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BEFORE THE

POSTAL RATE COMMISSION

WASHINGTON DC, 20268-0001

POSTAL RATE AND FEE CHANGES PURSUANT TO PUBLIC LAW 108-18

Docket No. R2005-1

DIRECT TESTIMONY

OF

JOHN KELLEY

ON BEHALF OF

UNITED STATES POSTAL SERVICE

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AUTOBIOGRAPHICAL SKETCH

My name is John Kelley. I am an economist in the Finance department at Postal Service Headquarters. I have been employed by the Postal Service since 1997. Prior to joining the Postal Service, I was employed as a statistician at the American Petroleum Institute as well as the Bureau of Labor Statistics. I received a B.S. in mathematics education from University of New Hampshire in 1986 and a M.A. in mathematics from Indiana University in 1990. I completed several graduate courses in sampling theory at George Washington University from 1993-1995.

SPONSORED LIBRARY REFERENCES

The following Library References are sponsored in my testimony:

USPS LR-K-39 Calculation of Distance-related Transportation Costs

USPS LR-K-67 Development of Delivery Unit Costs by Rate Category for First-Class Mail and Standard Mail

I. PURPOSE AND SCOPE OF TESTIMONY

The purpose of my testimony is to describe methodologies used in the following three analytical areas:

- Calculation of Distance-related Transportation Costs
- Calculation of Delivery Costs by Rate Category for First-Class Mail and Standard Mail.
- Description of sample design for the City Carrier Street Time Study (CCSTS)

Inputs and Outputs by Section

Below I list the inputs used, and outputs produced, in each of the three analytical areas:

i. Distance-Related Transportation Costs

Inputs

USPS LR-K-5 Cost Segments and Components Report (Witness Meehan)

Outputs

USPS-LR-K-39 for the Roll Forward (Witness Waterbury)

ii. Delivery Costs by Rate Category for First-Class Mail and Standard Mail

Inputs

USPS-T-2 for in-office casing costs (Witness Shaw)

USPS-T-5 for city and rural carrier volumes by shape (Witness Harahush)

USPS-T-10 for test year costs (Witness Waterbury)

USPS-T-13 for mail processing costs (Witness Smith)

USPS-LR-K-5 Cost Segments and Components (Witness Meehan)

USPS-LR-K-9 In-Office Cost System (IOCS) Statistical and Computer Documentation (Source Code and Data on CD-ROM)

USPS-LR-K-11 City Carrier Cost System (CCCS) Statistical and Computer Documentation (Source Code and Data on CD-ROM)

USPS-LR-K-12 Rural Carrier Cost System (RCCS) Statistical and Computer Documentation (Source Code and Data on CD-ROM)

USPS-LR-K-52 for test year piggybacks and CRA costs (Witness Smith)
USPS-LR-K-53 for mail processing units costs by shape (Witness Smith)
USPS-LR-K-87 for Revenue Pieces and Weight Estimates by Shape, Weight Increment, and Indicia (Witness Loestscher)

Outputs

USPS-LR-K-67 used by the following witnesses
Abdirahman (USPS-T-21) to develop letter costs
Moser (USPS-T-23) for final adjustments

iii. Sample Design for CCSTS

Inputs

None

Outputs

Witness Bradley (USPS-T-14)
Witness Stevens (USPS-T-15)

II. DISTANCE-RELATED TRANSPORTATION COSTS

In this section of my testimony I sponsor USPS-LR-K-39. This library reference is not related to any other analysis described in the testimony. A required input for LR-K-39 is the Cost Segments and Components report sponsored by Witness Meehan USPS-T-9. An output of LR-K-39 is the Roll-Forward sponsored by Witness Waterbury USPS-T-10.

The rate designs for certain zone-related products rely on drawing a distinction between distance and non-distance-related transportation costs. The calculation of these costs follows the Commission's methodology used in prior cases. The base year and test year calculations appear in an Excel spreadsheet in USPS-LR-K-39. Test year FedEx network costs are treated as non-distance-related in light of the fact that there is no mileage component to the rates FedEx charges for transportation service.

III. DELIVERY COSTS BY RATE CATEGORY FOR FIRST-CLASS MAIL AND STANDARD MAIL

In this section of my testimony I sponsor USPS-LR-K-67, Development of Delivery Costs by Rate Category for First-Class Mail and Standard Mail. This library reference is not related to any other analysis described in this testimony. Witness Abdirahman (USPS-T-21) uses the results of this library reference in developing letter costs. Witness Moser (USPS-T-23) uses the results for final adjustments.

This library reference updates the analyses done in library reference USPS-LR-J-117/R2001-1 (Development of Delivery Costs by Rate Category for First-Class Mail and Standard Mail) which was sponsored by Witness Schenk (USPS-T-43/R2001-1). The principal objective of this library reference is to calculate delivery costs by rate category for First-Class Mail and Standard Mail. This is the same objective that was performed by Witness Schenk in Docket No. R2001-1 and Witness Daniel in Docket No. R2000-1 (USPS-T-28/R2000-1).

Other testimony and library references used in the development of this section of the testimony include:

Witness Harahush (USPS-T-5) for city and rural carrier volumes by shape

Witness Meehan (USPS-T-9) for base year costs

Witness Waterbury (USPS-T-10) for test year costs

Witness Loetscher (USPS-T-32) for RPW volumes by shape

USPS-LR-K-5 for Cost Segments and Components (Meehan)

USPS-LR-K-52 for test year piggybacks and CRA costs (Waterbury)

USPS-LR-K-87 Revenue Pieces and Weight Estimates by Shape, Weight Increment, and Indicia (Loestscher)

The Postal Rate Commission's version is contained in USPS-LR-K-101 – Delivery Costs by Rate Category for First-Class Mail and Standard Mail using PRC methodology. Table 1, below, compares the final costs by rate category using the USPS and PRC versions for the test year:

Table 1: Test Year FY06 Unit Delivery Costs

First-Class Single Piece	**USPS Test Year Unit Costs**	**PRC Test Year Units Costs**
Single-Piece Letters	7.188	5.844
Single-Piece Flats	12.416	11.274
Single-Piece Parcels	30.049	26.144
Single-Piece Nonletters	14.423	12.967
First-Class Presort	**USPS Test Year Unit Costs**	**PRC Test Year Units Costs**
Nonautomation -- Nonmach Mixed ADC	10.918	9.810
Nonautomation -- Nonmach ADC	10.918	9.810
Nonautomation -- Mach Mixed AADC	3.929	3.972
Nonautomation -- Mach AADC	3.929	3.972
Nonautomation -- Nonmach 3-Digit	10.918	9.810
Nonautomation -- Nonmach 5-Digit	10.918	9.810
Nonautomation -- Mach 3-Digit	3.737	3.812
Nonautomation -- Mach 5-Digit	3.737	3.812
Automation Mixed AADC	4.148	4.155
Automation AADC	3.940	3.981
Auto 3-Digit Letters	3.846	3.903
Auto 5-Digit Letters CSBCS/Manual Sites	6.691	6.280
Auto 5-Digit Letters Other Sites	2.732	2.973
Auto 5-Digit Letters All	3.597	3.695
Auto CR Letters	6.520	6.136
Presort Flats	9.423	8.978
Presort Parcels	20.636	44.464
Presort Nonletters	9.527	9.305
First-Class Cards	**USPS Test Year Unit Costs**	**PRC Test Year Units Costs**
Single Piece Cards	8.888	7.015
NonAuto Presort Cards	3.362	2.847
Auto Mixed AADC Cards	3.555	2.981
Auto AADC Cards	3.371	2.853
Auto 3-Digit Cards	3.289	2.796
Auto 5-Digit Cards CSBCS/Manual Sites	5.798	4.534
Auto 5-Digit Cards Other Sites	2.306	2.116
Auto 5-Digit Cards All	3.069	2.644
Auto CR Cards	5.647	4.430
Standard Regular	**USPS Test Year Unit Costs**	**PRC Test Year Units Costs**
Nonautomation -- Nonmach Mixed ADC	11.049	6.552
Nonautomation -- Nonmach ADC	11.049	6.552
Nonautomation -- Mach Mixed AADC	3.879	3.733
Nonautomation -- Mach AADC	3.879	3.733
Nonautomation -- Nonmach 3-Digit	11.049	6.552
Nonautomation -- Nonmach 5-Digit	11.049	6.552
Nonautomation -- Mach 3-Digit	3.682	3.655
Nonautomation -- Mach 5-Digit	3.682	3.655
Automation Mixed AADC	4.104	3.821
Automation AADC	3.890	3.737
Automation 3-Digit Letters	3.794	3.699
Automation 5-Digit Letters	3.538	3.599
Regular Flat Subtotal	9.290	9.795
Regular Parcel Subtotal	28.948	31.687
Regular Nonletter Subtotal	10.093	10.689

Table 1, continued

Standard ECR - with DAL City –Carrier Street – Time Costs and DAL Rural-Carrier Costs included in the numerator of the ECR Saturation Letters Unit Cost

	USPS Test Year Unit Costs	PRC Test Year Units Costs
ECR Basic Auto Letters	2.902	4.818
ECR Basic Letters	5.358	9.694
ECR High Density Letters	4.508	4.436
ECR Saturation Letters	6.666	4.359
ECR Basic Flats	6.152	6.152
ECR High Density Flats	4.620	4.670
ECR Saturation Flats	3.168	4.108

Standard ECR - with DAL City Carrier Street-Time Costs and DAL Rural-Carrier Costs included in the numerator of the ECR Saturation Flats Unit Cost

	USPS Test Year Unit Costs	PRC Test Year Units Costs
ECR Basic Auto Letters	2.902	4.818
ECR Basic Letters	5.358	9.694
ECR High Density Letters	4.508	4.436
ECR Saturation Letters	3.876	N/A[1]
ECR Basic Flats	6.152	N/A
ECR High Density Flats	4.620	N/A
ECR Saturation Flats	4.241	N/A

To the extent that, in response to Commission Rule 53, I discuss and compare PRC versions of delivery costs by rate category for First-Class Mail and Standard Mail, I do not sponsor those materials, or in any way endorse the methodologies used to prepare them. In its Order No. 1380 adopting the roadmap rule, the Commission included the following statements regarding the role played by Postal Service witnesses under these circumstances:

> The comparison required by this exercise cannot be equated with sponsoring the preexisting methodology. It merely identifies and gives context to the proposed change, serving as a benchmark so that the impact can be assessed. … [W]itnesses submitting testimony under Rule 53(c) sponsor the proposed methodological changes, not the preexisting methodology. That they may be compelled to reference the preexisting methodology does not mean that they are sponsoring it.

[1] The PRC allocates some of the costs of delivering ECR DALs to Saturation letters and some of these costs to Saturation flats. All PRC-version city route-time, access-time, and coverage-related load time DAL costs are allocated to Saturation flats. However, the PRC-version city elemental load-time and total rural-carrier costs are apportioned to both Saturation letters and Saturation flats, through a distribution based on a combination of CCS, RCS, and RPW volumes. The large discrepancies between the methods leads to the conclusion that they cannot be compared.

Order No. 1380 (August 7, 2003) at 7. Therefore, although I may be compelled to refer to the PRC methodologies and versions corresponding to the Postal Service proposals which are the subject of my testimony, my testimony does not sponsor those PRC materials.

The approach used to develop the current delivery costs by rate category is considerably different from the one employed by the preceding effort (LR-J-117) which was adopted by the PRC in Docket No 2001-1/PRC-LR-7. The current USPS version relies on the costs produced by IOCS to distribute in-office subclass costs to rate categories for First-Class Mail and Standard Mail. The USPS version also uses CCS volumes to distribute city carrier street time costs and RCS volumes to distribute total rural-carrier costs to these same rate categories..

The PRC version distributes costs by rate category for First-Class Mail and Standard Mail in a different way. It uses RPW to distribute the city-carrier route, access, and coverage related load-time costs, and it uses a combination of IOCS, RPW, CCS, RCS, and city and rural crosswalks to distribute city-carrier in-office, elemental load, street support, and total rural-carrier costs to rate categories for First-Class Mail and Standard Mail.

The USPS version utilizes more consistent and justifiable methods to calculate delivery costs by rate category than previous efforts. As a result, the USPS model is superior to the previous work (and hence, by default, the PRC version that relies on that work). The objective, data inputs, and calculations involved in each Excel worksheet in LR-K-67 are in a Word document as part of that library reference.

IV. Sample Design for City Carrier Street Time Study (CCSTS)

In this section of my testimony, I describe the sample design utilized for the City Carrier Street Time Study (CCSTS). The purpose of this study was to update the Postal Rate Commission's (PRC) methodology used in Docket No. R2000-1. Further details about the study and its results are provided in the testimonies of Witness Bradley (USPS-T-14) and Witness Stevens (USPS-T-15).

The CCSTS utilizes a probability sample of one-hundred and sixty-seven ZIP Codes that contained city letter routes. The special feature of probability sampling is that it permits the use of the theory of probability for the computation, done from the sample itself by the use of explicit formulas, of the expected value of an estimate and of its sampling variation. A probability sampling design specifies definite rules for the selection of the sample, invariably by the use of random numbers.[2]

A probability sample is superior to a judgment sample since the quality of a probability sample can be determined through explicit formulae for precision as compared to a judgment sample which has no objective measure of its quality.[3]

The objective for this sample was to estimate the vast majority of variables of interest with a coefficient of variation of less than ten percent. Coefficient of variation (CV) is a measure of the relative error of the estimate. The CV is equal to the standard error of the estimate divided by the value being estimated.

Due to the lack of historical data on the variables being studied in the CCSTS, the estimated relative errors for different sample sizes were based on estimated average daily ZIP Code volumes obtained from historical City Carrier Cost System (CCCS) tests. The daily volume for a ZIP Code can be justified as a proxy for other variables of interest since volume is regarded to have a greater level of uncertainty than many other variables being studied in this survey. Therefore the precision based on volume provided an upper bound on the accuracy of the estimates obtained for any particular sample design.

The CCSTS frame consisted of all ZIP Codes that contained city letter routes. (The CCCS uses the same frame to select its probability-based sample and produce

[2] Deming, W Edwards, Sample Design in Business Research (John Wiley & Sons, 1960), pp 23-24.
[3] Deming, p.31

distribution keys as an input for the Cost Segments and Components.) Specifically, the CCSTS utilized a stratified systematic sample design. ZIP Codes were selected for the CCSTS. All routes within a selected ZIP Code participated in the study.

The primary purpose of stratification is to increase the precision of the estimates for a given sample size. Stratification is one way to use statistical information to acquire a better estimate than would be possible otherwise.[4]

Stratification yields larger gains in precision when the following three conditions occur: 1) the population is composed of institutions that vary widely in size; 2) the principal variables to be measured are closely related to the sizes of the institutions; and 3) a good measure of size is available for setting up the strata.[5]

ZIP Codes do possess those properties which, in theory, offer large gains in precision through stratification. The measure of size for this study is the number of city letter routes within a particular ZIP Code. ZIP Codes consist of large units, some with over eighty city letter routes, as well as small units, many with less than five city routes.

Secondly, two principal variables of interest, volume and time, are highly correlated with this measure of size. ZIP Codes with more city letter routes will tend to have more street time and higher mail volume than ZIP Codes with fewer city letter routes.

Lastly, the frame of ZIP Codes and city letter routes is very stable and has been used for several years to select the sample for CCS, which is a sample of city letter routes. As a result, it gives a reliable measure of size for each ZIP Code.

Since our population has 1) large and small units; 2) a high correlation between variables of interest and the sizes of the units; and 3) a frame with a reliable measure of size, a stratified design was employed with the expectation of improving the precision of the estimates.

Eligible ZIP Codes were classified into three strata by the number of city letter routes that were within each ZIP Code. ZIP Codes with less than eleven city letter routes were placed in one stratum, ZIP Codes with more than ten city letter routes and less than sixty-one letter routes were placed in another stratum. Finally, ZIP Codes with

[4] Deming, p 277.
[5] Cochran, William G, Sampling Techniques (John Wiley & Sons, 1977), p 101.

more than sixty city letter routes were placed in a third stratum. Stratification of the sample into three groups was sufficient to meet our precision needs.

The strata boundaries for the first two strata were determined using the method credited to Dalenius and Hodges – often referred to as the cum $\sqrt{f}$ rule[6] – using the number of city letter routes per ZIP Code- for the frequency distribution necessary to implement this method.

There are a variety of methods of allocating a fixed sample size amongst defined strata. Neyman[7] allocation was utilized, assuming a fixed cost per unit, to select the sample sizes for the first two strata.

The third stratum, the one that consisted of ZIP Codes with more than sixty letter routes, was designed to be a certainty stratum – all ZIP Codes in that stratum were to be selected. From a theoretical perspective, a certainty stratum improves the precision of the estimates because, by definition, there is no sampling error from a certainty stratum – since if the sample were repeated the same estimates would occur.

ZIP Codes were selected by sorting them in ascending order within each stratum and choosing a systematic random sample.

Since ZIP Codes are organized on a geographical basis, this selection process ensured that each stratum would include a spread of ZIP Codes across the country. An efficient method to obtain a geographic dispersion of ZIP Codes across the nation without increasing the sample size to an extremely high and costly level was to implement a systematic design.

An assumption was made that placing the ZIP Codes in ascending numerical order within each stratum did not constitute a correlated ordering for our variables of interest in this study. With this assumption, the sample can be considered equivalent to a stratified random sample.[8]

The supposition that sorting the ZIP Codes in ascending order is equivalent to a random ordering probably leads to under estimating the true precision of the results, using standard formulae for calculating variances assuming a stratified random sample.

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[6]Cochran, William G, Sampling Techniques, 3rd Edition, (John Wiley & Sons, 1977), pp 129-130.
[7] Cochran, p. 99.
[8] Cochran, p 213.

Systematic sampling is more precise than simple random sampling when the variance of the possible samples is larger than the population variance as a whole.[9]

ZIP Codes that are close to each other in an ascending sorted list are also often close in a geographical sense. ZIP Codes that are close geographically have the potential to be under the same management directives and are more likely to have similar policies and procedures than ZIP Codes that are under different management. As a result, there should be a tendency for greater variation between ZIP Codes, for our variables of interest, that are farther apart numerically and geographically as compared with those that are close together. This tendency should give us some benefit from our stratified systematic design as compared to a stratified random design.

This stratified systematic sample design selected two-hundred and twenty-one ZIP Codes for the CCSTS. The estimated CV for this sample was less than five percent for the bulk of variables being studied. The sample size was later reduced to one-hundred and sixty-seven ZIP Codes which did result in a slightly higher CV.

The reduction in the sample size occurred in two phases, but for essentially the same reason: to reduce the cost of collecting the information. As with most surveys, cost is a critical driver of the final sample size. Sample surveys impose a burden on those collecting the data. Concessions often need to be made to the data collectors to account for the time involved in collecting accurate data. If unrealistic demands are placed upon those responsible for collecting the data, biased results from non-sampling error have a tendency to occur.

One must face the fact that the overall usefulness and reliability of a survey may actually be enhanced by reducing the size of the sample and using the money saved to reduce the non-sampling errors.[10]

This survey required the cooperation and diligence of numerous letter carriers, supervisors, and postmasters. Since they were such a critical component of the data collection effort in this study, we felt it was extremely important to address their concerns and maintain the integrity of a probability sample design. Those goals were achieved with a two-phase sample reduction plan, discussed in what follows..

[9] Cochran, p.208.
[10] Deming, p.62.

Sound statistical principles were used to reduce the sample size from two-hundred and twenty-one to one-hundred and sixty-seven ZIP Codes. Random numbers, rather than judgments, were used throughout the entire sample selection and reduction process to arrive at the final list of ZIP Codes.

First, the certainty stratum, the stratum that contained ZIP Codes with more than sixty letter routes, incurred a reduction in sample size from forty-eight ZIP Codes to twelve ZIP Codes. The sample was reduced by ordering the ZIP Codes in ascending order and selecting a random start – a random number between one and four – and choosing the ZIP Code corresponding to the random start on the ordered list and every fourth ZIP Code thereafter until the end of the list was reached.

This stratum was selected for sample reduction due to the high cost per ZIP Code of collecting survey data. Each participating ZIP Code was reimbursed for its labor costs due to the carriers scanning their activities as well as counting a portion of their mail. There was a direct correlation between the number of city routes in a ZIP Code and cost of data collection for that ZIP Code. Therefore, the stratum that contained the ZIP Codes with the largest number of city routes was first targeted for reduction to reduce the cost of the survey. This phase of the reduction process reduced the sample by thirty-six ZIP Codes in the third stratum, the one that contained ZIP Codes with an excess of sixty city letter routes. After this reduction, the sample size was one-hundred and eighty-five ZIP Codes.

While the first phase of curtailing the sample did produce a significant cost reduction for the survey, it was determined that additional costs needed to be removed before the full study commenced. Therefore, a second phase of decreasing the sample size was implemented before the study began.

The second phase of the sample reduction involved accommodating specific groupings of ZIP Codes with a particular characteristic due to their concerns about the expense of collecting the information as well as possible impacts on delivering the mail.

For this study, we needed precise mail counts, as well as carriers who would accurately scan their daily activities. The field was primarily concerned with maintaining a high level of service, and maintaining their costs at or below budgetary levels. Despite the fact that the offices were being compensated for carrier and supervisor time

associated with this study, there was still anxiety about service impacts and cost overruns at the district and post office levels. In an effort to alleviate the uneasiness about the study before it began, the sample was reduced to include only one ZIP Code per finance number.

A finance number is a number that identifies an installation for processing its financial data. After careful review of the time involved in collecting the data by carriers as well as supervisors, it was decided that it was very important not to saddle a particular finance number with substantial additional costs due to participation in the data collection effort. We felt it was very reasonable for a finance number to incur the cost collecting this important information for one ZIP Code, but concluded the burden would be too high to require additional ZIP Codes within a finance number to participate in the CCSTS.

For those finance numbers which had multiple ZIP Codes in the sample after the first reduction phase, one ZIP Code was randomly selected to participate in the study. The multiple ZIP Codes could be from different strata, but only one ZIP Code from that finance number ultimately was selected for participation in the study. This phase of the sample reduction removed eighteen ZIP Codes from the sample, which reduced the sample size from one-hundred and eighty-five to one-hundred and sixty-seven ZIP Codes.

The final sample consisted of twenty-nine ZIP Codes with less than ten city letter routes, one-hundred and twenty eight ZIP Codes with more than ten and less than sixty-one letter routes, and ten ZIP Codes with more than sixty city letter routes.
The level of precision for the final sample utilized for the CCSTS was a CV of less than six percent for the preponderance of variables being studied which was lower than our initial objective of a relative error of ten percent. This provided an ample cushion between the expected precision from the final sample and accuracy required during the initial planning stages of the CCSTS.

An important aspect of sample design is to choose a sample that results in a higher level of precision than ultimately desired to account for the likelihood that the final amount of collected data will be less than expected from the original sample size due to non-response or information being unusable from a small number of sites. This reduces

the sample size and the expected precision from the original sample size. Since there was a sizable gap between the expected accuracy from a final sample of one-hundred and sixty-seven ZIP Codes and the initial targeted level of precision, it was extremely unlikely that the estimates from this survey would not meet the original precision objective of a relative error of less than ten percent.

A comparison of the sample design for CCSTS and the 1986 Street Time Survey (STS), which is a critical component of the current Postal Rate Commission methodology now seems appropriate.

Before discussing the sample design employed by the STS, it is imperative to talk about the significant technological differences between the years 2001 and 1986 that enabled a significantly improved design for the CCSTS.

For the CCSTS, an accurate list of city letter routes was available through an extract from the Address Management System (AMS). Special purpose routes are not included in the frame for the CCSTS. This was not able to be done for the STS since the frame did not distinguish between regular letter routes and special purpose routes.

Secondly, for the CCSTS, carriers were able to record their activities using scanners – devices they carry and utilize on a daily basis. This permitted the CCSTS to collect information, without sub-sampling, continually throughout the time the carrier was on the street. The STS beeped the carriers, at most three times per day, to record their activities on the street. As a result, the precision of the estimates calculated for the STS must consider the sampling error associated with the sub-sampling procedure implemented. The CCSTS does not contain that element of uncertainty since the entire carrier day was included rather than just a fraction.

The STS sampled ninety-one sites which had over two-thousand four-hundred city routes. Forty percent of the routes included in the study were from eleven cities. The STS sample included letter routes and special purpose routes.

The STS sub-sampled the carrier's activities on the street by beeping the carrier at most three times per day and the carrier recorded the activity being performed at the time of the beep. The STS consisted of seven-thousand one-hundred and three tallies. At three tallies per day, approximately two-thousand four-hundred days were sampled, and, using four hours of street time per day, about nine-thousand six-hundred hours of

carrier street time were recorded for the STS. Due to the fact that the STS involved sub-sampling of carrier's activities, there is sampling error associated with capturing that information. In addition, due to the very limited number of beeps per day, the impact of data collection errors were magnified due to the weights associated with each carrier tally.

The CCSTS compares favorably to the previously-used STS. The final sample for the CCSTS consisted of one-hundred and sixty-seven ZIP Codes geographically disbursed throughout the nation as compared with ninety-one for the STS. Merely increasing the sample size from ninety-one sites to one-hundred and sixty-seven sites decreases the first stage sampling error by twenty-six percent for the CCSTS, ignoring the benefits of the stratification utilized in the CCSTS. The precision gain from increasing the sample size can be approximated by taking the ratio of the square root of the STS sample size to the square root of the CCSTS sample size.

All city letter routes within a selected ZIP Code participated in the study. Special purpose routes were not part of this study. This resulted in more than three-thousand five-hundred city letter routes in the study.

Moreover, the CCSTS did not involve sub-sampling of street activities. Thus there is no sampling error with this part of the data collection effort. Unlike the CCSTS, the STS did contain positive sampling error at this stage. The sampling error with the STS is due to the fact that if the carriers were beeped at different times during the same day different results could occur. Sampling error is additive across stages since the sampling is done independently. Therefore the CCSTS has a lower sampling error at the first and second stages and since the sampling error is additive a lower total sampling error and thus produces more precise estimates.

In addition, the CCSTS was better equipped to handle non-sampling error because an incorrect scan sequence by a carrier probably would only consist of a few minutes of time, which presumably would be lessened by large amount of time scanned accurately.

For each selected route a carrier's entire time on the street – approximately four to five hours daily – was recorded by the carrier using scanners. This was done for twelve consecutive delivery days. The CCSTS expected to record carrier street

activities for *more than one-hundred and fifty thousand hours*. This expectation was approximately fifteen times the amount of carrier street time captured by the STS, with a much greater level of precision,.

In summary, the sample design for the CCSTS is superior to the one employed by the STS. The CCSTS utilized a larger sample size of ZIP Codes, with a better geographic spread, as well as recording vastly more actual carrier street time information than the STS. This resulted in much more precise estimates being calculated from the CCSTS than the STS.