aged x were born x years ago when the population was smaller than it is now in the ratio e^{-rx}, so the number that would be counted as of age x would be proportional to the survivors from one birth times e^{-rx}. On a radix of one birth in each region the stable multi-group population would show the age and region distribution $e^{-rx}l(x)$; on a basis of q_i births in the ith region it would show

$$e^{-rx}l(x)\mathbf{Q}, \tag{17.6.1}$$

where $\mathbf{Q}$ is the diagonal matrix containing the q_i. The jth element of the ith row of $e^{-rx}l(x)\mathbf{Q}$ is $e^{-rx}l_{ij}(x)q_j$, which is the number of persons of age x out of the q_j born in the jth region that will be found at stability in the ith region. The $\mathbf{Q}$ is the multi-region analogue of the stable equivalent (Keyfitz 1968; see Chapter 8).

Such a model mimics observed populations with a closeness that depends on how nearly constant is the regime of mortality and fertility to which they have been subject. The model tells the implication of present rates—what the outcome will be if they continue unchanged for two or three generations. It tells, for example, where the Northeast would stand with respect to the rest of the United States if the age-specific rates of 1967–72 continued to prevail.

Formulae of this chapter have been applied to census and vital records that profess to cover the whole population. Another way of saying this is that the errors of such data are not of a random nature, and so the guarantees of accuracy that probability sampling can offer are not available for them.

Demographers increasingly gather their own data by sample survey methods. The results of such enquiries are usually tabulated in extensive cross-classifications, and bring the authors face to face with difficult questions of statistical significance. The pioneer on searching through contingency tables to find what conclusions can properly be drawn from them is Leo A. Goodman, whose log-linear methods are now widely used; for presentations relevant to our applications, see Bishop et al. (1975) and Fingleton (1984), for applications to the problem of choosing demographic state variables see Caswell (1988a, MPM Chapter 3).

18
Family Demography

For most purposes of population study there is no need to consider any unit intermediate between the individual and the larger group consisting of all the individuals included within some area—state, province, county, or nation. Recognizing only two units, population and individual, permits the construction of models that are readily expounded and understood. Demographers, following in the footsteps of Lotka and other predecessors, have worked hard to simplify this much-too-complex material.

The choice of unit for demographic (as for any other) analysis depends on the problem to be solved. For forecasts of total population, of the future labor force, or of the pension burden, it has seemed sufficient to work with the individual, and often without characterizing each individual beyond age and sex. One supposes that individuals give rise to other individuals over the course of time in a renewal process, irrespective of marriage or co-residence; individuals are discrete from birth; they live their separate lives, reproduce, and die.

For some purposes the recognition of an intermediate unit is unavoidable. Individual demography can tell us little about how the population fits into the housing stock; it can tell nothing about the kin networks among which mutual aid and protection take place. It falls short of explaining fertility change, insofar as the couple rather than the individual is the decision-making unit. Children are not born to couples independently at random, but couples take account of the number of children already born to them and of other aspects of their family situation at any given moment. When family constitution was stable it attracted less attention from scholars and lay people. Enormous changes in family and residential arrangements since World War II have aroused the current interest in family demography.

18.1 Definitions

This chapter concerns three kinds of unit intermediate between the individual and the population: the kin group, the residential family, and the household. The kin group are parents and children, siblings, nephews, nieces and cousins, irrespective of where they are living. The family, for census purposes, is not the totality of relatives but only those that live together in a given household or dwelling. This is the convenient unit of census enumeration—since the members know one another, the census information on all can be obtained from whoever answers the door when the enumerator calls. The members of the kin groups recognized by the census taker are in the first place the nuclear family—husband, wife, and children—and then the resident extended family that includes parents and in-laws of the husband or wife. The household is the persons living in a given residential unit, however that may be defined—by separate entrance from the street (i.e., without the need to pass through the premises of some other household), or full complement of cooking, washing, and other facilities. It is not easy to apply such definitions across cultures; those cultures in which privacy is important are likely to have more stringent physical requirements for a living space to be considered a separate household than those in which less privacy is desired or can be afforded.

Thus the unit for the analysis with which this chapter deals can be:

1. The kin group, irrespective of its living arrangement, and however dispersed. In demographic (though not in genealogical) work the data are confined to living members. As among kin groups one can recognize: (i) the nuclear family, consisting of father, mother, and children; (ii) the stem family, including ancestors in direct line and children of all generations; (iii) the extended family that includes all generations and all collaterals. Individuals belong in general to more than one family; even on the narrowest definition, individuals are usually members of a family of orientation, into which they are born, and a family of procreation, where they in their turn become parents.

2. The residential group, people living in a household, which is to say, sharing kitchen, bathroom, and other facilities, whether or not they are related.

3. Those members of a family that live in a given household. This cross between the kin group and the residential group is the natural object of census inquiries, and it is widely enumerated and tabulated. But it omits much; the common case where a couple have parents living in an adjacent apartment is unrecognized; for many purposes propinquity is important and makes for what is in some respects a joint family, not captured by censuses.

18.1.1 Classifications

The problems of family demography do not end with the definition of the unit, but go on with the classification of types of that unit, whatever it may be. For the residential family, i.e., kin members within a household, the classifications used by censuses are many. The problem is to recognize the main forms of co-residence without multiplying excessively the number of types.

One summary solution is to classify by generations. Such a summary has been used by the Chinese census of 1982 and elsewhere. Comparing the Chinese material with that for Canada 1981, we find that one-person families were 20.3 percent of the whole in Canada, against 7.9 percent in China; one couple with no others, 22 percent in Canada against 4.8 percent in China. In both countries the biggest group was two generations (typically a couple and their children with no others) numbering 47.4 percent of the whole in Canada, 64.8 percent in China. Three or more generations, without unrelated members were 2.3 percent in Canada, 17.2 percent in China which accords with the common stereotype.

Trends over time are substantial and unidirectional. The United States proportion of one-person households was 13.3 percent in 1960, 17.5 percent in 1970. Three or more generations, with or without unrelated members, dropped from 4.7 percent to 3.5 percent in the United States in the course of the 1960s. Over longer periods the differences are dramatic; one-person households were 4 percent of the whole in 1790 and 23 percent in 1980.

One can speculate on the effect of China's new marriage law; will requiring children to look after their elderly parents prevent China from following the evolution of the West toward separate living for old people?

Another equally simple classification is given in the Canadian census of 1981. Five categories in all are recognized, and these are tabulated by age of wife and other characteristics. Thus we have

Husband-wife, no children	851,000
Husband-wife with children	3,267,000
Husband-wife, empty nest	968,000
Male lone parent	83,000
Female lone parent	464,000

out of a total of 5,632,000 families renting or owning their dwellings. By using the distribution of these by age of wife it is possible to see in cross-section the various stages in the family life cycle (*Canadian Statistical Review*, September 1984, p. viii).

Once the unit intermediate between the individual and the population is defined and enumerated in a census, so that classified counts are available of the number of households and the number of persons in individual households, tabulations can be made of the distribution of units by type (husband and wife and children, widow with child, etc.) according to census characteristics of individuals (occupation, earnings of senior member) and of the dwellings that contain them (number of rooms, rent paid).

Beyond these static qualities at the time of the census are family history materials, portraying longitudinally how individuals circulate through families over time—arrival of children, their departure 20 or so years later, the deaths of successive family members. Analysis of typical family histories and the way a family is transformed from one type to another, i.e., following the family through its event history, is the object of extensive modelling and simulation that will be discussed below. Comparative study between countries and cultures, as well as between historical epochs, is an important part of family history.

18.1.2 *Theory and Statistical Compilation*

The Italian statistician Barberi complained about the shortage of statistical data on the family, attributing it to the lack of theoretical study of the family as such (*in quanto tale*) as against its individual components (Barberi 1972). A statistical agency could not usefully collect data on an entity whose essential features had not been brought out by theoretical analysis.

On the other hand, the United Nations (1963) says the opposite—that the lack of theory is due to the lack of statistical information: "The paucity of demographic studies of families and households is due largely to the lack of pertinent census and survey data."

This is the classical problem of the direction of causation that dogs all social science. Both contentions are right. Theory and data influence each other reciprocally, and the absence of one is a handicap to the other. But an underlying factor operates to hamper both—as John Bongaarts (1983) tells us, the complexity of the subject makes it difficult both to gather data and to develop rational understanding.

Thus at the meta-level of the discussion of family demography, i.e., before we get into the subject proper, there lies a problem: does A cause B (Barberi), does B cause A (United Nations), or are both A and B caused by C (Bongaarts)?

18.2 Kinship

To see the effect of the flows of mortality, fertility, and divorce on kinship we need not census-type data but a model in which cross-sectional numbers of various kin are expressed in terms of those flows. A number of such models are given in Chapter 15 above; others in Goodman, Keyfitz, and Pullum (1974).

All of these formulae assume independence in the births. It requires a simulation experiment to find how the results must be modified to recognize nonindependence, in particular to impose the condition that after a birth at least 9 months (in practice usually much longer) must elapse before there can be another birth. Recently Le Bras (1984) has carried out such experiments and found that the average number of kin do not come out very differently with the recognition of dependence between successive births. Experimenting to ascertain distributions remains to be done; the microsimulation (or individual-based model) approach discussed in Section 15.9 is available for this.

One can start from the viewpoint of the parents as above and see how many children they would have alive (for example, after age 65) at given rates of mortality and fertility, or alternatively one can start with the children, and see how many would come into pension still having parents who are on pension. We saw (Section 15.1) that the probability that a woman aged α has a living mother is given by first considering the probability conditional on the child having been born at age x of the mother, in which case the chance that the mother is alive is $l(x+\alpha)/l(x)$, and then taking out the condition by averaging this quantity over all the ages of childbearing. The expression for the number of persons who have a living father is identical, provided we make the definitional modification that ages are measured from the time of conception (when we know that the father was alive) rather than from birth, say ages x^* and α^*, where $x^* \approx x + \frac{3}{4}$, etc. Hence the probability that a person aged α has a living father and mother is

$$M_1(\alpha)M_1^*(\alpha^*), \tag{18.2.1}$$

where we suppose that father's and mother's mortality are independent.

We want to translate these probabilities for individuals into a number for the population. Suppose that the age distribution of the female population is $p(\alpha)\,d\alpha$ and of the male population is $p^*(\alpha^*)$, where $\int_0^\omega p(\alpha)\,d\alpha$ is the total female population, etc.

Then the number of individuals, say over 65, who have a living mother and father is

$$\int_{65}^{\omega}\int_{65}^{\omega} M_1(\alpha)M_1^*(\alpha^*)\left[p(\alpha)+p^*(\alpha^*)\right]\,d\alpha\,d\alpha^*. \tag{18.2.2}$$

As with other formulae, the use of these is not to estimate the number of persons in the population with living mother and father (which can be done much better by a census or survey) but to find how that number varies with the mortality schedule, when all other variables are constant.

18.2.1 Inference from Kin Counts

One of the uses of expressions for the number of kin is what may be called backward inference, going not from the flow inputs—birth rates, etc.—to the number of kin, but from the numbers of kin as counted to the birth and other rates. Goldman (1978) showed how kin expressions for the number of sisters could be used to calculate the rate of increase of a population. She equates the observed ratio of younger to older sisters to the theoretical rates.

Suppose that we have a survey, such as an anthropologist might make, in which women are asked how many older and how many younger sisters were ever born to their mother, and the ratio of younger to older designated Z. The ratio of expressions such as those of Section 15.3 above can be equated to the observed Z and the unknown r, the rate of increase, calculated. An exact solution to the equation may be found by one iterative process or another, or else one may resort to approximations.

McDaniel and Hammel (1984) extended the idea to instances where one enquires not on the number ever born, but only whether the respondent is the first- or the last-born of her sorority or sibset. This is even easier for the respondent to recall. The ratio S of those who are youngest to those who are oldest provides an estimate of the rate of increase r whose sampling error is slightly greater than r obtained from Goldman's Z but is less subject to reporting error. It is hard to think of a survey question less demanding than whether the respondent is the eldest child, the youngest child, or somewhere between.

18.2.2 Widowhood

A couple are married at age x of the groom and age y of the bride; after t years the probability that both husband and wife are still alive is $l^*(x+t) \times l(y+t)/l^*(x)l(y)$, where $l^*(x)$ is the probability of surviving to age x from birth for a male, and $l(y)$ to age y for a female; we will throughout distinguish the male life table with an asterisk. The expected future lifetime together of the couple is the integral of this over t.

We can generalize by making x and y the ages of the couple at any time subsequent to marriage without needing to change the expression. Thus when either member has attained age 65 the expected future number of years together is given by the formula

$$\overset{\circ}{e}_{xy} = \int_0^\infty \frac{l^*(x+t)}{l^*(x)} \frac{l(y+t)}{l(y)}\, dt, \tag{18.2.3}$$

where now x and y are the ages of husband and wife at the given later point in their lives.

The probability that the wife will die first is

$$\int_0^\infty \frac{l^*(x+t)}{l^*(x)} \frac{l(y+t)\mu(y+t)}{l(y)}\, dt \tag{18.2.4}$$

and that the husband will die first is the same, but with $\mu^*(x+t)$ replacing $\mu(y+t)$. The sum of these is readily shown to be equal to unity in the same way that $\int_0^\infty l(y+t)\mu(y)\,dy/l(y)$ is unity. Continuing we can find the number of years of widowhood as the expected number of years a woman will live, $\overset{\circ}{e}_y$, less the number of years in the marriage, $\overset{\circ}{e}_{xy}$, that is $\overset{\circ}{e}_y - \overset{\circ}{e}_{xy}$, and of widowerhood similarly $\overset{\circ}{e}{}^*_x - \overset{\circ}{e}{}^*_{xy}$, assuming no remarriage.

Applying such formulae to the United States from 1950 to 1980 Goldman (1983) explains a large part of the observed increase in the number of widows as compared with widowers: with current life tables and ages at marriage the theoretical probability of a wife outliving her husband is about 70 percent. To bring the probability down to 50 percent would require that brides be about 7 years older than grooms. The 70 percent probability of the wife outliving her husband translates into an expected three to one ratio of widows to widowers in the population—partly due to the widow living longer after the dissolution of the marriage by death than does the widower, partly to higher remarriage rates for males.

But many marriages are dissolved otherwise than by death. It is not wholly realistic to neglect divorce, separation, and annulment. If we know the rate at which these occur we can assimilate it into the preceding formulae by adding it to the death rates of the partners. Call $\delta(t)$ the rate of dissolution otherwise than by death at t years after the marriage (or more generally t years after the couple are aged x and y, respectively). The probability of the marriage holding out to time t and then breaking up in the interval $(t, t+dt)$ is

$$\exp\left[-\int_0^t \delta(\tau)\, d\tau\right] \delta(t)\, dt \tag{18.2.5}$$

if we abstract from mortality. Including mortality requires entering this last expression in the preceding integrals. Thus the probability of the marriage dissolving at time t either by death of the male partner or divorce is

$$\frac{l^*(x+t)}{l(x)} \frac{l(y+t)}{l(y)} \exp\left[-\int_0^t \delta(\tau)\, d\tau\right] \left[\mu^*(x+t) + \delta(t)\right] dt. \tag{18.2.6}$$

18.2.3 Theoretical Number of Families in the Population

For the number of families and their ratio to the population, as expressed by the headship rate, a different approach is available. Suppose that we define any woman above a certain age who does not have a living mother to be the head of a household. The problem of finding the number of households in the country is then reduced to finding the number of women whose mother has died.

To derive this we started (Chapter 15) with the (conditional) probability $l(y+\alpha)/l(y)$ that a woman now aged α who was born at age y of her mother has a living mother. To remove the condition we averaged over all ages of childbearing, i.e., weighted by $e^{-ry}l(y)m(y)$, to find

$$M_1(\alpha) = \int_a^b \frac{l(y+\alpha)}{l(y)} e^{-ry} l(y)m(y)\, dy. \tag{18.2.7}$$

In terms of $M_1(\alpha)$ the fraction of women aged α who are heads of families must be

$$1 - M_1(\alpha) \tag{18.2.8}$$

and the total number of families is this weighted by the age distribution $p(\alpha)\, d\alpha$:

$$\int_a^\infty [1 - M_1(\alpha)]\, p(\alpha)\, d\alpha, \tag{18.2.9}$$

where a is some suitable minimum age.

The formulae are exact, but the model on which they are based is not as realistic as might be wished. Note that considerable departure from realism in these and other formulae need not vitiate conclusions drawn from them by sensitivity analysis. They are primarily used to find how much difference it makes to family constitution of mortality declines by 100δ percent, or fertility rises by 100ε percent.

18.2.4 Decomposing Widowhood

Widowhood and widowerhood are not mere consequences of improved longevity alone, but depend on the profiles of age-specific death rates of men and women. That a population has high or low mortality does not as such imply anything about widowhood.

If the peaking of the male curve is earlier than the peaking of the female curve then this by itself will result in many widows and relatively few widowers. But another factor is dispersion around the peak. Wide dispersion will produce many widows and widowers, even abstracting from the sex differential, i.e., if the peaks of mortality for men and women coincide. With little dispersion about the peaks, and peaks coinciding, then there will be few widows and widowers in the population. The model built on formula 18.2.4 will permit more precise statements than these, and they can be verified on the increment–decrement model of Chapter 17.

Calculations of the probability of widowhood that suppose a uniform age of marriage for men and another for women, i.e., that omit variability in marriage ages, will underestimate the amount of widowhood and widowerhood. The underestimate disappears if the age of marriage of men and women is the same and men and women all die at the same age, in which case there would be no widows or widowers. Allowing variation in the age of marriage for men and for women would make some widows and some widowers in the model. Thus one of the components of the amount of widowhood is variability in the age of marriage (a) for men and (b) for women. If the probability of dying varies among individual males of a given age, that will add what may be called a frailty component to widowhood.

The general supposition, then, is that the number of survivors at any given moment of marriages broken by death does not depend much on whether overall mortality is high or low, but on the difference between male and female mortality, and the breadth or narrowness of spread of both the male and female curves. This suggests a decomposition in which widows and widowers may be attributed to:

(1) Unequal average ages at marriage of men and women.

(2) Variations around that mean age for each of men and women.

(3) Unequal average mortality for men and women.

(4) Variation around that mortality for men and women, on the usual life table supposition that everyone in the population has the same chance of dying at any given age, but ages differ.

(5) Variation in frailty—i.e., probability of dying—of individuals of each sex about the average.

Each of these represents a certain kind of heterogeneity. For example, (2) is heterogeneity in ages at which individuals marry, and (5) is heterogeneity around the mean mortality of the person's sex at given age, unmeasurable for an individual but very real nonetheless. The full decomposition may be carried out by microsimulation.

18.3 The Life Cycle

The family, whether of kin or of residence, changes over the course of time. If one starts with a couple that have just married, then follows through as they have their children and as the children grow, one sees the residential family expanding over time to a certain maximum, perhaps 5 to 20 years after marriage in contemporary America, after which the children leave home, and the family shrinks back to the original couple, and sooner or later to only one of them. To compare two populations in regard to residential family size in effect averages much disparate material; what one should be comparing is the family sizes of the two populations at given stages as they go through this evolution.

Paul Glick, a pioneer in this field, made the first serious effort to trace the family life cycle statistically. His initial work analyzed cross-sectional census data; he compared family sizes at different ages of head. Subsequent work compared real cohorts; Table 18.1 gives an example.

The family life cycle is important in the study of migration. A high proportion of moves are associated with the beginning of working life, with marriage, and with retirement (Rogers 1984). A population in which there is a high proportion of young people will, other things being equal, have more movers than one in which there are many middle-aged. Those in which there are many retired persons who have made their move from the place of work to the place to which they retire will again have few movers. Movement is considerable for couples that have not had, or have just had, a child, and less for those with school-age children (Burch 1984, p. 182).

Life cycle theory has been developed in economics to allow for the fact that persons have some time-related options in regard to expenditures; within some limits they can advance or delay their purchases, and one can suppose they time their expenditures so as to maximize total satisfaction, which means to equalize marginal satisfaction at the various junctures of the life cycle. Such equalization must be subject to a personal discount rate. The distribution of expenses over time cannot be understood except in terms of the formation of a family and later its dissolution. When marrying and setting up a home people often dissave, buying on installment or borrowing in some other way until they have the "standard package"; only after that do their savings turn positive. The life cycle can be studied by demographic models with many states, either directly from a life cycle graph as in Chapters 3 and 7, or beginning with the multi-state life table as presented in Chapter 17.

18.3.1 Shape of Family Tree

As birth and death rates decline, the living kin group becomes elongated; in each generation there are fewer members, but more generations coexist (Glick 1977, 1979). The old person has fewer children and each of these has fewer children, but the chain extends further down—even to great grandchildren. To how many generations the chain extends depends on age at marriage and childbearing as well as on longevity.

Table 18.1. Comparison of live cycles of two cohorts, showing median ages of mother*

	First marriage about	
Median age of mother at	1905	1975
First marriage	21.4	21.2
Birth of first child	23.0	22.7
Birth of last child	32.9	29.6
Marriage of last child	55.4	52.3
Death of one spouse	57.0	65.2

**Source*: Paul Glick (1977).

The concept of a family cycle was early presented by Glick (1955, 1977). Riley et al. (1983) discuss the number of contemporary generations in an extended family with present longevity as against earlier high mortality. Probability of orphanhood, number of siblings, probability of three, or even four, successive generations alive at the same time, are all of importance and trends in them in relation to the trends in mortality and fertility need study. The elongation of the chain can be traced using expressions such as those of Chapter 15 above, developed in Goodman, Keyfitz, and Pullum (1974). The problem will be to remove some of the restrictive assumptions, or where this is impossible to estimate their effect on the results.

18.3.2 Headship

Brass (1983) has developed a useful way of tracing the effects of birth, death, marriage, and divorce. In the real world these are indeed proximate determinants; in the analysis they are inputs to the representation of family formation and dissolution. Brass's approximations show that at the low levels of mortality now attained it is age at marriage and fertility that count most for resident family size, with divorce becoming important in some circumstances.

Brass's way of doing family demography is to select a "marker" and to suppose a certain rate at which others attach themselves to this marker. One can imagine a girl child as a marker, first being born, sooner or later getting married—i.e., having a spouse attached—then having a child, then another child, then becoming divorced. Alternatively, one could start the process with a male marker and proceed similarly to the construction and ultimately the dissolution of the family unit.

That theory helps relate the resident family to various demographic factors (Burch 1979, Burch et al. 1983, Bongaarts 1983). In one application of this theory Brass ascertained the direct influence of fertility: a 10 percent increase in fertility results in a 4 to 6 percent increase in the size of the resident family. Using females as the markers for determining the advent of new resident families, it turns out that an increase of 1 year in the average age at which females leave home raises the family size by about $2\frac{1}{2}$ to 5 percent for a fixed level of fertility.

18.4 Household Size Distribution

The enormous differences in the size distribution of households are shown by the successive censuses (Table 18.2, provided by the Population Ref-

Table 18.2. Household size: 1790–1980
(Percentage distribution of households by number of persons)

Number of persons	1790	1900	1930	1940	1950	1960	1970	1980
Total	100	100	100	100	100	100	100	100
One	4	5	8	7	11	13	17	23
Two	8	15	23	25	29	28	29	31
Three	11	18	21	22	22	19	17	17
Four	14	17	18	18	18	18	16	15
Five	14	14	12	12	10	11	10	8
Six or more	49	31	18	16	10	11	11	6
Average persons per household	5.79	4.76	4.11	3.67	3.37	3.33	3.14	2.75

Sources: Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Part 1 (Washington, DC: U.S. Government Printing Office, 1975) Series A291 and A335–349, p. 42, and "Provisional Estimates of Social, Economic and Housing Characteristics," *1980 Census of Population and Housing, Supplementary Report* (Washington, DC: U.S. Government Printing Office, 1982) Table P-1, p. 3.

erence Bureau). In 1790 just 4 percent of all households consisted of one person; in 1980, 23 percent were one-person households. In 1790, 49 percent of households consisted of six or more persons; in 1980, only 6 percent had six or more persons. During that time the average number of persons went down from 5.79 to 2.75. The trend to separate living was not uniform over the period, but seems to have been accelerating, with far more change from 1960 to 1980 than over the entire first century after the founding of this country.

18.4.1 Separate Living

The liberation to which our age testifies so amply has roots that go back to the Enlightenment, in ideas of individual worth, as Lesthaege points out (1983, cited in Burch 1984), and built into this is the liberation from the need to live with others. Pampel (1983) attempts to find to what degree the living alone that we observe can be explained by compositional variables, including age, income, etc. If the increase is fully accounted for by the fact that there are more old people, that incomes are higher, etc., then we do not need to search further. However, he finds that these compositional variables go only part of the way to explaining the observed increase in living alone.

Various writers have found that factors associated with modernization are associated with living alone. Correlations are positive between living alone and income or education and negative between living alone and fertility. Some of this could be due to intermediate variables—if fertility is lower for the better off, then they are more likely to live alone because they

have fewer kin. (The effect is opposite to that in many nonwestern societies, where the joint family represents an upper-class way of living: the family property is what holds a large number of individuals in one household. The propertyless more often separate into nuclear families.)

The American positive association of living alone with income seems to imply that the better off are more isolated. But this is hardly in accord with many kinds of evidence that the better off are more likely to participate in social activities of all kinds, that they have more extensive kin and friendship networks. One can believe, however, that relatives are a larger fraction of the total social contacts of the poor than of the well off.

The components of the rise in separate living since World War II are multiple. Young people leave the parental home earlier, setting up separate households without either marrying or going to college. Retired people more and more live by themselves instead of with their married children. Divorce has increased, and both members of the former couple do not always remarry.

Underlying this is another level of causation, of which the literature stresses three elements.

(a) People have always wanted the privacy and independence of separate living, but only now have incomes risen enough to support it. This applies especially to the old, who have been aided by the growth of private pensions and social security.

(b) The simple absence of kin. With smaller birth rates there are fewer relatives in every generation, so a widow is less likely to have a child with whom she can live. What may be thought of as a narrowing of the genealogical tree must be a part of any explanation.

(c) Changed preferences. There has been a major change in the culture, of which one manifestation is the greater value set on privacy. This explanation has no value without an independent measure of it. Without such a measure the expression "wish for privacy" is just another name for separate living, and we are no further ahead.

Burch (1984) does better than simply telling us that there has been a cultural change; he argues that there has been a change in age and sex roles. With women's liberation and increasing freedom for children has come a situation where the members of the household are more or less autonomous, and all tend to resemble one another in their skills and activities. There is thus less room for a division of labor among them. That means less differentiation and so less of the solidarity that comes from the division of labor among differentiated individuals in the social as in the biological world, and consequently less to be gained from living together.

On the other side, "The young, the old, women, the unmarried, servants, boarders—all have been accorded more nearly equal 'rights' to various household goods previously reserved to the patriarch or breadwinner." This in effect makes the household more "crowded" in the sense that there is more competition for scarce, space-related goods. It is as though the democratization of the family has deprived members of the super- and subordinate niches that each formerly occupied. Thus on the one side adult numbers compete with one another for the scarce good of space, and on the other have little dependence on one another, so they might as well live separately.

18.5 Economic, Political, and Biological Theory

The economic theory of the family has been developed by Gary Becker (1991). Women have a comparative advantage in work in the home because it is they who have to bear and raise the children in any case, and while they are at home doing this they may as well also do the housework. Women need marriage to protect themselves against being abandoned with children whom they would not have the means to support. Within the family a degree of altruism exists: each person's utility function depends positively on the utility of others, and the family as a whole can be thought of as having a collective utility function.

Very different is a political theory of the family by which there is indeed a division of labor, but it is determined by the power and solidarity of labor, and not in altruism, but in their having no choice. In exchange for protection for life they were sheltered from (or kept out of) the world. Traditional societies could impose an acceptance of this breadwinner–homemaker family by suitable indoctrination of girls from earliest ages. Kingsley Davis has developed this realistic perspective in unpublished work.

A game theory model due to Luce and Raiffa (1957) offers a very persuasive explanation of past and present changes. In what they call the Battle of the Sexes there are two players, A and B. A, the husband, favors activity I and B, the wife, activity II. That alone would cause them to separate, except that both prefer activities in common. For A the utility of I is a, and this is greater than the utility b of II, which in turn is greater than c, the utility of the couple breaking up. Similarly, with primes, for B, except that for B the utility of I is b' and of II is a', with $a' > b'$. That is to say, A wants to do I and B wants to do II. For the marriage to be stable c, the utility for A of breaking up the marriage must be less than a or b, and similarly with primes for B. With this condition the solutions are both doing I or both doing II. The model admits two ways in which these can be arrived at: by altruism or by imposition. The outcome depends on which player is more anxious to avoid separation; until women worked separation could have been disastrous for the wife, indifferent for the husband. The observer is hard put to distinguish between the effect of altruism and the effect of power; the Luce–Raiffa model is convincing because it accepts both possibilities.

The utilities in the Luce and Raiffa payoff matrix are

		(A) Husband's choice I	(A) Husband's choice II	
(B) Wife's choice	I	a, b'	c, c'	$a > b > c,$
	II	c, c'	b, a'	$a' > b' > c'.$

(18.5.1)

If $a' > b' > c'$, and $c' > c$ then the man has power. If c and c' are more nearly equal, then the sexes are more equal and the woman has a chance of attaining her goal. The model applies to a matter as trivial as going out to dinner versus staying home, as well as to the most solemn decisions that married couples make.

The implications of a utilitarian or contractual relation have been worked out in a tradition of thought about the family that runs through Durkheim, Schumpeter (1950, p. 157), and more recently William Goode. Thus Schumpeter in a characteristically farsighted phrase speaks of "the heavy personal sacrifices that family ties and especially parenthood entail under modern conditions," and Goode, "If larger part of one's life benefits are to be derived from job holding, in a social setting where emotional relations can be fleeting and superficial without incurring social disapproval, then it seems likely that future investments in the family ... may be lessened" (p. 79, in *Toqueville Review*). The stability of the family was all along based on the division of labor within it, but this could only be maintained with a concentration of authority, almost invariably in the male. Such a view, with its pessimistic conclusions, is supported by statistics of divorce, of later marriage, of nonmarriage, of increasing illegitimacy.

More upbeat is the argument that democracy within the family of course changes its nature, and of course no one can deny that divorce has increased, but the fact is that most people still marry, and the usual purpose of divorce is to escape one marriage in order to engage in another. It is almost as though the very concern about the quality of marriage and family life is what leads to divorce and trying again. No empirical evidence is likely to disprove this.

18.6 Family Policy

One test of theories of the family is whether policies based on such theories work. There has been a good deal of such testing in the United States by policy analysis and supplementation in recent years, especially in the field of welfare, and the results are not encouraging (Glazer 1984): "A program meant to reduce the distress of widows and unmarried mothers and their children, and designed to maintain them at a minimal but decent level, seemed to be accompanied by a rising number of such women. Welfare assistance was an incentive for mothers to push fathers out of the home."

The hope had been that mothers and children would have husbands and fathers, and that with the support of unemployment insurance, old-age pensions, and full-employment policies the family would be held together, with the husband-father the principal wage earner and Aid to Families with Dependent Children (AFDC) a transitory necessity only. But in fact AFDC became a program for mothers of illegitimate children, and the number of these increased rapidly, with half of the number being black.

If that incentive system was wrong, then could not ingenuity devise a better one? Just as the income tax does not deprive people of the incentive to work, so support should not prevent them from working, provided they were able to keep some fraction—say half—of their earnings. This application of the income tax principle did operate as theory said it should, but it too had a perverse effect: in repeated trials it raised the divorce rate. Evidently the grant made wives independent and a larger number of couples took advantage of this to separate or divorce. The Negative Income Tax could maintain the incentive to work, but only at the cost of increasing divorce (Hannan et al. 1977).

An example of the perverse way in which policy measures can operate is shown by the Swedish experience. In the postwar period Sweden experienced a labor shortage, and its response was various measures to encourage women to enter the labor force. The measures were successful. As among women with children, 44.6 percent were in the labor force in 1965 and 69.0 percent in 1975. But the longer-run effect was delay of childbearing and a lower birth rate. As the resultant small cohorts reach maturity the entrants into the labor force will diminish.

Thus measures to increase the labor force that were successful in the short run can have the effect of diminishing the labor force in the longer run.

Boudon (1977) gives other examples of the perversity of social life in the face of measures to influence it. More specifically in relation to our field, Henripin (1977) shows how difficult it is to alter demographic trends. Yet in certain less-developed countries genuine examples of the success of the policy are apparently to be found.

19

Heterogeneity and Selection in Population Analysis

Heterogeneity in the underlying population places difficulties in the way of interpretation of all statistical data based on averages. No two persons are equally likely to die in the next year; no two marriages are equally likely to be broken up by divorce; no two businesses are equally likely to fail; no two automobiles are equally likely to break down. That on the average a given make of automobile will travel 50,000 miles without major repairs offers little assurance for any particular automobile. Averages can be applied to individual cases only at great risk. This gross aspect of heterogeneity is *not* the subject of the present chapter.

People vary in respect of age, and mortality comparisons between populations have attempted to take account of age at least since the time of John Graunt. More recently, matrix and multi-state methods have made it straightforward to incorporate measurable sources of heterogeneity other than, or in addition to, age. Nothing more need be said here beyond the customary exhortation to break down aggregates into homogeneous subgroups for purposes of analysis.

But what about differences among individuals not ordinarily tabulated in mortality statistics? Mr. A has a heart murmur, or is a heavy drinker, and these affect his chances of survival. Beyond such differences, that could be distinguished in the data collection but are usually neglected, are differences that could not possibly be described. One cannot provide examples of the indescribable, but one can be certain that two individuals, even though alike in every possible statistical categorization, do not have identical probabilities of dying in the next year.