# A RESPECIFICATION OF VARIABLES IN COHORT ANALYSIS

Daniel O. Price, University of Texas at Austin

Some of the basic problems in cohort analysis were delineated and a suggested approach was presented in Mason, Mason, Winsborough and Poole (1973). Some of the same problems were dealt with in a somewhat different framework by Riley, Johnson, and Foner (1972). The present article attempts to deal with the problem of separating Age, Cohort, and Period effects in cohort analysis by respecifying the variables, then presents an example of the proposed approach.

Cohort Analysis. A cohort is a group of individuals, areas, families, or other units of observation that were similar on some specified characteristic at some point in time. The most frequent usage of the term is as a birth, or age, cohort -- those individuals born in a particular year or time period. However, one might have a marriage cohort made up of all individuals who were first married during a certain year, a labor force cohort made up of all individuals who first sought work during a certain year or time period, or even a census tract cohort made up of census tracts that first exhibited some specified characteristic at a particular point in time. In cohort analysis this group, homogeneous with respect to some characteristic at a specified point in time, is "followed" over the years subsequent to the time when it was identified as a cohort. Other cohorts that exhibited the relevant characteristic at different points in time are also "followed," and comparisons are made within cohorts, between cohorts, and at particular points in time.

Utility of Cohort Analysis. Norman Ryder (1964, 1965, 1968) has made a sound case for the value of examining social change by cohorts. This leads to a better understanding of the phenomena than does the examination in cross-section. In fact examination by cross-section may be misleading. If, for example, one looks at median income by age one sees the medians increasing with increasing age up to about ages 40 or 45 and then decreasing with further increases in age. This has led to the conclusion that people reach their maximum earning capacity sometime in their forties and are likely to have declining earnings after that. An examination of median earnings by cohorts indicates that median earnings continue increasing throughout the labor force history or at least until beyond age 60. At a particular point in time people aged 55 may have lower median earnings than those aged 45, but their earnings at age 55 are higher than they were when they themselves were 45, ten years earlier. This can be seen only with examination of the data by cohorts.

Previous Specification of Relevant Variables in Cohort Analysis. Most works in cohort analysis have accepted the specification of the relevant variables as Age, Period, and Cohort effects. The Age Effect is the change in the relevant variable with increasing age. The Period Effect is the change in the relevant variable across all ages at a particular point in time associated with some societal event such as a recession, sudden inflation, a war, etc. The Cohort Effect is the differences in level of the relevant variable from one cohort to the next.

These sources of variation seem to be conceptually distinct but, as ordinarily defined, are not mathematically independent because if any two of these variables are known the third is determined. One of the best analyses of this situation and one of the best proposals for separating these three effects was that made by Mason, et. al. (1973). They point out that the technique they suggest cannot be expected to yield meaningful results unless the investigator also utilizes relatively strong hypotheses about the nature of these effects. The results obtained by investigators using the method suggested by Mason et. al. (1973) have, in general, not been too useful because this point has been ignored. (See Glenn, 1975.) A respecification of the relevant variables seems to be due, and one proposal for this is the basis of the present article.

## RESPECIFICATION OF RELEVANT VARIABLES

If further progress is to be made in cohort analysis it would seem that the relevant variables must be more precisely defined. Ideally the specification would make possible the separation of Age, Period, and Cohort Effects but should also be based on an underlying reasonableness. The following identification of these variables not only seems to build on an underlying reasonableness but gives mathematical specifications for the variables.

The approach followed is to separate, by definition, the variables from their effects. Age, Cohort and Period are inextricably confounded since Age plus Cohort equals Period. However, it seems possible to define the effects of these variables in such a way as to be independent, especially if we specify a certain priority among them.

Age Effect. The Age Effect not only seems to be clear conceptually but would seem to occupy a certain primacy among the various effects because it is so omnipresent. Increasing age is the essential characteristic of a cohort, and virtually all dependent variables change with increases in age. Riley et. al. (1972) documents the basic importance of age in our society, not only as a variable, but as a basis for stratification. The age effect is therefore defined in traditional fashion as the changes in the dependent variable associated with increases in age of a cohort.

In virtually no dependent variable is there any reason for assuming that the age effect is constant at all ages. In general the age effects should be assumed to be nonlinear, the exact form dependent on the dependent variable under consideration. Age effects exist within cohorts and should not be assumed to be the same from one cohort to another.

The observations of a dependent variable made on the members of a cohort at increasing ages form a time series of observations. These are not independent observations, and if the time interval (the different ages) at which observations are made is sufficiently reduced, the relationship forms a smooth curve. Thus the age effect is defined mathematically as the slope of the curve fitted to the set of observations made at different points in time (at different ages) for a specified cohort. If we take

$$Y = f(A|C)$$

which indicates that the dependent variable is a function of age for a specified cohort, then the age effect can be defined as

$$\text{Age Effect, } E_A = f'(A|C)$$

which in words says that the Age Effect is the derivative, or slope, of the mathematical function relating the dependent variable, Y, to age for a specified cohort.

Important assumptions in the above definition are that the function is continuous and reflects the pattern of changes in Y with increasing age. It is possible to develop "pathologic" situations in which the function is discontinuous, but these are rare or nonexistent in real life. If every person were required to retire at precisely age 65, then a discontinuity would result at that point; however, even then we might not observe a discontinuity if observations were being made on age groups.

It is also important that the above definition assumes that the function, $f(A|C)$, reflects the pattern of changes in Y with increasing age. This is always a problem in the analysis of time series -- to extract the trends without allowing perturbations to disturb the trend but also without ignoring perturbations that might be reflecting "real" effects or changes in trend. This problem is recognized along with the subjectivity which is involved in efforts at its solution. As Mason et. al. (1973) points out, the investigator must utilize relatively strong hypotheses about the substantive material under study in order to come out with meaningful findings. We will not discuss this problem further at this point but will come back to it later because we assume that the period effects which we are trying to identify are the cause of some of these perturbations or deviations from pattern.

We have defined Age Effect as the first derivative of the function relating the dependent variable to Age in a specified cohort, and have pointed out that this function should be taken as nonlinear. The exact nature of the function should ideally be developed from theoretical notions about the relationship between the dependent variable and age. The development of functions which can be theoretically justified is an important area of research and should not be looked upon as simple empirical curve-fitting. A good fit to any curve can be obtained with the use of Fourier Series, but theoretical sense can be made of the result only in certain areas of electronics. The use of regression equations is "curve-fitting", but rarely is any thought given to the appropriateness of the usual assumption of linearity. Efforts must be made to associate mathematical form with substantive theory.

There are situations, however, where a good fitting mathematical curve is useful even when it has no basis in substantive theory. If the mathematical equation fits the observations very closely, it may be used as a convenient description of the data, and information about the data may be abstracted from the mathematical equation more easily than from the observations. In such situations it should be kept in mind that the mathematical equation is a description of the observations and it would be dubious to use it for extrapolation beyond the range of the observations. In the example given in the latter part of this paper, the mathematical equation is taken as a description of the observations from which information may be abstracted. No attempt is made in this example to develop a theoretically justifiable mathematical form.

Cohort Effects. Cohort Effects are usually referred to as the differences between cohorts, and in Mason et. al. (1973) are assumed to be a constant level of difference between cohorts in the dependent variable. Following the manner in which age effects were defined, we define cohort effects as the change in the dependent variable as one moves from one cohort to the next at a specified age. In symbols, if

$$Y = f(C|A),$$

then the Cohort Effect is $\Delta Y$ for two successive cohorts at a specified age.

At this point it is not assumed that the function, $f(C|A)$, is necessarily continuous. We assumed that $f(A|C)$ was continuous because observations in a cohort at successive ages are not independent and may theoretically be taken at infinitesimally close intervals. A similar line of reasoning may be utilized if we consider theoretically narrow cohorts, say only one day in width rather than the usual 5 or 10 years. Given the stability of the social structure and the social interaction of individuals of similar ages, it is reasonable to assume that a characteristic of individuals who are some specified age today, say 34, will not differ significantly from the same characteristic of individuals who were 34 yesterday or those who will be 34 tomorrow. Thus, we now assume continuity of the function $f(C|A)$ for all ages. If

$$Y = f(C|A)$$

is a continuous function for all ages, then the Cohort Effect can be defined as

$$\text{Cohort Effect, } E_C = f'(C|A).$$

In words, the Cohort Effect is the derivative, or slope, of the function relating the dependent variable to Cohort for a specified age.

This definition does not imply that the cohort effect between two cohorts is constant for all ages, nor does it imply that the cohort effect is constant between all cohorts at any given age. Just as thought needs to be given to the nature of the association between the dependent variable and age, so thought needs to be given to the nature of the relationship between the dependent variable and cohorts. This is the way a particular characteristic is changing over time for a specified age group in society. In fact, this definition of Cohort Effect can be considered an operational definition of one aspect of social change.[1] The mathematical form describing this relationship should be developed on the basis of our theories of social change. Again, the substantive implications of the mathematical form should be examined for reasonableness. If the mathematical form chosen is a polynomial of second degree with respect to cohort, this implies that the cohort effect will change between successive pairs of cohorts but that the change will be by a constant amount. For example, school enrollment of individuals aged 20-24 may well be expected to be higher from one cohort to the next, but do we expect the increase to be by a constant amount or do we expect the proportion enrolled to increase but by decreasing amounts as the level approaches 100 percent? It is important to consider the substantive implications of the mathematical form and to derive the mathematical form from theoretical considerations if possible. For purely descriptive purposes, however, an empirically fitted mathematical function can be useful.

Age and Cohort Interaction Effects. If $f(C|A)$ is continuous for all Ages, and if $f(A|C)$ is continuous for all Cohorts, as assumed above, then it follows that

$$Y = f(A,C)$$

is a continuous function. This function may be visualized geometrically as a nonlinear surface above an Age by Cohort base in which the height of the surface above the base at a particular point is the value of the dependent, or relevant, variable for that particular Age and Cohort combination. The slope of this surface in any plane perpendicular to the Age axis is the Cohort effect at that point, and the slope of the surface in any plane perpendicular to the Cohort Axis is the Age effect at that point. In symbols we can define the age and cohort effects on the basis of the function.

$$Y = f(A,C)$$

$$\text{Age Effect} = E_A = \frac{\partial Y}{\partial A}$$

$$\text{Cohort Effect} = E_C = \frac{\partial Y}{\partial C}$$

Another important aspect which can be examined within this formulation is the change in age effect from one cohort to another. This is the same as the change in cohort effect with increasing age but is perhaps easier conceptualized as the changing age effect over time. Is the rate at which white females are leaving the labor force between the ages of 25 and 26 increasing or decreasing? The answer to this question is called the Age and Cohort Interaction Effect and is defined as

$$\text{Age and Cohort Interaction Effect} = E_{AxC} = \frac{\partial Y}{\partial A}\frac{\partial Y}{\partial C}$$

The changes in Age Effect from one time period to another can be taken as the measure of another aspect of social change.

The identification of this interaction between age and cohort effects provides additional information in cohort analysis. If the direction of this interaction effect follows a pattern for all ages at a particular point in time, then it might be identified as a period effect, because it would seem reasonable to attribute it to some social event happening at that time. The social event has upset the regular pattern of age and cohort effects and thus has caused the cohorts to change with respect to the variable being studied. These Age by Cohort Interaction Effects are important in their own right and may or may not be identified as one aspect of Period Effects, which are discussed next.

Period Effects. In studying social change the effects associated with aging, and the historical effects over time associated with cohort effects, are felt to be of primal importance. The Period Effects are defined as those changes in the dependent variable caused by some event or events at a particular period in time that cause transitory departures at all ages from the established age and cohort patterns. It is not specified that the effect is the same at all ages.[2]

It has been indicated above that if the interaction effect follows a pattern for all ages at a particular point in time, it may be identified as a period effect since Period Effects are defined as departures at all ages from the established Age and Cohort patterns.

Period effects may take a different form. They may occur as consistent deviations from the Age and Cohort patterns established by the function $Y = f(A,C)$. The identification of Period Effects may be made from an examination of the deviations from the surface described by $Y = f(A,C)$, at a particular point in time. On the basis of substantive knowledge of the dependent variable and on the basis of the deviations, one begins to formulate ideas as to the nature of the Period Effects one is trying to identify.

There are several sorts of Period Effects that one can identify theoretically, and the search procedures will vary depending on the nature of the Period Effect. For example, if the dependent variable is income, one might imagine a recession causing a drop (or slackening in increase) of median incomes at all ages, and thus a trough effect. If the mathematical form fitted to the surface is quite complex, it may fit into this trough and deviations from the surface will not help in identifying it. However, if the mathematical form is not too complex and the longer term, more stable, pattern is followed by the surface, the deviations for this point in time will all be negative. A peak effect might be similarly identified with positive deviations.

If the Period Effect is in the nature of rapid inflation, one may have a cliff effect where the median incomes rise sharply at that point in time for all ages and then continue on their previous trend but at a higher level. This type of period effect will be more difficult to identify from deviations because it will change the overall slope of the basic pattern, causing negative deviations on one side of the "cliff" and positive deviations on the other side.

If the surface, f(A,C), were not fitted by ordinary least squares but by the least absolute value approach or a related technique (see Armstrong and Frome, 1976 and in press, and Tukey, 1977), the Period Effects as defined here would be more easily identified. A case could also be made that the Age and Cohort Effects, as defined, would be more meaningful because of the surface's conformity to "pattern". Some of the possibilities in this direction are being explored.

A computer plot of the observed data over an Age-by-Cohort base may be useful in identifying Period Effects. Since period effects may be of several different sorts, there is probably no one best technique for identifying them. This is consistent with our general view of reality. Events happening at a particular point in time are of a wide variety of sorts and can produce a variety of consequences so that no one particular type of pattern can be expected as a Period Effect.

One might object to the proposed definition of Period Effects on the basis that all Period Effects aren't apparent at the time of the causative factor. The Depression, for example, had effects on children growing up at that time that were not exhibited until later in life. In the system proposed here, such effects become identified as cohort effects or age by cohort interaction effects. Period effects as defined here are the consequences of those events which have a relative transitory effect across all ages.

## ILLUSTRATIVE EXAMPLE

The dependent variable examined in this illustration is the labor force participation of white females as measured by percent in the labor force. The data are for the period 1940 through 1970. The cohorts are five year age groups identified by the year in which they were 20-24 years of age. The group 45-49 in 1940 is defined as cohort 15 since they were 20-24 years old in 1915. Age is taken as the midpoint of the five year age interval. The basic data are shown in Table 1.

Since the purpose of this illustration is to demonstrate the sorts of descriptive information that can be extracted from a set of observations by use of the approach suggested above, no effort is made to develop a mathematical expression on the basis of substantive theory. So long as the expression for f(A,C) fits the observations closely, the derived information can be taken as descriptive of the original data. In this illustration f(A,C) is taken as

$$f(A,C) = a+b_1C + b_2A + b_3A^2 + b_4A^3 + b_5C^2 + b_6AC + b_7A^2C + b_8A^3C + b_9AC^2 + b_{10}A^2C^2 + b_{11}A^3C^2$$

This expression was fitted to the observations of Table 1 by ordinary least squares with a resulting multiple correlation of .984. This high correlation indicates that we have achieved a fairly accurate description of the original observations and can place some confidence in the derived descriptive information. The high multicollinearity and the lack of substantive theory used in developing the polynomial form indicate that we should not attempt to attach meanings to the specific values of the regression coefficients. Partial derivatives of the expression f(A,C) were evaluated at five year Age and Cohort intervals to produce the values of Age, Cohort, and Age by Cohort Interaction Effects shown in Tables 2, 4 and 5. If f(A,C) had been developed on the basis of substantive theory, we might have computed valued for years yet to come and a comparison of these projections with actual observations would become a test of the theory underlying the model.

Age Effects. The data of Table 2 show that recent cohorts of white females start reducing their labor force participation about age 55 and that this age has been declining. The cohort of 1910 for example didn't start reducing its labor force participation until about age 60. Also the rate of withdrawal from the labor force after these ages has been increasing in more recent cohorts; the cohort of 1910, for example, at age 62.5 was reducing its labor force participation about half a percentage point with each increase of one year in age while the cohort of 1930, at the same age, was withdrawing from the labor force by nearly three percentage points with each year increase in age. This is doubtless due to Social Security and the increasing number and quality of retirement plans.

Given the mathematical formulation it is possible to make estimates of the age at which each white female cohort begins reducing its labor force participation. This is also, of course, the point of maximum participation. For selected years between 1940 and 1970, it was determined which cohort was at its maximum point at the specified year, the age of the cohort at that point, and the level of labor force participation. (Cohorts one year in width were utilized in this exercise.) The results are shown in Table 3. The data of this table suggest that the age of maximum labor force participation for white female cohorts has been declining but seems to be stablizing at about age 54.

The age effects in Table 2 show that among white females the age effects are negative at younger ages and then become positive somewhere before age 35. This is the "labor force drop-out" of white females during childbearing ages. Table 2 indicates that the age at which this drop-out stops, a point of minimum labor force participation, has been declining. The cohort which had reached its minimum point in each of selected years was determined and the age and labor force participation at that point was computed. The results are shown in Table 3 along with the maximum points. This estimated age of minimum labor force participation has declined from 37 in 1940 to a little over 25 in 1970, and if the pattern continues future cohorts of white females will not show a "labor force drop-out". This changing pattern is the result of several factors -- declining fertility, increasing childlessness, and increasing pressure for development of maternity policies that do not require females to withdraw from the labor force during the child bearing years.

Cohort Effects. Table 4 shows us that the cohorts of 1940, 1945, and 1950 had negative cohort effects at age 22.5. Thus we can say that the proportion of white females in the labor force at age 22.5 declined from 1940 through 1950 but started increasing between 1950 and 1955 and by 1970 was increasing by approximately one and three fourths percentage points a year. Table 4 shows us that except for younger females in earlier cohorts the labor force participation of females at all ages has been increasing between 1940 and 1970. This table also shows that below age 40 this increase has been at an increasing rate but above age 40 the amount of increase each year has been declining. This suggests that there might be a plateau for level of white female labor force participation at various ages. At the oldest age, 62.5, the increase in labor force participation has been by approximately two thirds of a percentage point a year and increasing very slightly.

Age by Cohort Interaction Effects. Table 5 shows the change in cohort effect per year increase in age, or what is the same thing, the change in age effect at a given age from one cohort to the next. At all ages under 30 these interaction effects are positive which means that the change in white female labor force participation per year increase in age is changing in a positive direction from one year to the next. Those white females who were 22.5 in 1945 were dropping out of the labor force by nearly three percentage points with each year increase in age, but this positive interaction term tells us that this rate of change was becoming less negative (more positive) with each succeeding year. The change in labor force participation with increasing age has been becoming more positive with each succeeding year for all white females under 30 during the period 1940 through 1970.

If we look at ages over 50 we find the interaction terms all negative. The rate at which cohorts over 50 are changing their labor force participation with increasing age has become less positive with each succeeding year. Women at 52.5 are still increasing their proportion in the labor force with each increasing year of age, but from year to year in time the amount of increase is less. Since females over 55 are dropping out of the labor force with increasing age, this negative interaction effect means that each succeeding year in time they are withdrawing from the labor force at increasing rates.

Period Effects. Table 6 shows the deviations between the observed points and the surface described by the regression polynomial. These deviations are arranged by time periods because the most likely sort of period effect would result in nearly all positive (or negative) deviations at some point in time. The data of Table 6 show no indication of a period effect although it is possible that if some method other than least squares had been used to fit the regression surface, a period effect might have shown up.

Limitations. The utility of the method outlined and illustrated is still to be fully explored but it would appear to be fruitful for variables such as labor force participation, income, etc. The development of mathematical forms with substantive meaning will doubtless pose problems but may stimulate more rigorous thinking on the nature of age and cohort effects. Two different mathematical forms, each of which correlates with the observations as closely as the example above, will probably yield similar interpretations, though one may provide more meaningful projections. This approach would not seem particularly applicable to a variable such as fertility where for most individuals the relevant value of the variable is its cumulative value. However, a cumulative measure of fertility might be used with a generalized Pearl-Reed Growth curve as the mathematical form. (An analogous situation would be trying to study mean or median income in a cohort when the variable that was most relevant to each individual was the total earned since birth, with individuals stopping work when a certain grand total had been earned.) A careful examination of a computer drawn perspective plot of the original observations or of the surface described by the basic regression equation might yield many of the same interpretations made from Tables 2-6, but the actual magnitude of the changes taking place would not be known.

Conclusions. Definitions of age effects, cohort effects, and age by cohort interaction effects have been developed in mathematical form for use in cohort analysis. Period effects have been defined independently of these and suggestions have been made for identifying period effects depending on their nature. The method has been illustrated utilizing the labor force participation of white females for the period 1940 through 1970. The approach suggested seems to offer real possibilities for use in cohort analysis. The approach also points up the need for continuing examination of the relationship between substantive theory and mathematical form.

## FOOTNOTES

[1]This suggested operational definition of social change is subsumed under that suggested by Ryder (1964). He says "The definition of social change prompted by these considerations is the modification of processual parameters from cohort to cohort." (p. 461) His discussion indicates that he includes "short-run change," which he identifies with a "period-specific event," along with "long-run change," which "is characterized by differences in functional form from cohort to cohort other than those betraying the characteristic age pattern." The definition of social change suggested by the present author is not identifical to Ryder's "long-run change" but is closely related.

[2]This point of view is similar to that of Ryder (1964) in his discussion of short-run changes. ". . . the manifestation of a period-specific event or situation that 'marks' the successive cohort functions at the same time, and thus at successive ages of the cohorts in question. Frequently such manifestations take the form of fluctuations, in the sense that a counteracting movement occurs subsequently, which erases the impact of the situation in the eventual summary for the cohort." (p. 462)

## REFERENCES


Armstrong, R. D. and E. L. Frome. "Least absolute value estimators for one-day and two-way tables." Center for Cybernetic Studies Research Report CCS 266. Austin: The University of Texas, 1976.

______. "A comparison of two algorithms for absolute deviation curve fitting." Journal of the American Statistical Association. Accepted for publication.

Glenn, Norval D. "Some cautions concerning statistical attempts to separate age, period, and cohort effects." Paper given at American Political Science Association meeting, San Francisco, Sept. 2-5, 1975.

Mason, Karen Oppenheim, William M. Mason, H.H. Winsborough and W. Kenneth Poole. "Some methodological issues in cohort analysis of archival data." American Sociological Review 38 (April, 1973) 242-258.

Riley, Matilda White, Marilyn Johnson and Anne Foner. Aging and Society, Vol. III: A Sociology of Age Stratification. New York: Russell Sage Foundation, 1972.

Ryder, Norman B. "Notes on the concept of a population." The American Journal of Sociology 59 (March, 1964) 447-463. Reprinted in Riley, et. al., 1972.

______. "The cohort as a concept in the study of social change." American Sociological Review 30 (December, 1965) 843-861.

______. "Cohort analysis." The International Encyclopedia of the Social Sciences. Vol. 2. New York: The Macmillan Company and the Free Press, 1968. 546-550.

Tukey, J. W. Exploratory Data Analysis. Reading, Mass.: Addison-Wesley, 1977 (Limited preliminary edition, 1970).


Table 1. Percent of White Females in the Labor Force by Age and Cohort, 1940 to 1970. (Cohorts identified by year in which members were 20-44.)

| Cohort | Age 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | 56.4 | | | | | | | | |
| 1965 | | 55.9 | | | | | | | |
| 1960 | 44.8 | | 43.7 | | | | | | |
| 1955 | | 33.5 | | 42.1 | | | | | |
| 1950 | 43.6 | | 33.5 | | 49.0 | | | | |
| 1945 | | 31.3 | | 38.5 | | 52.2 | | | |
| 1940 | 45.7 | | 29.1 | | 43.9 | | 51.5 | | |
| 1935 | | 34.2 | | 32.1 | | 46.4 | | 47.1 | |
| 1930 | | | 29.1 | | 34.9 | | 45.1 | | 35.9 |
| 1925 | | | | 26.1 | | 33.6 | | 39.1 | |
| 1920 | | | | | 24.0 | | 29.8 | | 29.0 |
| 1915 | | | | | | 21.9 | | 25.2 | |
| 1910 | | | | | | | 19.8 | | 20.0 |
| 1905 | | | | | | | | 17.4 | |
| 1900 | | | | | | | | | 13.9 |

Table 2. Age Effects by Age and Cohort for Labor Force Participation of White Females, 1940 to 1970. (Age effect is the percentage points change in labor force participation per year increase in age.)

| Cohort | Age 22.5 | 27.5 | 32.5 | 32.5 | 42.5 | 47.5 | 52.5 | 57.5 | 62.5 |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | .02 | | | | | | | | |
| 1965 | - .42 | .17 | | | | | | | |
| 1960 | - .94 | .06 | .74 | | | | | | |
| 1955 | -1.53 | -.16 | .78 | 1.31 | | | | | |
| 1950 | -2.21 | -.50 | .71 | 1.40 | 1.58 | | | | |
| 1945 | -2.97 | -.94 | .50 | 1.37 | 1.64 | 1.34 | | | |
| 1940 | -3.81 | -1.50 | .18 | 1.21 | 1.61 | 1.37 | .49 | | |
| 1935 | | -2.16 | -.27 | .94 | 1.48 | 1.34 | .52 | -.97 | |
| 1930 | | | -.85 | .55 | 1.24 | 1.24 | .55 | -.85 | -2.94 |
| 1925 | | | | .03 | .91 | 1.09 | .57 | -.66 | -2.58 |
| 1920 | | | | | .48 | .87 | .58 | -.40 | -2.06 |
| 1915 | | | | | | .59 | .59 | -.07 | -1.38 |
| 1010 | | | | | | | .59 | .32 | - .55 |
| 1905 | | | | | | | | .78 | .44 |
| 1900 | | | | | | | | | 1.59 |

Table 3. Estimated Ages of Minimum and Maximum Labor Force Participation Between Ages 22 and 65 for White Female Cohorts, and Percent in Labor Force at those Points for the Period 1940-1970

| Year | Minimum point Age | Minimum point Percent | Maximum point Age | Maximum point Percent |
|---|---|---|---|---|
| 1940 | 37.0 | 26.7 | | |
| 1945 | 33.8 | 28.3 | | |
| 1950 | 31.5 | 29.9 | 56.8 | 28.5 |
| 1955 | 29.8 | 32.4 | 55.5 | 36.2 |
| 1960 | 28.2 | 37.1 | 54.8 | 42.6 |
| 1965 | 26.8 | 44.5 | 54.5 | 47.8 |
| 1970 | 25.4 | 53.5 | 54.4 | 52.2 |

Note: The maxima and minima are for cohorts, not for years. The cohort of white females that entered the labor force about 1916 reached maximum labor force participation at age 56.8 in 1950, their maximum being lower than the minimum labor force participation of the cohort that entered the labor force about 1941 and reached a minimum at age 31.5 in 1950.

Tables 4-6 are available from author: Dept. of Sociology, University of Texas, Austin, Tx. 78712.