you are done sampling for a week, you should mark where you stopped forming four-digit numbers in the table of random numbers. For example, the symbol, $, has been

inserted between digits 1 and 5 in row 1 and column 3 of Table 63.01. You should start the above process for a later week after that mark.

(f) Once you are done sampling for a year, you should mark where you stopped forming four-digit numbers in the table of random numbers if you plan to use this method of random sampling in the future.

    (1) If you number your service units exactly as for a previous sampling year, you should start the above process for a new sampling year after the last mark of your previous sampling year.

    (2) If you number your service units with a different approach for a new sampling year, you may start the above process anywhere in the table of random numbers.

§ 63.13 What are the pros and cons of using a table of random numbers?

(a) Using a table of random numbers for random sampling has the following advantages:

    (1) It is applicable to all situations.

    (2) You do not need to list explicitly all service units.

(b) It has the following disadvantages:

    (1) You must number your service units consecutively without gaps, at least within each subset of your service units. Subsets are formed by route, type of service days, etc.

    (2) You may not be able to take advantage of the serial numbers you have already assigned to your service units for internal purposes.

    (3) It can be difficult to use if the serial numbers have a large number of digits.

§ 63.15 What information should I keep from my sampling process?

(a) You should have an auditable record of your sampling process. That record should cover the following:

    (1) A written description of the sampling plan.

    (2) A written procedure for your method of selecting a sample at random.

    (3) The list of all service units from which you selected a sample at random for each act of sampling. For example, you should have 52 such lists if you did weekly sampling for an entire year.

    (4) The random sample.

Subsection 65 – Collecting Data from the Random Sample

§ 65.01 What method may I use to collect the sample data?

(a) One common method involves one or more ride checkers observing and recording passenger activities while riding in a transit vehicle.

(b) An increasingly common method uses APCs to record passenger activities instead.

(c) You may use one of these or any other method to collect the data from each service unit of your random sample as long as your method meets these criteria:

    (1) it obtains data from direct measurement or direct observation without passenger intercept,

    (2) it provides data you must have to determine PMT for each service unit, and

    (3) it meets the requirements on measurement accuracy in the *NTD Reporting Manual*.

§ 65.03 What approach may I use to determine PMT for each service unit of my sample?
  (a) You may use the load-based approach. It determines PMT by multiplying the number of passengers onboard a transit vehicle between each pair of consecutive stops by the distance between these stops.
  (b) You may also use the distance-based approach. It determines PMT by keeping track of the distance traveled by each passenger carried by a service unit of your random sample.

§ 65.05 What data items must I collect to use the load-based approach for scheduled services?
  (a) You must collect the required data items separately for each one-way vehicle trip in your service unit.
    (1) If your service unit is a round-trip bus trip, for example, it has two one-way vehicle trips.
    (2) If a service unit is a one-way train trip with three passenger cars, for example, it has three one-way vehicle trips.
  (b) The following data items are required for each one-way vehicle trip:
    (1) the number of people who boarded at each stop,
    (2) the number of people who alighted at each stop,
    (3) the distance between any pair of consecutive stops at which boardings or alightings occurred,
    (4) the number of people onboard the vehicle between any pair of consecutive stops,
    (5) the number of people who stayed on from the previous one-way vehicle trip, and
    (6) the number of people who remained on the vehicle at the last stop.

§ 65.07 What data must I collect to use the load-based approach for non-scheduled services?
  (a) For commuter vanpool, the following data items are required for each direction of commuting:
    (1) the number of people who boarded at each pick-up location,
    (2) the number of people who alighted at each drop-off location, and
    (3) the distance between any pair of consecutive stops at which pick-up or drop-off occurred.
  (b) For demand response (DR and DT), you must collect the required data items continuously during the entire vehicle day sampled:
    (1) the odometer reading at each pick-up location,
    (2) the number of people onboard between each pair of consecutive locations at which pick-up or drop-off occurred, and
    (3) the odometer reading at each drop-off location.
  (c) You should treat non-commuter vanpool as demand response for data collection.

§ 65.09 How should I determine between-stop distances for the load-based approach?
  (a) You should avoid using maps to estimate between-stop distances under all circumstances.
  (b) For services without designated stops, including demand response (DR and DT), jitney (JT), vanpool (VP), or fixed-route services without designated stops:

(1) If available, you should always use the onboard odometer to determine the between-stop distances for each service unit in your random sample. You should make sure that the vehicles for the sampled service unit have a working odometer onboard before they start for the sampled service unit.

(2) If your vehicle does not have an onboard odometer, you should determine the distance by retracing the path and the stops by automobile.

(3) You should record your odometer readings at least to one-tenth of a mile.

(c) For ferryboat (FB), aerial tramway (TR) and all rail services, you may want to predetermine the between-station distances for all routes and directions.

(d) For fixed-route services with designated stops, you should use one of two approaches:

(1) predetermine the between-stop distances for all routes and directions, or

(2) record the onboard odometer readings at individual stops.

(e) You may use different methods to predetermine the between-stop distances:

(1) use an up-to-date GIS of your network of routes and stops, or

(2) record the odometer readings while you drive through all of your routes and related deviations and directions.

(f) If you predetermine between-stop distances, you must keep them updated to reflect any changes in your services.

§ 65.11 What additional data should I collect to identify each service unit of my sample?

(a) You must record the date and the type of service days for all cases.

(b) For commuter rail (CR), heavy rail (HR), and light rail (LR), you must also record the weekday time period that you will be reporting to the NTD for weekdays.

(c) If your sampling plan is based on the PPMT option, you must record route identification.

(d) If your sampling plan is based on service grouping, you should also record information that is necessary to determine group membership of each service unit in the random sample.

§ 65.13 When do I use the different approaches to determining PMT?

(a) The load-based approach is applicable to all circumstances. Under conditions of heavy loads or high boarding volumes, however, extra care must be taken to maintain the required level of measurement accuracy.

(b) The distance-based approach is useful under several circumstances. For examples:

(1) All passengers board and alight at the same locations, such as inclined plane (IP), aerial tramway (TR), and most ferryboat (FB) operations.

(2) Services with a small number of passengers who board and alight at a small number of stops, such as demand response (DR and DT).

(3) Services with a small number of frequent passengers who board and alight at a small number of stops, such as commuter vanpool.

(4) Any service with a ticketing system that keeps track of the origin and destination for every boarding with a known distance.

§ 65.15 What instrument should I use to collect the data for the distance-based approach?

(a) You may use any instrument that you have designed as long as you can use it to record the required data items correctly.

(b) If you use human ride checkers, the instrument may be a piece of paper and a pencil or it may be a hand-held device.

(c) Appendix 92 provides an example of both blank and filled-out paper instruments for the distance-based approach.

§ 65.17 What instrument should I use to collect data for the load-based approach?

(a) You may use any instrument that you have designed as long as you can record the required data items correctly.

(b) If you use APCs, the instrument would be computer software and hardware that records the counts and other data items transmitted from the APCs.

(c) If you use human ride checkers, the instrument may be a piece of paper and a pencil or it may be a hand-held device.

(d) If you use a hand-held device, it is critical that the unit accepts counts of boardings and alightings that may not be equal for a one-way vehicle trip.

(e) The instrument you design may take slightly different formats for different services. Three examples of blank and filled-out instruments are shown as appendices:
(1) demand response – Appendix 93.
(2) commuter vanpool – Appendix 94.
(3) fixed-route services – Appendix 95.

(f) If you are going to use one of these example instruments, you should study it carefully before reading the following guidance.

§ 65.19 What pre-survey procedures should I follow if I use a paper instrument and human ride checkers?

(a) You should use an appropriate survey sheet for each service unit selected in the sample. This survey sheet may be one of those from the appendices or one that you have designed, but it is important that you select a survey sheet that is designed for the service to be surveyed.

(b) For non-scheduled services, including demand response (DR and DT) and vanpool (VP), a survey sheet should be used for each driver of the survey vehicle during an entire day.

(c) For scheduled services, a survey sheet should be used for each one-way vehicle trip of your service unit that you have chosen for your sampling plan.

(d) The ride checker(s) should carry several extra survey sheets in the event that extra sheets are needed.

(e) You should learn about the likely load and boarding volumes for each service unit to be surveyed.
(1) You may need to use more than one ride checker under conditions of high loads and high boarding volumes.
(2) If more than one ride checker is used, the separate survey sheets should also be labeled with the door(s) that each ride checker is responsible for.

(f) If you rely on the onboard odometer to determine the between-stop distances, make sure that it works properly. If you cannot fix a malfunctioning odometer in time for a ride check, use a different vehicle with a working odometer.

(g) Before going into the field, the survey supervisor should fill in the data items that identify the service unit to be surveyed. If your service unit has more than one one-way vehicle trip, identify each one-way vehicle trip separately.

(h) If you rely on predetermined between-stop distances, the survey supervisor should also use the survey sheet(s) in Appendix 95 to:
  (1) Fill in the stop numbers in column (7) and stop descriptions in column (8) for all stops.
  (2) Cross out column (9) to avoid confusion in the field.
(i) You should write the page numbers in the box in the lower right-hand corner of each survey sheet if you use more than one survey sheet for a given one-way vehicle trip.

§ 65.21 What manual survey procedures should I follow for demand response (DR and DT) with the distance-based approach?
(a) You may use the survey sheet for the distance-based approach in Appendix 92.
(b) You must record individual trips by each pair of origin and destination. The filled-out form in Appendix 92 illustrates three cases of pick-up and drop-off patterns:
  (1) The first pick-up illustrates the "one origin-many destinations" case. The driver picked up 16 passengers at 1020 J Street. He immediately distributed these passengers according to their three drop-off destinations under item (8).
  (2) The second pick-up illustrates the "one origin-one destination" case. At the next pick-up address, 506 10th Street, 17 passengers boarded and all were driven to the same destination. Here, a single line records all the necessary information.
  (3) The last two pick-ups illustrate a "many origins-one destination" case. Here, the driver records the pick-up addresses and repeats the destinations; that is, he handles each as an individual trip.
(c) You must record the odometer readings for each pick-up and drop-off.
  (1) Item (7), "Pick-Up Odometer Reading," should be recorded immediately upon picking up the passenger(s).
  (2) Item (8), "Drop-Off Odometer Reading," should be recorded immediately upon dropping off the passengers.
  (3) You should also record the odometer readings to at least one-tenth of a mile when the odometer allows.
(d) You should use additional pages if a service unit involves more stops than are given on a page. You should write the page numbers in the box in the lower right-hand corner.
(e) As an alternative to data recording by the driver, the driver can call in the information to the dispatcher if you have two-way radio communications on all vehicles.
  (1) When the driver arrives at a pick-up point, he can call in items (5)-(8).
  (2) When he arrives at each destination, he can call in item (9) and verify how many passengers were dropped off at that destination.

§ 65.23 What manual survey procedures should I follow for demand response (DR and DT) with the load-based approach?
(a) You may use the survey sheet for the load-based approach for demand response in Appendix 93.
(b) For each pick-up or drop-off, you must record the following:
  (1) whether it is a pick-up or drop-off in column (5),
  (2) a description of the location in column (6),
  (3) the odometer reading in column (7), and
  (4) the leaving load in column (8).

(c) The filled-out form in Appendix 93 shows the recorded information for the example shown in Appendix 92. The leaving load at the last drop-off location should be 0.
(d) You should record the odometer readings to at least one-tenth of a mile.
(e) You should use additional pages if a service unit involves more stops than are given on a page. You should write the page numbers in the box in the lower right-hand corner.
(f) As an alternative to data recording by the driver, the driver can call in the information to the dispatcher if you have two-way radio communications on all vehicles. Before leaving each pick-up or drop-off location, the driver can call in items (5)-(8).

§ 65.25 What manual survey procedures should I follow for commuter vanpool with the load-based approach?
(a) Suppose that you have chosen to sample on a monthly basis.
(b) Before a new month starts, you should communicate with the driver of each sampled vanpool about the days on which he must collect sample data during the new month.
(c) For each sampled vanpool day, the driver should fill in the identification data before he leaves home, including the date, the day of week, and the vanpool number.
(d) The driver is required to record the travel data, including the van odometer reading whenever any rider gets on or off the van along with the number of riders who get on the van and the number of riders who get off the van. This recording is to be done separately for travel to work and travel from work. The filled-out form in Appendix 94 shows the travel data for a vanpool of 6 riders with a round-trip-distance of 78 miles. The driver picks up all 5 riders at a single location but drops them off at three different locations in the morning. In the afternoon, the process reverses itself.
   (1) Once the driver gets on the van in the morning, he should enter 1 in the ON column (6) and record the odometer reading at 29,366.0 in column (8).
   (2) He then leaves for picking-up 5 fellow vanpoolers at another location. Once they get on the van, he should enter 5 in (6), and record the odometer reading at 369.1 in (8) before departing that location.
   (3) At the first drop-off location, 3 vanpoolers get off. Before leaving, the driver should enter 3 in the OFF column (7), and record the odometer reading at 395.3 in (8).
   (4) One vanpooler gets of the van at each of the next two drop-off locations. Before leaving these locations, the driver should enter 1 in the OFF column, and record the odometer reading at 396.8 and 397.5, respectively.
   (5) Finally, the driver arrives at his own destination. Before he leaves the van, he should record the odometer reading again at 405.0.
(e) The day after each sample day, you should communicate with each driver involved in collecting sample data to determine if he actually recorded the sample data. Sample data may be not recorded for a variety of reasons.
   (1) If the data were collected, the driver should send the filled-out survey sheet immediately,
   (2) If the driver forgot to collect the data, he should be asked to collect the data next day,
   (3) If the driver refused to collect the data or the vanpool has been terminated, a replacement vanpool day should be selected at random.

§ 65.27 What instructions should I give my ride checkers if I do not use predetermined between-stop distances for fixed-route services?

   (a) Take enough copies of the survey sheet in Appendix 95 or an alternative sheet.

   (b) Use separate survey sheets for separate one-way vehicle trips if your service unit has more than one one-way vehicle trip.

   (c) Use additional survey sheets if needed for a given one-way trip.

   (d) Board the transit vehicle at the beginning point of the service unit and position yourself so that you can observe the doors for which you are responsible.

   (e) Before the vehicle leaves the beginning point, record:

      (1) Stop #1 in column (7),

      (2) stop description of the beginning point in column (8),

      (3) odometer reading to at least one-tenth of a mile in column (9),

      (4) number of passengers who have stayed onboard from the last trip (13), and

      (5) number of passengers boarded in (10), including the passengers who have stayed onboard from the last trip in (e)(4).

   (f) When the vehicle leaves the beginning point, record the number of passengers onboard in column (12), including any passengers who have stayed onboard from the last trip.

   (g) Only at points where the vehicle stops during the service unit, record:

      (1) stop number in (7),

      (2) stop description in (8),

      (3) odometer reading (from the driver) in (9),

      (4) passengers boarded in (10), and

      (5) passengers alighted in (11).

   (h) Between stops, count the number of passengers on board (12). You should record this number as the leaving load. For example, between stops 2 and 3 you should record this number in the row for stop 2 rather than in the row for stop 3.

   (i) At the end point of each one-way trip, record the number of passengers who will stay on board to the next trip in column (14) and in column (11) as passengers alighted.

§ 65.29 What steps should I take if I fail to collect the sample data from a particular unit?

   (a) You may fail to collect the required sample data from any particular unit in your sample:

      (1) The unit may be canceled for a variety of operational reasons.

      (2) The ride checker(s) may fail to show up for the unit.

      (3) The ride checker(s) may fail to collect the data.

   (b) You must replace the missed unit as soon as possible on the same type of service days.

   (c) For period-based sampling:

      (1) If the rest of the sampling period (a week, a month, or a quarter) has at least one service day of the same type as the missed service unit, select one service unit from the next service day of the same type. For example, if the missed service unit is on the second Monday of a month and your sampling is monthly, you should get a replacement unit from the third Monday of the month.

      (2) If the rest of the sampling period does not have any service day of the same type left, select one service unit from the first service day of the same type during the next sampling period. For example, if the missed service unit is on a Monday and your sampling is weekly, you should get a replacement unit from the next Monday.

   (d) For interval-based sampling:

(1) If the rest of the report year has at least one service day of the same type as the missed service unit, select one service unit from the next service day of the same type.

(2) If the rest of the report year does not have any service day of the same type left, select one service unit from the next day of service.

(e) The replacement unit must be selected at random in all cases.

Subsection 67 – Correcting Errors in the Raw Sample Data

§ 67.01   What steps should I take after I have collected the sample data?
(a) Design a format for recording your sample data.
(b) Enter the raw data.
(c) Process the entered data.
(d) Identify errors in the entered data.
(e) Identify sources of the data errors, if any.
(f) Correct the data errors, if any.
(g) What you should do within each step depends on your situation. To be specific, the following example is used for the rest of this subsection:
  (1) you collect sample data with human ride checkers from one-way bus trips with designated stops,
  (2) you use the load-based approach to determining PMT,
  (3) you use predetermined between-stop distances, and
  (4) you have collected sample data from a route whose longest one-way trip is 4 miles.

§ 67.03   What should I consider in designing the format for data recording?
(a) The data items you have collected to determine PMT. The exact data items depend on your service and the approach you have taken to determine PMT.
(b) The data items that identify the service units in your sample.
(c) A format that is easy for data analysis.
(d) Suppose that you have designed a format in Table 67.01. With this format, you enter the field data (7)-(14) as they appear on the field survey sheet shown in the filled-out form in Appendix 95. Item (8) is not shown due to space limit. The identification data items at the top of the survey sheet (1)-(6) are repeated for each stop of this one-way trip.

Table 67.01. Example Format for Data Recording

Date (1)	Day of Week (2)	Time Period (3)	Route No. (4)	Trip No. (5)	Direction (6)	Stop Sequence (7)	Distance to Next Stop (9)	No. of Pass. Boarded (10)	No. of Pass. Alighted (11)	No. of Pass. On Board (Leaving Load) (12)	No. of Pass. from Previous Trip (Stop 1 only) (13)	No. of Pass. Continuing to Next Trip (Last Stop only) (14)
10/13/05	Thur	Midday	11	408	Outbound	1	0.3	20	0	20	2	
10/13/05	Thur	Midday	11	408	Outbound	2	0.7	2	1	21		
10/13/05	Thur	Midday	11	408	Outbound	3	0.6	0	2	19		
10/13/05	Thur	Midday	11	408	Outbound	4	0.3	1	3	17		
10/13/05	Thur	Midday	11	408	Outbound	5	0.5	1	10	8		
10/13/05	Thur	Midday	11	408	Outbound	6	0.8	0	2	6		
10/13/05	Thur	Midday	11	408	Outbound	7	0.2	0	1	5		
10/13/05	Thur	Midday	11	408	Outbound	8	0.1	0	2	3		
10/13/05	Thur	Midday	11	408	Outbound	9	0.1	0	2	1		
10/13/05	Thur	Midday	11	408	Outbound	10	0.3	0	0	1		
10/13/05	Thur	Midday	11	408	Outbound	11	0.1	0	0	1		
10/13/05	Thur	Midday	11	408	Outbound	12	0.0	0	1	1		1

§ 67.05 When should I enter my sample data?

(a) You should have the sample data from each service unit entered immediately after your ride checker(s) has come back from the field.

(b) This has a number of advantages:
  (1) reducing the chance of loss of information,
  (2) increasing the chance of correcting data errors, if any,
  (3) being ready to use the cumulative sample data any time during the sampling year, and
  (4) minimizing the rush at the end of the year.

§ 67.07 How should I process the entered data?

(a) You should process the data as follows immediately after you have entered them. If your service unit has more than one one-way vehicle trip, you should process the data for individual one-way vehicle trips:
  (1) Sum the number of passengers boarded at individual stops in column (10) of Table 67.01 to get the total number of passengers boarded (UPT). It is 24 in this case.
  (2) Sum the number of passengers alighted at individual stops in column (11) of Table 67.01 to get the total number of passengers alighted. It is 24 in this case.
  (3) Calculate the load between every pair of two consecutive stops. Table 67.03 shows an example and the formulas for calculating leaving loads and arriving loads.
  (4) Calculate PMT for each pair of consecutive stops by multiplying the calculated load with the between-stop distance. Table 67.03 also shows the calculation of PMT with both leaving loads and arriving loads.
  (5) Calculate total PMT. It is 47.8 miles in this case.
  (6) Divide total PMT by the total number of passengers boarded to get APTL. It is 1.99 miles in this case.
  (7) Calculate vehicle trip length by summing up the predetermined between-stop distances in column (9). It is 4.0 miles in this case.

(b) If your sampling plan is based on the PPMT option, you should also process the data as follows immediately to calculate the ratio of PMT to PPMT for each service unit:

(1) Calculate the average route length for each route.
(2) Calculate PPMT by multiplying UPT by average route length.
(3) Divide PMT by PPMT to get the ratio for each service unit.
(4) Follow Subsection 85 on calculating average route length and PPMT.

Table 67.03. Calculation of Loads and PMT

Load Type	Stop Sequence	Distance to Next Stop	No. of Pass. Boarded	No. of Pass. Alighted	No. of Pass. from Previous Trip	Calculated Load	PMT
Leaving Load	1	0.3	20	0	2	20	6.0
	2	0.7	2	1		21	14.7
	3	0.6	0	2		19	11.4
	4	0.3	1	3		17	5.1
	5	0.5	1	10		8	4.0
	6	0.8	0	2		6	4.8
	7	0.2	0	1		5	1.0
	8	0.1	0	2		3	0.3
	9	0.1	0	2		1	0.1
	10	0.3	0	0		1	0.3
	11	0.1	0	0		1	0.1
	12	0.0	0	1		0	0.0
	Total	4.0	24	24	2	N/A	47.8

Load for Stop 1 =   Current Boarding
Load for Other Stops =   Previous Load + Current Boarding - Current Alighting

Load Type	Stop Sequence	Distance from Previous Stop	No. of Pass. Boarded	No. of Pass. Alighted	No. of Pass. from Previous Trip	Calculated Load	PMT
Arriving Load	1	0.0	20	0	2	0	0.0
	2	0.3	2	1		20	6.0
	3	0.7	0	2		21	14.7
	4	0.6	1	3		19	11.4
	5	0.3	1	10		17	5.1
	6	0.5	0	2		8	4.0
	7	0.8	0	1		6	4.8
	8	0.2	0	2		5	1.0
	9	0.1	0	2		3	0.3
	10	0.1	0	0		1	0.1
	11	0.3	0	0		1	0.3
	12	0.1	0	1		1	0.1
	Total	4.0	24	24	2	N/A	47.8

Load for Stop 1 =   0
Load for Other Stops =   Previous Load + Previous Boarding - Previous Alighting

§ 67.09   How may I use the processed data to identify potential errors in the sample data?
   (a) Make sure that UPT and PMT are consistent for each service unit in the sample. For example, they should both be zero or both be positive.
   (b) Compare vehicle trip length with the longest actual length of the route. Vehicle trip length must not exceed the longest route length.
   (c) Compare APTL with vehicle trip length and route length. APTL must not exceed either.
   (d) Compare the total number of passengers boarded with the total number of passengers alighted. They must be equal.
   (e) Examine the calculated load at the end point of the trip. It must be zero for leaving loads.
   (f) If calculated, examine the PMT to PPMT ratio for each service unit. It must not exceed 1.

§ 67.11   How do I identify the sources of any errors?
   (a) If you have identified any error from the previous step, you should start with the calculations you did in processing the sample data to determine if an error is a calculation error or an error in the sample data.
   (b) Check if you have correctly calculated loads, UPT, PMT, and APTL.
   (c) Check if you have used between-stop distances and loads consistently:
      (1) If you use leaving loads, you must use the distance to the next stop. The distance should be zero for the ending point of a one-way trip.
      (2) If you use arriving loads, you must use the distance from the previous stop. The distance should be zero for the beginning point of a trip.
   (d) Check the predetermined between-stop distances you entered.
   (e) Compare your calculated load with the observed load from the field.

§ 67.13   How do I correct any errors?
   (a) Table 67.05 shows an example of sample data for a one-way trip where PMT is based on calculated leaving loads. The first row of Table 67.07 shows the vehicle trip length, UPT, PMT, APTL, and the ratio of PMT/PPMT for this trip.
   (b) It has the following errors:
      (1) Vehicle trip length > route length.
      (2) APTL > route length.
      (3) Total boardings in column (10) < total alightings in column (11).
      (4) The load at the end stop < 0.
   (c) Error (b)(1) clearly indicates errors in the predetermined between-stop distances. If you check what you have entered in column (9), you would notice the 7 miles from stop 3 to stop 4. Correct the data-entry error by replacing 7 by 0.7. After this change,
      (1) vehicle trip length matches the route length,
      (2) APTL becomes smaller than the route length, and
      (3) PMT is reduced to 34.7 with an APTL of 1.58 miles.
   (d) To identify the source of error (3), compare the calculated loads with the observed loads. You may notice that the calculated load is lower by 2 at the first stop. It appears that the ride checker did not include the number of passengers from the previous trip in the number of boardings at the first stop. With this correction,
      (1) Boardings become greater than alightings.

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(2) PMT is increased to 42.7 miles with an APTL of 1.78 miles.

Table 67.05. Example of Correcting Data Errors

Stop Sequence	Distance to Next Stop	No. of Pass. Boarded	No. of Pass. Alighted	Observed Leaving Load	No. of Pass. from Previous Trip (Stop 1 only)	No. of Pass. Continuing to Next Trip (Last Stop only)	Calculated Leaving Load	PMT
(7)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1	0.0	18	0	20	2		18	0.0
2	0.3	2	1	21			19	5.7
3	7.0	0	2	19			17	119.0
4	0.6	1	3	17			15	9.0
5	0.3	1	9	8			7	2.1
6	0.5	0	2	6			5	2.5
7	0.8	0	1	5			4	3.2
8	0.2	0	2	3			2	0.4
9	0.1	0	2	1			0	0.0
10	0.1	0	0	1			0	0.0
11	0.3	0	0	1			0	0.0
12	0.1	0	1	1		1	-1	-0.1
Total	10.3	22	23		2	1	N/A	141.8

(e) To identify why boardings are still larger than alightings, compare the recalculated loads with the observed loads again. You may notice that the recalculated load starts deviating from the observed load at stop 5. Since the calculated load is one passenger too big, increase the number of alighted passengers at stop 5 by 1 from 9 to 10. With this correction,
(1) Boardings equal alightings,
(2) The leaving load at the end stop is 0, and
(3) PMT is further reduced to 40.3 with an APTL of 1.68 miles.
(f) You should also check the consistency between between-stop distances and the calculated loads. Column (9) is based on the distance from the previous stop, but the calculated load is the leaving load. Correcting this error leads to a final PMT of 47.8 with an APTL of 1.99 miles.
(g) Table 67.07 also shows vehicle trip distance, UPT, PMT, APTL, and ratio PMT/PPMT for the cumulative corrections in (c), (d), (e), and (f).

Table 67.07. Impacts of Correcting Errors

Error Corrections	Vehicle Trip Length	PMT	UPT	APTL	PMT/PPMT
No corrections	10.3	141.8	22	6.45	0.63
§69.13 (c)	4.0	34.7	22	1.58	0.39
§69.13 (c) + (d)	4.0	42.7	24	1.78	0.44

| §69.13 (c) + (d) + (e) | 4.0 | 40.3 | 24 | 1.68 | 0.42 |
| §69.13 (c) + (d) + (e) + (f) | 4.0 | 47.8 | 24 | 1.99 | 0.50 |

§ 67.15 What should I do if I fail to correct the data errors for a particular service unit?
(a) You should treat the service unit as if it were missed for data collection.
(b) You should follow the guidance in §65.29 for getting a replacement unit.

§ 67.17 What steps should I take after I have identified and corrected errors in my data?
(a) You should stack the corrected sample data from the field as shown in Table 67.01 in one or more worksheets. These worksheets along with the survey sheets become an auditable record of your sample data.
(b) You should enter the summary data at the level of your unit of sampling and measurement in a separate worksheet. These summary data are ready for developing new sampling plans or for estimating service-consumed data for the NTD.
(c) Table 67.09 shows how that summary worksheet looks with the column headings and the summary sample data for one service unit.

Table 67.09. Example of Summary Sample Data

Date	Day of Week	Time Period	Route No.	Trip No.	Direction	Vehicle Trip Length	UPT	PMT
(1)	(2)	(3)	(4)	(5)	(6)			
10/13/05	Thur	Midday	11	408	Outbound	4.0	24	47.8

SECTION 70 – ESTIMATION WITHOUT 100% UPT

Subsection 71 – General Directions

§ 71.01   What service-consumed data must I estimate without 100% UPT?
   (a) You must estimate both UPT and PMT.
   (b) The following table shows the data items you must estimate.

Table 71.01. Service-Consumed Data Items without 100% UPT

If your mode is	you must estimate
demand response – taxi (DT)	• annual total UPT and PMT
commuter rail (CR), heavy rail (HR), or light rail (CR)	• annual total UPT and PMT • average daily UPT and PMT by type of service days • annual total UPT by weekday time period
any other mode	• annual total UPT and PMT • average daily UPT and PMT by type of service days

§ 71.03   What do I need to do in general to get estimates of these data items?
   (a) You must determine sample averages.
   (b) You must determine expansion factors.
   (c) You must combine the expansion factors and sample averages to get the corresponding estimates of service-consumed data.

§ 71.05   What is a sample average?
   (a) A sample average is the sample total divided by the number of service units in the sample.
   (b) It may be calculated for the entire annual sample, by the type of service day, or for specific weekday time periods.
   (c) Sample averages are used to estimate service-consumed data when your sampling plan is based on the base option.

§ 71.07   What is an expansion factor?
   (a) A measure of actual services operated during a given duration of time.
   (b) It is used to convert sample averages to totals in the given duration. The total number of one-way bus trips operated during an entire report year is an example of an expansion factor in actual services operated; when multiplied by sample average PMT per one-way bus trip, it yields a measure of annual total PMT.

§ 71.09   How is the guidance organized?
   (a) The guidance is separate in three subsections for three modal groups to reduce confusion over the different units of sampling and measurement that are typically used for these three modal groups:

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(1) Non-scheduled services, including demand response (DR and DT), vanpool (VP), jitney (JT), or público (PB) (Subsection 73).
(2) Rail services, including heavy rail (HR), commuter rail (CR), light rail (LR), monorail and automated guideway (MG) (Subsection 75).
(3) Bus services, including bus (MB), commuter bus (CB), bus rapid transit (RB), or trolley bus (TB) (Subsection 77).
(b) Subsection 79 contains the guidance on combining expansion factors and sample averages to get estimates of service-consumed data.

Subsection 73 – Non-Scheduled Services

§ 73.01   What expansion factor should I use for non-scheduled service?
(a) You should use your 100% count of vehicle days as the expansion factor.
(b) For estimating annual total PMT and UPT:
    (1) Use annual total count of vehicle days if your sampling plan is not based on grouping.
    (2) Use annual total count of vehicle days by group if your sampling plan is based on grouping.
(c) For estimating average daily PMT and UPT by type of service days, use annual total count of vehicle days by type of service days.

§ 73.03   What sample average should I use for non-scheduled service?
(a) You must use the ratio of sample total PMT over sample total vehicle days as the sample average to estimate PMT.
(b) You must use the ratio of sample total UPT over sample total vehicle days as the sample average to estimate UPT.
(c) For estimating annual total PMT and UPT:
    (1) Use the sample averages for the entire sample if you do not group your service.
    (2) Use the sample averages for each group if your sampling plan is based on grouping.
(d) For estimating average daily PMT and UPT by type of service days, use the sample averages by type of service days. If your sample happens not to include any vehicle-days for a particular day type (e.g., Saturday), use the sample average for the entire sample.

§ 73.05 How do I determine annual vehicle days actually operated for non-scheduled services?
(a) You should use a spreadsheet or some other mechanism to record the daily number of passengers carried by individual vehicles in your fleet for an entire year.
(b) Figure 73.01 shows an example of such a spreadsheet with the following assumptions:
    (1) your fiscal year runs from July 1 through June 30,
    (2) you operate every day, and
    (3) your fleet has 100 vehicles.
(c) Once you have such a spreadsheet, you can easily determine the daily number of vehicles operated by type of service days in two steps:
    (1) For any one operating date, count the number of vehicles in the fleet that carried at least one passenger on that date.
    (2) Summarize the daily number of vehicles operated by type of service days.

(d) You can also use such a spreadsheet to determine the number of vehicles operated for each group if your sampling plan is based on service grouping.

	B	C	D	E	F	G	H	I	J	...	CZ	DA
1	Date	Month	Day of Week	Daily Passengers Carried by Vehicle No.								
2				1	2	3	4	5	6	...	100	Total
3	7/1/09	July	Wed									
4	7/2/09	July	Thu									
5	7/3/09	July	Fri									
6	7/4/09	July	Sat									
...	...	...	...									
367	6/30/10	June	Wed									
368	Total											

Figure 73.01. Daily Passenger Count Worksheet for Non-Scheduled Services

Subsection 75 – Rail Services

§ 75.01   What expansion factor should I use for rail services?
  (a) The unit of sampling and measurement you have chosen for your sampling plan determines the expansion factor you should use.
  (b) While you could have chosen any unit of sampling measurement for your sampling plan, it most likely is one of the following:
      (1) One-way car trips.
      (2) One-way train trips.
      (3) Round-trip car trips.
      (4) Round-trip train trips.
  (c) The following assumes that your sampling plan is based on one-way car trips.
  (d) For estimating annual total PMT and UPT:
      (1) Use annual total one-way car trips if your sampling plan is not based on grouping.
      (2) Use annual total one-way car trips by group if your sampling plan is based on grouping.
  (e) For estimating average daily PMT and UPT by type of service days, use annual total one-way car trips by type of service days.
  (f) For estimating annual total UPT for heavy rail (HR), commuter rail (CR), light rail (LR) by weekday time period, use annual total one-way car trips by weekday time period.

§ 75.03   What sample average should I use for rail services?
  (a) The unit of sampling and measurement you have chosen for your sampling plan determines the sample average you should use.
  (b) While you could have chosen any unit of sampling measurement for your sampling plan, it most likely is one of the following:
      (1) One-way car trips.
      (2) One-way train trips.

(3) Round-trip car trips.

(4) Round-trip train trips.

(c) Assuming that your unit of sampling and measurement is in one-way car trips, Table 75.01 shows the sample averages you should use.

(d) If your sample happens not to include any one-way car trips for a particular weekday time period, use UPT per one-way car trip for weekdays to estimate the annual total UPT for this weekday time period.

Table 75.01. Sample Averages for Rail Services

If the service-consumed measure is	and if the measure is	and if your sampling plan is	and if your mode is	then you should calculate the following sample average
UPT	for annual total	not based on grouping		UPT/one-way car trip
		based on grouping		UPT/one-way car trip by group
	for daily average			UPT/one-way car trip by type of service days
	by weekday time period		commuter rail (CR), heavy rail (HR), or light rail (LR)	UPT/one-way car trip by weekday time period
PMT	for annual total	not based on grouping		PMT/one-way car trip
		based on grouping		PMT/one-way car trip by group
	for daily average			PMT/one-way car trip by type of service days

§ 75.05 What steps should I follow to calculate sample averages?

(a) Aggregate the field sample data to the individual service units in your sample after you have identified and corrected any errors in the data.

(b) If the unit of sampling and measurement for your sampling plan is one-way car trips, sum these quantities over individual one-way car trips in the sample to get sample totals:

(1) for the entire sample,

(2) by type of service days,

(3) by weekday time period if your service is commuter rail (CR), heavy rail (HR), or light rail (LR), and

(4) by group if your sampling plan is based on service grouping.

(c) Count the number of one-way car trips in the sample:

(1) for the entire sample,

(2) by type of service days,

(3) by weekday time period if your service is commuter rail (CR), heavy rail (HR), or light rail (LR), and

(4) by group if your sampling plan is based on service grouping.

(d) Divide sample totals by the number of one-way car trips for the entire sample, by type of service days, by weekday time period if applicable, or by service group if applicable.

§ 75.07 How should I determine annual services actually provided as expansion factors?
    (a) You should measure annual services actually provided in the unit of sampling and measurement you have chosen for your sampling plan.
    (b) For estimating annual totals of service-consumed data, you should follow these steps:
        (1) Start with your schedule.
        (2) When the schedule is changed by policy or by emergency conditions, the count from the schedule must be adjusted accordingly.
        (3) You must also include added services such as trippers and other special operations.
        (4) If your sampling plan is based on service grouping, you must also count annual services actually provided for each group.
    (c) For estimating service-consumed data by type of service days, you should also start your schedule, and exclude scheduled services on atypical days.
    (d) For estimating annual total UPT for commuter rail (CR), heavy rail (HR), or light rail (LR) by weekday time period, you should start with your weekday schedule, and exclude scheduled services on atypical weekdays.
    (e) Refer to the *NTD Reporting Manual* on determining what are considered atypical days.

Subsection 77 – Bus Services

§ 77.01 What expansion factor should I use for bus services?
    (a) The unit of sampling and measurement you have chosen for your sampling plan determines the expansion factor you should use.
    (b) While you could have chosen any unit of sampling measurement for your sampling plan, it most likely is in one-way bus trips or in round-trip bus trips.
    (c) The following assumes that your sampling plan is based on one-way bus trips.
    (d) For estimating annual total PMT and UPT:
        (1) Use annual total one-way bus trips if your sampling plan is not based on grouping.
        (2) Use annual total one-way bus trips by group if your sampling plan is based on grouping.
    (e) For estimating average daily PMT and UPT by type of service days, use annual total one-way bus trips by type of service days.

§ 77.03 What sample average should I use for bus services?
    (a) The unit of sampling and measurement you have chosen for your sampling plan determines the sample average you should use.
    (b) While you could have chosen any unit of sampling measurement for your sampling plan, it most likely is in one-way bus trips or in round-trip bus trips.
    (c) Assuming that your unit of sampling and measurement is in one-way bus trips, Table 77.01 shows the sample averages you should use.
    (d) If your sample happens not to include any one-way bus trips for a particular day type (e.g., Saturday), use the sample average for the entire sample.

Table 77.01. Sample Averages for Bus Services

If the service-consumed measure is	and if the measure is	and if your sampling plan is	then you should calculate the following sample average
UPT	for annual total	not based on grouping	UPT/one-way car trip
		based on grouping	UPT/one-way car trip by group
	for daily average		UPT/one-way car trip by type of service days
PMT	for annual total	not based on grouping	PMT/one-way car trip
		based on grouping	PMT/one-way car trip by group
	for daily average		PMT/one-way car trip by type of service days

§ 77.05   What steps should I follow to calculate sample averages?
(a) Aggregate the field sample data to the individual service units in your sample after you have identified and corrected any errors in the data.
(b) If the unit of sampling and measurement for your sampling plan is one-way bus trips, sum these quantities over individual one-way bus trips in the sample to get sample totals:
  (1) for the entire sample,
  (2) by type of service days,
  (3) by group if your sampling plan is based on service grouping.
(c) Count the number of one-way bus trips in the sample:
  (1) for the entire sample,
  (2) by type of service days,
  (3) by group if your sampling plan is based on service grouping.
(d) Divide sample totals by the number of one-way bus trips for the entire sample, by type of service days, or by service group if applicable.

§ 77.07 How should I determine annual services actually provided as expansion factors?
(a) You should measure annual services actually provided in the unit of sampling and measurement you have chosen for your sampling plan.
(b) For estimating annual totals of service-consumed data, you should follow these steps:
  (1) Start with your schedule.
  (2) When the schedule is changed by policy or by emergency conditions, the count from the schedule must be adjusted accordingly.
  (3) You must also include added services such as trippers and other special operations.
  (4) If your sampling plan is based on service grouping, you must also count annual services actually provided for each group.
(c) For estimating service-consumed data by type of service days, you should also start with your schedule, and exclude scheduled services on atypical days. Refer to the *NTD Reporting Manual* for determining what are considered atypical days.

Subsection 79 – Estimating Service-Consumed Data

§ 79.01 How should I estimate the annual total of my service-consumed data?
    (a) If your sampling plan is not based on service grouping, you should multiply your sample average for the entire sample with the annual total of your corresponding expansion factor to get an estimate of the annual total.
    (b) If your sampling plan is based on service grouping, you should take a two-step approach:
        (1) Multiply your sample average with your corresponding expansion factor for each group, and
        (2) Sum the above products across all groups to get your annual total.

§ 79.03 How should I estimate average daily of service-consumed data by type of service days?
    (a) If you operate your service only on weekdays, all you need to do is to divide your estimated annual total by the number of typical weekday days of service.
    (b) If you operate your service on Saturdays, Sundays, or both as well, you should take the following two steps:
        (1) Multiply your sample average(s) for each type of service days with the corresponding expansion factor to get the annual total for each type of service days.
        (2) Divide the annual total for each type of service days by the corresponding number of typical days for each type of service days.

§ 79.05 How should I estimate annual total UPT for each weekday period for commuter rail, heavy rail, and light rail?
    (a) For each of the weekday periods, you should simply multiply the sample average UPT you have calculated for that period by the corresponding expansion factor to get an estimate of the annual total UPT for that weekday period.

SECTION 80 – ESTIMATION WITH 100% UPT

Subsection 81 – General Directions

§ 81.01   What service-consumed data must I estimate with 100% UPT?
(a) You must estimate PMT.
(b) The following table shows the data items you must estimate.

Table 81.01. Service-Consumed Data Items with 100% UPT

If your sampling plan is based on the	you must estimate
APTL option	• annual total PMT • average daily PMT by type of service days
PPMT option	• annual total PMT • average daily PMT by type of service days

§ 81.03 What do I need to do in general to get estimates of these data items?
(a) You must determine expansion factors.
(b) You must determine sample ratios.
(c) You must combine the expansion factors and sample ratios to get the corresponding estimates of service-consumed data.

§ 81.05   What is a sample ratio?
(a) A sample ratio is the ratio between the sample total of one measure of service-consumed and the sample total of another measure of service-consumed. This *Sampling Manual* uses two sample ratios:
   (1) The ratio of sample total PMT over sample total UPT gives the sample APTL.
   (2) The ratio of sample total PMT over sample total PPMT gives the sample PMT/PPMT ratio.
(b) They may be calculated for the entire annual sample or by the type of service days.

§ 81.07   What is an expansion factor when I have 100% UPT?
(a) A measure of actual services consumed during a given duration of time.
(b) It is used to convert sample ratios to totals in the given duration. A 100% count of UPT consumed during an entire year is an example of an expansion factor in service consumed; when multiplied by sample APTL, it yields a measure of annual total PMT.

Subsection 83 – APTL Option

§ 83.01   What expansion factor should I use for the APTL option?
(a) You must use your 100% count of UPT as the expansion factor.

(b) For estimating average daily PMT by type of service days, use your annual total 100% count of UPT by type of service days.

(c) For estimating annual total PMT:

   (1) Use your annual total 100% count of UPT if your sampling plan is not based on grouping.

   (2) Use your annual total 100% count of UPT by service group if your sampling plan is based on grouping and you have reliable 100% counts of UPT by service group and have entered information into the template accordingly in developing your current template sampling plan. Refer to cell M52 of the PeriodInput Worksheet in the template you used in developing your current period-based template sampling plan, and it should be 1.

   (3) Use your annual total 100% count of UPT if your sampling plan is based on grouping but you do not have reliable 100% counts of UPT by service group and you have entered information into the template accordingly in developing your current period-based template sampling plan. Refer to cell M52 of the PeriodInput Worksheet in the template you used in developing your current period-based template sampling plan, and it should be 0.

§ 83.03 What sample ratio should I use for the APTL option?

(a) You must use the sample APTL as the sample ratio.

(b) Use sample APTL by type of service days for estimating average daily PMT by type of service days. If your sample happens not to include service unit for a particular day type (e.g., Saturday), use the sample APTL for the entire sample for this day type.

(c) For estimating annual total PMT:

   (1) Use sample APTL for the entire sample if you do not group your service.

   (2) Use sample APTL for each group if your sampling plan is based on grouping and you have reliable 100% counts of UPT by service group and have entered information into the template accordingly in developing your current period-based template sampling plan. Refer to cell M52 of the PeriodInput Worksheet in the template you used in developing your current period-based template sampling plan, and it should be 1.

   (3) Use weighted sample APTL for the entire sample if your sampling plan is based on grouping but you do not have reliable 100% counts of UPT by service group and you have entered information into the template accordingly in developing your current period-based template sampling plan. Refer to cell M52 of the PeriodInput Worksheet in the template you used in developing your current period-based template sampling plan, and it should be 0.

§ 83.05 How should I determine the APTL from my sample?

(a) You must determine the sample APTL for a given sample as the ratio of sample total PMT over sample total UPT for the following cases:

   (1) for the entire sample,

   (2) by type of service days, or

   (3) by service group if applicable.

(b) You must not determine the sample APTL as the average of the APTL across individual service units in the sample.

(c) To determine the weighted sample APTL for an entire sample as required by question §83.03(c)(3), you should follow these steps:
(1) Determine each group's size in the number of service units actual operated.
(2) Compute each group's share of the number of service units actually operated. These shares must sum to 1.
(3) Determine each group's sample size in the number of service units in the sample.
(4) Determine each group's sample total UPT.
(5) Determine each group's sample total PMT.
(6) Compute each group's sample average for UPT.
(7) Compute each group's sample average for PMT.
(8) Sum the product of each group's share of the number of service units actually operated and its sample average UPT.
(9) Sum the product of each group's share of the number of service units actually operated and its sample average PMT.
(10) Compute the ratio of the result from (9) to the result from (8). This ratio gives the weighted sample APTL.
(11) Table 83.01 shows these steps with an example.

Table 83.01. Example of Estimating Weighted Sample APTL

Step	Description	Service Groups		
		Short Routes	Medium Routes	Long Routes
1	Group size in service units	109,685	331,033	35,325
2	Group size in shares	0.2304	0.6954	0.0742
3	Sample size	116	386	47
4	Sample total UPT	1,157	8,181	1,592
5	Sample total PMT	3,989	42,966	7,003
6	Sample average UPT	10.0	21.2	33.9
7	Sample average PMT	34.4	111.3	149.0
8	Weighted sample average UPT	19.55		
9	Weighted sample average PMT	96.38		
10	Weighted sample APTL	4.93		

§ 83.07 How should I estimate annual total PMT for the APTL option?

(a) If your sampling plan is not based on service grouping, you should multiply your sample APTL for the entire annual sample with your corresponding annual expansion factor (i.e., 100% count of annual UPT) to get an estimate of the annual total PMT.
(b) You should take a two-step approach if your sampling plan is based on service grouping and you have reliable 100% counts of UPT by service group:
(1) Multiply your sample APTL with your corresponding expansion factor for each group, and
(2) Sum the above products across all groups to get your annual total PMT.
(c) If your sampling plan is based on service grouping but you do not have reliable 100% counts of UPT by service group, you should multiple your weighted sample APTL as computed in question §83.05 with your 100% count of annual UPT.

(d) If your sampling plan is based on service grouping, refer to cell M52 of the PeriodInput Worksheet in the template you used in developing your template sampling plan for what you have entered into cell M52 on whether you have reliable 100% count of UPT by service group.

§ 83.09 How should I estimate average daily PMT by type of service days?
(a) If you operate your service only on weekdays, all you need to do is to divide your estimated annual total PMT by the number of typical weekday days of service.
(b) If you operate your service on Saturdays, Sundays, or both as well, you should take the following two steps:
    (1) Multiply your sample average APTL for each type of service days with the corresponding 100% count of UPT to get the annual total PMT for each type of service days.
    (2) Divide the estimated annual total PMT for each type of service days by the corresponding number of typical days for each type of service days.

Subsection 85 – PPMT Option

§ 85.01 What expansion factor should I use for the PPMT option?
(a) You must use your 100% count of PPMT as the expansion factor.
(b) For estimating annual total PMT:
    (1) Use annual total PPMT if your sampling plan is not based on grouping.
    (2) Use annual total PPMT by group if your sampling plan is based on grouping.
(c) For estimating average daily PMT by type of service days, use annual total PPMT by type of service days.

§ 85.03 How do I determine annual total PPMT?
(a) Suppose that:
    (1) Your unit of sampling and measurement is one-way bus trips, and
    (2) You are going to estimate annual total PMT.
(b) You should do the following for each route:
    (1) Determine the annual number of vehicle revenue miles for the report year.
    (2) Determine the annual number of vehicle revenue one-way trips for the report year.
    (3) Divide the annual number of vehicle revenue miles by the annual number of vehicle revenue one-way trips to get the average route length.
    (4) Multiply your route-level 100% counts of UPT with the calculated average route length to get route-level PPMT.
(c) You should sum the calculated route-level PPMT across all routes to get your annual PPMT for all routes.
(d) Table 85.01 illustrates how you may accomplish (b) and (c).

Table 85.01. Calculating Annual Total PPMT for All Operating Routes

Route Number	Route Name	Annual Revenue Trips	Annual Revenue Miles	Average Route Length	100% UPT	100% PPMT
90	Blue Line	3,869	9,975	2.58	22,866	58,952
50	Red Line	3,286	10,310	3.14	23,634	74,148
14	Prospect	1,643	10,690	6.51	24,506	159,446
12	Beechcrest	1,643	11,835	7.20	27,131	195,435
17	College	3,286	30,666	9.33	70,298	656,036
37	Park 100	1,325	22,733	17.16	52,112	894,068
8	Washington	3,392	61,077	18.01	140,012	2,521,072
19	Castleton	1,696	32,916	19.41	75,457	1,464,491
26	Keystone	1,378	28,505	20.69	65,344	1,351,666
10	10th St.	3,339	69,897	20.93	160,231	3,354,198
Total						10,729,514

(e) If your sampling plan is based on service grouping, you must also determine PPMT for each group. Suppose, for example, that you have grouped your short routes into one group and your longer routes into another. Table 85.03 illustrates how you may use route-level information on annual revenue miles, annual revenue trips, and annual UPT to determine PPMT for each group.

Table 85.03. Calculating Annual Total PPMT by Route Group

Route Group	Route Number	Annual Revenue Trips	Annual Revenue Miles	Average Route Length	100% UPT	100% PPMT
Short Routes	90	3,869	9,975	2.58	22,866	58,952
Short Routes	50	3,286	10,310	3.14	23,634	74,148
Short Routes	14	1,643	10,690	6.51	24,506	159,446
Short Routes	12	1,643	11,835	7.20	27,131	195,435
Short Routes	17	3,286	30,666	9.33	70,298	656,036
	Total					1,144,018
Long Routes	37	1,325	22,733	17.16	52,112	894,068
Long Routes	8	3,392	61,077	18.01	140,012	2,521,072
Long Routes	19	1,696	32,916	19.41	75,457	1,464,491
Long Routes	26	1,378	28,505	20.69	65,344	1,351,666
Long Routes	10	3,339	69,897	20.93	160,231	3,354,198
	Total					9,585,496

§ 85.05   How should I get the sample total of PPMT for each service unit?
   (a) You should follow the guidance for question § 85.03 to determine the average route length for each route.

(b) Identify the route for each one-way trip in your service units in the sample.

(c) Multiply the sample UPT by the average route length for each one-way trip to get sample PPMT for each one-way trip.

(d) Sum the trip-level PPMT for all one-way trips in a service unit to get sample PPMT for each service unit.

§ 85.07   What sample ratio should I use for the PPMT option?

(a) You must use the ratio of sample total PMT over sample total PPMT as the sample ratio.

(b) For estimating annual total PMT:
    (1) Use sample PMT/PPMT ratio for the entire sample if you do not group your service.
    (2) Use sample PMT/PPMT for each group if your sampling plan is based on grouping.

(c) For estimating average daily PMT by type of service days, use the sample PMT/PPMT ratio by type of service days.

§ 85.09   How should I determine the PMT/PPMT ratio for a sample?

(a) You must determine the sample PMT/PPMT ratio for a given sample as the ratio of sample total PMT over sample total PPMT.

(b) You must not determine the sample ratio as the average of the PMT/PPMT ratio for individual service units in the sample.

§ 85.11 How should I estimate annual total PMT for the PPMT option?

(a) You should multiply your sample PMT/PPMT ratio for the entire annual sample with the annual total of your PPMT to get an estimate of the annual total PMT if your sampling plan is not based on service grouping, or

(b) You should take a two-step approach if your sampling plan is based on service grouping:
    (1) Multiply your sample PMT/PPMT ratio with your corresponding annual total PPMT for each group, and
    (2) Sum the above products across all groups to get your annual total PMT.

§ 85.13 How should I estimate average daily PMT by type of service days?

(a) If you operate your service only on weekdays, all you need to do is to divide your estimated annual total PMT by the number of typical weekday days of service.

(b) If you operate your service on Saturdays, Sundays, or both as well, you should take the following two steps:
    (1) Multiply your sample PMT/PPMT ratio for each type of service days with the corresponding annual total PPMT to get the annual total PMT for each type of service days.
    (2) Divide the annual total PMT for each type of service days by the corresponding number of typical days for each type of service days.

SECTION 90 – APPENDIXES

Appendix 91 – Definitions

§ 91.01   What do the sampling-related terms mean?

Alternative sampling plan. A sampling plan that reflects the conditions of your service, and is independently developed and certified by a qualified statistician to meet FTA's 95% confidence and 10% precision levels. It is one of two forms of customized sampling plans. The other form is template sampling plans. It is equivalent to an alternative sampling technique as defined in the *NTD Reporting Manual*.

Confidence level. The chance of an estimate of service-consumed data obtained through random sampling falling within a particular range of the true value. FTA requires a minimum level of 95% confidence for estimates of annual UPT and annual PMT reported to the NTD. A particular confidence level is only meaningful when it is stated with a particular precision level.

Customized sampling plan. A sampling plan that reflects the conditions of your service and meets FTA's 95% confidence and 10% precision levels. It is either a template sampling plan or an alternative sampling plan. It differs from a ready-to-use sampling plan in that it takes account of the specific characteristics of your service.

Efficiency option. A characteristic of a sampling plan that affects its sampling efficiency.

Initial annual sample size. The annual necessary sample size of a period-based template sampling plan that is determined from the companion spreadsheet template before it is allocated to each quarter, month, or week. This can differ from the realized annual sample size for a given set of sample data.

Mandatory revising year. A report year for which you must consider whether you need to revise your template sampling plan.

Margin of safety. A percent increase in the statistical variation of your sample data in developing a template sampling plan. For example, if the statistical variation of your sample is S and the margin of safety is 25%, you must use $1.25S$ as the statistical variation in developing your template sampling plan. A margin of safety of 25% is used automatically for all period-based template sampling plans. If you develop alternative sampling plans, you should also use this margin of safety. The objective is to counter the potential fluctuations in the statistical variation in a sample from one year to another due to sampling and other reasons.

Major change to a service. Any change to your service that is likely to lead to major changes in how your customers use your service. Examples of major changes include making transfers fare free; adding or cutting express routes; expanding or contracting your service by

more than 25% in vehicle revenue miles; or restructuring your service affecting more than 25% of your service in vehicle revenue miles.

Necessary sample size. The sample size that meets FTA's minimum 95% confidence and 10% precision levels and uses a 25% margin of safety.

Precision index. A number that reflects the level of precision that your current NTD sample achieves in the resulting annual total PMT. It is used for you to determine whether you must revise your current template sampling plan after you have made major changes to your service since you started using the current template sampling plan. Once you have entered your current sample data into the template for this Sampling Manual as if you are going to develop new template sampling plans, this precision index is made available in the PeriodPrecision Worksheet for period- based sampling and in the IntervalPrecision Worksheet for interval-based sampling.

Precision level. The degree of errors in an estimate of service-consumed data obtained through random sampling that is stated in percentage terms relative to the true value. FTA requires a minimum of 10% precision for estimates of annual service-consumed data reported to the NTD. A particular precision level is only meaningful if it is stated with a particular confidence level.

Random sampling. Selection of one or more service units at random from a list of service units to be operated.

Ready-to-use sampling plan. A sampling plan that has been developed specifically for this *Sampling Manual* with sample data from a variety of transit agencies. It does not necessarily reflect the conditions of your service. Ready-to-use sampling plans have limited applicability.

Realized annual sample size. The annual necessary sample size of a period-based template sampling plan that is based on quarterly, monthly, or weekly sampling. For example, if you choose weekly sampling and your template sampling plan requires 3 one-way trips per week, the realized annual sample size would be 156 one-way trips.

Sample size. The number of service units that are sampled, and for which unlinked passenger trips and passenger miles traveled are measured.

Sampling efficiency. The degree to which a sampling plan minimizes the necessary sample size for meeting FTA's confidence and precision levels. Sampling plans that take advantage of certain characteristics of your service can sometimes require a smaller necessary sample size. A smaller necessary sample size reduces the time and cost of sampling, data collection, and data processing.

Sampling frequency. The number of times per year that a sample is drawn; in this *Manual*, sampling frequency is quarterly, monthly, or weekly for period-based sampling, and is every day, every 2nd day, every 3rd day, every 4th day, every 5th day, and every 6th day for interval-

based sampling. For example, if your period-based sampling plan requires 10 service units per month, before the current month ends you must select at least 10 at random from the full list of all service units to be operated during the next month.

Sampling plan. A plan for selecting service units at random, for collecting sample data, and for estimating annual service-consumed data that meets FTA's 95% confidence and 10% precision levels. Each sampling plan consists of four elements: a unit of sampling and measurement, a set of efficiency options, a sampling frequency, and a necessary sample size.

Sampling without replacement. Selection of a sample of service units at random without the chance of a single service unit being selected more than once.

Sampling year. Any report year for which you obtained annual UPT, annual PMT, or both through random sampling that meet FTA's 95% confidence and 10% precision levels. It can be a mandatory sampling year or an intermediate report year for which you choose to sample.

Service grouping. One efficiency option for which you divide your service into two or more groups with the objectives of reducing within-group differences and increasing between-group differences. For example, separating your bus routes into express routes and local routes is likely to reduce differences in average passenger trip length across one-way bus trips within each group.

Service unit. An amount of revenue travel by a single transit vehicle, a set of transit vehicles, or a component of a transit vehicle. For non-scheduled services, it is typically one vehicle day. For scheduled bus services it is typically either a one-way bus run or else a round-trip bus run. For rail services, it is either a one-way car run, a one-way train run, or a round-trip car run or a round-trip train run.

Statistical variation. The degree of differences in a quantity across the full list of service units operated during a given duration of time, such as differences in PMT across all one-way trips of a bus service in a full report year. A larger variation requires a greater sample size to meet given confidence and precision levels.

Table of random numbers. A list of integers whose frequency and order of appearance in the list have been determined entirely by chance. It is the basis of a commonly used method of random sampling.

Template sampling plan. A sampling plan that is developed with the companion template of this *Sampling Manual*.

Unit of sampling and measurement. A service unit you choose for your sampling plan.

§ 91.03   What do the data-collection terms mean?
Arriving load. The number of passengers onboard a transit vehicle as it arrives at a stop.

Automatic passenger counter. An automated means of counting passengers as they board or alight transit vehicles with treadle mats, infrared beams, or other devices placed by the doors of a transit vehicle.

Calculated load. The number of passengers onboard a transit vehicle as it arrives at or leaves a stop that you calculate from data on boardings and alightings at individual stops. It should equal the observed load.

Commuter vanpool. A common form of vanpool service (VP) that comprises vans, small buses and other vehicles operating as a ridesharing arrangement, providing transportation to a group of workers commuting directly between their homes and their regular work sites within the same geographical area. The vehicles would not be in revenue service during the working hours of the participating workers.

Distance-based approach. A method to obtain PMT that keeps track of the distance traveled by every passenger.

Leaving load. The number of passengers onboard a transit vehicle as it leaves a stop.

Load-based approach. A method to obtain PMT that is based on the boardings and alightings at individual stops and on the distance between consecutive stops.

NTD sample. The sample of service units you select at random according to your sampling plan that meets FTA's 95% confidence and 10% precision levels for reporting to the NTD.

Observed load. The number of passengers onboard a transit vehicle as observed directly by a ride-checker while onboard that transit vehicle.

Ride check. A method of collecting sample data with one or more persons observing and recording passenger boarding and alighting activities while riding in a transit vehicle.

Stop. Any spatial location at which a transit vehicle allows passengers to board or alight from the vehicle.

Vehicle trip length. The total distance traveled by a transit vehicle during a one-way trip for scheduled services. For example, the cumulative distance traveled from the beginning point to the end point of a particular alignment of a route is the vehicle trip length for this trip. The vehicle trip length may vary by direction and alignment for a given route.

§ 91.05   What do the estimation-related terms mean?

100% count. A method of obtaining service-consumed data. This term also often refers to the results of a 100% count. For UPT, it involves counting passengers each time they board a transit vehicle in revenue service, such as through a registering farebox. For PMT, it involves recording the distance traveled by all passengers. A 100% count of PMT is typically only possible for systems that have only two stops, for rail systems that record entry and exit from the system, or for rail systems that rely upon destination-based tickets.

Average passenger trip length (APTL). The average distance traveled for an unlinked passenger trip. It is calculated as PMT divided by UPT.

Average route length. The average length of a route actually traveled by vehicles in scheduled services.   It is calculated by dividing the annual vehicle revenue miles by the number of annual vehicle revenue one-way trips for that route.

Expansion factor. A measure of actual services operated or consumed during a given duration of time. It is used to convert a sample average to the total of service-consumed data for that duration. It varies with sampling plans. The total number of one-way bus trips operated during an entire report year is an example of an expansion factor; when multiplied by the sample average PMT per one-way bus trip derived from annual NTD sample, it yields a measure of annual total PMT.

Passenger miles traveled (PMT). The total distance traveled by all passengers during a given period.

Potential passenger miles traveled. The maximum number of passenger miles that could have been traveled by all passengers along a given fixed route during a year (or some other time duration.) It is calculated by multiplying a 100% count of UPT times the average route length of that route during that duration.

Sample average. The sample total divided by the number of service units in the sample. It may be calculated for the entire annual sample, or by the type of service day, or for specific weekday time periods. For example, dividing the total PMT in an annual NTD sample by the total number of one-way bus trips in the annual NTD sample gives a sample average PMT.

Sample data. The data collected from a sample of service units according to a sampling plan that meets FTA's 95% confidence and 10% precision levels.

Sample ratio. The ratio of the sample total for one measure of service-consumed over the sample total for another measure of service-consumed. For example, the ratio of the sample data for PMT over the sample total for UPT gives the sample APTL. It may be calculated for the entire annual sample, or by the type of service days, or for individual service group if your sampling plan is based on service grouping.

Sample total. The sum total of all data across the service units in a random sample. For example, if you are sampling for PMT, the PMT sample total is the sum of the PMT collected for each of the one-way bus trip in the sample. It may be calculated for the entire annual sample, or by the type of service day, or for specific weekday time periods.

Service-consumed data. Passenger miles traveled and unlinked passenger trips.

Type of service days. Weekdays, Saturdays, or Sundays. For scheduled services, service days in a report year are classified according to the schedule operated on that day. If a

weekday that is a holiday is served with a Sunday schedule, that weekday is considered to be a Sunday. For non-scheduled services, service days are the actual days of a week regardless of whether they are a holiday or not.

Typical day. For your scheduled services, it is a day on which you operate your normal, regular schedule and there are no anomalies such as extra service added for a special event or reduced service as a result of weather or interruption. For your non-scheduled services, it is any day of operation.

Unlinked passenger trips (UPT). The number of passengers who board transit vehicles in revenue service. Passengers are counted each time they board a vehicle, no matter how many vehicles they use to travel from their origin to their destination.

Weekday time periods. Weekday AM Peak, Weekday Midday, Weekday PM Peak, and Weekday Other. The *Reporting Manual* instructs how you should define the start and end points of each period.

§ 91.07   What do the reporting terms mean?
Auditable record. Documentation of information collected and processes used in collecting that information that demonstrates your compliance with NTD requirements. Such documentation may also help quality control within your agency when your NTD staff change over time.

First-time reporting. Reporting of a particular service to the NTD for the first time.

§ 91.09   What abbreviations for general terms are used in this Manual?
APTL. Average passenger trip length in miles

APC. Automatic passenger counter

FTA. Federal Transit Administration

NTD. National Transit Database

PMT. Passenger miles traveled

PPMT. Potential passenger miles traveled

UPT. Unlinked passenger trips

§ 91.11   What abbreviations for NTD modes are used in this Manual?

CB. Commuter bus – Fixed-route bus systems that are primarily connecting outlying areas with a central city. Service typically uses over-the-road buses with service predominantly in one direction during peak periods, limited stops, and routes of extended length.

CC. Cable car – A railway propelled by moving cables located beneath the street. While popular at the turn of the last century, the only surviving system is operated in San Francisco.

CR. Commuter rail – Rail service operating on either old freight railways, or on tracks that are shared with freight railways, Amtrak, or both. The service is characterized by relatively long distances between stops, for service primarily connecting a central city with outlying suburbs and cities. The service may be either diesel or electric-powered and usually has grade-crossings with roadways.

DR. Demand response – Shared-ride demand response service is scheduled in response to calls from passengers. Many transit systems operate demand response (DR) service to meet the requirements of the Americans with Disabilities Act (ADA).

DT. Demand response - Taxi – A special form of the demand response mode operated through taxicab providers. The mode is always purchased transportation type of service.

HR. Heavy rail – An electric railway that operates local service in exclusive right-of-way. The service is characterized by long trains of six to eight cars or more and by relatively short distances between stops for local service within a city and the immediate suburbs. The Nation's traditional subway systems are classified as heavy rail.

JT. Jitney – A transit mode comprising of owner-operated passenger cars or vans operating on fixed routes (sometimes with minor deviations) as demand warrants without fixed schedules or fixed stops.

LR. Light rail – An electric railway that operates local service in mixed traffic with road vehicles, or has grade crossings with roadways. The service is characterized by short trains of one to four cars and by relatively short distances between stops for local service within a city and the immediate suburbs.

MB. Bus – Fixed-route bus service is the most-prevalent mode in the country. MB service is powered by a motor and fuel contained within a vehicle. Deviated fixed-route service is also reported as MB.

MG. Monorail and automated guideway – An electric railway that straddles a single guideway. It may have vehicle operators or may use computers to guide the vehicles.

PB. Público – Publicos are jitney services operated in Puerto Rico. A transit mode comprising of passenger vans or small buses operating with fixed routes but no fixed schedules. Publicos (PB) are a privately owned and operated public transit service which is market oriented and unsubsidized, but regulated through a public service commission, state or local government. Publicos (PB) are operated under franchise agreements, fares are regulated by route and there are special insurance requirements. Vehicle capacity varies from eight to 24, and the vehicles may be owned or leased by the operator.

RB. Bus rapid transit – Fixed-route bus systems that either (1) operate their routes predominantly on fixed-guideways (other than on highway high occupancy vehicle (HOV) or shoulder lanes, such as for commuter bus service) or (2) that operate routes of high-frequency service with the following elements: Substantial transit stations, traffic signal priority or preemption, low-floor vehicles or level-platform boarding, and separate branding of the service. High-frequency service is defined as 10-minute peak and 15-minute off-peak headways for at least 14 hours of service operations per day. This mode may include portions of service that are fixed-guideway and non-fixed-guideway.

SR. Streetcar rail – Rail systems operating routes predominantly on streets in mixed-traffic. This service typically operates with single-car trains powered by overhead catenaries and with frequent stops.

TB. Trolleybus – Fixed-route service using rubber tire buses powered by electric current from overhead wires using trolley poles. Service using rubber tire replica trolleys or historic trolleys, powered by an on-board motor are not included in this mode.

TR. Arial tramway – A system of aerial cables with suspended vehicles.

VP. Vanpool – A commuting service operating under prearranged schedules for previously formed groups of riders in vans.

YR. Hybrid rail – Rail systems primarily operating routes on the National system of railroads, but not operating with the characteristics of commuter rail. This service typically operates light rail-type vehicles as diesel multiple-unit trains (DMU's).

Appendix 92 – Distance-Based Survey Sheet

Distance-Based Survey Sheet				
(1) Survey Date _____			(2) Day of Week _____	
(3) Survey Vehicle No. _____			(4) Driver No. _____	
(5)	(6)	(7)	(8)	(9)
No. of Pass.	Pick-UP Location	Pick-UP Odometer Reading	Drop-Off Location	Drop-Off Odometer Reading

Page

	Distance-Based Survey Sheet			

(1) Survey Date _____2-26-2008_____   (2) Day of Week _____Thursday_____

(3) Survey Vehicle No. _____45_____   (4) Driver No. _____15_____

(5)	(6)	(7)	(8)	(9)
No. of Pass.	Pick-UP Location	Pick-UP Odometer Reading	Drop-Off Location	Drop-Off Odometer Reading
2	1020 J Street	38,452.0	450 L Street	38,453.5
3	"	38,452.0	380 Alaska	38,454.0
11	"	38,452.0	Fenton + Colesville Rd.	38,454.7
17	506 10th Street	38,456.0	Silver Spring Station	38,459.4
2	13th + K	38,465.0	Walter Reed Hospital	38,470.0
1	655 M Street	38,468.8	"	38,470.0

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Appendix 93 – Load-Based Survey Sheet for Demand Response (DR or DT)

Load-Based Survey Sheet for Demand Response (DR or DT)			
(1) Survey Date _____		(2) Day of Week _____	
(3) Vehicle No. _____		(4) Driver No. _____	
(5)	(6)	(7)	(8)
Activity	Location Description	Odometer Reading	Leaving Load
		Page	

Load-Based Survey Sheet for Demand Response (DR or DT)			
(1) Survey Date _____2/26/2008_____ (2) Day of Week _____Thursday_____			
(3) Vehicle No. _____54_____ (4) Driver No. _____15_____			
(5)	(6)	(7)	(8)
Activity	Location Description	Odometer Reading	Leaving Load
Pick-up	1020 J Street	38,452.0	16
Drop-off	450 L Street	38,453.5	14
Drop-off	380 Alaska	38,454.0	11
Drop-off	Fenton + Colesville Rd	38,454.7	0
Pick-up	506 10th Street	38,456.0	17
Drop-off	Silver Spring Station	38,459.4	0
Pick-up	13th + K	38,465.0	2
Pick-up	655 M Street	38,468.6	3
Drop-off	Walter Reed Hospital	38,470.0	0

Page [   ]

Appendix 94 – Load-Based Survey Sheet for Commuter Vanpool

Load-Based SURVEY SHEET for Commuter Vanpool				
(1) Date _____ (2) Day of Week _____ (3) Vanpool No. _____				
(4)	(5)	(6)	(7)	(8)
Direction	Pickup/Drop-off	#of people who got **ON** the Van	# of people who got **OFF** the Van	Van odometer reading when people got **ON/OFF** the Van
TO WORK	**Van Starts**			
	1st Pick-up			
	2nd Pick-up			
	3rd Pick-up			
	4th Pick-up			
	5th Pick-up			
	6th Pick-up			
	1st Drop-off			
	2nd Drop-off			
	3rd Drop-off			
	4th Drop-off			
	5th Drop-off			
	6th Drop-off			
	Van Parks			
FROM WORK	**Van Starts**			
	1st Pick-up			
	2nd Pick-up			
	3rd Pick-up			
	4th Pick-up			
	5th Pick-up			
	6th Pick-up			
	1st Drop-off			
	2nd Drop-off			
	3rd Drop-off			
	4th Drop-off			
	5th Drop-off			
	6th Drop-off			
	Van Parks			

Page [_____]

		Load-Based SURVEY SHEET for Commuter Vanpool		

(1) Date _____2-26-2008_____ (2) Day of Week _____Thursday_____ (3) Vanpool No. _____28706_____

(4) Direction	(5) Pickup/Drop-off	(6) **#**of people who got **ON** the Van	(7) # of people who got **OFF** the Van	(8) Van odometer reading when people got **ON/OFF** the Van
TO WORK	**Van Starts**	1		29,366.0
	1st Pick-up	5		369.1
	2nd Pick-up			
	3rd Pick-up			
	4th Pick-up			
	5th Pick-up			
	6th Pick-up			
	1st Drop-off		3	395.3
	2nd Drop-off		1	396.8
	3rd Drop-off		1	397.5
	4th Drop-off			
	5th Drop-off			
	6th Drop-off			
	Van Parks		1	405.0
FROM WORK	**Van Starts**	1		29,405.0
	1st Pick-up			
	2nd Pick-up			
	3rd Pick-up			
	4th Pick-up	1		412.5
	5th Pick-up	1		413.2
	6th Pick-up	3		414.7
	1st Drop-off			
	2nd Drop-off			
	3rd Drop-off			
	4th Drop-off			
	5th Drop-off			
	6th Drop-off		5	440.9
	Van Parks		1	444.0

Page [   ]

Appendix 95 – Load-Based Survey Sheet for Fixed-Route Service

Load-Based Survey Sheet for Fixed-Route Service

(1) Date _____ (2) Day of Week _____ (3) Time Period _____

(4) Route No. _____ (5) Trip No. _____ (6) Direction _____

(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Stop ID	Stop Description	Odometer Reading (to 10th of a mile)	No. of Pass. Boarded	No. of Pass. Alighted	No. of Pass. On Board (Leaving Load)	No. of Pass. from Previous Trip (Stop 1 only)	No. of Pass. Continuing to Next Trip (Last Stop only)

Page [   ]

Load-Based Survey Sheet for Fixed-Route Service

(1) Date _____10-13-2005_____ (2) Day of Week _____Thursday_____ (3) Time Period _____Midday_____

(4) Route No. _____11_____ (5) Trip No. _____408_____ (6) Direction _____Outbound_____

(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Stop ID	Stop Description	Odometer Reading (to 10th of a mile)	No. of Pass. Boarded	No. of Pass. Alighted	No. of Pass. On Board (Leaving Load)	No. of Pass. from Previous Trip (Stop 1 only)	No. of Pass. Continuing to Next Trip (Last Stop only)
1	Plaza	41,214.8	20	0	20	2	
2	City Hall	215.1	2	1	21		
3	Bloxham / Adams	215.8	0	2	19		
4	FAMU # 1	216.4	1	3	17		
5	FAMU # 2	216.7	1	10	8		
6	FAMU # 3	217.2	0	2	6		
7	Lake Bradford / Kissimmee	218.0	0	1	5		
8	Indian River / Levy	218.2	0	2	3		
9	Hillsborough / Levy	218.3	0	2	1		
10	Alumin Village / Levy	218.4	0	0	1		
11	Iamonia / Levy	218.7	0	0	1		
12	Iamonia / McCaskill	218.8	0	1	1		1

Page _____

Appendix 96 – Daily Log Sheet for Commuter Vanpool

Daily Log Sheet for Commuter Vanpool

(1) Month ___August 2008_____ (2) Vanpool No. _____578_____

(3) Date	(4) No. of Riders to Work	(5) No. of Riders from Work	(6) Total One-Way Trips
1	///// //	///// /	13
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
23			
24			
25			
26			
27			
28			
29			
30			
31			

Appendix 97 – Full Table of Contents

Appendix 98 – Table of Random Numbers

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053
7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045
9	89579	14342	63661	10281	74553	18103	57740	84378	25331	12566
10	85475	36857	53342	53988	53060	59533	38867	62300	08158	17983
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912
24	29334	27001	87637	87308	58731	00256	05834	15398	46557	41135
25	02488	33062	28834	08751	19731	92420	60952	61280	50001	67658
26	81525	72295	04839	96423	24878	82651	66566	14778	76797	14780
27	29676	20591	68086	26432	46901	20849	89768	81536	86645	12659
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067
29	05366	04213	25669	26422	44407	44048	37937	63904	45766	66134
30	91921	24618	64117	94305	26766	25940	39972	22209	71500	64568
31	00582	04711	87917	77341	42206	35126	74087	99547	81817	42607
32	00725	69884	62797	56170	86324	88072	76222	36086	84637	93161
33	69011	65795	95876	55293	18988	27354	26575	08625	40801	59920
34	25976	57948	29888	88604	67917	48708	18912	82271	65424	69774
35	09763	83473	73577	12908	30883	18317	28290	35797	05998	41688
36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008
38	46503	18584	18845	49618	02304	51038	20655	58727	28168	15475
39	92157	89634	94824	78171	84610	82834	09922	25417	44137	48413
40	14577	62765	35605	81263	39667	47358	56873	56307	61607	49518

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
41	98427	07523	33662	64270	01638	92477	66969	98420	04880	45585
42	34914	63976	88720	83765	34476	17032	87589	40836	32427	70002
43	70060	28277	39475	46473	23219	53416	94970	25832	69975	94884
44	53976	54914	06990	67245	68350	82948	11398	42878	80287	88267
45	76072	29515	40980	07391	58745	25774	22987	80059	39911	96189
46	90725	52210	83974	29992	65831	38857	50490	83765	55657	14361
47	64364	64712	33339	31926	14883	24413	59744	92351	97473	89286
48	08962	88358	31662	25388	61642	34072	81249	35648	56891	69352
49	95012	68379	93526	70765	10592	04542	76463	54328	02349	17247
50	15664	10493	20492	30391	91132	21999	59516	81652	27195	48223
51	16408	81899	04153	53381	79401	21438	83035	92350	36693	31238
52	18629	81953	05520	91962	04739	13092	97662	24822	94730	06496
53	73115	35101	47498	87637	99016	71060	88824	71013	18735	20286
54	57491	16703	23167	49323	45021	33132	12544	41035	80780	45393
55	30405	83946	23792	14422	15059	45799	22716	19792	09983	74353
56	16631	35006	85900	98275	32388	52390	16815	69298	82732	38480
57	96773	20206	42559	78985	05300	22164	24369	54224	35083	19687
58	38935	64202	14349	82674	66523	44133	00697	35552	35970	19124
59	31624	76384	17403	53363	44167	64486	64758	75366	76554	31601
60	78919	19474	23632	27889	47914	02584	37680	20801	72152	39339
61	03931	33309	57047	74211	63445	17361	62825	39908	05607	91284
62	74426	33278	43972	10119	89917	15665	52872	73823	73144	88662
63	09066	00903	20795	95452	92648	45454	09552	88815	16553	51125
64	42238	12426	87025	14267	20979	04508	64535	31355	86064	29472
65	16153	08002	26504	41744	81959	65642	74240	56302	00033	67107
66	21457	40742	29820	96783	29400	21840	15035	34537	33310	06116
67	21581	57802	02050	89728	17937	37621	47075	42080	97403	48626
68	55612	78095	83197	33732	05810	24813	86902	60397	16489	03264
69	44657	66999	99324	51281	84463	60563	79312	93454	68876	25471
70	91340	84979	46949	81973	37949	61023	43997	15263	80644	43942
71	91227	21199	31935	27022	84067	05462	35216	14486	29891	68607
72	50001	38140	66321	19924	72163	09538	12151	06878	91903	18749
73	65390	05224	72958	28609	81406	39147	25549	48542	42627	45233
74	27504	96131	83944	41575	10573	08619	64482	73923	36152	05184
75	37169	94851	39117	89632	00959	16487	65536	49071	39782	17095
76	11508	70225	51111	38351	194444	66499	71945	05422	13442	78675
77	37449	30362	06694	54690	04052	53115	62757	95348	78662	11163
78	46515	70331	85922	38329	57015	15765	97161	17869	45349	61796
79	30986	81223	42416	58353	21432	30502	32305	86482	05174	07901
80	63798	34995	46583	09785	44160	78128	83991	42865	92520	83531

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
81	82486	84846	99254	67632	43218	50076	21361	64816	51202	88124
82	21885	32906	92431	09060	64297	51674	64126	62570	26123	05155
83	60336	98782	07408	53458	13564	59089	26445	29789	85205	41001
84	43937	46891	24010	25560	86355	33941	25786	54990	71899	15475
85	97656	63175	89303	16275	07100	92063	21942	18611	47348	20203
86	03299	01221	05418	38982	55758	92237	26759	86367	21216	98442
87	79626	06486	83574	17668	07785	76020	79924	25651	83325	88428
88	85636	68335	47539	03129	65651	11977	02510	261113	99457	68645
89	18039	14367	61337	06177	12143	46609	32989	74014	64708	00533
90	08362	15656	60627	36478	65648	16764	53412	09013	07832	41574
91	79556	29068	04142	16268	15387	12856	66227	38358	22478	73373
92	92608	82674	27072	32534	17075	27698	98204	63863	11951	34648
93	23982	25835	40055	67006	12293	02753	14827	23235	35071	99704
94	09915	96306	05908	97901	28395	14186	00821	80703	70426	75647
95	59037	33300	26695	62247	69927	76123	50842	43834	86654	70959
96	42488	78077	69882	61657	34136	79180	97526	43092	04098	73571
97	46764	86273	63003	93017	31204	36692	40202	35275	57306	55543
98	03237	45430	55417	63282	90816	17349	88298	90183	36600	78406
99	86591	81482	52667	61582	14972	90053	89534	76036	49199	43716
100	38534	01715	94964	87288	65680	43772	39560	12918	86537	62738
101	13284	16834	74151	92027	24670	36665	00770	22878	02179	51602
102	21224	00370	30420	03883	94648	89428	41583	17564	27395	63904
103	99052	47887	81085	64933	66279	80432	65793	83287	34142	13241
104	00199	50993	98603	38452	87890	94624	69721	57484	67501	77638
105	60578	06483	28733	37867	07936	98710	98539	27186	31237	80612
106	91240	18312	17441	01929	18163	69201	31211	54288	39296	37318
107	97458	14229	12063	59611	32249	90466	33216	19358	02591	54263
108	35249	38646	34475	72417	60514	69257	12489	51924	86871	92446
109	38980	46600	11759	11900	46743	27860	77940	39298	97838	95145
110	10750	52745	38749	87365	58959	53731	89295	59062	39404	13198
111	36247	27850	73958	20673	37800	63835	71051	84724	52492	22342
112	70994	66986	99744	72438	01174	42159	11392	20724	54322	36923
113	99638	94702	11463	18148	81386	80431	90628	52506	02016	85151
114	72055	15774	43857	99805	10419	76939	25993	03544	21560	83471
115	24038	65541	85788	55835	38835	59399	13790	35112	01324	39520
116	74976	14631	35908	28221	39470	91548	12854	30166	09073	75887
117	35553	71628	70189	26436	63407	91178	90348	55359	80392	41012
118	35676	12797	51434	82976	42010	26344	92920	92155	58807	54644
119	74815	67523	72985	23183	02446	63594	98924	20633	58842	85961
120	45246	88048	65173	50989	91060	89894	36036	32819	68559	99221

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
121	76509	47069	86378	41797	11910	49672	88575	97966	32466	10083
122	19689	90332	04315	21358	97248	11188	39062	63312	52496	07349
123	42751	35318	97513	61537	54955	08159	00337	80778	27507	95478
124	11946	22681	45045	13964	57517	59419	58045	44067	58716	58840
125	96518	48688	20994	11090	48396	57177	83867	86464	14342	21545
126	35726	58643	76869	84622	39098	36083	72505	92265	23107	60278
127	39737	42750	48968	70536	84864	64952	38404	94317	65402	13589
128	97025	66492	56177	04049	80312	48028	26408	43591	75528	65341
129	62815	08075	09788	56350	76787	51591	54509	49295	85830	59860
130	25578	22950	15227	83291	41737	79599	96191	71845	86899	70694
131	68763	69576	88991	49662	46704	63362	56625	00481	73323	91427
132	17900	00813	64361	60725	88974	61005	99709	30666	26451	11528
133	71944	60227	63551	71109	05624	43836	58254	26160	32116	63403
134	54684	93691	85132	64399	29182	44324	14491	55226	78793	34107
135	25946	27623	11258	65204	52832	50880	22273	05554	99521	73791
136	01353	39318	44961	44972	91766	90262	56073	06606	51826	18893
137	99083	88191	27662	99113	57174	35571	99884	13951	71057	53961
138	52021	45406	37945	75234	24327	86978	22644	87779	23753	99926
139	78755	47744	43776	83098	03225	14281	83637	55984	13300	52212
140	25282	69106	59180	16257	22810	43609	12224	25643	89884	31149
141	11959	94202	02743	86847	79725	51811	12998	76844	05320	54236
142	11644	13792	98190	01424	30078	28197	55583	05197	47714	68440
143	06307	97912	68110	59812	95448	43244	31262	88880	13040	16458
144	76285	75714	89585	99296	52640	46518	55486	90754	88932	19937
145	55322	07598	39600	60866	63007	20007	66819	84164	61131	81429
146	78017	90928	90220	92503	83375	26986	74399	30885	88567	29169
147	44768	43342	20696	26331	43140	69744	82928	24988	94237	46138
148	25100	19336	14605	86603	51680	97678	24261	02464	86563	74812
149	83612	46623	62876	85197	07824	91392	58317	37726	84628	42221
150	41347	81666	82961	60413	71020	83658	02418	33322	66036	98712
151	38128	51178	75096	13609	16110	73533	42564	59870	29399	67834
152	60950	00455	73254	96067	50717	13878	03216	78274	65863	37011
153	90524	17320	29832	96118	75792	25326	22940	24904	80503	38928
154	49897	18278	67160	39408	97056	43517	84426	59650	20247	19293
155	18494	99209	81060	19488	65596	59787	47939	91225	98768	43688
156	65373	72984	30171	37741	70203	94094	87261	30056	58124	70133
157	40653	12843	04213	70925	95360	55774	76439	61768	52817	81151
158	51638	22238	56344	44587	83231	50317	74541	07719	25472	41602
159	69742	99303	62578	83575	30337	07488	51941	84316	42067	49692
160	58012	74072	67488	74580	47992	69482	58624	17106	47538	13452

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
161	18348	19855	42887	08279	43206	47077	42637	45606	00011	20662
162	59614	09193	58064	29086	44385	45740	70752	05663	49081	26960
163	75688	28630	39210	52897	62748	72658	98059	67202	72789	01869
164	13941	77802	69101	70061	35460	34576	15412	81304	58757	35498
165	96656	86420	96475	86458	54463	96419	55417	41375	76886	19008
166	03363	82042	15942	14549	38324	87094	19065	67590	11087	68570
167	70366	08390	69155	25496	13240	57407	91407	49160	07379	34444
168	47870	36605	12927	16043	53257	93796	52721	73120	48025	76074
169	79504	77606	22761	30518	28373	73898	30550	76684	77366	32276
170	46967	74841	50923	15339	37755	98995	40162	89561	69199	42257
171	14558	50769	35444	59030	87516	48193	02945	00922	48189	04724
172	12440	25057	01132	38611	28135	68089	10954	10097	54243	06460
173	32293	29938	68653	10497	98919	46587	77701	99119	93165	67788
174	10640	21875	72462	77981	56550	55999	87310	69643	45124	00349
175	47615	23169	39571	56972	20628	21788	51736	33133	72696	32605
176	16948	11128	71624	72754	49084	96303	27830	45817	67867	18062
177	21258	61092	66634	70335	92448	17354	83432	49608	66520	06442
178	15072	48853	15178	30730	47481	48490	41436	25015	49932	20474
179	99154	57418	09858	65671	70655	71479	63520	31357	56968	06729
180	08759	61089	23706	32994	35426	36666	63988	98844	37533	08269
181	67323	57839	61114	62192	47547	58023	64630	34886	98777	75442
182	09255	13986	84834	20764	72206	89393	34548	93438	88730	61805
183	36304	74712	00374	10107	85061	69228	81969	92216	03568	39630
184	15884	67429	86612	47367	10242	44880	12060	44309	46629	55105
185	18745	32031	35303	08134	33925	03004	59929	95418	04917	57596
186	78934	40086	88292	65728	38300	42323	64068	98373	48971	09049
187	17626	02944	20910	57662	60161	38579	24580	90529	52303	50436
188	27117	61399	50967	41399	81636	16663	15634	79717	94696	59240
189	93995	18678	90012	63645	85701	85269	62263	68331	00389	72571
190	67392	89421	09623	80725	62620	84162	87368	29560	00519	84545
191	04910	12261	37566	80016	21245	69377	50420	85658	55263	68667
192	81453	20283	79929	59839	23875	13245	46808	74124	74703	35769
193	19480	75790	48539	83703	15537	48885	02861	86587	74539	65227
194	21456	13162	74608	81011	55512	07481	93551	72189	76261	91206
195	09406	20912	46189	76376	25538	87212	20748	12831	57166	35026
196	09866	07414	55977	16419	01101	69343	13305	94302	80703	57910
197	86541	24681	23421	13521	28000	94917	07423	57523	97234	63951
198	10414	96941	06205	72222	57167	83902	07460	69507	20600	08858
199	49942	06683	41479	58982	56288	42853	92196	20632	62045	78812
200	23995	68882	42291	23374	24299	27024	67460	94703	40937	16961

Rows	Columns									
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202	04909	58485	70686	93930	34880	73059	06823	80257	44193	08337
203	46582	73570	33004	51795	86477	46736	60460	70345	37322	19987
204	29242	89792	88634	60285	07190	07795	27011	85941	01852	43096
205	68104	81339	97090	20601	78940	20228	22803	96070	10251	62711
206	17516	02182	82504	19880	93747	80910	78260	25136	62018	62919
207	50711	94789	07171	02103	99057	98775	37997	18325	88281	61091
208	39449	52409	75095	77720	39729	03205	09313	43545	43786	70443
209	75629	82729	76916	72657	58992	32756	01154	84890	04107	17469
210	01020	55151	36132	51971	32155	60735	64857	35424	25257	93844
211	08337	89989	24260	08618	66798	25889	52860	57375	52815	43539
212	76829	47229	19706	30094	69430	92399	98749	22081	52564	90431
213	39708	30641	21267	56501	95182	72442	21445	17276	90344	33199
214	89836	55817	56747	75195	06818	83043	47403	58266	52630	75573
215	25903	61370	66081	54076	67442	52964	23823	02718	28786	06121
216	71345	03422	01015	68025	19703	77313	04555	83425	46763	95315
217	61454	92263	14647	08473	34124	10740	40839	05620	62418	73374
218	80376	08909	30470	40200	46558	61742	11643	92121	22294	26648
219	45144	54373	05505	90074	24783	86299	20900	15144	26506	53770
220	12191	88527	58852	51175	11534	87218	04876	85584	78465	82182
221	62936	59120	73957	35969	21598	47287	39394	08778	38036	30140
222	31588	96798	43688	12611	01714	77266	55079	24690	84716	77732
223	20787	96048	84726	17512	39450	43618	30629	24356	05294	34236
224	45603	00745	84635	43079	52724	14262	05750	89373	79088	38088
225	31606	64782	34027	56734	09365	20008	93559	78384	99219	61747
226	10452	33074	76718	99556	16026	00013	78411	95107	10786	44886
227	37016	64633	67301	50949	91298	74968	73631	57397	08632	04762
228	66725	97865	25409	37498	00816	99262	14471	10332	19035	21695
229	07380	74438	82120	17890	40963	55757	13492	68294	87170	49468
230	71621	57688	58256	47702	74724	89419	08025	68519	95188	54788
231	03466	13263	23917	20417	11315	52805	33072	07723	87876	75258
232	12692	32931	97387	34832	53775	91674	96549	37635	91118	31062
233	52192	30941	44998	17833	94563	23062	95725	38463	03665	49189
234	569691	72529	66063	73570	86860	68125	40436	31303	79330	59083
235	74952	43041	53869	15677	78598	43520	97521	83248	52173	17636
236	18752	43693	32867	53017	22661	39610	03796	02622	78267	24503
237	61691	04944	43111	28325	82319	65589	66048	98498	46941	81427
238	49197	63948	38947	60207	70667	39843	60607	15328	09528	17277
239	19436	87291	71684	74859	76501	93456	95714	92518	10683	75617
240	39143	64893	14606	13543	09621	68301	69817	52140	03976	48795

Rows	Columns									
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242	55847	56155	42878	23708	97999	40131	52360	90390	73108	40475
243	94095	95970	07826	25991	37584	56966	68623	83454	49461	97707
244	11751	69469	25521	44097	07511	88976	30122	67542	54825	03274
245	69902	08995	27821	11758	64989	61902	32121	28165	21326	97375
246	21850	25352	25556	92161	23592	43294	10479	37879	21825	11453
247	75850	46992	25165	55906	62339	88958	91717	15756	78817	35541
248	29648	22086	42581	85677	20251	390641	65786	80689	49066	14456
249	82740	28443	42734	25518	82827	35825	90288	32911	79666	52959
250	36842	42092	52075	83926	420875	71500	69216	01350	92846	84792
251	89429	26726	15563	94972	78739	04419	60523	31022	23728	37647
252	43427	25412	25587	21276	44426	17369	29010	45337	90245	92053
253	58575	81958	51846	02676	67781	95137	88430	78260	66962	31812
254	61888	71246	24246	23487	78639	92006	63846	92263	33212	26516
255	73891	47025	40937	71907	26827	98865	38882	25757	26662	91441
256	40938	73894	40854	15997	55293	95033	31736	75068	91314	75293
257	98053	43567	17292	86908	71364	06089	92394	73691	57883	09983
258	59774	29138	46993	39836	99596	59050	25419	04130	54632	17223
259	09765	07548	63043	59782	81449	13652	94420	74460	46707	94303
260	38991	64502	24770	29209	82909	66610	84418	66214	26001	78685
261	25622	27100	56128	62145	82388	45197	97609	83942	01120	71717
262	21864	74120	66231	82306	91784	33177	17681	18963	07216	49288
263	81171	75639	60863	49562	28846	81581	10249	23190	53440	32357
264	69874	52803	28544	51569	56090	44558	42095	92311	57915	13368
265	27848	51107	05761	02159	53911	01952	59273	32250	39647	29908
266	69407	69736	75375	31488	67528	84234	76462	13628	21286	13736
267	29418	03091	06364	13151	40663	43633	87954	69800	24773	62596
268	38222	31231	79415	44558	62490	26936	49682	16307	98535	44822
269	94720	83796	93251	03568	62484	29140	14152	37044	90398	92042
270	45275	16852	02284	41361	73733	61486	33189	08907	41159	08147
271	97260	09552	82626	42915	45847	87401	13339	53850	34931	00602
272	01990	65259	60684	78175	43825	45211	86287	78190	02431	66251
273	24633	42314	81192	50253	67516	59076	92006	65676	87343	89231
274	98071	52677	74920	74461	52266	26967	68284	31612	40335	28865
275	34101	79442	88403	48541	13010	16596	72001	38546	76305	22119
276	77186	93967	25918	66403	73837	73445	86663	15929	08237	05647
277	23114	05481	42335	51396	60823	22680	50459	05429	35227	92559
278	59988	49944	41038	99977	16348	41119	51548	19511	90148	65604
279	11852	42254	82304	05588	75165	20179	94198	25700	33473	59554
280	59992	87922	56299	01700	07003	97507	69260	53349	86947	27517

Rows	Columns									
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282	39663	61401	24171	42702	70588	53144	27087	05591	57759	51394
283	53542	72009	96296	68908	58657	87117	21483	28879	20480	57309
284	25996	76108	98476	36397	89457	19577	65877	04802	61938	25032
285	91106	26450	11451	50328	29084	32332	08635	25192	31337	20249
286	37133	88924	27845	13024	90687	23726	11212	30414	42185	49224
287	13982	25736	10087	16762	02564	27250	79316	83848	38684	20552
288	26663	36187	81688	25005	46677	75851	73938	73044	05132	61204
289	62572	08275	16313	24936	81680	53829	40412	01479	24241	58488
290	65925	95455	08383	24643	72962	08172	37824	87587	40698	34964
291	97978	74676	08942	48919	51592	71196	48534	16955	25759	95645
292	01914	42524	67820	47985	91773	10383	89514	07557	02084	16736
293	68565	44811	39238	70394	78555	33539	56310	40809	63204	14479
294	54370	31672	03893	32423	54092	69375	63308	08016	28407	98287
295	79954	89601	23881	46951	69084	33477	87968	15639	82409	34125
296	55479	01059	44229	56975	06785	80930	26443	44892	77561	51123
297	38114	70330	42157	86699	46212	74692	92603	91306	58558	57280
298	29766	83452	66202	02488	72704	97821	70614	53616	39050	30355
299	31771	70640	34779	41831	33456	53194	19602	74194	61154	51774
300	77322	87188	83577	99067	83235	48662	31503	54829	54723	13177
301	64670	10396	82981	58320	71478	08143	48294	42631	45464	58092
302	25771	02205	73984	28436	88192	11470	11775	67385	66360	59884
303	25771	13537	54984	89406	88326	33993	92324	13249	35271	60400
304	91224	22417	44820	26189	57541	87558	45835	28461	54835	92411
305	75179	64320	71523	67868	38883	09674	27645	76240	47587	01677
306	64654	91085	65818	03313	39273	46384	66677	14148	87552	38383
307	98059	81123	67832	04102	66188	78200	67466	46043	65406	22834
308	38765	63585	18810	95805	11414	58096	00295	82626	42683	44518
309	01921	03564	71754	10213	80383	13473	94128	62199	59411	46782
310	16211	93671	27704	66778	96307	06732	63750	04191	40003	51653
311	70832	86076	61527	56123	48514	53935	86784	42351	67586	07432
312	22332	94265	67627	85815	00394	75271	98385	53697	56378	50592
313	81333	45965	64171	84367	15052	37965	03122	81914	69381	70034
314	39333	47453	66174	04546	10594	64271	61026	39471	55981	18628
315	29195	20825	50878	80273	26285	90070	79586	12449	77293	36577
316	74420	64037	06960	52109	08821	60143	34485	19257	29417	72713
317	22763	16508	24866	13177	07464	51790	65802	95718	28560	11332
318	72919	54618	40616	33287	51274	78491	53604	66742	97777	64468
319	91285	42402	15922	90033	21555	31647	22288	75692	20592	84620
320	85431	19857	97246	46118	71222	82744	67892	77155	10785	00344

Rows	Columns									
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322	88903	46592	60637	65231	08778	86813	47819	19218	46837	89671
323	29830	24899	85457	19548	83355	52479	77801	01596	48890	56104
324	22832	47422	08073	10107	46772	92299	42975	86376	27869	52954
325	75159	14809	11930	83531	51239	86298	72661	63015	98804	98491
326	99390	08217	56276	09263	82685	30451	25742	41105	74711	42007
327	68622	80897	08902	10867	91379	30068	84289	45020	92459	03831
328	92393	95901	41179	72129	72502	91097	09488	84896	37720	68104
329	53122	66033	38229	51879	29925	45574	53938	72801	64067	76328
330	43251	11941	86631	93264	53433	70281	55000	24550	74751	32855
331	16613	24901	34866	75002	55163	68300	20070	36953	39378	71191
332	12010	60852	92603	70393	17989	95755	14672	58786	41996	02893
333	85528	97879	27814	08219	02908	71582	31439	00360	72264	87245
334	32590	55079	33556	83169	92087	77939	53792	78795	58159	86394
335	91934	30650	16449	15805	61551	38689	59179	85485	18537	70496
336	80614	10150	09389	61892	79477	14522	40270	45744	29582	29717
337	62398	12034	90764	52872	22285	50592	42505	80560	38213	18917
338	02222	46811	05145	67916	15184	02636	59078	57773	21259	86090
339	08690	31785	61664	61322	24149	21471	23328	03093	31266	14840
340	61187	73897	66168	12885	73191	89432	65414	41886	75911	35708
341	12324	61149	85643	64999	63738	46671	25408	69313	54455	04917
342	47635	42279	98620	70677	52386	50904	97403	03931	42090	28179
343	70965	00390	08878	75373	70276	71889	86953	37931	23286	20508
344	58764	15262	96814	54548	00042	19721	78869	85937	36639	29135
345	07429	05609	31207	50254	68389	07714	92268	64698	32823	60122
346	15665	28659	54952	53217	76898	88931	25786	55912	85269	29212
347	64208	53232	99459	43605	04553	48451	68154	49436	49891	65524
348	17952	73276	52567	48489	64264	24220	55498	97548	98437	26033
349	60531	43217	39999	38615	97195	76928	87688	99010	90189	12522
350	76692	39999	43254	68110	88053	88727	14187	98623	84225	78440
351	06433	80674	24520	18222	10610	05794	37515	48619	62866	33963
352	39298	47829	72648	37414	75755	04717	29899	78817	03509	78673
353	89884	59651	67533	68123	17730	95862	08034	19473	63971	37271
354	61512	32155	51906	61662	64130	16688	37275	51262	11569	08697
355	99653	47635	12506	88535	36553	23757	34209	55803	96275	26130
356	95913	11085	13772	76638	48423	25018	99041	77529	81360	18180
357	55864	44004	13122	44115	01601	50541	00147	77685	58788	33016
358	35334	82410	91601	40617	72876	33967	73830	15405	96554	88265
359	57729	88646	76487	11622	96297	24160	09903	14047	22917	60718
360	86648	89317	63677	70119	94739	25875	38829	68377	43918	77653

Rows	Columns									
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362	81307	13114	83580	79974	45929	85113	72268	09858	52104	32014
363	02410	96385	79007	54939	21410	86980	91772	93307	34116	49516
364	18969	87444	52233	62319	08598	09066	95288	04794	01534	92058
365	87863	80514	66860	62297	80198	19347	73234	86265	49096	97021
366	68397	10538	15438	62311	72844	60203	46412	65943	79232	45702
367	28529	45247	58729	10854	99058	18260	38765	90038	94209	04055
368	44285	09452	15867	70418	57012	72122	36634	97283	95943	78363
369	86229	22510	33571	23309	57040	29285	67870	21913	72958	75637
370	84842	05748	90894	61658	15001	94055	36308	41161	37341	81838
371	56970	10799	52098	04184	54967	72938	56834	23777	98392	31417
372	83125	58077	60490	44369	66130	72936	69848	59973	08144	61070
373	55503	21383	02464	26141	68779	66388	75242	82690	74099	77885
374	47019	06683	33203	29608	54553	25971	69573	83854	24715	48866
375	84828	61152	79526	29554	84580	37859	28504	61980	34997	41825
376	68921	31331	79227	05748	51276	57143	31926	99915	45821	97702
377	36458	28285	30424	98420	72925	40729	22337	48293	86847	43186
378	95752	96065	36847	87729	81679	59126	59437	33225	31280	41232
379	26768	02513	58454	56958	20575	76746	49878	06846	32828	24425
380	42613	72456	43636	58085	06766	60227	96414	32671	45587	79620
381	95457	12176	65482	25596	02678	54592	63607	82096	21913	75544
382	95276	67524	63564	95958	39750	64379	46059	51666	10433	10945
383	66954	51574	64776	92345	95110	59448	77249	54044	67942	24145
384	17457	44151	14113	62462	02798	54977	48349	66738	60184	75679
385	03704	23322	83214	59337	01695	60666	97410	55064	17427	89180
386	21538	16997	33210	60337	27976	70661	08250	69599	60264	84549
387	57178	16739	98310	70348	11317	71623	55510	64756	87759	92354
388	31048	40058	94953	55866	96283	46620	52087	80817	74533	68407
389	69799	83300	16498	80733	96422	58078	99643	39847	96884	84657
390	90595	65017	59231	17772	67831	33317	00520	90401	41700	95510
391	13570	34761	98939	78784	09977	29398	93896	78227	90110	81378
392	15340	88760	57477	13898	48431	72936	78160	87240	52716	87697
393	64079	07733	36512	56186	99098	48850	72527	08486	10951	26832
394	63491	84886	67118	62063	74958	20946	28147	39338	32169	03713
395	92003	76568	41034	28260	79708	00770	88643	21188	01850	69689
396	52360	46658	66511	04172	73085	11795	52594	13287	82531	04388
397	74622	12142	68355	65635	21828	39539	18988	53609	04001	19648
398	04157	50979	61343	64315	70836	82857	35335	87900	36194	31567
399	86003	60070	66241	32836	27573	11479	94114	81641	00496	36058
400	41268	80187	20351	09636	84668	42486	71303	19512	50277	71508

Rows	Columns									
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402	93320	80269	56684	39192	53220	74539	26393	00787	94490	23386
403	18806	70257	96424	13606	14356	76599	25390	63236	04513	16358
404	22253	45923	29815	18578	23316	30896	64771	11220	86218	75956
405	93640	45982	40011	74142	29106	45729	43406	21457	04301	39651
406	47630	45980	76619	57138	57492	00030	77897	76236	64990	35985
407	01781	55061	07455	47083	71870	90597	10151	59606	96919	31174
408	69694	45054	33587	03664	95007	31567	25334	26433	75002	67607
409	51236	05052	26503	94651	29874	73492	88941	08488	09418	08173
410	89445	51039	73837	26720	38650	47322	68474	95047	20404	41577
411	40867	96834	02162	41517	88937	26099	56047	49164	35127	64916
412	92946	56944	93407	05010	54896	33173	30548	23667	43171	47849
413	75898	02275	90768	31902	52114	36634	46803	97970	92216	55398
414	22729	21695	90824	80500	09332	54667	46696	38166	02005	24615
415	28733	62663	23644	16416	47135	39137	62190	31032	58702	03805
416	51323	37770	42114	79742	59905	38480	25293	32993	36946	62701
417	69325	65551	49927	68073	56979	49454	79451	60753	70872	07422
418	11333	60801	36992	76128	27959	41306	93543	15926	99159	27102
419	86347	03703	36778	72501	95229	65735	14269	50220	77270	68604
420	73452	36179	82893	92262	43850	31888	71151	40682	49775	63628
421	75483	74009	73699	05870	36804	89338	73891	40740	98753	74566
422	73302	84917	75122	34085	86208	98399	79433	61960	01720	87458
423	42785	24350	05933	65282	12832	75382	29826	33197	81781	53542
424	40429	33209	58622	09308	38098	55947	12001	73526	23170	13721
425	92876	58271	99325	12301	72957	22690	62705	73892	01974	77759
426	32951	39844	99126	94838	48715	36586	42076	15283	19280	29166
427	099772	28139	48130	73301	35915	90923	19255	75242	84655	30163
428	78459	91322	50072	77941	65046	78363	21951	42319	46472	67617
429	14419	96517	99075	43664	81119	63487	95589	51785	07398	23245
430	97769	50967	24427	21011	92226	44380	23422	10654	43617	80504
431	09175	37545	39088	06879	21277	05153	81855	84043	35307	59465
432	52062	95519	54087	14072	50953	63477	64635	34552	75243	70222
433	70558	85169	01086	97202	10390	01819	88167	21851	87837	85287
434	22553	61317	08968	67521	16627	48855	97263	94242	93354	72446
435	95216	75263	60351	02643	00063	20824	67468	89441	84055	47035
436	49087	61399	47781	32173	96672	04528	15881	46764	20115	03226
437	24808	79068	70787	43106	97133	37236	77888	48451	20788	44648
438	89879	79942	43781	05069	80143	59176	47392	70372	26899	16228
439	61178	79295	58926	21977	28435	32631	23062	31822	70462	05965
440	37444	56047	23208	34710	12147	28558	58817	98807	56776	08129

| Rows | Columns | | | | | | | | | |
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
441	99633	00363	16853	20789	87674	03938	36077	41012	08813	51168
442	87363	59239	42023	78056	51254	95644	90527	41398	74996	94977
443	23923	87269	85277	34727	78036	74471	12157	11655	25194	47557
444	45610	26370	13094	34500	36750	54517	85011	26567	04021	32485
445	44166	80095	08286	38126	48834	73423	13617	08853	16286	16023
446	81876	27486	53925	22330	37168	97954	11967	03309	97096	64221
447	79400	83852	52174	42577	18553	14023	69629	61913	41050	69689
448	42799	46647	36718	49704	17150	07935	62372	39933	20838	27652
449	09302	36408	64569	93033	95645	56791	14830	81699	45057	85796
450	88078	81456	17242	84590	93660	34619	51965	85618	36558	54410
451	85018	23508	91507	76455	54941	72711	39406	94620	27963	96478
452	11904	73678	08272	62941	02349	71389	45605	60947	60775	73181
453	75344	98489	86268	73652	98210	44546	27174	27499	53523	63110
454	65566	65614	01443	07607	11826	91326	29664	01603	23156	89223
455	51872	72294	95432	53555	96810	17100	35066	00815	01552	06392
456	03805	37913	98633	81009	81060	33449	68055	83844	90942	74857
457	21055	78685	71250	10329	56135	80647	51404	06626	10042	93629
458	48977	36794	56054	59243	57361	65304	93258	56760	63348	24949
459	93077	72941	92779	23581	24548	56415	61927	64416	29934	00755
460	84533	26564	91583	83411	66504	02036	02922	63569	17906	38076
461	11338	12903	14514	27585	45068	05520	56321	22693	35089	07694
462	23858	68500	92274	87026	99717	01542	72990	43413	59744	44595
463	94096	74920	25822	98026	05394	61840	83089	09224	78530	33996
464	83160	82362	09350	98536	38155	42661	02363	67625	34683	95372
465	97425	47335	69709	01386	74319	04318	99387	86874	12549	38369
466	83951	11954	24317	20345	18134	90062	10761	54548	49505	52685
467	93085	35203	05740	03206	92012	42710	34650	73236	66167	21788
468	33762	83193	58045	89880	78101	44392	53767	15220	66319	72953
469	49665	85397	85137	30496	23469	42846	94810	16151	08029	50554
470	37541	82627	80051	72521	35342	56119	97190	43635	84249	61254
471	22145	85304	35348	82854	55846	18076	12415	30193	42776	85611
472	27153	08662	61078	52433	22184	33998	87436	37430	45246	11400
473	00301	49425	66682	25442	83668	66236	79655	88312	93047	12088
474	43815	43272	73778	63469	50083	70696	13558	98995	58159	04700
475	14689	86482	74157	46012	97765	27552	49617	51734	20849	70198
476	16680	55936	82453	19532	49988	13176	94219	88698	41755	56216
477	86938	60429	01137	86168	78257	86249	46134	51865	09836	73966
478	33944	29219	73161	46061	30946	22210	79302	40300	08852	27528
479	16045	67736	18608	18198	19468	76358	69203	02760	28625	70476
480	37044	52523	25627	63107	30806	80857	84383	78450	26245	91763

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
481	61471	45322	35340	35132	42163	69332	98851	50252	56911	62693
482	47422	21296	16785	66393	39249	51463	95963	07929	66728	47761
483	24133	39719	14484	58613	88717	29289	77360	09030	39605	87507
484	67253	67064	10748	16006	16767	57345	42285	56670	88445	85799
485	62382	76941	01635	35829	77516	98468	51686	48140	13583	94911
486	98011	16503	09201	03523	87192	66483	55649	36764	86132	12463
487	37366	24386	20654	85117	74078	64120	04643	14351	71381	28133
488	73587	83993	54176	05221	94119	20108	78101	81276	00835	63835
489	33583	68291	50547	96085	62180	27453	18567	55524	86088	00069
490	02878	33223	39199	49536	56199	05993	71201	78852	65889	32719
491	91498	41673	17195	33175	04994	09879	70337	11861	69032	51915
492	91127	19815	30219	55591	21725	43827	78862	67699	01009	07050
493	12997	55013	18662	81724	24305	37661	18956	50064	39500	17450
494	96098	13651	15393	69995	14762	69734	89150	93126	17700	94400
495	97627	17837	10472	18983	28387	99781	52977	01657	92602	41043
496	40064	47981	31484	76603	54088	91095	00010	13800	76690	75133
497	16239	68743	71374	55863	22672	91609	51514	98135	42870	48578
498	58354	24913	20435	30965	17453	65623	93058	08313	99293	00990
499	52567	65085	60220	84641	18273	49604	47418	90974	83965	62732
500	06236	29052	91392	07551	83532	68130	56970	33273	61993	88407
501	88188	99345	94118	40373	50387	24802	81352	61640	56614	71506
502	05200	50533	59428	02797	16833	10038	18901	40743	99449	49825
503	82828	41316	92617	31346	89263	06589	07121	07151	23905	98435
504	71006	99318	19269	35233	79183	78538	06326	62715	28701	52809
505	05937	00875	32264	82808	00229	03868	71072	11519	44876	34508
506	06021	04370	93070	90737	05354	68427	25554	11165	00123	80338
507	54789	10960	44023	57857	56556	83993	70787	28193	65872	33723
508	90400	05707	29128	14859	84117	72206	53740	00464	51853	78852
509	51424	01651	99970	73521	82356	03297	36288	93531	69269	84798
510	79743	88757	43370	86536	07166	06401	14413	23643	21527	91902
511	77418	00322	98854	51507	00565	33066	65791	47857	32483	38493
512	17580	49302	16408	05678	75532	46218	74359	77556	82242	00134
513	15489	45559	28548	64330	42126	43145	81287	73884	69312	03395
514	56342	66773	18536	32600	73958	75993	84250	19254	06677	54192
515	20202	19216	23762	47856	04623	70728	86657	70801	53719	25214
516	84877	51708	69357	67914	55372	97225	52837	46723	00256	96221
517	01647	00311	44989	21900	96079	15793	13148	01433	78721	02647
518	45652	89311	45302	74539	32045	86727	40595	55953	93448	07805
519	79975	06153	08932	59185	71386	19070	87098	19392	13899	56096
520	49744	54713	37053	77467	15348	03383	96086	93295	12413	55774

Rows	Columns									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
521	40922	94903	29638	46870	14108	84391	87313	65969	43349	85142
522	53319	48020	77444	51447	07916	99506	83504	22290	63835	45589
523	76682	10559	85446	56236	85919	76388	59850	03262	60347	31077
524	48869	97229	69581	84581	71728	45150	16901	88717	62688	24822
525	95961	19279	38078	17473	43945	21562	90937	52140	73771	56084
526	16521	25945	94076	91281	92272	41233	58614	18912	58454	34011
527	78282	26332	44072	55104	16895	98311	56005	23331	21939	03463
528	43473	39179	53174	43498	72674	13087	54261	01844	45738	93150
529	06513	31352	09177	21367	64725	23784	18125	74873	83971	92678
530	48734	39737	03448	99009	98136	34562	30339	93143	07350	94289
531	54832	70111	48339	75270	11652	41697	43277	58089	70520	96997
532	55844	69515	22658	75438	83086	41325	04694	40359	28351	53492
533	42829	54398	93338	90705	00626	87752	93482	27726	51835	23966
534	81128	63461	10925	44382	73365	98875	77605	27351	49177	36914
535	62885	26354	10368	78026	00186	46783	02059	98892	98061	15330
536	19525	10375	27010	42791	49471	90607	98103	31752	04842	13693
537	26570	99202	73924	59888	01827	93314	63949	35394	12989	05867
538	04772	17749	01537	96036	02102	02622	06007	52239	61201	57415
539	49129	12491	62552	64323	44856	29045	76871	80449	81351	73642
540	19937	75104	57780	95871	94547	53541	77723	54114	90290	62627
541	52571	67962	72775	28480	87411	12075	45177	08796	99297	48807
542	54943	80723	81195	84069	28144	48106	04169	16575	62665	97861
543	16375	88048	29625	08111	92924	53335	09525	88290	17679	08945
544	38745	91458	30363	95005	55854	38628	13599	73065	40870	82576
545	09937	17776	86425	88916	80594	28347	08092	64255	55604	78635
546	30097	47192	27960	15937	42080	61048	14358	44508	72683	51088
547	02410	60124	62825	42947	74590	89730	16073	28184	30078	92578
548	44804	80165	19442	72194	76910	40274	93861	06568	92482	70037
549	37352	79142	51032	58844	03167	57351	51850	92810	35331	78995
550	60640	14199	48263	71533	94235	42431	44114	90993	41149	06159
551	91610	78188	70960	63990	75601	40719	30421	61611	99904	32812
552	33703	90322	64835	44919	05944	55157	21524	15227	96909	44592
553	30613	74952	51132	01915	92747	64951	17012	64161	18296	22851
554	29975	89868	94738	17752	35156	35749	10367	07684	36188	18510
555	28551	90707	88916	19509	25625	58104	32586	86679	50720	94953
556	20969	99570	91291	90700	21916	81825	44394	42880	01547	85590
557	52666	19174	39615	99505	63213	21069	10634	12952	12234	90511
558	30680	19655	63348	58629	18425	84903	42508	32307	84115	27156
559	00849	74917	97758	16379	58678	44947	05585	56941	85104	20285
560	14110	06927	01263	54613	16439	11458	18593	64952	29372	74461