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CENTRO LATINOAMERICANO DE DEMOGRAFIA

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THE MEASUREMENT OF FERTILITY CHANGES WITH SAMPLE SURVEY DATA

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The method proposed here for measuring changes in fertility with sample survey data is a revision of a paper presented at the 1966 annual meeting of the Population Association of America. Several important modifications have been made to take into account criticisms presented on that occasion, especially by Howard Brunsman, Jeanne Clare Ridley and Mindel Sheps. Also included are innovations suggested by Alberto Bayona and Juan Chackiel, second-year students at CELADE. In addition, thanks to the cooperation of Bayona, it has been possible to illustrate the method with data for Mexico City from CELADE's urban fertility survey.

The point of departure for the method is the pioneering proposal of Donald J. Bogue contained in a book prepared for the 1965 International Conference on Family Planning Programmes. Bogue suggested using retrospective data on birth and pregnancy histories from sample surveys as a means of coping with the problem of sampling error involved in controlling the great host of heterogeneous factors, such as education, socio-economic status, religion, ethnicity and urban-rural residence, that can affect the measurement of fertility levels in two successive time-periods. The originality of Bogue's proposal lies in its use of "exactly the same sample of persons" for measuring the level of fertility in each time-period. Bogue observes that, if different samples are used for each time-period, "the size of sample needed to obtain precise measure of change would be intolerably large" 1/.

Although Bogue's method represents a giant step forward, it does present certain difficulties. In a comparison of age-specific fertility rates during two successive five-year periods, even though the data are based on exactly the same sample of women, the women in any given five-year age group, let us say 30 to 34, are no longer, as Bogue himself has recognized, exactly the same women in each quinquennium. Women age 30 to 34 in each year of the first quinquennium will be 35 to 39 in the corresponding year of the subsequent quinquennium and, therefore, belong to

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1/ Donald J. Bogue, Inventory, explanation, and evaluation by interview of family planning: motives-attitudes-knowledge-behavior, University of Chicago, 1965, p. 117.

a different age group. We hasten to add that this difficulty should not be exaggerated. Women age 32, for example, in the last year of the first quinquennium will still be in the 30 to 34 age group during the first two years of the second quinquennium. It can be shown that as a consequence of this kind of overlap, 40 percent of the women-years of exposure in a given age group represent the same women in each quinquennium and only 60 percent are different. Nevertheless, the difference remains substantial, and the problem of sampling error is too great to be overlooked 2/.

Before proceeding further, it should be clearly stated that the purpose of the method proposed here is not to measure the effectiveness of family planning programmes. Its purpose is to measure change in fertility and its use is not restricted to populations where a family planning programme is in operation. This is not to say, however, that it has no utility for family planning evaluation. Two logical stages in the evaluation of the effectiveness of a programme must be distinguished. First, it is necessary to determine whether a change in fertility has in fact occurred and secondly, if a decline has occurred, what contribution to this decline can be attributed to the family planning programme. Our concern here is only with the first stage, to measure the extent and direction of whatever change in fertility may have occurred.

2/ Bogue's method and the method proposed here have the singular feature that their effectiveness is inversely related to the quality of the sample. In a high-quality, strictly random sample in which the probability of each person's being drawn into the sample is completely independent of every other person's probability, the women in each age group constitute a completely different sample of women.
Most fertility surveys, however, cut their interviewing costs by the use of cluster sampling in which clusters are sampled independently and then all (or most of) the persons in each cluster that is drawn are included in the sample. In cluster sampling the women from different age groups are drawn from the same clusters so that the characteristics of each age group are no longer independent. If, for example, the clusters drawn in the sample are overly-representative of low-income, low-educational sectors of the population, all the different age groups will tend to be over-represented in the same sense (although, of course, not to the same extent).

Furthermore, it is not claimed that our method is a final, definitive solution to the problem of sampling error in the measurement of fertility changes on the basis of sample survey data. What we do claim is that this method represents an advance with respect to Bogue's method in the sense that for any given sample size, sampling error is less with this method than with Bogue's method. In this connection, it is perhaps appropriate to quote from a letter of Ronald Freedman commenting on the earlier version of our method: "As with Don Bogue's original proposal, the size of sample required to measure the kinds of changes likely to occur in age-specific rates is....much larger than we usually get in sample surveys. [3/] It is our hope that the presentation of this paper will stimulate discussion leading to still further improvements with regard to minimum sample size requirements.

In order to present the method it is necessary to make a distinction between two different kinds of sampling error deriving from the fact that the different samples of women in each quinquennium may be differentially unrepresentative with respect: a) to their <u>level</u> of fertility, and b) to the proportion of women whose fertility is <u>changing</u> or is changing rapidly. To illustrate this distinction, a hypothetical case for women age 30 to 34 in Mexico City is presented. In the first quinquennium, from 1954 to 1958, women in this age group have an age specific rate of 200 births per thousand women-years of exposure; in the second quinquennium, from 1959 to 1963, the corresponding rate is 150 births per thousand women-years, a decline of 25 percent. Sampling error could have affected this result in two ways. It may be that fertility did not change at all, but that the second quinquennium sample was differentially unrepresentative in the sense of being relatively overloaded with more educated women, with more economically active women, with more urban natives, with more unmarried women, etc. All of their lower fertility would then be attributable to a relative underestimation of the second quinquennium <u>level</u> of fertility on account of sampling error.

It could also be the case, however, that fertility did decline, but that the change did not occur equally among all sectors of the population in the given age group. Since the cohorte being compared in the two quinquennia are essentially different samples, the second quinquennium cohort will to some extent be relatively either overloaded or underloaded with women among whom fertility was declining most. If

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3/ Letter dated 2 February 1966.

it is overloaded in this way, the amount of change will be overestimated; if it is underloaded, the change will be underestimated by virtue of this kind of sampling error.

The distinction is important. Sampling error with respect to fertility change causes the amount of change to be over -or underestimated. Sampling error with respect to fertility level produces the appearance of change in fertility that did not in fact occur. It is this second kind of sampling error -that with respect to fertility level- that the method proposed here claims to eliminate in large part.

Later on, a suggestion will be made for reducing considerably the other kind of sampling error -that with respect to fertility change. Meanwhile, it should be noted that these two kinds of sampling error are not mutually exclusive and each may be present at the same time. When different samples are used for each quinquennium, there will always exist some degree of sampling error with respect to fertility level. Sampling error with respect to fertility change however, can occur only when a change in fertility has actually taken place. It follows, therefore, that a method such as ours, which claims to eliminate most of the sampling error with respect to fertility level will be relatively free of both kinds of sampling error in situations where is little or no change in fertility and sampling error with respect to fertility change does not have to be taken into consideration.

The procedure for eliminating sampling error with respect to fertility level requires the use of two six-year periods instead of two quinquenia. However the last year of the first six-year period is the same as the first year of the second six-year period, so that only eleven years of observation are used. When the method is employed for evaluating family planning programmes, the year that falls in both six-year periods could appropriately be the year in which the programme was initiated. In illustrating the method with data from the CELADE urban fertility survey, for which the last year of observation was 1963, we shall use the eleven years, 1953 to 1963, as the years of observation. Despite the fact that the central year, 1958, had no special significance for family planning programmes, we shall adopt Bogue's terminology of base period and treatment period and designate the first six years, 1953 to 1958, as the base period and the last six years, 1958 to 1963, as the treatment period.

The tabulations required to calculate the age-specific fertility rates are: a) the distribution of the women in the sample by individual year of age in each of the eleven years of observation, and b) the number of live births born in each year of observation to the women in each individual year of age. This information permits the calculation of individual age-specific rates for women of any given individual age x during each of the eleven years of observation, and therefore the combination of individual age rates into any desired combination of five-year age rates.

The essences of the method consists in observing for each five-year age group, x, x+4, the change in fertility of the identically same women during the first and second halves of the base period, and then to compare these changes with the corresponding changes observed for women of the same age group during the first and second halves of the treatment period. It is of crucial importance to note that while the age groups used in comparing the changes refer to essentially different samples of women, the changes observed during each period are based on the same sample of women.

In order to measure fertility change in a six-year period with exactly the same women, allowance must be made for aging. This is accomplished, first by calculating the age-specific fertility rates for women age x-1.5, x+2.5 in each of the first three years of the period, and then by calculating similar rates for the same women in each of the last three years of the period when they are three years older so that their age in each year of observation is x+1.5, x+5.5. The average age of these women during the entire six-year period will be x, x+4, the conventional five-year age group. To express the procedure more concretely, let us take the age group 30 to 34. We use the ages 28.5 to 32.5 during the first three years of the period and the ages 31.5 to 35.5 in the last three years in order to get an average age of 30 to 34 during the period. The problem of calculating rates by half-year ages, it may be observed in passing, is resolved by assuming, for example, that women born in 1925 and were 28 years old in 1953, the first year of observation, had an average age of 28.5 during that year. Table 1 shows as an example from the Mexico City data how these age-specific rates were calculated for the age group 30 to 34 during the base period. Altogether there were 207 births for 967 women-years of exposure in the ages 28.5 to 32.5 in the first three years, and 201 births for the same 967 women-years of exposure in the ages 31.5 to 35.5 in the last three years. The age specific rate is shown as declining during the base period from 214 per 1 000 women-years of exposure to 207. This decrease of about 3 percent could easily be

Table 1

CHANGE IN BASE PERIOD AGE SPECIFIC FERTILITY FOR MEXICO CITY WOMEN WITH AVERAGE AGE 30 TO 34

(Change from 1953-55 for women age 28.5 to 32.5 to 1956-58 for same women age 31.5 to 35.5)

Annual Data During Base Period

Year of observation	Age during year of observation	N° of women	N° of live births	Live births per 1 000 women
1953	28.5 - 32.5	308	59	192
1954	28.5 - 32.5	324	76	235
1955	28.5 - 32.5	335	72	215
TOTAL	28.5 - 32.5	967	207	
1956	31.5 - 35.5	308	70	227
1957	31.5 - 35.5	324	74	228
1958	31.5 - 35.5	335	57	170
TOTAL	31.5 - 35.5	967	201	

Data for each Base Period Triennium

Triennium	Age during years of triennium	Women-years of exposure	N° of live births	Live births per 1 000 exposure years
1953-55	28.5 - 32.5	967	207	214
1956-58	31.5 - 35.5	967	201	207

Source: Tabulations from CELADE's Urban Fertility Survey.

attributed to the three years of aging experienced by the sample cohort in view of the well-know tendency of age-specific fertility rates to taper off with increasing age after reaching a maximun somewhere in the 20's.

How this method functions to eliminate sampling error with respect to level of fertility is perhaps best illustrated by returning to our hypothetical case where base period fertility in the ages 30 to 34 in Mexico City was 200 per 1 000 women and only 150 in the treatment period. Let us suppose that this apparent decrease of 25 percent was due entirely to sampling error with respect to level of fertility and that there was in fact no change in fertility. In this case, using the method proposed here of comparing the changes occurring in each period, it would be reasonable to expect to find in the treatment period, where the age-specific fertility level is 25 percent lower, a small decrease of approximately the same magnitude as that of three percent observed for the based period cohort in the preceding paragraph. This approximately same small change in each period would lead us correctly to infer that there had been no significant change in fertility trends in the base and treatment periods. By comparing changes of fertility instead of levels of fertility in the two periods, the apparent 25 percent decrease due to sampling error in the estimation of the level of fertility in the two periods gets washed out, despite the fact that the two cohorts whose changes are compared are essentially different samples.

We had originally thought, before we applied the method to the data from CELADE's urban fertility surveys, that (quite apart from considerations of sampling error) an important fringe benefit from the point of view of family planning evaluation lay in its ability to discern whether changes in fertility had been taking place prior to the initiation of a programme, and to use these base period changes as the reference point for evaluation of the programmes effectiveness. An increase in fertility during the treatment period need not imply that the programme had been without effect. Providing there had been an even greater increase in the base period, the effect of the programme could have been to decelerate this rate of increase. Similarly, a decrease of fertility in the treatment period could be significant only if there had not been a similar or greater decrease during the base period. The comparison of levels of fertility in each quinquennium on the other hand, might easily lead users of the way of measuring change to take for granted that fertility had been constant during the base period.

We had also thought, before we consulted the CELADE data, that a fringe benefit of secondary importance in this method was its manner of disposal of a potentially serious source of bias -the increasing forgetfulness of birth as the reference period lies further in the past. The comparison of levels of fertility in the base and treatment periods would ordinarily involve a greater underestimation of births in the more remote base period and, therefore, an underestimation of whatever decrease had in fact occurred. It is possible that our method would largely avert this kind of bias. First, because changes are calculated after only a three instead of a five year interval so that forgetfulness would be less serious, and secondly, because, in comparing changes in the base and treatment periods using three year intervals in each instance, it was supposed that approximately the same differential forgetfulness would be involved in each change and that this would to some extent wash out in the comparison of changes in each period. We cautiously say "to some extent" because it would wash out completely only if it can be assumed both that forgetfulness is an increasing linear function of time (an unverified though not unplausible assumption) and also that the incidence of forgetfulness is approximately the same in any two different samples of women of the same age group and is, therefore, not subject to sampling error (an assumption of more dubious validity).

Table 2, with data from the Mexico City CELADE survey, illustrates how the method functions. It shows not only the age-specific fertility rates in each half of both the base and treatment periods, but also the percentage changes in each period in each age group. In addition, a facsimile 4/ of the Total Fertility Rate is used as a summary measure in order to indicate the over-all picture of whatever changes have been taking place.

Several comments are in order here. In the first place, if we disregard for a moment the age-specific rates and concentrate attention on the Total Fertility Rates, the advantage of the method is readily apparent. Whereas a comparison of levels of fertility in the two periods shows an increase from 4,18 births to 4,70, an increase of 12,5 percent, the comparison of changes within each period suggests more or less constant fertility throughout both the base and treatment periods. In the base period the Total Fertility Rate increased 2.4 percent, from 4.13 to 4.23,

4 / Because only women in the ages 20 to 50 were included in the survey, age-specific rates could not be obtained for the age groups 15 to 19, 40 to 44 and 45 to 49 for all the eleves years of observation prior to the survey. In order to get rates all age groups in both the base and treatment periods, it is necessary to get birth histories of women in the ages 15 to 60 at the time of the survey.

whereas in the treatment period there is a correspondingly small decrease of 2.5 percent, from 4.76 to 4.64.

Secondly, the underdeclaration of births due to forgetfulness turns out to be graver than we had expected. In Table 2 it can be seen that the age-specific rates are invariably higher in the treatment period than in the base period. This is a feature characteristic of the data for all the cities in the survey. It is very evident in the age-specific rates that Bogue tabulated for as many quinquennia in the past as the births histories permitted. Despite a few exceptions, a general tendency for successively lower rates in each quinquennium as one recedes further into the past can clearly be discerned in all age groups in all the cities. To handle this problem, Bogue has proposed using tabulations only on those children born alive and still living and then reverse-surviving these in order to estimate total live births.

The effect of differential underdeclaration of births when only a three-year interval is used instead of a five-year interval is not altogether clear from the data in Table 2. The more rapidly forgetfulness increases with the passage of time, the more there will tend to be the appearance of invariably increasing fertility in both the base and treatment periods so that it would no longer be possible to establish with any degree of assurance whether base period fertility had been constant, increasing or decreasing. Forgetfulness of this magnitude does not manifest itself in the data of Table 2. Out of eight observed changes in the two periods, there are only three increases (all in the two younger age groups) instead of in all eight, as would be expected if underdeclaration were the predominating feature of comparisons based on these three-year intervals. Furthermore, in the central age groups, 25 to 29 and 30 to 34, all observed changes are relatively small.

The two other age groups, 20 to 24 and 35 to 39, are more difficult to interpret. Here the changes observed are larger, considerably larger than what one would expect to result solely from three years of aging. While the magnitude of change in the 20 to 24 age group could conceivably be due to the combined effect of aging (because of fewer single women with increasing age) and forgetfulness, this kind of explanation cannot be used for the decreases of 41 percent and 20 percent observed in the 35 to 39 age cohort. In this age group aging and forgetfulness would tend to have opposite effects, since aging results in lower fertility and forgetfulness produces the appearance of higher fertility. Furthermore, there is no basis for supposing that forgetfulness would be so much greater among the younger women. The dismaying instability of some of the estimated

TABLE 2

AGE-SPECIFIC FERTILITY RATES DURING FIRST AND SECOND HALVES OF BASE AND TREATMENT PERIODS, 1953-63, MEXICO CITY

AVERAGE AGE OF COHORTS DURING BASE AND TREATMENT PERIODS	BASE PERIOD							TREATMENT PERIOD						
	WOMEN-YEARS OF EXPOSURE		NUMBER OF LIVE BIRTHS		LIVE BIRTHS PER 1 000 EXPOSURE YEARS		RELATIVE CHANGE	WOMEN-YEARS OF EXPOSURE		NUMBER OF LIVE BIRTHS		LIVE BIRTHS PER 1 000 EXPOSURE YEARS		RELATIVE CHANGE
	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58		1958-60	1961-63	1958-60	1961-63	1958-60	1961-63	
15 TO 19	NOT AVAILABLE													
20 TO 24	1 299	1 299	241	357	186	275	+48%	1 523	1 523	368	433	242	284	+17%
25 TO 29	1 080	1 080	277	284	256	263	+3%	1 299	1 299	365	356	281	274	-3%
30 TO 34	967	967	207	201	214	207	-3%	1 080	1 080	272	245	252	227	-10%
35 TO 39	669	669	114	67	170	100	-41%	967	967	171	137	177	142	-20%
40 TO 44	NOT AVAILABLE													
45 TO 49	NOT AVAILABLE													
"TOTAL FERTILITY RATE" a/					4,13	4,23	+2,4%					4,76	4,64	-2,5%

SOURCE: TABULATIONS FOR MEXICO CITY FROM CELADE's URBAN FERTILITY SURVEY.

a/ "TOTAL FERTILITY RATE" DEFINED AS THE SUM OF THE AVAILABLE AGE-SPECIFIC FERTILITY RATES MULTIPLIED BY FIVE.

age-specific rates tends to confirm Freedman's opinion, mentioned above, that the sample size required for measuring changes in age-specific fertility rates is much larger than what we usually get in sample surveys.

Insufficiency of sample size does not in this case, however, appear to be related to sampling error. Each estimated change in fertility was based on two three-year periods of observation for exactly the same sample of women so that any unrepresentativeness of the sample would tend to be equally characteristic of both the first and the second three-year periods. The instability of the data would seem rather to derive from the instability inherent in vital statistics based on relatively small populations. It is discouraging to note that the number of women-years of exposition used in calculating three-year rates ranges from 669 for base period women age 35 to 39 to 1 523 for treatment period women in the ages 20 to 24.5/

Another possible explanation of unstable age-specific fertility rates is that there may have occurred changes in the timing and spacing of births unrelated to the total number of children women will have at the end of their reproductive period. Changes in timing and spacing of this kind, however, should not be of great importance in high fertility populations where reproduction control is minimal.6/

Pending further investigation, therefore, with data from considerably larger samples, it cannot be determined whether and to what extent differential underdeclaration of births due to forgetfulness obscures the trend of fertility during the base period. Even if this trend gets obscured, the loss involved is not very great. The most important piece of information for family planning programme evaluation is the knowledge of whether and by how much fertility in the treatment period is declining faster or increasing less slowly than in the base period. It is less important to know whether the decrease has been accelerating or the increase has been decelerating. Following this line of reasoning, Bayona has proposed comparing the observed fertility rate in the last half of the treatment period with an expected rate calculated by applying the change observed in

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5/ Bogue's method, it must be conceded is superior in this respect since he calculates five-year rates for five-year age groups and gets an average mileage of 25 women-years of exposition per woman in the sample; our method of three-year rates for five-year age groups has an average of only 15 women-years of exposition.

6/ In any event the distorting effect of changes in timing and spacing are inherent in period-analysis of fertility changes. Only cohort analysis can eliminate this kind of distortion. Here is where family planning programme evaluation gets strung up on the horns of this period-cohort dilemma. Cohort analysis is most appropriate for determining whether and how much fertility has changed and period analysis best determines when the change occurred. Cohort analysis has the further liability of not being suited to current situations in which the base period to the rate observed in the first half of the treatment period.7/ Identical observed and expected rates in this comparison would mean the same change, if any, ocurred in both the base and treatment periods.

The data in Table 2, for example, show the Total Fertility Rate in the base period to have increased 2.4 percent, from 4.13 to 4.23. The expected rate for the second half of the treatment period, assuming a similar increase of 2.4 percent over the rate of 4.76 in the first half of the treatment period, is 4.88. The observed rate for this three-year period is 4,64 -5 percent less than the expected rate. The extent to which the observed rate is less than the expected rate tells us the magnitude of the downward change in fertility. This downward change, however, does not distinguish between a decelerating increase and an accelerating decrease.

The remaining paragraphs of this paper are devoted to that kind of sampling error -that with respect to fertility change- which the method proposed here makes no claim to eliminate. The comments that follow, it would seem, therefore, are equally applicable either to Bogue's method or our modification of Bogue's method.

In the first place, it is worth noting that significant declines in fertility during a period of demographic transition apparently have been the result of some combination of three different ways in which fertility may decline:

a) Widening differential fertility whereby fertility declines among certain sectors of the population -the better educated, the urban residents, etc.

b) Fertility declining in proportionately the same amount among all sectors of the population.

c) Changing population composition with a shift from the high to the low fertility categories of each differential characteristic.

6/(continued)
women in the high fertility ages still have 20 to 30 years to go before they have completed their fertility and the definitive cohort analysis can be made.
Unfortunately, family planning programme evaluation needs the simultaneous solution to all three of these difficulties. It needs to know how much fertility declined, when the decline occurred, and it needs to know these as soon as possible after it has occurred.

7/ Alberto Bayona Nuñez, Consideraciones al método de Carleton para medir cambios de la fecundidad utilizando informacion proveniente de muestras pequeñas. CELADE, 1969 (unpublished manucript).

We submit that sampling error with respect to fertility change is of consequence only to the extent that declining fertility comes about differentially. We believe we have demonstrated elsewhere that changes in population composition cannot be of great significance in a short-run fertility decline except in the unusual case where the magnitude of both the change in composition and in the differential also are very great 8 /. Furthermore, to the extent the decline takes place proportionately the same throughout the population, sampling error is irrelevant since all samples must be equally representative of the population with respect to fertility change.

The key, therefore, to reducing sampling error with respect to fertility change is to find some way of controlling for differential fertility decline. Chackiel, mindful of the fact that most fertility differential characteristics such as education, urban-rural residence, female economic activity, and age at marriage, tend to a considerable degree to be mutually overlapping, has suggested that standardization of the base and treatment period cohorts by one significant characteristic such as education might well eliminate the greater part of this kind of sampling error.

Standardization, however, would require elaborate tabulations by level of education by individual age for each year of observation. The rates for some levels of education at certain ages would be tenuously based on a very small number of cases. Under the circumstances, standardization by use of a matching process would seem most adequate. This could be done in such a way that would neither destroy the probabilistic character of the sample nor reduce the sample size of either cohort.

By way of example let us consider the 412 Mexican women of average age 18.5 in 1953, the first year of the base period and compare them with the 497 women of the same age in 1958, the first year of the treatment period. Let us suppose, hypothetically that each cohort of women is differentially distributed into three educational categories: low, medium and high (whose definition would undoubtedly vary from country to country) as shown in Table 3:

8 / Robert O. Carleton, "Fertility trends and differentials in Latin América", Milbank Memorial Fund Quarterly, Vol. XLIII, N° 4, Oct. 1965, pp. 15-29.

Table 3

WOMEN IN MEXICO CITY OF AVERAGE AGE 18.5 BY LEVEL OF EDUCATION

Educational level	Age 18.5 in 1953		Age 18.5 in 1958	
	Number	Percentage	Number	Percentage
Low	268	65	298	60
Medium	103	25	139	28
High	41	10	60	12
Total	412	100	497	100

The matching process could be done by successive approximation, beginning perhaps with the educational category where there is the largest percentage difference between the two cohorts -in this instance the low educational level. One would raise the proportion of women in this category in the 1958 cohort to 65 percent, the proportion found in the 1953 cohort. This would be accomplished by drawing at random from the cards for the 298 women in this category in the 1958 cohort and duplicating the cards of the women thus drawn until the percentage of low education women in this cohort reaches the desired 65 percent. This would require 72 duplications, derived by solving the following formula:

$$\frac{298 + x}{497 + x} = \frac{65}{100} \quad \text{for } x.$$

In this particular instance, raising the percentage of women with low education has the effect of bringing the medium category down to 24 percent and the high education category down to 11 percent, virtually the same as the percentages in the 1953 cohort. If one or more of these other categories had remained significantly different, the matching process would have had to be applied again to the remaining category showing the greatest difference. It is important to note that one must always duplicate cards from the cohort with the smaller percentage instead of eliminating cards from the cohort with the larger percentage. In this way, the number of <u>different</u> women in each cohort sample stays the same. Eliminating cards would reduce the number of different women and, therefore, increase the sampling error.

This kind of standardization by matching, which would also have to be applied to the second year and third year cohorts of the base and treatment periods, would be greatly simplified if a computer programme would be developed for processing the data. Once the labor can be entrusted to the computer, more complex processes of standardising by two or three differential categories at a time would become a possibility. In this way sampling error would be brought largely under control. The big problem remaining would be that of the instability of vital statistics rates with relatively small populations.

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