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NATIONAL ACCIDENT SAMPLING SYSTEM SAMPLE DESIGN, PHASES 2 AND 3

Executive Summary

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16. Abstract

This report describes the Phase 2 and 3 sample design for the National Accident Sampling System (NASS). It recommends a procedure for the first-stage selection of Primary Sampling Units (PSU's) and the second-stage design for the selection of accidents for investigation. Cost models are developed to estimate the operating characteristics of the NASS. The design features extensive use of stratification and clustering. Controlled probability selection is used to insure geographic dispersion of the 75 recommended investigation sites, including the initial 10 NASS pilot sites.

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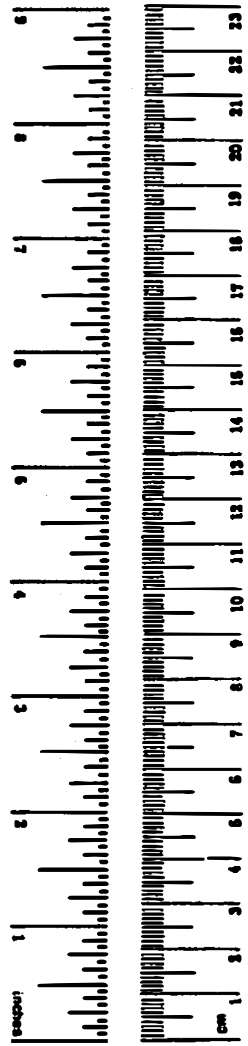
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

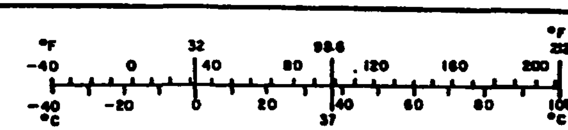
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



EXECUTIVE SUMMARY

1. NASS Objectives

This document summarizes the final report of the redesign of the sample for the National Accident Sampling System (NASS). The NASS, under development by the National Highway Traffic Safety Administration (NHTSA), will provide a representative source of traffic accident data for use in rule making activities and by accident researchers. To quote the NHTSA [1], the NASS should fulfill the following objectives:

> "The National Highway Traffic Safety Administration (NHTSA), in the mid-1970's, recognized the urgent need to embark on a major effort that would fulfill the following objectives:
>
> 1. To estimate and report national statistics on highway safety that describe accidents, their causes, and consequences, at a level of detail beyond current records systems.
>
> 2. To establish a detailed data base and data collection capability that can be used for safety countermeasure design and evaluation.
>
> The National Accident Sampling System (NASS) was initiated in 1977 and was conceived as a network of data collection teams trained to collect uniform and detailed driver, occupant, vehicle, and highway scene information on a probability sample of the Nation's motor vehicle accidents."

To accomplish our goals, we began by working with the agency in attempting to define those statistics considered to be the most important and upon which the design should be based. The agency has summarized these statistics in [2].

This NCSA report states that NASS should report annually on the following key accident characteristics:

"A. The traffic toll - estimates of the number of injuries nationwide, classified by Abbreviated Injury Scale level, by type of disability suffered, by length of hospital stay and layoff from work, and by specific injury type fatalities also will be classified.

B. Detailed characteristics of fatal accidents, including accident severity, accident configuration, roadway classification, type of vehicle involved, driver and occupant types, availability and use of countermeasures.

C. Detailed characteristics of injury accidents, where 'injuries' are classified by their AIS levels, by specific injury type and by consequences.

D. Injury and fatality rates per accident-involved occupant for various types of accidents, vehicles and occupants.

E. Countermeasures availability, usage in accidents, and effectiveness (e.g., safety belts, motorcycle rider helmets).

F. Accident and injury rates per unit of exposure."

While a sample design cannot in general produce an optimal design for more than one dependent variable, it is possible to construct a procedure which results in small sampling errors for a variety of variables. This was an important goal of the NASS redesign. The basic approach was to determine a practical, that is, workable field data collection system. We assumed that a fixed budget was available and we wished to reduce the sampling errors of a selection of key statistics, exemplified by those listed above.

2. Survey Conditons Affecting the NASS Design

Early in the planning of the NASS program, it became evident that the source of accident information should be a probability sample of accidents selected within a sample of sites called primary sampling units (PSU's). By organizing the program in this way, it would be possible to base the NASS estimates on information collected in a limited number of areas each staffed by a small number of select and intensively trained accident investigators.

The process of designating a sample of this kind falls into the following major steps: Define a universe of PSU's that, taken together, encompass all areas of the country; assemble the PSU's into strata as homogeneous as possible with respect to accident characteristics; select one PSU from each of the strata; select a sample of police jurisdictions within the sample PSU's; within each sample jurisdiction select samples of accidents for investigation by a team of trained investigators. Several factors had to be considered when designing the multi-stage sample of PSU's, police jurisdictions and accident report forms. We will discuss the conditions affecting the first stage, the sample of PSU's, and then those affecting the design of the sample within PSU's.

2.1 Conditions Affecting the Selection of PSU's

The NHTSA invested considerable resources during the establishment of the initial 10 pilot sites. Since these sites were a probability sample and represented over a tenth of all teams to be involved, it was desirable to retain these selected PSU's in the NASS. This requirement of retaining initial selections placed a constraint on the first-stage design. To accomplish this goal, and to have a probability sample for the first stage, we defined new strata of PSU's within the initial 10 pilot strata. That is, for a 75-strata design, seven or eight new strata would be formed within each of the 10 original strata To do this stratification, variables other than those used in the initial stratification were used.

A second major condition which impacted the selection of PSU's dealt with phasing in of investigation sites over time. Clearly, the simultaneous introduction of a substantial number of new teams would produce difficult logistical problems. Since it was not expected that the funding required to procure and train all new teams would be available in a single fiscal year, it was necessary to design subsamples which would designate sites for introduction each year until all teams were active in data collection. There are major advantages to drawing the subsamples on a probability basis so that unbiased national estimates with calculable precision can be made. It is clear that estimates based on subsamples will not be as precise as those ultimately expected. Still, the extensive resources required to operate the NASS during the introductory years can be made to yield valid statistical estimates. This formed the other goal in our design of a first-stage selection process.

2.2 Conditions Affecting the Selection of Accidents for Investigation

The within PSU samples also faced several constraints. The first of these was to insure that teams were kept busy regardless of variations in the local accident experience. Earlier data collection schemes utilized by the agency were based on the notion of using fixed sampling rates, in some instances by including all accident reports involving vehicles with license tags ending in a specific digit. Another approach to accident selection took "all" accidents of a specific severity occurring on certain days. The number of days used for the selection varied by severity. For example, collection of fatals occurred most frequently and of non-injury accident least frequently, thus producing an oversampling of more serious accidents.

For the NASS, we concluded that a more rigorously defined case load should be provided. To this end, the within-PSU design calls for the advance designation of the number of cases to be selected on each day of sampling. To control any increases in sampling error due to variations in selection probabilities, the number of cases designated by day of week should reflect the likely accident counts distributed by day of week. If twice as many accident reports will be listed on Monday as on Wednesday, for example, then twice as many cases should be selected for investigation from Monday than from Wednesday. The distribution of accident occurrence over time must be assumed when teams are first initiated. However, as accident listings become available, the assignments can be revised, based on empirical results.

One other factor affecting the design of within-PSU samples is the need to control the time lag between the occurrence of an accident and its designation for investigation. Obviously, as this lag increases, the accident trail grows dimmer making it more difficult to obtain needed data. The ideal situation to control on lag would be to visit police jurisdictions daily. This however is not likely to be practical since the added number of visits to jurisdictions would leave less time for investigation. To recapture the time for investigations, it would be necessary to reduce the number of jurisdictions visited for listing. It is not desirable to reduce the proportion of jurisdictions visited as this increases the within-PSU sampling error. The approach taken was to select sampling days so that the lag was generally no more than a week. To do this, every jurisdiction sampled was contacted at least weekly with the larger jurisdictions contacted more frequently. Larger metropolitan jurisdictions, for example, were contacted daily.

3. Overview of Proposed NASS Design for the Continuous Sampling System

Although NASS will be used to gather a variety of statistical data related to highway safety, the design was geared to provide greatest efficiency for the ongoing studies of accidents, referred to as the Continuous Sampling System (CSS). Consequently, the requirements for the CSS dominated the development of the sample design.

The vehicle accident universe from which cases are selected for investigation consists of all accidents for which police reports are completed and filed. The universe may contain non-towaway accidents, or it may be limited to towaway only cases. While there are many other vehicle accidents of interest, national estimates from the CSS will project to the population of accidents for which police reports are available. (Other elements of NASS will deal with the balance of the accident population.) The NASS design for the CSS is based on the sampling of accident reports found at police jurisdictions, and it is this universe about which estimates can be made with known precision.

The sample design contains three stages: the selection of primary sampling units (PSU's) consisting essentially of metropolitan cities or counties or groups of counties; the sampling of police jurisdictions within the PSU's; and lastly, the listing and sampling of accident reports filed with the police jurisdictions. While each of the sampling stages is dealt with individually, it is necessary to view the process in a unified way to determine the best procedures to use at each stage.

Some of the actual sampling was completed during this project, notably the identification of the PSU's in which the full NASS will operate. For the within-PSU sampling procedures, 10 examples have been completed; one for each of the pilot sites. Guidelines are described in this report whereby the pilot PSU procedures can be upated and similar samples can be drawn in the remaining PSU's. Each, however, must be tailored to the site; therefore, certain types of information must be gathered before a design is completed for the other PSU's. Procedures for sampling reports listed in the PSU's were developed and used during the pilot. The procedures can be generalized for use in the other sites; but it would be desirable to review periodically the weights for various accident strata to insure that the NASS objectives are being met most efficiently.

It was possible to retain the original 10 pilot PSU's in the full design while maintaining a probability sample. The technique involved defining new strata within the original 10 strata used to select the pilot sites. Each of these strata supplied one PSU, ten of which were the original pilot sites. By so doing, we recognize that sampling from a set of completely independent strata would produce estimates with sampling errors somewhat lower than the procedure used. However, the obvious benefit of conserving the investments made in the pilot sites was overwhelming, and, and we felt, justified the procedure used.

For reasons discussed later in the report, we recommended that a total of 75 strata should be chosen. Obviously, the logistical problems of initiating 65 new teams while operating 10 existing teams would be difficult. To this end, a method for selectively phasing in teams over several years was needed. The probability sample was randomly divided so that teams could be added slowly, yet national estimates could be made each year. Of course, the sampling errors of estimates produced before all teams are operating will be larger than expected for the sytem when completed.

Good sample design should make efficient use of available resources. This includes benefits that are obtained through the use of good estimators; we propose several candidates to be evaluated when data from all sites become available. The goal in evaluating these estimators is to make use of known totals, such as FARS data, or to request data, such as from nonsampled jurisdictions, which can help in reducing the variability of estimates by ratio estimation techniques.

Finally, a useful sample design should not stop with the production of estimates. Rather, it should include the ability to estimate sampling, and where possible nonsampling errors. The NASS, being a large-scale, ongoing survey, should be no exception. The estimates of national accident characteristics will be far more meaningful when joined with some measure of their precision. To this end, we have proposed the use of replication methods for estimating sampling errors for a variety of statistics. The method is quite general and can be applied to complex estimates of many kinds.

4. Summary of the Design

In this section, we review the major steps taken during the contract and summarize important conclusions reached during each phase of the work. The contract consisted of the following stages:

1. Familiarization with the NASS
2. Definition of PSU, measures of size, and stratification
3. Develop within - PSU sampling plans
4. Develop a cost model and combine it with variances to select an optimum design
5. Select a sample of PSU's and subsamples of these PSU's for phased introduction
6. Develop estimation procedures and techniques for computing sampling errors

Each of the above stages will be discussed below.

4.1 Familiarization with NASS

Since two of the project staff were new to the NASS, some orientation was necessary. A visit to a NCSS site was made to witness the operating characteristics of investigation teams. One clear observation which resulted from the visit was the need to control the caseload of the team and thereby improve the balance of investigative work over time.

4.2 Definition of PSU's, Measures of Size, and Stratification

The first major component of the design that was resolved was the organization and identification of Primary Sampling Units

(PSU's). Each PSU defines an area in which an investigation team would operate. Generally, sampling errors can be reduced by assembling PSU's into homogeneous groups (strata) within which the characteristics of interest are expected to be similar. It remained to decide whether one or more PSU's should be selected from each stratum. The choice depends, to some degree, on the expected effectiveness of the stratifiers.

We have decided to view the first stage of selection as a stratified sample, with only one PSU selected from each stratum. An obvious alternative is to use half the number of strata and select two PSU's from each. Briefly, this latter procedure allows for unbiased estimates of sampling error whereas the former method does not. However, selection of one PSU per stratum uses the maximum number of strata and therefore results in more precise estimates. The increased precision over two or more PSU's per stratum depends on the effectiveness of the stratification variables. As it turned out, the between-PSU component appeared to be a significant part of the total variance; therefore, it seemed important to reduce it as much as possible, even at the price of introducing a small upward bias in the estimates of variance. We have therefore chosen to use a one PSU per stratum sample design.

To study the effect of stratifiers and to choose a measure of size for use in assigning selection probabilities, an automated data file describing PSU's was needed. The first step in creating such a file was to review the PSU's as originally defined by the Highway Safety Research Institute and modify their definitions where appropriate [3]. Changes were made in the following areas:

- Aggregating the originally defined New England PSU's to form contiguous areas;
- Addition of Hawaii PSU's, and
- Treatment of Alaska PSU's.

A data file was constructed to evaluate various measures of size and stratification procedures and to estimate the influence of these on variances. Each record in the file represents a PSU; the data items contained in the record describe the characteristics of the PSU. Information was collected from the following sources:

- County City Data Book, 1972 and 1977;
- Fatal Accident Reporting System, 1975 through 1977;
- Vehicle registrations from R.L. Polk;
- Highway mileage data from FHWA; and
- Recodes describing terrain, days of sunshine and rainfall from almanacs.

The variable selected for use as the measure of size was 1977 population. The choice was based on several factors. First, it was the most complete and most current item available. Second, it appeared to produce the smallest sampling errors for a variety of dependent (mostly FARS) variables. The square root of 1977 population seemed to be better for estimating rural accident characteristics, but the gains were not very substantial. The sampling errors for more general accident totals were smaller using population than for using the square root of population. Thus, it was decided to use 1977 population for the measure and to choose PSU's proportional to this measure.

The method used to compare the efficiencies of possible stratification variables was to compare computed values of the between-PSU variances within strata. Variances were computed for simple inflation (unbiased) estimators, as well as for ratio estimators that use census totals for all nonself-representing PSU's. The dependent variables generally were selected from the FARS and consisted of annual totals or differences between consecutive years.

Using the above procedures, stratification variables were identified which appeared to be the most helpful in reducing sampling error. These were: gasoline sales per capita, road miles per capita, and percent urban. In addition, geography and climate were considered to be of sufficient importance to insure a spread of the sites, and were also included as stratifiers.

4.3 Pilot Test: Within PSU Sampling

For the pilot test, we designed accident sampling procedures for each of the 10 sites. The philosophy which guided these designs was to satisfy three critical goals: (a) each class of accidents specified as an important group for separate analysis in NASS should have sampling fractions that will insure sufficient sample cases to make national estimates of key statistics with a specified precision; (b) the design must be a probability sample that will provide unbiased estimates as well as permit the calculation of sampling variances, and (c) it must be operationally feasible and economical, while providing a fairly uniform flow of work from week to week.

The following four points provide an overview of the procedure in each PSU:

1. On specified workdays a fixed group of police agencies is contacted by the investigators. The agencies consist of a sample (or in some cases all) of all those operating in the PSU. Contact may be in person or by telephone. At

each visit, the police accident reports (PAR's) are examined and a listing is made of all accidents that became available since the previous visits.

2. The new accidents listed are stratified by type, e.g., "motorcycle fatality," "A-injury truck accident," etc. There are 14 accident types that define the four categories of participants (non-occupant, motorcycle, truck, and other vehicle) crossed with three classes of severity (fatal, A-injury and BCOU), plus two categories which cover non-towaway truck and non-toway other vehicle accidents.

3. Since the NASS program is particularly interested in damage that occurs in the most severe types of accidents, these accidents are given a relatively higher likelihood than other accidents of being chosen for investigation. Numerical weights are assigned which increase the selection probabilities of the most serious types of accidents. The accident listings (weighted to account for the sampling of jurisdictions and the oversampling of certain accident types) are transcribed into an ordered list and an estimated total measure of size is prepared for the day. The measure of size is the sum of the products of the weight and the number of accidents listed in each category.

4. The measure of size and the assigned number of accidents to be selected for the day are used to determine the sampling rate. A random number is selected to designate the first case chosen for investigation. From the first selection, the remaining sample accidents are then designated systematically using the weighted list of accidents. The selected accidents are assigned unique identification numbers, and the field study commences.

There should be differences in the accident sampling procedures employed at the various operating sites because it would be inefficient to apply the same method of sampling in each of the NASS PSU's. The sample PSU's have substantial variations in geographic area, population density, and number of police jurisdictions producing accident reports. All of these factors will influence the sampling system devised for each site. A number of other administrative requirements, designed to equalize the investigator's fieldwork during the implementation of NASS have also affected the within PSU sample designs. Some of these objectives, such as equalizing the workload at each site, and controlling the lag time between occurrence and listing of accidents, are being evaluated and revised prior to beginning the full NASS program. The sampling methods at each of the 75 PSU's will be drawn up just prior to their introduction of the NASS.

The pilot test was also used to obtain data on the operating characteristics of NASS investigation teams. These data were obtained by monitoring team activities by means of a daily activity log. The logs were maintained by each team member and recorded the amount of time and travel needed to perform various aspects of the investigation. Parameters of a cost model were then derived which were used in the optimization task.

4.4 NASS Optimization

The aim of the optimization process was to choose the sample design that, for a fixed budget, would provide the greatest reliability for the estimates needed to meet the major requirements of the NASS program. Alternative methods that could be used for most steps in a sample design were developed; at each step, the preferred alternative was chosen by comparing the reliability, feasibility, and cost of the various alternatives.

The NASS requirements have been stated in general terms as demanding "reliable estimates of national accident statistics which are of continued high interest" and directs the program to "be flexible enough to accomodate studies of timely and topical issues". These requirements mean that the NASS design must have a general purpose orientation seeking to provide good estimates for a variety of statistics.

It is not possible to design a general purpose sample that would be optimum for each of the wide variety of statistics that would be estimated. For example, to minimize the variances for most statistics relating to total motor vehicle accidents, it is necessary to sample all motor vehicle accidents at approximately the same rate. This would produce a quite small sample of fatal accidents. An equal probability sample is thus inconsistent with the requirement to produce data of acceptable reliability for the various severity level accidents. Variances for the separate severity level accidents can be reduced but at the cost of reducing the reliability of estimates for the total of all accidents. Consequently, we chose a design which is a compromise; one that will produce reasonable results for all objectives but not necessarily the best result for each objective.

The textbook method of defining an optimum sample operates under the assumption that the total cost of a survey and the total variance of survey estimates can be expressed as continuous functions of the design parameters, such as, total sample size, number of teams, workload per team member, etc. The designs that could be postulated for solutions to the NASS problem do not have such convenient cost and variance relationships. The functional relationships that do exist are more like step functions; for example, the numbers of PSU's and team size are meaningful only as integers and changes in either of the values are reflected in discontinuous changes in other design parameters in order to stay within the fixed budget. It was possible, however, to construct some relationships that operated within fairly small limits of variation.

The annual budget for on-going costs of data collection was fixed at $11,350,000 when non-towaways are excluded from the CSS (when included, the budget was set at $11,800,000). The stated budget limits do not cover the cost of the survey start-up, refresher training, statistical and engineering R&D, computer processing of data, unreported accident survey, exposure data collection or other costs that do not relate directly to NASS data collection activities. The costs of editing and imputation which vary directly with the sample size are included.

The following five steps describe the optimization process which we used:

1. Select a set of alternative sample designs that appear to be feasible,
2. Establish relationships that would express the costs for variations within each design,
3. Use the separate cost relationships to determine the sample sizes possible for the design for the given budget described above,
4. Estimate the reliability of estimates that would be prepared from each design, and
5. Use the expected reliability and any feasibility advantages among the designs to choose the sample that appears to be closest to the optimum.

Five design sizes, ranging from 35 to 125 PSU's, were analyzed. For each size, designs both including and excluding non-towaways were considered. When the relative sampling errors of level and change for the alternative designs were compared, the design consisting of 75 PSU's seemed the preferred one. This size provided good overall estimates without requiring team sizes as small as one-person. One-person team size is considered undesirable from an operations standpoint because it does not contain any backup to take of investigators' illness, vacation, attrition, etc.

4.5 Sample Selection

After the stratification procedure was determined and the results of the optimization analysis completed, the sample PSU's were selected. The selection of PSU's was done in a manner chosen to insure the retention of the original 10 sites. Had independent selections been made in each stratum, few, if any, of the pilot PSU's would have been selected. The procedure for selecting the 75 PSU's met the following three requirements.

1. Retain the 10 pilot PSU's while maintaining a probability sample. This requirement was imposed to protect the investment in the 10 PSU's even though it was known that a small increase in variance would result.

2. Use a controlled selection technique to provide additional benefits of stratification without increasing the number of PSU's. Its value was in increasing the geographic spread of PSU's.

3. Provide for a three-phase activation of the NASS teams, with roughly one third of the new 65 PSU's being added in each year. This phasing-in should be done so that the samples are always true probability samples of the total United States. This requirement spreads out the large start-up effort of the design.

During the first phase, twenty additional sites will be added to the initial 10 pilot sites. During the next two phases, first 22 then 23 sites will be added to arrive at the full 75-PSU design.

4.6 Estimation Methods and Computation of Sampling Errors

Two types of estimators were proposed, unbiased inflation estimators and ratio estimators. The inflation estimator operates by multiplying the information from each sample accident by the inverse of the probability of selecting the accident. Although this is a simple concept, the estimator turns out to be fairly complex, reflecting the involved method of designating sample accidents within the PSU's used for the CSS. The estimate is actually the sum of products of two random variables, one product for each day of sampling. Each of these random variables makes a contribution to the sampling error of the estimates.

Several types of ratio estimation are proposed. Some forms are intended to reduce the within-PSU variability of the random variables involved in the products just mentioned. Other forms will attempt to reduce the variance between PSU's by employing independent estimates of national statistics that can also be estimated from the NASS sample PSU's. These procedures usually exhibit smaller mean square errors than inflation estimates and provide some protection against nonsampling errors which may occur in data preparation.

The computation of sampling errors for a multipurpose survey using a variety of estimation procedures and a complex sample design is a complicated undertaking. We have recommended a system that is flexible enough to provide measures of reliability for most of the estimates that are to be produced from the CSS data. Certain simplifying assumptions and compromises are needed to reduce the task to manageable proportions.

We recommend and have described, the use of balanced half-sample replications for the estimation of sampling errors. The method consists of drawing a set of random subsamples from the full sample in a specific way. This is done differently in five large self-representing PSU's than in the 70 smaller, nonself-representing sites. In the latter, the 70 PSU's are combined into 35 pairs and each random subsample consists of 35 selections, one from each pair. For the self-representing PSU's, time, in the form of consecutive weeks, define the pairs. One week from each pair of weeks is selected for the subsamples.

The method of replications has special advantages in reducing the complexity of variance computations when complicated estimation methods are used. A possibly more important benefit is that it may be applied to compute sampling errors for more complex statistics without the need for new variance expressions. Application of the method requires carrying out three simple steps:

- Assemble data for the sample units that make up each of the replicates; this amounts to making a copy of the sample data for each unit in each of the subsamples of the full sample.
- Perform the estimation procedure on each of the replicates. The same estimation procedure, prepared for the full sample, is applied separately to each of the replicates.
- Calculate the dispersion of the resulting estimates among the replicates to estimate the variance of the full sample; a relatively simple computation formula is used.

With procedures for computing sampling error estimates programmed on the computer, it would be possible to compute and display in a report estimates of the sampling error for each of the CSS statistics being tabulated from the full sample. However, estimates of sampling errors are themselves likely to be subject to fairly large sampling errors. Consequently, we suggest that methods of stabilizing the sampling error estimates, for example, by generalization or by averaging over time should be examined. As the CSS is planned to be a continuing program, the sampling errors can be computed at each period of tabulation. This will allow a body of experience to be assembled that may enable a more stable set of reliability measurements to be prepared. Methods of generalizing sampling error estimates such as those used in the Census Bureau's Current Population Survey should be examined to see if they can be adapted to the NASS situation.

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[3] _____________, "Design for NASS, A National Accident Sampling System" by A. Wolfe, J. O'Day and R. Kaplan, DOT-HS-4-00890 (1976).