

USE OF MULTIPLICITY RULES IN SURVEYS OF JEWISH POPULATIONS

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Introduction

The National Jewish Population Study (NJPS), recently conducted in the United States, will for the first time provide comprehensive demographic statistics on the American Jewish population. In this paper, we discuss a methodological innovation that was introduced into NJPS in order to improve the reliability of the vital statistics that will be derived from the survey. The innovation represents the first application of a multiplicity design to a national household survey of population change. Our three major objectives in this paper are (i) to describe in a general way the multiplicity design⁽¹⁾ as applied to surveys of population change, (ii) to describe, specifically, the multiplicity design of the NJPS, and (iii) to consider the potential applicability of multiplicity designs to Jewish population surveys in other countries of the world.

Aside from the State of Israel itself, Jewish vital statistics are available from the official vital registration system for those few countries that have religion recorded on their vital certificates. Hence, when these statistics are needed⁽²⁾, they would in most instances have to be collected in *ad hoc* surveys such as single retrospective surveys. In this type of population survey, a single interview is conducted in which household respondents report retrospectively about the vital events that occurred during a predesignated calendar period prior to the survey, usually referred to as the reference period. This survey procedure has presented basic methodological difficulties and the

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- (1) For further information on the theory and application of multiplicity surveys see: Sirken, Monroe G. "Household Surveys with Multiplicity". *Journal of the American Statistical Association*. Vol. 65, March 1970. p. 257-66. Idem. "Survey Strategies for Estimating Rare Health Attributes". In: *Proceedings of the Sixth Berkeley Symposium of Mathematical Statistics and Probability*. Berkeley, California: University of California Press, 1972. p. 135-144. Idem. "Design of Household Sample Surveys to Test Death Registration Completeness". In: *Demography*, Vol. 10, no.2, August 1973, p. 469-478.
 - (2) For information on the availability of Jewish vital statistics in the U.S. see: Goldstein, Sidney. "Sources of Statistics on Jewish Vital Events and Migration in the United States". In: *Papers in Jewish Demography 1970*. Jerusalem, The Institute of Contemporary Jewry, The Hebrew University of Jerusalem, 1973. p. 63-108.

vital statistics it produces are usually subject to large sampling and measurement errors. The multiplicity survey design seeks, by collecting supplementary data not conventionally reported in household surveys, to improve the quality of the survey estimates. The multiplicity design is particularly applicable to retrospective surveys of population change for minority populations having close kinship relationships. On the one hand the survey estimates of minority populations would be subject to especially large sampling errors. On the other hand, close kinship relationships would mean that relatives would be able to provide the supplementary information needed by the multiplicity design to improve the reliability of the survey estimates. Since both of these population attributes describe the Jewish population in most countries, the technique appears to be particularly applicable to Jewish population surveys.

The Multiplicity Survey

Single retrospective surveys of population change adopt counting rules for linking persons who experienced vital events during the reference period to the housing units where the events are eligible to be counted in the survey. These counting rules are usually referred to as residence rules in household surveys. For instance, the *de jure* residence rule in single retrospective surveys links vital events to the usual place of residence of the individual that experienced the event. If the event was a death, the usual place of residence would be defined as the place the person resided when death occurred. For vital events other than deaths, the usual place of residence would be defined as the place the person experiencing the event resides when the survey is conducted. Conventionally, household surveys have adopted counting rules, such as the *de jure* residence rule, which have the property of uniquely linking every event to one and only one housing unit. Thus, according to the *de jure* rule a person who died would be eligible to be enumerated at his place of residence at death and would be ineligible to be enumerated at any other addresses. We refer to rules with this uniqueness property as conventional counting rules.

On the other hand, multiplicity surveys are based on counting rules which make persons who experienced vital events eligible to be counted at more than one housing unit. We refer to rules with this property as multiplicity rules. Rules that link events to the housing units of relatives of persons who experienced the events as well as to *de jure* residences of the persons themselves are multiplicity rules since presumably every person has a *de jure* residence and most persons have relatives living at other residences. If the multiplicity rule stated, for example, that decedents are linked to their *de jure* residences as well as to the housing units of their surviving children and siblings, the deaths would be eligible to be counted at housing units where the decedents formerly resided as well as at housing units that are occupied by the decedents' surviving children and siblings. They would be ineligible to be counted at any other housing units, however.

The number of different housing units that the counting rule defines as eligible to report a particular vital event in the survey is called the multiplicity of the event. The counting rule, whether a conventional or a multiplicity rule is biased if it does not link every event to at least one housing unit. According to the conventional counting rule, the multiplicity of every event is one, since by definition every person who experienced an event is uniquely linked to a single housing unit. According to multiplicity rules, however, the multiplicities of events are not all necessarily equal to one and rarely would they be the same for all events. Consequently, for the estimators based on the multiplicity survey to be unbiased, it is necessary to weight every enumerated event by the reciprocal of its multiplicity. This implies that it is necessary to ascertain the multiplicity of every event enumerated in the multiplicity survey since its multiplicity is rarely known independently. The supplementary information needed to ascertain the multiplicity of an event enumerated in the multiplicity surveys is collected from the same household that reports the event in the survey.

Before proceeding further, let us briefly illustrate the differences between conventional and multiplicity surveys by comparing the information about deaths that would be collected at a typical housing unit. In the case of a *de jure* conventional rule, for instance, the housing unit would be screened only for those deaths that occurred during the reference period to persons while they resided in the unit. In the case of a multiplicity rule which links decedents to their *de jure* residences and to the residences of surviving children and siblings, the housing unit would be screened for any deaths that occurred to persons who formerly resided in the unit as well as for deaths among persons whose children or siblings reside in the unit when the survey is conducted. Moreover, once a death is screened in the survey, its multiplicity would be ascertained by asking the household respondent supplementary questions to determine the number of different housing units that were eligible to report the decedent. In view of the multiplicity rule of this example, this number would be equal to the number of different housing units that are the residences of the decedent's surviving children or siblings or that was the decedent's former residence.

In this illustration, the multiplicity survey collects two kinds of supplementary information from a housing unit which would not be collected by the conventional survey: (i) It counts persons who died elsewhere if their surviving siblings or children reside in the housing unit. (ii) It ascertains the multiplicity of every enumerated death. Both surveys would enumerate persons who died in the housing units and both surveys would collect the identical substantive information for the enumerated deaths.

Vital statistics based on household sample surveys of population change are generally subject to large sampling errors because vital events are relatively rare population events. For example, deaths would be enumerated in only one out of about 40 or 50 housing units if a *de jure* residence rule were adopted in a survey conducted in the

United States. Multiplicity rules offer a strategy for increasing the proportion of housing units in which events would be enumerated in the survey. A small pilot study⁽³⁾ conducted in the United States indicates that the multiplicity rule that links decedents to housing units of siblings and children as well as to their former *de jure* residences increases about three fold the proportion of housing units in which deaths would be enumerated in a survey based on a *de jure* residence rule. If this finding is substantially valid, it would imply that the multiplicity rule would decrease the sampling variance of the mortality statistics based on the conventional rule by about two-thirds. However, the opposite effect would occur if, for example, fewer housing units were linked to vital events by the multiplicity rule than by the conventional rule.

Estimates of population change based on household surveys are invariably subject to large measurement error because vital events are underreported at the housing units to which they are linked by the counting rule. Whether or not particular deaths are missed often depends on the counting rule. For instance, deaths linked to their *de jure* residences are often missed because the decedents' former *de jure* residences are not occupied by members of their former households when the survey is conducted. This would happen if the decedent had lived alone or had lived in a household which moved before the survey was conducted. The situation is further complicated in the U.S. since there appears to be a tendency for the death of a person to result in the dissolution or change of residence of his household. Similarly, events linked by multiplicity rules to the housing units of relatives would be underreported to the extent that the relatives did not know the events occurred, forgot they occurred, or had for any other reason failed to report the events in the survey.

The overall strategy of the multiplicity sample survey is to select the counting rule which for fixed costs minimizes errors in the survey estimates. Frequently, the counting rule that decreases sampling errors, has the effect of increasing measurement errors. Hence, the object of the counting rule strategy is to select from the set of all competitive counting rules that particular rule that minimizes the joint effect of sampling and measurement errors. Eventually statistics derived from the NJPS will be useful in evaluating alternative counting rules. Unfortunately, these statistics have not yet been tabulated and hence they are not available for this paper.

In the next section of this paper we describe the multiplicity design of the National Jewish Population Study, particularly the counting rules that were used to enumerate births, infant deaths, non-infant deaths, marriages, and divorces. We also discuss some of the lessons

(3) Sirken, Monroe G. and Royston, Patricia N. "Reasons Deaths are Missed in Household Surveys of Population Change". In: *Proceedings of the Social Statistics Section*. Washington, D.C., American Statistical Association, 1970. p. 361-64.

that we have learned from the survey. Since counting rules are culture-bound, we do not necessarily expect that the NJPS counting rules would be optimum or even appropriate for Jewish population surveys conducted in other countries. Therefore, in the final section, we illustrate the multiplicity rule implications of some demographic and cultural factors associated with different types of Jewish communities, and with different segments of the Jewish population within the same communities.

National Jewish Population Study

The NJPS was based on a complex sample design involving a national sample of about seventy-five hundred Jewish households that were located in about one hundred different localities. Within each of the localities the sample of Jewish households was selected in two ways. The list sample contains the names of persons who had made charitable contributions to national Jewish organizations or who were members of Jewish organizations or synagogues. The area sample developed lists of Jewish persons who were ineligible for the list sample.

The NJPS was initiated in 1970 and was completed early in 1973. It was limited to households that contained one or more Jewish persons. For purposes of the study, a person was considered Jewish if he said he was Jewish, or if it was said he was Jewish, or if he was reported to have a Jewish mother or father. If the screening questions that the interviewer asked in the NJPS indicated that one or more family members were Jewish, the interview was completed for all family members. In this way information was obtained about mixed marriages which was one of the major objectives of the survey. If none of the household members were Jewish, the interview was terminated. Termination of the interview for this reason was much more likely to occur for households in the area sample than in the list sample.

The NJPS was designed to produce comprehensive demographic statistics on the American Jewish population. In addition to the screening questions noted above, the survey questionnaire, which required about two hours to complete, was derived into ten topical sections and a multiplicity section. The topic sections are:

<i>Section</i>	<i>Topic</i>
A	Family Background
B	Religion
C	Jewish Education
D	Organizations
E	Marriage and Family
F	Mobility and Housing
G	Community Involvement
H	Education and Labor Force
I	Attitudes
J	Income and Contributions

Our interest in this paper is limited to the multiplicity section which was the last section of the NJPS questionnaire. The multiplicity section was designed to produce vital statistics and vital rates for the Jewish population during 1969. The population denominators needed for the rates will be obtained from the screening section which identifies the Jewish persons in the sample and from the topic sections which classify these persons by demographic variables. The multiplicity section identified and collected information on Jewish births, deaths, infant deaths, marriages and divorces which occurred during 1969.

A facsimile of the multiplicity section of the NJPS questionnaire is reproduced in the appendix. There are essentially two distinct parts to a multiplicity questionnaire: (i) a screening section and (ii) the survey vital record forms.

The purpose of the screening section of the NJPS multiplicity questionnaire was to identify the vital events that occurred during 1969 that were linked to the housing units by the counting rules used in the survey. The screening section is divided into three parts. The first (items M-1 through M-11) screens the births and infant deaths that the household is eligible to report; the second (items M-12 through M-18) screens the non-infant deaths; the third (items M-19 through M-27) screens the marriages and divorces.

A survey record form was completed for each vital event identified by the screening section. Three kinds of survey record forms were used in the NJPS. Survey birth record forms were completed for births and infant deaths, survey death record forms for non-infant deaths, and survey marriage record forms for marriages and divorces.

The survey record forms served two purposes: (i) they collected the substantive items of information about the reported events consistent with the vital statistics that would be derived from the study and (ii) they ascertained the multiplicity of the reported events. These multiplicities, we explained earlier, are needed in order to assure that the estimators of the multiplicity survey are unbiased. Ascertaining the multiplicity involved asking a series of questions to determine the number of different housing units that would be eligible to report the vital event in compliance with the NJPS counting rules.

The kinds of screening questions that are appropriate for identifying the vital events that are linked to the housing units and the kinds of questions that are appropriate for ascertaining the multiplicities of the reported vital events depend, of course, on the kind of counting rules that are used in the survey. These rules would vary from one survey to another and they would often vary within the same survey for different vital events. For instance, the NJPS used three distinctly different sets of counting rules. Essentially, the same set of rules was used to enumerate births and infant deaths, another set was used for non-infant deaths, and a third set of rules was used for marriages and divorces. These rules are described below separately for births, deaths, and marriages and divorces.

a. Births

The NJPS counting rules for infants who were born during 1969 differentiated between infants that survived to the date they were enumerated in the survey and those that succumbed prior to that date. The survivors were linked to their own *de jure* residences as well as to the *de jure* residences of their maternal aunts and maternal grandparents. The infants who died were also linked to the residences of maternal aunts and grandparents, but they were linked to their mothers' rather than their own *de jure* residence.

In view of these rules, births that occurred during 1969 and survived to the survey date would be enumerated in a NJPS housing unit if either the baby's maternal aunt, or maternal grandparent or the baby itself resided in the unit. In the event the baby had died prior to the survey, it would be linked to the housing unit if the baby's mother resided in the unit. The multiplicity of a baby who survived to the survey date would be equal to the number of different housing units containing either a maternal aunt or maternal grandparent or the baby itself. The multiplicity of a deceased baby would be equal to the number of different units containing either its mother, a maternal aunt or a maternal grandparent.

b. Deaths

The NJPS counting rules for persons who died during 1969 differentiated between infant and non-infant deaths. The rules for counting infant deaths were the same as those for infants who were born during 1969 and who died prior to the survey date. Thus, infant deaths were linked to the *de jure* residences of their mother, their maternal aunts and their maternal grandparents. Infants who were born and also died during 1969 would be counted as both a birth and an infant death. However, infants who died in 1969 but were born during 1968 would be counted as deaths and not as births, and infants who were born in 1969 and died during 1970 would be counted as births in the survey but not as infant deaths.

Non-infant deaths were linked to the *de jure* residence of their surviving spouses, siblings, and children, and consequently, a death would be enumerated in a housing unit if it were the *de jure* residence of either the wife, a sibling or a child of the decedent. The multiplicity of a non-infant death would be equal to the number of different units containing either the decedent's surviving spouse, sibling or child.

Unlike the counting rules for births, infant deaths, marriages and divorces, it was not feasible in the NJPS to use counting rules for non-infant deaths which linked decedents to their *de jure* residences. Consequently, decedents who did not have a surviving spouse or at least one surviving sibling or child were not linked to any household and hence were missed in NJPS.

c. *Marriages and Divorces*

The NJPS counting rule linked persons who were married and/or divorced during 1969 to the *de jure* residence(s) of the married (divorced) couple and to the *de jure* residences of their respective parents. Consequently, marriages and divorces would be counted at a NJPS housing unit if either one or both of the married (divorced) couple resided there or if a parent of either spouse lived there. The multiplicity of a marriage or divorce is equal to the number of different housing units containing either one of the spouses or any of their parents.

Problem Areas Identified from NJPS

Experience in the field operations of NJPS and in the coding of the multiplicity material pinpointed several problems relating to the implementation of the multiplicity design. These problems are briefly noted below:

1. For about ten per cent of the completed interviews in the NJPS the multiplicity questions were not asked. This occurred primarily as a result of administrative decisions when it became necessary to reduce the length of the interview.
2. When NJPS was launched, it was anticipated that the field interviewing would largely be completed during 1970. With this in mind, the reference period specified in the multiplicity questions was calendar year 1969. Once it was clear that the interviewing would go beyond 1970, a decision had to be made on whether or not to change the reference period. On the one hand, the increase in the length of the recall period for the interviews conducted after 1970 argued for changing the reference period. On the other hand, the confusion that might result in the field operations if we altered the reference period in the middle of the survey convinced us to retain 1969 as the reference period throughout the survey.
3. An unknown number of non-infant deaths were missed in NJPS because the decedent did not have either a surviving spouse or at least one surviving sibling or child. There are no data available yet to permit us to determine how serious a problem this may be. Impressionistically, the evidence suggests that for the Jewish population in the U.S. the problem may be minimal.
4. The NJPS questionnaire and enumerator manual failed to specify how adoptions were to be handled in the multiplicity section. As a result, there is no certainty that adopted babies and babies given out for adoption were reported uniformly on the survey. We decided that babies identifiable as adoptions would not be counted as births or infant deaths.
5. The NJPS questionnaire and enumerator manual failed to specify that relatives living outside the continental United States, were not covered by the survey. However, this did not represent an insurmountable problem since place of residence was collected for all events and rela-

tives. Hence it was feasible to exclude them while editing the survey questionnaires.

6. The NJPS questionnaire and enumerator manual failed to specify that vital events that occurred to non-Jewish relatives were to be excluded and that non-Jews were ineligible to report events that occurred to their Jewish relatives. Since religion was ascertained on the survey record forms, it was feasible to eliminate the non-Jewish vital events. However, it was not feasible to recalculate the multiplicities of events by eliminating the non-Jewish relatives since the religion of the relatives was not ascertained in the survey.

Problems to be Considered in Developing Multiplicity Rules

Most of the problems already noted with respect to implementation of the multiplicity design of NJPS also have relevance for use of multiplicity surveys in other countries including the multiplicity survey currently being developed in Israel with support from the U.S. National Center for Health Statistics. Indeed, because Israel has such a very heterogeneous population with regard to culture - place of origin duration of residence, and family structure, it lends itself particularly well to further evaluation of the practical use of the multiplicity design under varying conditions.

In undertaking the Israeli multiplicity study the impact of demographic and cultural factors which are unique to the Israeli population, will have to be taken into account in developing the multiplicity rules. Also, it is fully recognized that were multiplicity surveys attempted in other Jewish communities of the world, different kinds of problems would arise associated with the unique characteristics of those particular places. At this point, however, these problems can be anticipated only at a very abstract level and certainly a number of unanticipated situations might well arise. Therefore, we will limit this discussion to providing a few illustrations of the effect that religion, as such, might have on the multiplicity rules.

In any society which is characterized by intermarriage between Jews and non-Jews as well as by changing patterns of Jewish identification among persons born as Jews, serious consideration must be given to the effect of religious identification on the multiplicity rules. In the multiplicity survey, information is sought not only on the Jewish vital events experienced by persons residing in the sample households but also on vital events which occurred to their Jewish relatives residing in other households. The success of the method depends on the selection of those rules which maximize the likelihood that the household members responding to the multiplicity questions are familiar both with the events and with the Jewish identity of the relatives residing elsewhere.

Judaism has traditionally frowned upon illegitimacy; yet, as increasing secularization characterizes a number of Jewish communities around the world, an increasing proportion of Jewish births will likely

occur either to women who are not married at the time of the child's birth, or who were not married at the time of conception. Assuming that the parents are married before the birth of the child, the impact on the multiplicity rules may be limited to the quality of the answers given with respect to date of marriage in relation to date of birth of first child. The problem would be more serious if an illegitimate birth occurs. Then, it is quite likely that the relatives of the father of the child would not be familiar with the event and would not therefore be in a position to report it. Where there is evidence of a significant portion of illegitimate births, the matrilineal side should be emphasized by the multiplicity rules. On the other hand, in those communities where illegitimacy is not a problem, the number of events reported in the survey could be increased by linking births to both of the matrilineal and the patrilineal sides of the family.

Since the legal and religious requirements for divorce may vary considerably both among countries and among different subsegments of the Jewish population within countries, attention must be given to the various forms which marital dissolution may take among couples in different Jewish communities. To the extent that the legal basis for a divorce and the processes involved for obtaining divorce are comparatively easier in some countries than in others, the rate of divorce will vary accordingly. In those countries in which divorces are handled by religious procedures, it may well be that the greater difficulty involved leads either to separation without divorce or to arranging for the divorce outside the boundaries of the particular jurisdiction. This argues not only for determination of the place of occurrence of the event, but for some attention to *de facto* separations in lieu of *de jure* divorce. The extent to which these differences may affect the quality of the reporting of divorce needs particular attention in specifying the multiplicity rules.

The accuracy of reporting of vital events in the survey may be affected by the type of calendars being used in the community. Among the Jewish population, reliance upon the Gregorian calendar vis-a-vis the Hebrew calendar may vary considerably from one community to another and, again, among subsegments within a single Jewish community. Exclusive reliance on one or the other of these two calendars as the reference period in a retrospective survey could lead to considerable variation in the quality of reporting. To complicate the situation further, it could well be that in Moslem countries or in Israel itself some individuals might respond in terms of the Moslem calendar year. Recognition of this problem can lead to appropriate modifications in the wording of the questions or the instructions to interviewers. To the extent, however, that all the reported events should occur within a specified period of time, it is important that a standard reference period be used for all respondents and that maximum efforts be made to avoid the possibility of confusion through use of different calendars.

Summary and Conclusions

Official vital records of most countries do not contain information on religion; it is not therefore generally possible to obtain separate statistics on births, deaths, marriages, and divorces for the Jewish population. Moreover, efforts to obtain such data on an *ad hoc* basis through conventional, single retrospective household surveys are invariably frustrated by large sampling errors due to the relative rarity of the events and by large measurement errors due to the underenumeration of vital events.

The use of multiplicity rules in single retrospective surveys provides a strategy for reducing sampling and measurement errors of vital statistics. Multiplicity rules permit vital events to be enumerated at the housing units of relatives as well as at the place of residence of the persons who experience the events. Permitting relatives, who do not live with the persons who experienced the events, to report the events in the survey may improve the overall quality of the survey statistics. The multiplicity design appears to be particularly promising for producing vital statistics for minority populations with close kinship relationships. Since the Jewish populations in most countries have these attributes, the technique would appear to be particularly useful in Jewish population surveys.

A multiplicity design was incorporated into the U.S. National Jewish Population Survey (NJPS) and is presently being developed for use in a national sample survey of the Israeli population, including the administered territories. Experience in using multiplicity in NJPS points to several problem areas: (1) the need to give the multiplicity questions a key priority if the survey instrument covers many other topics; (2) the need to complete the interviewing within a short time in order to have a standard reference period for which the vital events are reported; (3) specification of counting rules to provide maximum coverage of vital events, especially deaths and (4) the need for greater clarification in data collection concerning the vital events that the counting rules imply are eligible to be reported and the relatives that are eligible to report them in the survey.

In pursuing multiplicity in other countries and determining the most appropriate counting rules to be used, account needs to be taken of the wide range of cultural and demographic differences which characterize the many Jewish communities in the world as well as subsegments of the Jewish population within given countries. Among religious, demographic, and other variables which may affect the level of knowledge and the accuracy of reporting of events by given household and non-household member are: level of Jewish identification and secularization; strength of kinship ties, size and structure of household; residence patterns, attitudes toward and extent of adoption, illegitimacy, non-religious marriages; use of specific calendars (Hebrew, Gregorian, Moslem) for reference purposes; and migration patterns. Without further research, the specific impact of each of these and other factors cannot be assessed.