Determining an Optimal Item-Outlet Sample Design for the 1987 U.S. Consumer Price Index Revision

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This paper describes the program methodology employed to determine the sample design for the Revised Consumer Price Index (CPIR). This methodology is based on a set of models relating the data collection costs and the associated variance of average price change to item and outlet selection variables for the sample design. With these models, the optimal allocation of data collection resources to minimize the overall variance of price change, subject to various budgetary constraints, can be regarded as an integer nonlinear programming problem. Models for both variance and data collection costs are given. They are followed by descriptions of methods used to estimate model coefficients. Finally, solutions to the design problem posed under varying assumptions of annual price change and cost constraints are discussed.

Background

The Consumer Price Index

For a full discussion of the CPI, we refer the reader to the the BLS Handbook of Methods, Vol. II (1984). In the following we will give brief descriptions of those aspects of the CPI which are pertinent to our design problem.

The CPI is a fixed-quantity price index which is a ratio of the costs of purchasing a set of items of constant quality and quantity in two different time periods. Let I(t,0) denote the index for time t where 0 represents a base or reference period. Then

$$I(t,0) = 100 \cdot \left(\sum_i \left(C_0(i) \cdot R(i,t,0)\right)\right) / \sum_i C_0(i),$$

where i denotes the item stratum, a set of goods or services, $C_0(i)$ denotes a base period cost weight or estimate of expenditures in the base or reference period on stratum i, and R(i,t,0) denotes the long term relative or estimate of price change from the reference period to time t for stratum i.

Alternatively, I(t,0) may be expressed in terms of components of the index for a previous period:

$$I(t,0) = 100 \cdot \left(\sum_i C_{t-1}(i) \cdot R(i,t,t-1)\right) / \sum_i C_0(i) ,$$

where $C_{t-1}(i)$ denotes the cost weight for stratum i at time t-1; that is,

$$C_{t-1}(i) = C_0(i) \cdot \prod_{s=1}^{t-1} R(i,s,s-1), \text{ and}$$

R(i,t,t-1) denotes the one period relative or estimate of price change from the period t-1 to time t. Here R(i,t,t-1) is defined as

$$R(i,t,t-1) = \frac{\sum_q W_{iqjt} \left(P_{iqjt}/P_{iqj0}\right)}{\sum_q W_{iqjt-1}\left(P_{iqjt-1}/P_{iqj0}\right)} , \text{ where}$$

P_{iqjt} is the price of the qth quote in the jth outlet in time period t for item stratum i, and W_{iqjt} is the final weight for the qth quote in the jth outlet in time period t for item stratum i, and where the sum is over all quotes for the item stratum in the geographic area for which the index applies.

The commodities and services (C&S) component of the CPI is computed from measurements of price change on selected commodities and services, observed in selected outlets in selected geographic areas across the United States. For purposes of the sample design, all commodities and services were grouped into eight major groups:

Food and Beverages	Transportation
Fuels and Utilities	Medical Care
Household Furnishing	Entertainment
Apparel and Upkeep	Other C&S

These major groups consist of more narrowly defined categories called expenditure classes. Within expenditure classes, items are grouped into strata. The item stratum is the most refined classification of consumer expenditures for which an index is computed. Each item stratum comprises one or more entry level items (ELI's). An ELI is the level of specification for a commodity or service with which a data collector enters an outlet for pricing.

A market basket is a basic geographic area for which a fixed set of goods and services is priced on a monthly or bimonthly basis. There are two types of market baskets: self-representing primary sampling units (PSU's) such as New York, Los Angeles, and Chicago, which were selected with certainty; and sets of two or more non-self-representing PSU's which were selected according to a probability sample. For purposes of variance computation and operational manageability, samples for self-representing PSU's are split into two or more replicate panels, historically called half-samples.

In CPI sample selection, entry level items to be priced in each major group are selected from item strata by a systematic probability proportional to size (pps) procedure. Item selections are independently drawn for each PSU and for each replicate within each PSU. Corresponding to each item in every stratum is a POPS category. A POPS category is a broad category of items which are normally sold in the same kinds of retail outlets. Outlets corresponding to the POPS categories of selected items are sampled separately by a systematic pps procedure. Sampled items then are priced for the CPI on a monthly, bimonthly, or seasonal basis in the outlets accordingly selected.

History

Optimizing sample selection is not a new concept. Kish (1965), Hansen, Hurwitz, and Madow (1953), and Cochran (1977) present several examples of sample design optimization via cost and error modelling. Groves and Lepkowski (1985) discuss cost and error modelling for telephone surveys, with special emphasis on stochastic cost components, nonsampling errors, and computer simulation to evaluate alternative sample designs.

Cost and sampling error models were first formulated for the item and outlet sample design for the 1978 CPIR [Westat, 1974]. In that instance, the modelled sampling variance for a single market basket included between item and between outlet components. Item classes comprised two categories - food, and other goods and services. Sample size allocations were made for six PSU groups. The data collection and processing cost function included components for initiation data collection, initiation office costs, repricing data collection, and repricing office costs. Selection of the ultimate sampling scheme was made based on evaluation of a number of alternative designs.

The models presented in this paper represent an elaboration of those used in the 1978 CPIR, with special emphasis on refinement of the models for eight separate major groups and eight PSU groups, and detailed use of administrative records and modelled estimates for cost and variance function coefficients. Additionally, solution methods used in this paper permitted the simultaneous solution for both item and outlet sample sizes which are local noninteger minimizers of the variance function under various assumptions of annual price change and multiple cost constraints.

The Design Problem

The overall objective of the CPIR design program was to determine values for all sample design variables which minimize the sampling variance of the "Commodities and Services" Consumer Price Index at the U. S. level, subject to certain spending constraints of the CPI budget. Here a one period price change for the ith item stratum for a given geographic pricing area or market basket is defined as R(i,t,t-1) above. Sample design variables for the C&S components of the CPI are: the number of PSU's in which to collect price data, the number of half-samples or replicates of the sample to draw in each PSU, the number of item strata selections (the number of ELI's) to be selected per each PSU half-sample by CPI major group, and the number of outlet selections per POPS category per PSU half-sample and major group.

The number of PSU's and half-samples per PSU were determined prior to the development of the models described herein (see [Dippo and Jacobs, 1983]). There will be 94 PSU's in the CPIR; they are listed in Table 1. These were divided into eight groups according to size, and it was assumed that the same outlet sample sizes would apply to all PSU's within the same group. It was also assumed that the same item selection sizes would apply for all PSU groups for a given major group. This reduced the allocation problem to determining the number of item strata selections per PSU half-sample by major group $\{K_j,\ j=1,8\}$, and the number of outlet selections per POPS category per PSU half-sample by major group $\{M_{ij},\ i=1,\ldots,8;\ j=1,\ldots,8\}$.

The design program consisted of 4 major activities. First, a variance function was developed to model the variance of price change for the "Commodities and Services" index for the U.S. as a function of the design variables. Second, a cost function was formulated to project the total annual cost of the C&S component of the CPIR for these same variables. Third, estimates for all coefficients of these functions were developed. Lastly, nonlinear programming techniques were used to determine approximately optimal values for the design variables under varying assumptions of annual price change and cost constraints. Detailed descriptions of these activities follow.

The Variance Function

The variance function for the CPIR was modelled for market baskets, i.e., geographic areas defined by PSU's or groups of PSU's. Each self-representing PSU comprises a single market basket. Non self-representing PSU's were grouped into twelve market baskets, each composed of two to ten PSU's. They are given in Table 2. It was assumed that the total variance of price change for major commodity group j within market basket k can be expressed as the sum of four components:

$$\sigma^2_{j,k} = \sigma^2_{p,j,k} + \sigma^2_{e,j,k} + \sigma^2_{o,j,k} + \sigma^2_{r,j,k}, \text{ where}$$

$\sigma^2_{p,j,k}$ is the component of variance due to the sampling of PSU's;

$\sigma^2_{e,j,k}$ is the component of variance due to the sampling of ELI's within item strata;

$\sigma^2_{o,j,k}$ is the component of variance due to the sampling of outlets;

$\sigma^2_{r,j,k}$ is the residual component of variance.

Similarly, it was assumed that the variance of price change of a sample unit (i.e., a single quote) within a major group j can be given by

$$\sigma^2_{unit,j} = \sigma^2_{p,unit,j} + \sigma^2_{e,unit,j} + \sigma^2_{o,unit,j} + \sigma^2_{r,unit,j}, \text{ where}$$

$\sigma^2_{p,unit,j}$ is the component of unit variance due to the sampling of PSU's;

$\sigma^2_{e,unit,j}$ is the component of unit variance due to the sampling of ELI's within item strata;

$\sigma^2_{o,unit,j}$ is the component of unit variance due to the sampling of outlets, and

$\sigma^2_{r,unit,j}$ is the residual component of unit variance.

Given these assumptions, it follows that each component of $\sigma^2_{j,k}$ can be expressed in terms of its corresponding unit variance components:

$$\sigma^2_{p,j,k} = \sigma^2_{p,unit,j}/N'_k, \text{ where}$$

N'_k is the number of non-self-representing PSU's in the market basket; Note $\sigma^2_{p,j,k}$ is 0 for self-representing PSU's.

$$\sigma^2_{e,j,k} = (\sigma^2_{e,unit,j}/N_k \cdot H_k \cdot K_j) \cdot fpc_j \cdot NC_j, \text{ where}$$

N_k is the number of PSU's, H_k is the number of half-samples per PSU in the market basket, K_j is the number of item selections per PSU half-sample, TI_j is the number of ELI's in the major group, $fpc_j = (1-K_j/TI_j)$ is a finite population correction factor, and NC_j is the percent of the strata in the major group which are noncertainty strata;

$$\sigma^2_{o,j,k} = \sigma^2_{o,unit,j}/(N_k \cdot H_k \cdot M'_{j,k} \cdot P_j),$$

where $M'_{j,k}$ is the number of unique inscope outlets selected per PSU half-sample per POPS category and P_j is the number of POPS categories in the major group, and

$$\sigma^2_{r,j,k} = \sigma^2_{r,unit,j}/(N_k \cdot H_k \cdot M'_{j,k} \cdot K_j \cdot P_j).$$

Thus the sampling variance of the "Commodities and Services" index takes the form

$$\sigma^2_{TOTAL} = \sum_j (relimp_j)^2 \sum_k (w_k)^2 \sigma^2_{k,j}, \text{ where}$$

w_k is the population weight of market basket k and $relimp_j$ is the relative importance of major group j. The relative importance of an item stratum or major group is obtained from the Consumer Expenditure Survey and is the percentage of total expenditures on all items which are expenditures on items in the stratum or major group. In this application, relative importances used were national averages.

The Cost Function

The total annual cost of the C&S components of the CPIR includes costs of initiation, initiation processing and review, personal visit and telephone pricing, and pricing processing and review. The costs of initiation and initiation processing and review for PSU group i and major group j are:

$$CI(M_{ij},K_j) = .2\, N_i \cdot H_i \cdot (C_{O,j} + C_{T,j}) \cdot (a_{ij} M_{ij} + b_{ij}) \cdot P_j + (C_{Q,j} + C'_{Q,j}) \cdot M_{ij} \cdot K_j \cdot NR_j,$$ where

N_i is the number of PSU's in PSU group i;

H_i is the number of half samples per PSU in PSU group i;

$C_{O,j}$ is the initiation cost per outlet for major group j;

$C_{T,j}$ is the travel cost at initiation per outlet for major group j;

$(a_{ij}M_{ij}+b_{ij})$ is a linear overlap function to adjust the number of designated outlets per POPS category PSU half-sample to account for the overlap in the outlet frame between POPS categories in the same major group for a PSU half-sample;

P_j is the number of POPS categories in major group j;

$C_{Q,j}$ is the initiation cost per quote for major group j;

$C'_{Q,j}$ is the initiation processing cost per quote for major group j;

M_{ij} is the number of designated outlet selections per POPS category per PSU half-sample for PSU group i, major group j;

K_j is the number of item strata selections for major group j, and

NR_j is the outlet in-scope rate for major group j.

The .2 factor in the above cost formula accounts for the rotation or re-initiation of the outlet sample in 1/5 of the sample PSU's each year.

The costs of pricing (personal visit and telephone) and pricing processing and review for PSU group i and major group j are:

$$CP(M_{ij},K_j) = MB_{ij} \cdot N_i \cdot H_i \cdot [M_{ij} \cdot NR_j \cdot [a_{ij} P_j ((C_{PV,O,j} + C_{PV,T,j}) \cdot (1-R_{T,O,j}) + C_{T,O,j} \cdot R_{T,O,j})) + K_j \cdot (C_{PV,Q,j} (1-R_{T,Q,j}) + (C_{T,Q,j} R_{T,Q,j}) + C_{p,q})] + b_{ij} \cdot P_j + ((C_{PV,O,j} + C_{PV,T,j}) \cdot (1-R_{T,O,j}) + C_{T,O,j} R_{T,O,j})],$$ where

$C_{PV,O,j}$ is the cost for a personal visit for repricing per outlet for major group j;

$C_{PV,T,j}$ is the travel cost for a personal visit for repricing per outlet for major group j;

$R_{T,O,j}$ is the proportion of outlets repriced by telephone for major group j;

$C_{T,O,j}$ is the cost for telephone collection per outlet for major group j;

MB_{ij} is a factor to adjust for the monthly/bimonthly mix of outlets and quotes by PSU and major product group;

$C_{PC,Q,j}$ is the per quote cost for a personal visit for repricing;

$R_{T,Q,j}$ is the proportion of telephone collected quotes for major group j;

$C_{T,Q,j}$ is the per quote cost for telephone collection for major group j, and

$C_{P,Q}$ is the per quote cost for processing repricing data.

Thus, the total cost function associated with data collection and processing for the "Commodities and Services" index, summed over all major groups and PSU groups is given by

$$TCOST = \sum_{i,j} CI\,(M_{ij},K_j) + CP\,(M_{ij},K_j)$$
$$= \sum_{i,j} N_i \cdot H_i \{M_{ij} [a_{ij} P_j (.2\,(C_{O,j} + C_{T,j}) + NR_j\, MB_{ij} \cdot ((C_{PV,O,j} + C_{PV,T,j})(1-R_{T,O,j}) + C_{T,O,j} \cdot R_{T,O,j})) + K_j\,(.2\,(C_{Q,j} + C'_{Q,j}) \cdot NR_j \cdot MB_{ij} \cdot (C_{PV,Q,j}\,(1-R_{T,Q,j}) + C_{T,Q,j} \cdot R_{T,Q,j} + C_{PQ}))] + b_{ij} \cdot P_j\,(.2\,(C_{O,j} + C_{T,j}) + MB_{ij} \cdot (C_{PV,O,j} + C_{PV,T,j})(1-R_{T,O,j}) + C_{T,O,j}R_{T,O,j}))\}.$$

The total travel cost function is a subtotal of the above, namely:

$$TRCOST = \sum_{i,j} N_i \cdot H_i \cdot P_j \{.2C_{T,j}(a_{ij}M_{ij} + b_{ij}) + MB_{ij}\,(a_{ij}NR_jM_{ij} + b_{ij}) \cdot C_{PV,T,j}\,(1-R_{T,O,j})\}.$$

We note here that the variance and total cost functions are nonlinear in the sample design variables $\{M_{ij}\}$ and $\{K_j\}$. The total travel cost function, however, is linear in the variables $\{M_{ij}\}$ and does not depend on the $\{K_j\}$.

Thus the sample design problem can be expressed as

$$\underset{\{M_{ij}\},\{K_j\}\ \text{integer}}{\text{minimize}} \quad \sigma^2_{TOTAL}$$

subject to
$$TCOST \le TCLIM,$$
$$TRCOST \le TRAVLIM,$$
$$M_{ij} \ge 1, \quad i=1,\ldots,8,\ j=1,\ldots,8,$$
$$K_j \ge STRATA_j, \quad j=1,\ldots,8,$$
$$K_j \le TI_j, \quad j=1,\ldots,8.$$

Here TCLIM and TRAVLIM are the design parameters representing total expenditure and total travel expenditure ceilings, respectively, and $STRATA_j$ and TI_j are the design parameters denoting the number of item strata and total number of ELI's, respectively, in the jth major group.

Model Coefficients

Estimates of components of the cost function were developed from agency administrative records. The initiation costs per outlet and per quote and the pricing costs per outlet and quote were obtained from field time reporting records for fiscal years 1982 and 1983. Time in outlet and travel time were obtained from field outlet initiation schedules. Time in outlet, travel time and type of contact (personal visit or telephone) were collected from pricing schedules for each collection period during the first six months of 1983. Times reported on initiation and pricing schedules were used to ratio adjust field administrative data to obtain initiation time per outlet and quote and pricing time per outlet and quote at the major group level. Hourly labor rates were derived from the total labor expenditures for fiscal year 1984 for the CPI, adjusted for expenditures not related to index production. Hourly rates were then applied to initiation and pricing times per outlet and quote to yield initiation and pricing costs per outlet and quote. Estimates of initiation and pricing costs per outlet and quote by major group are given in Table 3. The proportion of personal visit outlets and quotes by major group are also listed there. A detailed development of all unit costs is given in [Jacobs, 1984, Appendix I].

Monthly/bi-monthly factors for each major group were derived from current CPI samples. In-scope rates for each major group were developed from the results of initiation during outlet sample rotations during the first six pricing periods of 1983. Both of these factors are given by major group in Table 4. Overlap functions used to determine the number of unique outlets were developed by modelling the number of unique outlets obtained in simulations of the sampling procedures. These functions by major group are given in Table 5.

The total unit variance of price change was generated from generalized unit variance functions. These functions were obtained by modelling observations of the unit variance of price change as a function of price change by major group for two and six month changes for December 1979 through December 1982.

Intraclass correlations for each major group were obtained from models of the component unit relative variances. Component unit variances were estimated from CPI price data for October 1979 through September 1983. A detailed description of the models and methods used to estimate unit components of variance is given in [Jacobs, 1984, Appendix II]. Component estimates were calculated for 1, 2, 6, and 12 month changes. Relative variances were computed for the PSU, outlet, and ELI components by dividing the corresponding unit variances by the squared price change. Components of relative variance were then modelled as functions of price change with the functional form:

$$Y = b1\ X^{b2}\quad \text{, where}$$

Y =the PSU, ELI, or outlet relative variance and X =price change.
Intraclass correlations were then calculated by dividing the components of relative variance by their sum for each price change of interest. Final estimates of components of relative variance for a given time change and inflation rate were then obtained by multiplying modelled unit relvariances and their corresponding modelled estimates of intraclass correlations.

The values of the total unit variance of price change, σ^2_{unit}, and the intraclass correlations, δ_p, δ_e, and δ_o used in the design program are provided in Table 6. Values for each variable are presented by major group.

The Solution

A sequential unconstrained minimization technique, [Fiacco and McCormick, 1968] implemented in the nonlinear programming code Symbolic Factorable SUMT [Ghaemi and McCormick, 1979] was used to solve the design problem. Solution values of the sets $[M_{ij}]$ and $[K_j]$ were computed for various values of TCLIM and TRAVLIM and for modelled estimates of components of variance computed for various annual inflation rates and time periods.

In its final form, the design problem was solved with a total cost constraint of $7.163 million. This ceiling represents a total ceiling of $7.25 million, less $87,000 allocated a priori to support average motor fuel prices. A travel cost constraint of $610,000 was also imposed. As noted above, for each major group j, K_j was bounded below by the number of item strata in the major group and above by the number of ELI's in the major group. For the "Food and Beverages" group, a lower constraint of 73 item strata selections was imposed in order to support average food prices.

Unit variance and intraclass correlation estimates used were for a 6-month price change at a 10% annual rate. Design solutions were also found using model estimates for 2-month price changes at both 8% and 10% annual rates. Only minor differences were observed between the problem solutions found with variance estimates for the 6-month price change at 8% and 10% annual rates. The problem solution found for a 6-month price change at a 10% annual rate was selected as the final sample design for the 1984 outlet rotation because the estimates of unit variances and intraclass correlations for some major groups were slightly less stable at the 8% annual rate. Solutions using estimates for 2-month price changes were not used since some major groups have little or no price change in a short period.

Under the above assumptions the integer-rounded solution of the design problem yielded the following number of item strata selections per PSU half-sample and major group and outlet selections per POPS category, PSU half-sample and major group:

	PSU Group								K_j
	1	2	3	4	5	6	7	8	
Food & Beverages	11	7	15	11	9	5	3	7	73
Fuel & Utilities	10	6	12	9	7	5	2	5	12
Household Furn	2	1	3	2	2	1	1	1	66
Apparel & Upkeep	7	4	8	6	6	4	2	5	47
Transportation	5	3	7	5	4	3	1	3	34
Medical Care	3	2	4	3	3	2	1	2	18
Entertainment	4	3	6	4	5	3	1	3	27
Other C&S	2	2	3	3	3	2	1	2	21

With this allocation, 6224 outlets and 23,821 quotes will be initiated each year under outlet sample rotation. For ongoing pricing, there will be 249,466 outlet visits and 1,143,700 quotes collected each year, with an average of 4.6 quotes per outlet.

Conclusions

Cost and variance modelling, coupled with nonlinear programming techniques, has proven a useful tool in effective allocation of resources in the C&S component of the CPIR. Furthermore, it promises greater facility in dynamic revision of sample designs as current estimates of variance and cost components become available. The models given here are presently being validated via current CPI operational experience. Preliminary results indicate that outlet overlap in sampling frames between and within major groups is highly dependent on the item stratification and sample design. Current research is directed toward reassessing and remodelling this function and other components of the cost model, and toward incorporating other aspects of survey operations, such as balancing data collector workloads and changes in outlet sample rotations, which are not explicitly accounted for in these models.

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Table 1: PSU Groups

1. New York: A109 (4 hs.), A110, A111 (2 hs)
2. Los Angeles: A419 (4 hs.), A420 (2 hs.)
3. Chicago: A207 (4 hs.)
4. Philadelphia: A102 (2 hs.)
5. Detroit: A208 and San Francisco: A422 (2 hs.)
6. Large 'A' PSU's: A103, A104, A209, A210, A315, A316, A317, A318, A320 (2 hs. per PSU)
7. Small 'A' PSU's: A105, A211, A212, A213, A214, A215, A319, A321, A322, A423, A424, A425,A426, A427, A429, A433 (2 hs. per PSU)
8. Non self-representing PSU's: 1 hs. per PSU.

Table 2: Market Baskets in PSU Group 8

1.	L102,	L104,	L106,	L108		
2.	L210,	L212,	L214,	L216		
3.	L318,	L320,	L322,	L324,	L326	
	L328,	L330,	L332,	L334,	L336	
4.	L438,	L440,	L442,	L444		
5.	M102,	M104,	M106,	M108		
6.	M210,	M212,	M214,	M216,	M218,	M220
7.	M322,	M324,	M326,	M328,	M330	
	M332,	M334,	M336,	M338,	M340	
8.	M442,	M444,	M446,	M448		
9.	R102,	R104				
10.	R206,	R208,	R210,	R212		
11.	R314,	R316,	R318,	R320,	R322,	R324
12.	R426,	R428				

Table 3: Unit Costs by Major Group

	Initiation Unit Costs: Outlet	Quote	Travel	Process	Repricing Unit Costs: Outlet	Travel	Quote PV	Quote Tel	Process	Tel/TOT Outlets	Tel/TOT Quotes
Food & Beverages	14.08	8.73	37.50	10.23	1.04	12.02	0.87	0.58	1.77	.1164	.0479
Household Furn.	14.08	29.54	35.51	10.23	1.04	11.16	4.45	1.89	1.77	.2539	.2166
Fuel & Utilities	14.08	10.06	38.62	10.23	1.04	12.19	1.60	1.12	1.77	.6919	.7186
Apparel	14.08	22.53	29.89	10.23	1.04	9.91	4.50	1.07	1.77	.1801	.2214
Transportation	14.08	10.84	33.51	10.23	1.04	11.76	2.29	1.35	1.77	.3797	.3532
Medical Care	14.08	20.23	42.44	10.23	1.04	10.75	2.63	1.52	1.77	.4305	.3645
Entertainment	14.08	24.79	31.99	10.23	1.04	10.25	5.81	0.80	1.77	.4126	.6083
Other C&S	14.08	31.98	33.25	10.23	1.04	11.08	5.07	1.87	1.77	.3585	.3066

Table 4: Monthly/Bimonthly Pricing Factors and Outlet In-scope Rates

Major Group	Monthly/Bimonthly Factors PSU Group 1	2	3	4	5	6	7	8	In-scope Rate
Food & Beverages	12	12	12	12	11.85	11.7	11.7	11.7	.93
Household Furn.	12	12	12	12	9.07	6.15	6.15	6.15	.74
Fuel & Utilities	12	12	12	12	10.64	9.27	9.27	9.27	.87
Apparel	12	12	12	12	9	6	6	6	.86
Transportation	12	12	12	12	10.03	8.06	8.06	8.06	.84
Medical Care	12	12	12	12	9	6	6	6	.83
Entertainment	12	12	12	12	9.12	6.24	6.24	6.24	.83
Other C&S	12	12	12	12	9.86	7.71	7.71	7.71	.90

Table 5: Overlap Functions by Major Group (Y=aX+b) Where Y Is the Number of Unique Outlets for a Designated Sample Size X

Major Group/PSU Group	1	2	3	4	5	6	7	8
			Slope (a)					
Food & Beverages	.655003	.655003	.678834	.646928	.715599	.656731	.545808	.471177
Household Furn.	.508416	.508416	.571141	.556740	.598142	.528130	.452891	.448658
Fuel & Utilities	.692921	.692921	.751488	.746094	.802083	.563514	.536206	.584666
Apparel	.402834	.402834	.486228	.418395	.411272	.417205	.312807	.315459
Transportation	.669018	.669018	.661830	.658997	.726992	.621652	.579459	.589597
Medical Care	.879943	.879943	.938776	.931441	.951212	.931973	.854751	.812896
Entertainment	.419209	.419209	.450499	.427521	.352561	.401137	.360801	.375600
Other C&S	.573549	.573549	.575893	.532366	.528125	.519643	.547154	.511082
			Intercept (b)					
Food & Beverages	.422269	.422269	.444328	.450105	.353992	.435574	.472886	.494947
Household Furn.	.337383	.337383	.320853	.293491	.295795	.326997	.363407	.392245
Fuel & Utilties	.909439	.909439	.964286	.770089	.848214	.995129	.850249	1.007191
Apparel	.321970	.321970	.324317	.264443	.284040	.322704	.335023	.347461
Transportation	.403571	.403571	.365434	.348214	.327610	.374787	.438670	.465258
Medical Care	.500638	.500638	.376276	.406888	.510204	.452381	.557557	.599628
Entertainment	.181300	.181300	.170168	.160189	.197368	.212987	.224835	.243133
Other C&S	.095982	.095982	.039286	.033929	.038393	.055357	.136496	.128126

Table 6: Total Unit Variance and Intraclass Correlations by Major Group for a 6-Month Price Change at a 10% Annual Rate

Major Group	Total Unit Variance	Between PSU Intraclass Correlation	Between ELI Intraclass Correlation	Between Outlet Intraclass Correlation
Food & Beverages	44.04	.000	.271	.729
Household Furn.	13.85	.000	.437	.563
Fuel & Utilities	32.57	.169	.353	.456
Apparel	61.50	.003	.455	.543
Transportation	11.63	.000	.447	.553
Medical Care	35.38	.000	.469	.531
Entertainment	23.38	.000	.500	.500
Other C&S	15.22	.000	.486	.514