PROBLEMS ASSOCIATED WITH USING BUILDING PERMITS AS A FRAME OF POST-CENSUS CONSTRUCTION: PERMIT LAG AND ED IDENTIFICATION

Ronald Statt, E. Ann Vacca, Charles Wolters, and Rosa Hernandez
U. S. Bureau of the Census

I. INTRODUCTION

After each Decennial Census, research is undertaken to redesign the demographic surveys conducted by the Bureau of the Census. During the redesign phase, new information gained from the census is incorporated into the design of the demographic surveys. [1] Among the various research efforts is the development of multiple sampling frames. The demographic surveys' multiframe design consists of a frame of housing units constructed from the 1980 Census Address Registers, a frame of housing units missed by the 1980 census constructed from post-1980 Census Housing Unit Coverage Studies, a frame of post-1980 census housing units constructed from reports of building permit activity, a frame of area segments for areas where the quality of census addresses are questionable or permits are not issued and a frame of special places and mobile homes that can appear in each of the other frames but, generally, are handled separately. [2] It is very important to utilize these frames for maximum housing unit coverage, but with minimum overlap. It is equally important to ascertain accurate geographic identification of housing units in each frame.

The use of building permits to construct a sampling frame to reflect post-1980 census housing units poses several problems. One problem is how to determine an "optimal" month to begin sampling housing units from the permit frame to insure maximum housing unit coverage in the frame with minimum overlap of the 1980 census address frame. Another problem is how to geographically identify the housing units in the permit frame.

This paper presents the research and results pertaining to the determination of the optimal month to begin sampling building permits and presents the investigation into the feasibility of geographically identifying housing units in the permit frame by 1980 Census Enumeration Districts (EDs).

II. BACKGROUND

Housing units in existence at the time of the 1980 census are primarily represented by the 1980 Census Address frame. To this, we add housing units constructed since the 1980 census. A major portion of these newly constructed housing units is represented by the permit frame which covers areas where residential building permits are issued. The permit frame is created primarily through the use of monthly reports of permit activity provided by permit offices. From these reports, a permit register is created which estimates the number of housing units authorized by building permits in sample areas. The demographic surveys samples are selected from this monthly register of permit activity. The permit offices issuing the permits for sample housing units are then identified. Permit address listers visit the permit offices to list addresses for building permits issued for a specified one or two month period and records the number of housing units authorized by each permit. The sample housing units are then identified on the permit address listing to prepare interview materials. [3]

III. DETERMINATION OF AN "OPTIMAL" MONTH TO BEGIN PERMIT SAMPLING

When the demographic surveys were redesigned after the 1970 census, it was decided to begin sampling permit new construction addresses in January 1970. This date was selected on the premise that only a small number of housing units whose permits were issued on or after January 1, 1970 would be completed before April 1, 1970, Census Day, and was consistent with the date used for the redesign after the 1960 census. Consequently, the number of housing units contained on both the 1970 Census Address frame and the permit frame was believed to be insignificant as it had been in 1960, eliminating any need to identify "duplicate" units contained on both sampling frames. Unfortunately, in 1970, there were a number of housing unit addresses that did not appear on either sampling frame and therefore, given no chance of selection. These housing units had permits issued before January 1970, but were not completed until after the 1970 census. This resulted in a failure to represent approximately 600,000 housing units on either sampling frame. Housing units of this type are referred to as "permit lag" units. It was not until October 1978 that a coverage improvement sample was added to represent the permit lag units.

For the 1980 redesign of demographic surveys, research has been conducted to determine an optimal month to begin sampling building permits such that the coexistence of duplicate units and permit lag units would be kept to a minimum.

Formation of a Model. Two models were examined to determine an optimal month to begin sampling building permits. The first model defines the optimum to be the month prior to the 1980 census such that the number of building permits authorized in or following this month and associated with housing structures completed before the 1980 census is equal to the number of building permits authorized prior to this month and associated with housing structures not completed until after the 1980 census. This implies the optimal month to begin sampling building permits to be the month where the number of duplicate units (housing units contained on both the permit frame and the 1980 Census Address frame) is approximately equal to the number of permit lag units (housing units not contained in either sampling frame). Although this model does not completely eliminate permit lag units nor the chance of duplicate units, it does determine the month where the difference in the number of permit lag units and duplicate units is at a minimum. If either the number of permit lag units or duplicate units are large, the optimum in this model would not be very satisfactory.

The second model considered defines the optimal month to be that month prior to the 1980 census such that no housing structure associated with a building permit issued in or prior to this month was completed after the 1980 census. This model implies that every housing unit whose building permit was authorized in or prior to the optimal month ought to be contained in the 1980 Census

Address Registers. The model possesses the desirable property of theoretically eliminating permit lag units. However, this model poses two serious operational problems. First, the duplication of housing units between the permit frame and the 1980 Census Address frame would be high relative to the model previously discussed. Consequently, an additional expense is incurred for matching the Permit Address Listings to the 1980 Census Address Registers in order to identify and eliminate address duplicates. Second, this model would yield an optimal month exceeding the month determined in the previous model. Since many permit offices periodically destroy building permit records, the complete representation of permit new construction for many areas would not be feasible, because addresses are not available. Due to this maintenance problem, it would not be operationally possible to completely dispose of permit lag units if sampling operations were conducted under this model.

Provided the number of permit lag units or duplicate units is not too high, it would be operationally preferable to base the sampling on the first model. An analysis of permit data from previous years was performed to estimate the number of permit lag units and duplicate units for the optimal month under the first model. The results of the analysis indicated that neither the number of permit lag units nor duplicate units at the optimal month would be large, so that permit sampling can be conducted under the first model. Further details of the analysis can be obtained upon request.

An Estimator of the Optimal Month. Expressed in a definitive algebraic form, the optimal month to begin permit sampling is defined as the k^{th} month prior to the 1980 census such that the following relationship holds:

$$\sum_{i=1}^{k} N_i c_i = \sum_{i=k+1}^{m} N_i b_i \text{ with } c_i + b_i + r_i = 1$$

where c_i = the proportion of building permits authorized in the i^{th} month prior to the 1980 census that are associated with housing structures completed before the 1980 census,

b_i = the proportion of building permits authorized in the i^{th} month prior to the 1980 census that are associated with housing structures not completed until after the 1980 census,

r_i = the proportion of building permits authorized in the i^{th} month prior to the 1980 census that were eventually abandoned,

N_i = the number of building permits authorized in the i^{th} month prior to the 1980 census,

and m = the month prior to the 1980 census where 100 percent of the building permits authorized in this month and in all preceding months are associated with housing structures completed by the 1980 census.

To simplify the estimation procedure, allow r_i to be a constant r for each month prior to the 1980 census. This assumption is not unreasonable, as will be substantiated in the next section. Consequently,

$$c_i + b_i + r = 1 \text{ and } \sum_{i=1}^{k} N_i c_i = \sum_{i=k+1}^{m} N_i (1 - c_i - r).$$

Hence, $\sum_{i=1}^{m} N_i c_i = \sum_{i=k+1}^{m} N_i (1-r)$, or

$$\frac{1}{(1-r)} \sum_{i=1}^{m} N_i c_i = \sum_{i=k+1}^{m} N_i = (m-k)\bar{N}$$

where $\bar{N}$ equals the average number of permits issued in the (k+1) through m months prior to April 1980.

Solving for k we obtain: $k = m - \left[\frac{1}{(1-r)\bar{N}}\right] \sum_{i=1}^{m} N_i c_i$.

An estimator of k is given by $\hat{k}$

where $\hat{k} = m - \left[\frac{1}{(1-r)\bar{N}}\right] \sum_{i=1}^{m} N_i \hat{c}_i$

Since the optimal month is to be expressed as an integer, let $\tilde{k}$ be the estimator where $\tilde{k}$ equals the first integer greater than or equal to $\hat{k}$.

Description of Data. The optimal month to begin sampling permits may be affected significantly by two factors. These two factors and the various levels of these factors that were considered are given below.

1. Census Region
   - i. Northeast
   - ii. North Central
   - iii. South
   - iv. West
2. Size of Structure
   - i. 1 unit
   - ii. 2 to 4 units
   - iii. 5 or more units

The number of factor-level cells resulting from a complete cross-classification is 12. Using the estimator $\tilde{k}$, defined in the previous section, an estimate of the optimal month to begin sampling permits was computed for each factor-level cell, and is presented in table 1.

The estimates of the optimal months to begin permit sampling were computed using estimates of $\bar{N}$, r, m, c_i and N_i (i=1, ..., m) for each factor-level cell. To estimate the variables r, m, and c_i, it was necessary to use a time period other than the immediate period prior to the 1980 census. This was because estimates of r, m, and c_i based on permits authorized in months immediately prior to the 1980 census were not available. Building permits authorized in the 12-month period of 1974 were chosen to estimate these variables because the downward trend that existed for housing completions throughout 1974 was similar to the downward trend of housing completions for the 12-month period prior to the 1980 census. This is illustrated in the graph of a 4-month-moving-average for the estimated number of housing completions from January 1973 to May 1980, published in, "Construction Reports C-22: Housing Completions May 1980, U.S. Department of Commerce, Bureau of the Census."

Estimates of m and c_i (i=1, ..., m) for each factor-level cell were obtained from a sample of housing structures whose permits were authorized in 1974.[3] The construction progress of the sample was followed to either completion or abandonment to construct a cumulative distribution by month and by factor-level cell of the length of time between permit authorization and structure completion. Based on these 12 distributions, m and c_i (i=1, ..., m) were estimated for each factor level cell. Unfortunately, the completion rates used in the analysis did not reflect any seasonal effects such as winter weather conditions which may cause the completion of a housing structure to be delayed. The distributions were based only on the number of months from authorization to completion with no consideration to the specific month of authorization.

The 12 distributions also revealed that for some of the factor-level cells, 100 percent of the housing structures were not complete until after 50 months from the time of authorization. It would not have been feasible to equate m to the month where 100 percent of the housing structures were complete due to the lack of available permit data. Consequently, for each factor-level cell, m was equated to the month where construction was completed for at least 95 percent of the housing structures authorized in 1974. The 95 percent completion rate proved satisfactory because the necessary permit data for the analysis was available at the 95 percent completion rate and the variability of the estimated completion rates following m months was high with many of the estimates equaling zero. The residual 5 percent of each distribution representing the housing structures completed after m months was allocated proportionately to the m monthly completion rates that accounted for 95 percent of the completed structures. Estimates of m and c_i (i=1, ..., m) used to compute the optimal months can be obtained upon request.

Estimates of the monthly abandonment rates, r, for each factor-level cell were obtained from the monthly abandonment rates of 1974.[1] These rates ranged from 1.0 percent to 5.2 percent of the estimated number of permits authorized. The .052 monthly abandonment rate, r, was chosen to estimate k in each factor-level cell because a smaller proportion would have yielded a smaller $\tilde{k}$ and, consequently, a larger number of permit lag units. However, equating r to .010, the estimated minimum monthly abandonment rate of 1974, would have had little or no change on estimates of k presented in table 1.

To estimate the number of permits authorized each month prior to the 1980 census, N_i, for each category the following publication was used: "Construction Reports C-40: Housing Authorized by Building Permits and Public Contracts." Since k is unknown, the average number of permits authorized during the period (k+1) to m months prior to the 1980 census, $\bar{N}$, was estimated by

$\frac{1}{m} \sum_{i=1}^{m} N_i$ for each factor-level cell with estimates of m and N_i defined above.

Reliability of the Estimated Optimal Months to Start Sampling Building Permits

The estimator for the optimal month to start permit sampling had been expressed as $\tilde{k}$ which is equal to the first integer greater than or equal to $\hat{k}$. To obtain the variance of this estimator, the greatest integer function was disregarded. The estimator $\hat{k}$, being a function of the $\hat{c}_i$'s (i=1, ..., m) which were calculated from a sample of building permits authorized from January to December 1974, is subject to sampling variability. Although the quantities m, r, and N_i (i=1, ..., m) are sample estimates and also subject to sampling variability, they should have much smaller relative variances than c_i so that when deriving the variance of the estimater $\hat{k}$, they will be regarded as fixed. As the estimates $\hat{c}_i$ and $\hat{c}_j$ have been computed from the same sample of building permits, the covariance between $\hat{c}_i$ and $\hat{c}_j$ is nonzero. However, since the contribution of the covariance term to the variance of $\hat{k}$ should be relatively small, assume the covariance between $\hat{c}_j$ and $\hat{c}_i$, i, j=1,2, ..., m $i \neq j$ to be zero.

Taking all of these assumptions into account, the variance of $\hat{k}$ is estimated by

$$\sum_{i=1}^{m} \frac{N_i^2 \, \delta \, \hat{c}_i(1-\hat{c}_i)}{\bar{N}^2 \, (1-r)^2 \, n_i}$$

where δ is the design effect.[2] The design effects, as obtained from the Housing Completions Survey conducted by Census Bureau's Construction Statistics Division, are shown below:

Design Effects by Size of Structure

Size of Structure	Design Effect(δ)
1 unit	1.7
2 to 4 units	3.5
5 or more units	4.5*

*For Northeast use 5.5, and for South use 4.0.

The ratio N_i/n_i is the inverse of the sampling fraction for selection of permits for the i^{th} month prior to the census. Since this is essentially constant from month to month, set N_i/n_i = 1/f. This assumption transforms the variance formula to

$$\frac{\delta}{f \, \bar{N}^2(1-r)^2} \sum_{i=1}^{m} N_i \hat{c}_i(1-\hat{c}_i)$$

The sampling fractions vary with size of structure, but they are the same for each census region. They were obtained from Construction Statistics Division's Housing Starts Branch and are presented below:

Sampling Fractions by Size of Structure

Size of Structure	Sampling Fraction(f)
1 unit	1/40
2 to 4 units	1/16
5 or more units	1/2.5

The standard error of the estimate $\hat{k}$ for single unit structures, structures of 2-4 units, and structures of 5 or more units for each census region are shown in table 2. Confidence intervals at the 95 percent level are also exhibited. The estimate $\tilde{k}$ is shown in parenthesis.

Biases Present in the Estimation of the Optimal Months. The procedure used to estimate the optimal month to begin sampling building permits was biased for several reasons. These reasons are described below.

To estimate m and c_i (i=1, ..., m) the construction status of housing structures for a sample of building permits authorized in 1974 was followed to completion of construction or permit abandonment. For each cell category, a distribution by month of the time from permit authorization to structure completion was generated. It was assumed that these distributions would be similar to the corresponding distributions generated for permits issued in the months immediately prior to April 1980. In other words, it was assumed that the generated distributions were stationary. The estimates of the optimal months would be biased if the distributions were not stationary.

For each cell category, the distributions by month of the time from authorization to completion assumes that the time to complete a housing structure is the same no matter what month of the year the permit was authorized. This conceals the seasonality present in construction progress and may produce biased estimates.

Due to construction beginning prior to permit authorization for some structures, a number of structures were counted with zero months between authorization of permits and completion of structures. This count of structures was placed in the category of 1 month from authorization of construction to completion of construction. Since the count of structures falling in the category of zero months is a very small percentage of total permits authorized in 1974, the resulting bias should be slight.

The residual 5 percent of each distribution representing the housing structures completed after m months was allocated proportionately to the m monthly completion rates that accounted for 95 percent of the completed structures. This action placed an upward bias on the completion rates that resulted in an underestimate of the optimal months. However, since the percentage of structures completed after m months from authorization never exceeds 5 percent, the resulting bias should be slight.

A failure to enumerate completed structures in the 1980 census which were associated with permits authorized shortly before the census, could slightly bias the estimates of optimal months. These structures were thought to be completed based on a previously conducted survey, the Survey of Construction, which classifies such structures as complete, incomplete, or permit abandoned. The completion rates used in the analysis may be biased because they were not adjusted to reflect this problem.

The estimated completion rates, c_i's, may be biased due to definitional differences between a "complete" structure in the Survey of Construction (SOC) and the Bureau of the Census demographic surveys. The Survey of Construction designates a structure as complete if at least 50 percent of the housing units contained in the structure are occupied or available for occupancy. A housing unit is considered available for occupancy if all the finished flooring (or carpeting) has been installed. This implies that a housing unit is designated as complete if all the finished flooring or carpeting has been installed or if it is contained in a multi-unit structure where at least 50 percent of the units within the structure are occupied or available for occupancy. The demographic surveys definition designates a housing unit as complete if all the exterior windows and doors have been installed and the final usable floors were finished. Therefore, if a majority of the multi-unit structures have less than 100 percent but at least 50 percent of the housing units occupied or available for occupancy, then the completion rates used in the estimation are biased upward since the SOC would classify some housing units as complete that would be classified as "still under construction" in the demographic surveys. Conversely, if a majority of the multi-unit structures with at least one housing unit occupied have less than 50 percent of the housing units occupied or available for occupancy, then the completion rates used in the estimation are biased downward since the demographic surveys would classify some housing units as complete that would be classified as still under construction by the SOC.

Although each bias discussed above, by itself, should not significantly effect the estimation of the optimal months, the collective effect of all six is not known. A study is currently underway to reestimate the optimal months utilizing permit data authorized in the appropriate time periods. This study is designed to eliminate the first four biases discussed above.

IV. IDENTIFICATION OF PERMIT NEW CONSTRUCTION HOUSING UNITS BY ENUMERATION DISTRICTS (EDs)

The current design of demographic surveys geographically identifies housing units in the permit frame by grid map numbers and grid coordinates. Grid map numbers are assigned to maps to identify the Primary Sampling Units (PSUs), the number of counties within a PSU shown on the grid map, and the year the map was adopted. The grid coordinate is the alpha-numeric scale shown on the map. During the sampling, these grid coordinates are used to geographically sort the address. For each building permit listed, the permit address lister records the number of housing units authorized by permit, the address of the housing structure, and assigns a grid coordinate to each address.

The use of grid references for geographically identifying newly constructed housing units is not free of problems. One of the biggest problems associated with using grid references is the diversity of grid maps.

There is no uniform set of grid maps. The permit address lister is allowed to submit for approval any non-copyright map. There is no limit to the number of maps that can be submitted for approval or the number of times the same map can be submitted for updating during the decade. This results in increasing costs for producing the new or updated maps and clerically regridding sample housing units to conform with the grid system of the new map. The lack of standardization means the maps are not contiguous and in many cases the maps overlap. Another problem associated with using grid references occurs when the housing units in the permit frame are geographically coded for census use. Since the grid references do not correspond to census geography, the codes assigned to these housing units may not be accurate. A research proposal to computerize the sampling in the permit frame was accepted for redesign of the demographic surveys.[1] Computerization of the current gridding system would be especially difficult with grid maps changing every few years (if not more frequently). For these reasons, the feasibility of identifying housing units in the permit frame by 1980 census EDs was researched as a means of geographic identification.

Identifying housing units in the permit frame by 1980 census EDs is desirable because ED identification of permit housing units is consistent with housing unit identification in all other sampling frames. The permit frame was the only frame in 1970's design that did not identify housing units by ED. Also, all 1980 census EDs, unlike 1970 EDs, are mappable. That is, maps can be created which show the boundaries for all 1980 census EDs. The newly constructed housing units can be identified in the 1980 census EDs using these maps.

Alternative Methods of ED Identification. Two different methods of ED identification were investigated as alternatives to grid assignment. The first method was ED assignment by the permit address lister. This method is very similar to the grid assignment method except the lister would assign a 1980 census ED to each listed permit address using official ED maps which show the 1980 census boundaries. For this method, all sampling, geographic coding, and location of the sample unit for interview would be based on EDs.

The second method of ED identification was by computer. This method is different from the previous method in that the lister would only record the address for each listed building permit. The identification of permit addresses by EDs would be computerized. Here, the listed permit addresses would be keyed for use by computer. Once keyed, the permit addresses would be matched to the most current census address file. Assuming 20,000 permit addresses listed each month, approximately 15,000 of these addresses would have to be matched to the approximately 47,000,000 addresses on the census file. Only 15,000 permit addresses could be matched because the remaining 25 percent are located in areas not covered by the census file. To run such a match would cost approximately $35,000 per month. A 60 percent match rate (based on previous matching studies conducted for demographic surveys) between the permit addresses and census addresses reduces the number assigned EDs by computer to approximately 9,000 addresses or only 45 percent of the original 20,000 addresses. The remaining 55 percent would have to be clerically assigned to EDs which usually requires a hand-drawn map from the permit address lister. Since an estimated 55 percent of the permit addresses would be clerically assigned to EDs, in addition to the monumental job and large cost of matching a small number of permit addresses to the large census files, ED assignment by computer appears to be an inefficient method.

Advantages of ED Identification

- Identifying permit new construction housing units by EDs would be consistent with housing unit identification in all other sampling frames.
- ED identification allows determination of permit new construction housing units in the area frame (1980 census EDs that are listed due to incomplete or insufficient census addresses). If a permit new construction housing unit listed in the area frame was selected to be in sample from both the area and permit frames, the housing unit could be matched using ED to avoid duplication between frames. Currently, housing units are unduplicated by asking respondents a year-built question but the accuracy of this method has raised some concerns.
- ED identification allows determination of permit new construction housing units outside the permit office boundaries. In the 1970's design, the permit offices boundaries that existed at the time of the census were defined by the Census Bureau to be the boundaries for the entire decade. It is assumed that the 1980's design will use the same procedure for defining permit office boundaries. Therefore, if permit new construction housing units can be identified outside these boundaries, annexation problems can be avoided and problems caused by changes in the permit office boundaries can possibly be avoided. (Annexation problems occur when a permit office annexes an area of land which is non-permit and is included in the area sample prior to annexation. In this case, representing the same housing unit in the previous area sample and current permit sample must be avoided. Another problem is that the permit office may annex an area of land which is outside the demographic survey's definition of the sample PSU. Here, the units must be identified because the annex land may not be in a sample PSU. These two problems are not the only ones that can occur but they are examples of what is meant by annexation problems.)
- ED identification allows a match between permit new construction units from early 1980's and 1980 census to eliminate the permit lag and duplicate units discussed previously.
- ED boundaries, unlike grid coordinates, are stable throughout the decade eliminating problems caused by changing grid coordinates.
- EDs are contiguous with no overlap. Only one set of maps are needed with no updating during the decade. This eliminates problems caused with the diversity of grid maps.
- ED identification would allow more accurate geographic coding of sample units since the ED identification in the permit frame would agree with census geography.
- ED identification would make the survey interviewer's job of locating permit new construction housing units easier since EDs, unlike grids, have established census boundaries.
- ED identification would ease the computerization of sampling and coding in the permit frame since only one set of maps would be used for the decade with no updating.
- ED identification would result in better quality maps since all EDs are mappable with no overlap between EDs and better defined boundaries.
- Using ED maps would eliminate the costs for producing new and updated maps, and clerically regridding sampling housing units due to changes in grid maps.

Disadvantages of ED Identification

- Initial preparation of maps for ED identification would be costly. The cost of one set of maps for the entire nation is approximately $69,000. The cost of supplying five sets of maps for the entire permit operation is $345,000. This cost is estimated from the number of map sheets required and the size of the map sheet. To reproduce the maps would cost approximately 34 cents per square foot plus overheads.
- As ED maps will not be updated, new streets later in the decade will not appear on the maps. But any commercial maps can be used to locate the address and identify it on an official map.
- Permit address listers may find it difficult to handle a larger number and size of maps.
- As in any new procedure, ED identification may require additional training time and more detailed training packages.

Proposed Field Test. The preliminary investigation into identifying permit new construction housing units by EDs yielded very positive results. In addition to the above advantages, the field response to ED identification was very positive. Therefore, a field test of ED identification was designed to determine the feasibility of replacing the current grid system with an ED identification system. The Charlotte, NC and Chicago, IL Census Regional offices were selected for field test sites. A sample of the regular monthly assignments was selected for the two Regional Offices. The permit listers were instructed to assign EDs in place of grid coordinates to the permit housing units. The procedures for listing permits and addresses were to be followed as close as possible. The quality and quantity of the ED maps were to be examined to determine the feasibility of assigning ED using the available materials.

Time and mileage data was to be collected during the field test. This data was to be compared to time and mileage data collected earlier for the grid coordinate system to determine the cost differential, if any, between the two methods. A follow-up study was designated to calculate a monthly permit listers error rate to determine the accuracy with which EDs are assigned.

This field test, which at this time will not be implemented due to budget constraints [1], was to be the determining factor in whether ED identification would replace grid identification.

V. CONCLUSIONS

Two issues relative to the representation of permit new construction housing units in the demographic surveys conducted by the Bureau of the Census have been discussed in this paper. One issue involves the determination of the optimal month to begin sampling building permits. The second issue is an alternative means to geographically identify the housing units in the permit frame. For the first issue, creating distributions of the length of time from authorization of construction to completion of construction is a quick and inexpensive way of deriving the optimal month to begin sampling building permits. However, this alternative is subject to the validity of certain assumptions. A study is underway to reestimate the optimal months utilizing permit data for the appropriate time periods. Permit new construction units associated with permits issued prior to the 1980 census can be matched to the 1980 Census Address Registers to eliminate permit lag and identify address duplicates. Identifying permit addresses by EDs would facilitate this matching operation.

Although the ED assignment field test cannot be implemented at this time, the advantages of ED assignment cited in the preliminary research and the problematic grid coordinate system warrent further research into ED identification.

FOOTNOTES

[1]Construction Starts Branch identified sample permits from the Housing Starts Survey that were abandoned in the period 1975 to 1978, cross-classified them according to date of abandonment and date of permit issuance, and then computed monthly abandonment rates.

[2]The design effect is the variance estimate calculated from the survey sample design divided by the variance estimate of a simple random sampling design assuming the sample size for both designs is the same.

[3]Note: $b_{ij} = 1-r-c_{ij}$.

REFERENCES

[1] "Computerization of Permit Sampling Committee: Final Recommendation--Document #30." Internal Census Bureau Report, October 29, 1980.

[2] "Design of the CPS National Sample," The Current Population Survey: Design and Methodology. Technical Paper #40. Bureau of the Census, January 1978, pp. 15-20.

[3] Permit Address Listing Office Manual-Form 11-190, August 1978; Permit Address Listing Interviewer's Manual-Form 11-191, January 1978.

[4] "The Housing Starts, Sales, and Completions Survey, A Report on Methodology." Bureau of the Census.

Table 1--Optimal Months to Begin Sampling Permits by Census Region and Size of Structure

Optimal Permit Months (k)	Size of Structure		
	1 unit	2 to 4 units	5 or more units
Northeast	6	8	14
North Central	6	7	11
South	5	9	12
West	6	7	10

Table 2. Estimates of the Optimal Months to Begin Permit Sampling with Associated Standard Errors and 95 Percent Confidence Intervals

Census Region (1)	Size of Structure (2)	Estimate of $\hat{K}$ (Optimal Month) $\tilde{k}$ (3)	Standard Error for $\hat{K}$ (4)	Confidence Interval for $\hat{K}$ (5)
Northeast	1 unit	5.5 (6)	0.1224	(5.23, 5.71)
	2-4 units	7.4 (8)	0.6506	(6.10, 8.70)
	5 or more units	13.2 (14)	0.5486	(12.10, 14.30)
North Central	1 unit	5.4 (6)	0.0739	(5.25, 5.54)
	2-4 units	6.6 (7)	0.4254	(5.75, 7.45)
	5 or more units	10.5 (11)	0.2720	(9.96, 11.04)
South	1 unit	4.6 (5)	0.0654	(4.47, 4.73)
	2-4 units	8.5 (9)	0.4109	(7.67, 9.32)
	5 or more units	11.3 (12)	0.1918	(10.92, 11.68)
West	1 unit	5.2 (6)	0.0644	(5.07, 5.32)
	2-4 units	6.7 (7)	0.2609	(6.18, 7.22)
	5 or more units	9.2 (10)	0.1935	(8.81, 9.59)