Tables of Working Life: The Increment-Decrement Model

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Preface

Tables of working life are a popular statistical tool by which to summarize current patterns of labor force attachment. This bulletin discusses worklife methodology, introducing the "increment-decrement" technique recently adopted by the Bureau of Labor Statistics. New tables of working life for men and women for 1977 are presented together with revised estimates for 1970. Increment-decrement and conventional models are compared, and differences in findings are discussed.

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Chapter 1. The Worklife Expectancy of Men and Women

Working life tables summarize the long-term implications of present work patterns by modeling the lifetime experience of a hypothetical cohort which is assumed to "live through" the entire array of currently prevailing labor force rates. The experience of this synthetic cohort is used to determine how many years a person of a given age might expect to spend in the labor force, if participation patterns remained as they were in the reference year throughout his or her lifetime. In addition, the worklife model generates rates of labor force accession and separation, which describe patterns of mobility into and out of the labor market at each age.

The indexes generated by these tables have a broad range of applications. Labor analysts use the worklife expectancy index to compare degrees of labor force attachment between groups and over time, and to estimate the effects of various changes in behavior on lifetime work patterns. The index is also widely used in liability proceedings, as an indicator of work years lost and earnings foregone by individuals whose earning capacity has been reduced or impaired, or has been truncated by death or severe disability. Labor force mobility rates are frequently used to project replacement needs within occupations,[1] as well as to study patterns of labor turnover.

Recent changes in labor force behavior

The last set of working life tables published by the Bureau of Labor Statistics was based on the work patterns prevailing in 1970.[2] These patterns changed dramatically between 1970 and 1977, the year for which new tables are being presented (text table 1). The single most striking change during this period involved young women. The participation rate of women 25 to 34 rose by 14.5 percentage points in just 7 years. Men 60 to 64 experienced a drop in participation which was nearly as large, 12.1 percentage points. During this period, the entire age profile of participation for both sexes shifted. Young people (ages 16 to 24) became increasingly active. Older persons (55 and above) became less likely to work. The labor force attachment of men slackened somewhat in the prime ages and declined markedly above the age of 55. These participation changes contributed to a decline in the mean age of the male labor force.[3] Although the participation rates of women 55 and over were more stable than those of men, dramatic increases in the participation of women 16 to 54 had a similar effect on the age profile of the female labor force.

Text table 1. Civilian labor force participation rates by age and sex, annual averages, 1970 and 1977

Age group	Men			Women		
	1970	1977	Change 1970-77	1970	1977	Change 1970-77
16-19	56.1	61.0	4.9	44.0	51.4	7.4
20-24	83.3	85.7	2.4	57.7	66.5	8.8
25-34	96.4	95.4	-1.0	45.0	59.5	14.5
35-44	96.9	95.7	-1.2	51.1	59.6	8.5
45-54	94.2	91.2	-3.0	54.4	55.8	1.4
55-59	89.5	83.2	-6.3	49.0	48.0	-1.0
60-64	75.0	62.9	-12.1	36.1	32.9	-3.2
65 and over	26.8	20.1	-6.7	9.7	8.1	-1.6

Changes in worklife estimation procedures

The magnitude and character of these changes have rendered the 1970-based worklife estimates obsolete. Moreover, a careful reevaluation of the conventional worklife model has revealed some conceptual and technical deficiencies which have led to questionable estimates for certain population groups. For this reason, the staff of the Bureau of Labor Statistics has undertaken a study of alternative worklife estimation procedures. The new 1977-based working life tables for the United States are the result of one such alternative method, known as the "increment-decrement" or "multistate" life table model. It should be noted that these new estimates do not correspond directly with previously published figures. They reflect not only changes in the behavior of American adults, but also several fundamental changes in modeling procedures.

The increment-decrement model describes labor force attachment as a dynamic process. Members of the popu-

[1]These projections, produced by the Bureau of Labor Statistics, incorporate a single set of separation rates for each sex, irrespective of occupation. It may eventually be possible, using the worklife model introduced in this study, to prepare separate tables for various occupational clusters.

[2]Howard N. Fullerton, Jr., and James J. Byrne, *Length of Working Life for Men and Women, 1970*, Special Labor Force Report 187 (Bureau of Labor Statistics, 1976).

[3]The mean age of workers has also been depressed by the recent influx of baby-boom cohorts into the labor force. Working life tables attempt to look past such changes—which stem from fertility fluctuations—to identify the impact of mortality and labor force changes. (See the discussion of the stationary labor force, appendix B.) However, to the extent that its numbers have indirectly affected participation rates, the baby-boom cohort may have made its mark on recent worklife estimates.

lation are viewed as entering and leaving the labor market repeatedly during their lifetimes, with nearly all participating for some period during their lives. This scenario contrasts sharply with the assumptions underlying the previous model, that men enter and leave the labor force only once, and that women enter and leave only as the result of specific changes in marital and parental status. By assuming continuous participation, the conventional model tends to understate the size of the ever-active population and to overstate average worklife expectancies. This bias is especially severe for groups characterized by high labor turnover, such as women. The increment-decrement model identifies a larger group of persons over which to average total person years of work. Hence it produces somewhat lower mean work durations.

The new estimates

The new worklife estimates, based on patterns of labor force attachment observed in 1977—and on the important assumption that these remain constant in the future—are presented in tables 1-8 and summarized in text table 2. The reader should be aware that these estimates do not focus exclusively on time spent employed. They encompass all forms of labor force attachment, including unemployment. Following the long-established convention, the term "worklife" denotes the broader concept of time spent in the labor force. Members of the labor force are referred to as the "economically active" or simply "active" group. Those outside of the labor force are referred to as the "inactive" population.

In 1977 the average 16-year-old man could expect to spend 38.5 years as a member of the labor force. At 16, the typical woman could anticipate a worklife of 27.7 years. At age 50, the average man could look forward to 11.7 more years of economic activity; the average woman, 7.5.

It has long been recognized that persons who are already in the labor force are more likely to work in the future than are those not currently active. Published tables have alluded to this differential without clearly quantifying it. In the past they have displayed worklife durations for the total population and for those economically active. The new increment-decrement model also displays values for the missing group, those economically inactive (text table 2).

The distinction between active and inactive teenagers is somewhat vague: Most enter and leave the labor force repeatedly at this age. Hence the expectancy differential by status is relatively small—about 1.5 years at age 16. It widens to about 4 years by age 45. At midlife the two groups are no longer so similar. Those out of the labor force face longer periods of inactivity associated with a diminished propensity to reenter the job market.

Trends in worklife duration

Changes in methodology impede direct comparison between the 1977-based estimates and others previously published by the Bureau of Labor Statistics. There are substantial differences in the assumptions underlying the old and new models which markedly affect their outcomes. To bridge the gap, figures for 1970 have been re-estimated using the newer technique (appendix A). Comparisons of 1977 values with the early part of this century, 1900 to 1940, may not be seriously misleading. At that time work patterns conformed rather well with those assumed in the conventional tables. However, a growing disparity between assumed and actual behavior after World War II led to serious biases in the original 1950–70 estimates. Figures for working women were especially tenuous, overstating average work durations during that period. Apart from these values, the summary information of text table 3 gives a reasonable overview of changing work patterns during this century.

Text table 2. Worklife expectancies of the population and of active and inactive persons by age and sex, 1977

[In years]

Age	Men			Women		
	Total	Active	Inactive	Total	Active	Inactive
At birth	37.9	—	37.9	27.5	—	27.5
16	38.5	39.6	38.1	27.7	28.8	27.4
20	36.8	37.3	35.9	26.0	26.7	25.2
25	33.4	33.7	32.0	23.0	23.7	21.7
30	29.2	29.3	27.2	19.9	20.9	18.2
35	24.7	24.9	21.7	16.8	17.9	14.8
40	20.3	20.4	16.9	13.7	14.9	11.4
45	15.9	16.2	12.0	10.5	11.9	8.0
50	11.7	12.2	7.2	7.5	9.3	4.9
55	7.8	8.5	3.6	4.8	6.8	2.5
60	4.3	5.2	1.9	2.5	4.4	1.2
65	1.9	3.4	1.1	1.1	3.1	.6
70	.9	2.6	.6	.5	2.4	.2

In 1900, the life expectancy and worklife expectancy of men were very similar. The typical 20-year-old man could expect to spend just 4.4 years of his adult life outside of the labor force.[4] Over the next 77 years, male life expectancy at birth rose by about 23 years, with the bulk of the increase—about 17 years—being allocated to non-labor-force activities. During this entire period, male worklife expectancy at birth increased by less than 6 years. Looking at the most recent period—between 1970 and 1977—the increase in worklife expectancy was negligible. Virtually the entire increase in male life expectancy (2.2 years) was allocated to non-labor-force activities.

At the turn of the century, formal labor force activities occupied a small portion of the typical woman's lifespan—about 6 years.[5] Yet as the lifespan has lengthened, most of the additional years have been spent within the labor force. Female longevity has increased by about 29 years since 1900, of which about 21 have gone to labor market activities, and less than 8 to nonmarket pursuits. The increase in labor force activity was most pronounced

[4]Stuart H. Garfinkle, *The Length of Working Life for Males, 1900-1960*, Manpower Report No. 8 (U.S. Department of Labor, Manpower Administration, 1963).

[5]Fullerton and Byrne, *Length of Working Life, 1970*.

Text table 3. Changes in life and worklife expectancies by sex, 1900–1977

Worklife model, sex, and year	Life expectancy		Worklife expectancy			Inactive years (total population)		Percent of lifespan active		Ratio of female to male worklife expectancies
			All persons		Workers					
	At birth	At age 20	At birth	At age 20	At age 20	From birth	From age 20	From birth	From age 20	At age 20
Men										
Conventional model:										
1900	46.3	42.2	32.1	37.8	39.4	14.2	4.4	69.3	89.6	(1)
1940	61.2	48.6	38.1	39.7	41.3	23.1	7.1	62.3	84.8	(1)
1950	65.5	48.9	41.5	41.4	43.1	24.0	7.5	63.4	84.7	(1)
1960	66.8	49.6	41.1	40.9	42.9	25.7	8.7	61.5	82.5	(1)
1970	67.1	49.6	40.1	39.4	41.5	27.0	10.2	59.8	79.4	(1)
Increment-decrement model:										
1970	67.1	49.6	37.8	37.3	38.0	29.4	12.3	56.3	75.2	(1)
1977	69.3	51.3	37.9	36.8	37.3	31.5	14.5	54.7	71.7	(1)
Change:										
1900–77[2]	23.0	9.1	5.7	-1.0	-2.1	17.3	10.1	-14.8	-17.9	(1)
1970–77[3]	2.2	1.7	.1	-.5	-.7	2.1	2.2	-1.7	-3.5	(1)
Women										
Conventional model:										
1900	48.3	43.8	6.3	(4)	(4)	42.0	(4)	13.0	13.7	(4)
1940	65.7	50.4	12.1	11.9	(4)	53.6	38.5	18.4	23.6	30.0
1950	71.0	53.7	15.1	14.5	(4)	55.9	39.2	21.3	27.0	35.0
1960	73.1	55.7	20.1	18.6	37.3	53.0	37.1	27.5	33.4	45.0
1970	74.8	56.7	22.9	22.0	40.6	51.9	34.7	30.6	38.8	55.8
Increment-decrement model:										
1970	74.8	56.7	22.3	21.3	22.1	52.4	35.4	29.8	37.6	57.1
1977	77.1	58.6	27.5	26.0	26.7	49.7	32.6	35.7	44.4	70.7
Change:										
1900–77[2]	28.8	14.8	21.1	(3)	(3)	7.7	(3)	22.5	30.7	(4)
1970–77[3]	2.3	1.9	5.0	4.7	4.6	-2.7	-2.8	5.6	6.8	13.6

[1]Not applicable.
[2]Based on conventional model estimates for 1900 and increment-decrement model estimates for 1977.
[3]Based on the increment-decrement model.
[4]Data not available.

toward the end of this period. The average lifespan of women increased by 2.3 years between 1970 and 1977, yet their average duration of working life rose by 5.0 years. This was accomplished by the reallocation of time (nearly 3 years per woman) from home to market activities.

It is estimated that in 1940 the worklife duration of women was just 30 percent that of men.[6] By 1970 it was 57 percent, and by 1977 it had risen to 71 percent. At the turn of the century, the average 20-year-old man was likely to work during 90 percent of his remaining years, as against 14 percent for the average woman. By 1977 the figure for men had dropped to 72 percent, while that for women had risen to 44 percent. These figures do not take account of differences in hours worked, an important distinction. However, they do show that the relative roles of men and women shifted tremendously during this period.

[6] *Tables of Working Life: Length of Working Life for Men,* Bulletin 1001 (Bureau of Labor Statistics, 1950); *Tables of Working Life for Women, 1950,* Bulletin 1204 (Bureau of Labor Statistics, 1957).

Chapter 2. Rates of Labor Force Accession and Separation

An important function of a working life table is to quantify movements into and out of the labor force. In the past it has been *assumed* that men enter and leave the labor force only once during their lives, and that women do so only slightly more frequently in conjunction with changes in marital or parental status. The increment-decrement model for the first time actually *estimates* the number of moves which take place.

The conventional worklife model rested on cross-sectional data from a single point in time. Differences in the *labor force participation rates* of successive age groups were taken as a measure of net movement into the job market (for young people) and into permanent retirement (for older workers).

The increment-decrement model rests on longitudinal records of the labor force activities of specific individuals interviewed in the Current Population Survey (CPS). A year-to-year match of these records quantifies movements into and out of the job market, and the corresponding *transitional probabilities* at each age. Following the flow of individuals between recognized states (e.g., in and out of the labor force), and discounting these flows for mortality at each age, the new model generates information on the dynamics of lifetime movement between the job market and the outside world. Its results help to explain why the standard estimates of mobility have become increasingly unrealistic.

These tables show that the average male child born in 1977 could expect to enter the labor force 3.0 times and to withdraw from it voluntarily 2.7 times in his lifetime (text table 4). The average female child was likely to make 4.5 such entries and 4.4 voluntary withdrawals. The timing of these entries would be more compressed for men than for women, occurring primarily below the age of 25. Thus, at 25, the average man was likely to reenter just 1.1 more times, as against an average of 2.7 additional entries for women. These figures represent a volume of mobility nearly three times that assumed for men, and well above that assumed for women in the conventional worklife procedure.

The lifetime transition estimates were relatively stable between 1970 and 1977 (text table 5). So too were the expected durations in the labor force per entry, for men. The 1977 tables indicate that, over a lifetime, men averaged 12.6 years of labor force attachment per entry. Women averaged less than half this figure, 6.1 years. But men tended to complete their intermittent activity early in life. They were expected to remain 29.1 years per entry beyond the age of 25. By contrast, at 25, the expected duration per entry for women was just 8.6 years.

The majority of all young people have had some labor force experience before the age of 20. In 1977, the median age of first labor force entry for men was 16.4 years, while that for women was 16.6 years. Taking all entries and reentries together, the average male entrant was 26.9 years of age. The average female entrant was slightly older, 28.7 years.

Text table 4. Average remaining labor force entries and exits per person at specific ages, 1977

Exact age	Labor force entries remaining		Voluntary labor force exits remaining	
	Men	Women	Men	Women
At birth	3.0	4.5	2.7	4.4
16	2.6	4.3	2.7	4.4
20	1.8	3.4	2.2	3.9
25	1.1	2.7	1.7	3.2
30	.9	2.1	1.6	2.7
35	.8	1.7	1.5	2.3
40	.7	1.3	1.4	1.9
45	.6	1.0	1.4	1.6
50	.6	.7	1.3	1.3
55	.5	.5	1.2	1.0
60	.5	.3	1.1	.7
65	.4	.2	.7	.4
70	.2	.1	.3	.2

Grouping temporary and permanent exits, the average man leaving the labor force in 1977 was 38.7 years of age; the average woman, 33.9.[7] Among persons leaving the labor force after the age of 50, the median age of exits for men was 63.4 years. Women tended to leave somewhat earlier—half of all their exits had taken place by age 60.6.

Among male children born in 1977, it was expected that over one-quarter (27 percent) would die before retirement. Only about 1 in 10 (9.5 percent) of all female children was likely to die while economically active. The retirement age for both sexes appears to have dropped since 1970. This may help to explain the substantial decline in proportions expected to die while active.

[7]These figures naturally reflect heavy volumes of movement at both ends of the age spectrum. They do not necessarily indicate heavy volume at midlife.

Text table 5. Selected indexes of working life by sex, 1970 and 1977

Worklife measure	Men 1970	Men 1977	Women 1970	Women 1977
Median age at first labor force entry	16.5	16.4	16.8	16.6
Mean age of all first and repeat labor force entrants	26.6	26.9	29.2	28.7
Worklife expectancy (in years):				
At birth	37.8	37.9	22.3	27.5
At age 25	34.4	33.4	19.0	23.0
Number of labor force entries per:				
Person born	2.9	3.0	4.6	4.5
Person age 25	1.2	1.1	2.8	2.7
Expected duration in labor force per entry remaining (in years):				
At birth	13.0	12.6	4.8	6.1
At age 25	29.4	29.1	6.8	8.6
Number of voluntary exits from labor force per:				
Person born	2.6	2.7	4.5	4.4
Person age 25	1.9	2.0	3.3	3.3
Percent of workers expected to die while in the labor force	36.3	27.0	10.8	9.5
Mean age of all persons leaving the labor force:				
Total first and repeat exits	38.7	38.7	33.5	33.9
Voluntary withdrawals	36.1	37.0	32.9	33.4
Deaths of workers	57.3	55.6	58.1	56.3
Median age of persons leaving labor force at age 50 and above	65.0	63.4	61.4	60.6

At the aggregate level, the new tables also document a much greater volume of movement into and out of the labor force than has been quantified in the past (text table 6). The conventional model used totally different procedures to estimate these flows for men than for women. As a result, there appeared to be tremendous disparities between the male and female patterns of labor force entry and withdrawal. It was difficult to determine how much of this disparity was real, and how much simply a function of differences in procedure. The increment-decrement model utilizes a single procedure for both sexes, eliminating most of this method-related bias.

A comparison of the two sets of estimates for 1970 illustrates how this change alters our perception of the relative rates of men and women. The earlier model implied that about seven times as many men as women entered the labor force during the teenage years. In fact, the accession rates of teenage men and women are shown to be nearly identical. The old estimates showed no men entering the labor force beyond the age of 29. The new tables indicate that they continue to do so throughout their lives, increasing the pace of reentries after age 60. The new tables do confirm the previously held view that at most ages women have higher propensities to leave and reenter the labor force than do men. Between the ages of 25 and 44, they show that the typical working woman was four to five times as likely to leave the job market as was the average man.

The character of net flows is best seen when both entries and exits are stated as a ratio to total population (text table 7). Consider the pattern of events over a lifetime, as measured in 1977. Although the accession and separation rates of teenage men and women are roughly comparable, the net effect is a greater influx of men into the labor force by age 20. Thereafter gross entries for both sexes decline. A compensating drop in separations for men holds net entries at a high level. A rise in separations for women slows the pace of their net labor force gains. Because a larger share of the female population is outside the job market with a likelihood of entry, their labor force accession rates exceed those of men throughout life.

Net retirements peak between the ages of 60 and 64. For men, a substantial number of these exits are temporary. Beginning at age 60, their rates of labor force reentry increase, and above the age of 65 they exceed the corresponding rates for women.

The net population flows in text table 7 document a continuous expansion of the male labor force from age 16 to age 34 and a gradual contraction from age 35 onward. The net pattern for women is more complex: An expansion of the labor force in the teens, a net contraction in the late 20's, renewed expansion in the 30's, and a final contraction beginning at about age 40. The outflow in the late 20's is often dubbed the "fertility trough" because it coincides with a period of family formation. However, the gross flows shown in text table 7 suggest that reading the net profile as a summary of normal female experiences may lead to misconceptions about their work patterns. The modest pace of net entries for teenage women conceals very heavy movement into and out of the job market at this age. The "trough" at ages 25 to 29 suggests an increase in labor force withdrawals, when in fact separations actually decline at this age. The net outflow results from even sharper declines in labor force entries. The apparent resurgence of entries at age 30 occurs despite an actual drop in female accessions. It results from an even greater decline in the pace of withdrawals. The interpretation of net flows is greatly facilitated by an examination of these gross flows.

The pace of net labor force entries for young people of both sexes appeared to have quickened between 1970 and 1977 (text table 8). Here, too, net patterns seemed to arise from somewhat contradictory gross trends.

Only a small portion of the net increase in accessions can be traced to a rise in gross entries (text table 7). For men 20 to 34, and for most women above the age of 20, the pace of entries actually slowed during this period. Instead, the determining factor appears to have been a drop in gross labor force exits among persons 16 to 24. Their increased reluctance to leave the job market resulted in a more efficient expansion process. Much of the increase in labor force participation rates for persons in this age range could be traced to this decline in labor turnover.

Text table 6. Rates of labor force mobility by age and sex, conventional model, 1970, and increment-decrement model, 1970 and 1977

Age group	Conventional model, 1970		Increment-decrement model			
			1970		1977	
	Men	Women	Men	Women	Men	Women
	Labor force entries per 1,000 persons in the stationary population					
16-19	476.1	66.2	191.9	204.1	211.6	207.2
20-24	84.3	22.7	145.7	164.6	136.3	158.3
25-29	12.2	6.0	72.0	102.2	54.4	109.6
30-34	—	10.0	27.6	90.7	23.8	88.4
35-39	—	12.0	14.8	83.7	14.9	75.2
40-44	—	7.2	13.5	72.3	15.4	66.3
45-49	—	1.6	14.6	60.3	16.4	57.9
50-54	—	1.8	14.5	49.7	17.1	46.8
55-59	—	2.3	18.8	43.3	19.1	37.4
60-64	—	2.4	32.2	38.9	30.8	32.0
65-69	—	2.3	38.2	29.4	44.5	27.8
70-74	—	.6	36.7	16.0	35.7	16.1
	Labor force separations per 1,000 persons in the stationary labor force[1]					
	Conventional model, 1970		Increment-decrement model			
			1970		1977	
	Men	Women	Men	Women	Men	Women
16-19	1.7	24.5	299.0	455.7	254.7	290.5
20-24	2.3	42.5	160.6	321.0	125.0	226.3
25-29	2.0	18.4	47.1	231.2	42.7	182.9
30-34	2.5	11.0	20.5	206.3	24.3	134.7
35-39	4.4	4.8	20.6	162.6	18.5	112.8
40-44	6.7	3.7	24.3	132.7	22.9	105.3
45-49	11.0	15.0	27.6	121.9	30.5	107.7
50-54	17.2	33.1	35.3	115.4	42.1	110.8
55-59	32.9	61.8	58.7	131.5	74.6	136.2
60-64	103.3	165.9	137.5	200.8	209.7	251.9
65-69	170.7	193.2	264.2	308.9	376.2	369.7
70-74	166.4	234.8	343.1	402.8	441.9	388.7

[1] Separations include both voluntary withdrawals from the labor force and deaths of economically active persons.

Text table 7. Population-based rates of labor force accession and separation by age and sex, 1970 and 1977

(Per 1,000 persons in the stationary population)

Year and age group	Accessions		Separations		Net flow	
	Men	Women	Men	Women	Men	Women
1970						
16-19	191.9	204.1	125.0	149.8	66.8	54.3
20-24	145.7	164.6	104.0	150.1	41.7	14.5
25-29	72.0	102.2	39.6	109.8	32.4	-7.6
30-34	27.6	90.7	19.6	91.7	8.0	-1.1
35-39	14.8	83.7	19.9	76.5	-5.1	7.2
40-44	13.5	72.3	23.0	67.6	-9.5	4.7
45-49	14.6	60.3	25.5	63.3	-11.0	-2.9
50-54	14.5	49.7	31.8	58.4	-17.3	-8.7
55-59	18.8	43.3	49.8	60.7	-31.1	-17.4
60-64	32.2	38.9	97.1	71.9	-64.9	-33.0
65-69	38.2	29.4	113.2	62.9	-75.1	-33.4
70-74	36.7	16.0	74.8	35.9	-38.1	-19.9
1977						
16-19	211.6	207.2	124.3	127.9	87.3	79.3
20-24	136.3	158.3	93.9	142.0	42.5	16.2
25-29	54.4	109.6	38.6	116.0	15.8	-6.5
30-34	23.8	88.4	23.0	84.1	.8	4.3
35-39	14.9	75.2	17.6	73.5	-2.7	1.7
40-44	15.5	66.3	21.6	69.0	-6.1	-2.7
45-49	16.4	57.9	28.2	68.1	-11.8	-10.2
50-54	17.1	46.8	37.1	63.7	-20.0	-16.9
55-59	19.1	37.4	59.3	66.2	-40.2	-28.8
60-64	30.8	32.0	113.1	77.8	-82.3	-45.8
65-69	44.5	27.8	92.9	52.2	-48.4	-24.4
70-74	35.7	16.1	56.3	27.1	-20.6	-11.1

Text table 8. Net labor force transfers by age and sex, conventional model, 1970, and increment-decrement model, 1970 and 1977

(Per 1,000 persons in the stationary population)

Age group	Men			Women		
	Conventional model, 1970	Increment-decrement model		Conventional model, 1970	Increment-decrement model	
		1970	1977		1970	1977
16-19	475.0	66.9	87.3	58.9	48.1	79.3
20-24	82.3	41.7	42.5	3.7	10.0	16.2
25-29	10.3	32.4	15.8	-.5	-8.0	-6.5
30-34	-2.4	8.0	.8	6.1	-1.1	4.3
35-39	-4.2	-5.1	-2.7	10.1	7.2	1.7
40-44	-6.4	-9.5	-6.1	5.5	4.7	-2.7
45-49	-10.4	-11.0	-11.8	-5.5	-2.9	-10.2
50-54	-15.9	-17.3	-20.0	-13.4	-8.7	-16.9
55-59	-29.1	-31.1	-40.2	-22.4	-17.4	-28.8
60-64	-76.3	-64.9	-82.3	-46.0	-33.0	-45.8
65-69	-68.8	-75.1	-48.4	-30.5	-33.4	-24.4
70-74	-39.8	-38.1	-20.6	-21.7	-19.9	-11.1

At the same time, the withdrawal process for persons 45 to 64 also became more efficient. An increase in the labor force separations of men outweighed (but may also have brought about) a modest increase in labor force entries at this age. Women exhibited a stronger labor force attachment at all ages, 16 through 54. The slowdown of their separations at younger ages diminished the size of the labor reserve from which to draw older female entrants. Hence entries also declined. Despite this drop in turnover, there was a modest increase in net outward flow of women workers age 45 to 54. Those 55 to 64 in 1977 showed stronger evidence of the intent to retire: Higher rates of labor force separation were coupled with diminished rates of reentry. (The result was a drop in worklife expectancies for women 60 and above.)

Chapter 3. Increment-Decrement Tables of Working Life

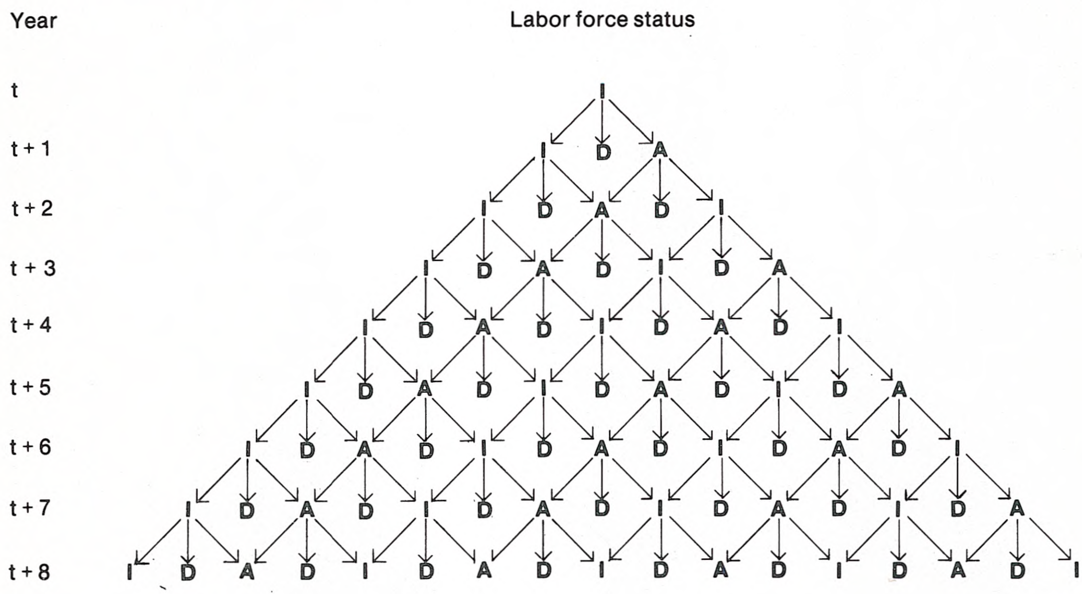
Increment-decrement working life tables are a powerful extension of conventional worklife methodology.[8] They overcome many of the limitations of the conventional model which stem from its convenient but simplistic design. Although the conventional model rests on a set of readily accessible data—cross-sectional rates of labor force participation—these data are not really appropriate to the study of labor force mobility. Inferring flows from stocks of workers at each age can lead to misconceptions about current labor force behavior. Furthermore, the original model was designed in the era of the desk calculator. Several simplifying assumptions were introduced to facilitate hand calculation. One such assumption, defining individual labor force attachments as continuous from age of entry to age of final retirement, overlooks short-term movements into and out of the job market. As we shift our attention to questions of labor force dynamics, this assumption masks much of the movement analysts would like to quantify.

In contrast, the increment-decrement model explicitly focuses on labor force mobility. The key statistic underlying these tables is the transition probability, drawn from observed patterns of labor force entry and exit at each age. There are no assumptions about normal work patterns. Instead, the model is used to estimate these norms.

The increment-decrement technique is less convenient to implement than was its predecessor. It involves a much more complex model format, one which necessitates the

[8] Many of the terms and functions of the new models are direct analogs of others found in the original technique. Readers unfamiliar with the earlier model will find the discussion in appendix B helpful in understanding this chapter.

Figure 1. **Alternative paths of survival and labor force attachment for persons alive at time t: Potential paths over an 8-year period**



I = Economically inactive (not in the labor force)
A = Economically active (in the labor force)
D = Dead

use of a computer. Moreover, the detailed longitudinal data on which it rests are not universally available. However, its findings are relatively free of model distortion and are credible and realistic. They are easier to understand and to explain and are more revealing of the underlying process of labor force attachment than were values based solely on labor force participation rates.

The increment-decrement working life table is one variation of what is known as the "multistate life table." A number of other forms in use today measure such phenomena as patterns of marital and residential change. In any multistate life table, members of the stationary population are assumed to move back and forth among life statuses according to prevailing age-specific probabilities of transition, until the last members finally enter the absorbing state of death. Life statuses are defined in a variety of ways, including but not limited to marital, labor force, and residential categories.

The simplest multistate model describes three options for the individual passing through a given age interval: He/she may remain in the same life status throughout, may change status, or may die. Figure 1 shows that, even with a single decision point per year, this construct quickly generates a tremendous number of potential paths.

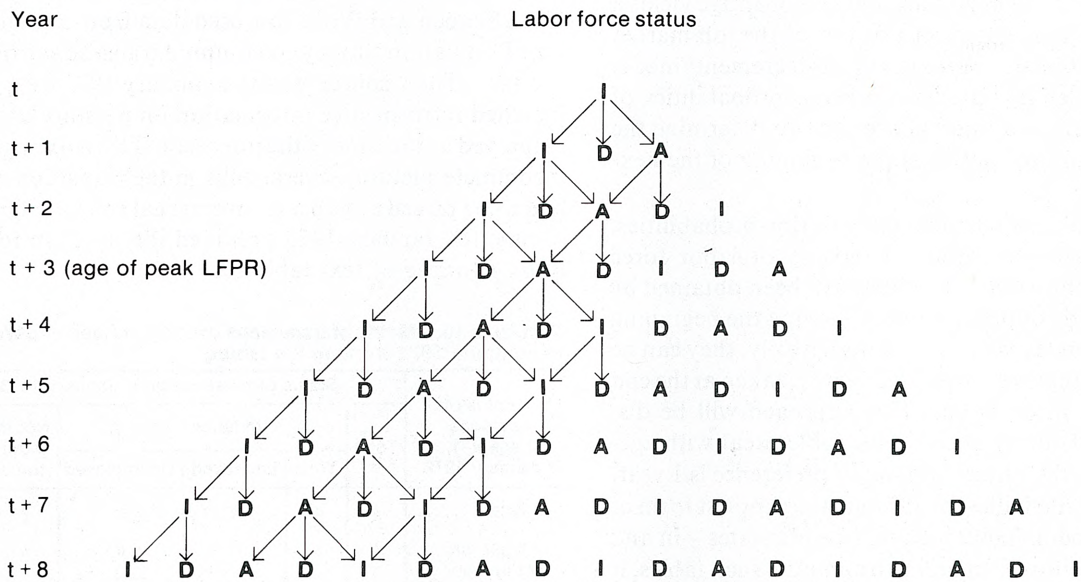
The developers of the original model avoided tracing most of these flows by disregarding temporary midlife labor force withdrawals and reentries. They reduced the estimation problem to one of first entries (in the age range of net entries) and final withdrawals (in the age range of net exits). (See figure 2.) They did so at the cost of certain unrealistic assumptions about individual labor force attachments. By failing to discount for turnover and periods of midlife inactivity, their model exaggerated individual worklife durations. The increment-decrement model, made feasible by the computer, provides a more complete accounting framework in which credits and debits can be appropriately recorded.

Literature on increment-decrement modeling

The use of three-state disability tables in Europe predates World War I. However, social scientists first turned their attention to multistate modeling in the 1970's. Andrei Rogers of the International Institute for Applied Systems Analysis in Laxenburg, Austria, was one of the first to exploit this technique. He expanded the basic life table to describe a multiregional system in which both migration and mortality patterns differed by location. Working alone and with Frans Willekens and others, he developed a number of interesting applications of the model, both in marital and labor force studies (see Bibliography, entries 27-36).

In a second research program at the University of Copenhagen, Jan Hoem and Monica Fong explored the relationship between multistate models and the theory of

Figure 2. **Alternative paths of survival and labor force attachment for persons alive at time t: Paths measured in the conventional worklife model**



I = Economically inactive (not in the labor force)
A = Economically active (in the labor force)
D = Dead

Solid lines denote paths traced in the conventional model.

stochastic processes. Their *Markov Chain Model of Working Life Tables* for the Danish labor force is an important contribution to the literature on multistate theory (15, 16).

Another advocate of multistate models has been Robert Schoen of the University of Illinois. Working with Land and Nelson, he has developed an increment-decrement table of marital status change (39, 40). Working alone and with Karen Woodrow, he has also developed increment-decrement tables of working life for the United States for 1972 (37, 41).

Willekens recently reestimated the Danish tables using his own simplified multiregional program. His program has been published both as a four-state marital status life table and as a two-state worklife model (51). Extensions of this analysis to social mobility and migration studies as well as further extensions of the marital tables have also been released (53, 54). Other important contributions to the literature include Krishnamoorthy (20), and Ledent (21, 22).

The fact that multistate models are applied to so many areas of study attests to their versatility. So long as the "states" in question represent alternatives among which members of the population may move, their specific character is unimportant. In some tables all movement is toward an absorbing life status (e.g., moves from "single" to "ever-married") while in others it is multidirectional (e.g., among geographic areas). All models include the ultimate absorbing state of death.

Overview of the model

In the conventional worklife model, a comparison of numbers active at the beginning and end of an age yields a net estimate of movement into or out of the job market during that interval. The increment-decrement model reverses this inference process. Instead, probabilities of movement during the interval are used to determine the number economically active at the beginning of the next age.

The key variable, a schedule of transition probabilities, is developed from longitudinal records of labor force behavior. For this study, the data have been obtained by matching records of persons interviewed at the beginning and end of calendar year 1977. Alternatively, they can be drawn from a single retrospective survey, taken at the end of the interval in question. (This approach will be discussed further below.) Because the tables deal with age-to-age changes, the survey interval of preference is 1 year.

The working life tables for 1977 are the simplest form of a multistate model, including just two life states—in and out of the labor force. In order to compute such tables, it is necessary to obtain all of the information shown in text table 9 for every age group.

Surveys seldom provide the mortality information needed for cells ***j***, ***k***, and ***l*** of this matrix. Instead, we must use vital statistics for the period to estimate the share of respondents lost through death. Differentials in mortality by labor force status have never been successfully quantified. Hence, although the model could accommodate different mortality schedules for those in and out of the labor force, the two groups are assumed to face identical risks of death.

Text table 9. Matrix of transitions over a 1-year interval

Status of respondents age x, time 1	Status of respondents age $x + 1$, time 2: Total	In labor force	Not in labor force	Dead
Total	*a*	*d*	*g*	*j*
In labor force	*b*	*e*	*h*	*k*
Not in labor force	*c*	*f*	*i*	*l*

The labor force flows shown as items ***d*** through ***i*** have been drawn from the records of individuals responding to the Current Population Survey (CPS) for January 1977 and again in January 1978. Their matched responses give a direct picture of year-to-year changes in labor force status. The totals in column 1 represent the sum of the remaining three columns.

There is a slight discrepancy between the age reference of survey data and that used in an actuarial model. Persons interviewed in a survey are on average a half-year older than their stated (integer) age. Thus the survey documents flows during the interval between ages $x + .5$ and $x + 1.5$. Values have been adjusted slightly to center them on the period between birthdays, ages x to $x + 1$. The resulting matrix represents numbers of persons who change (or fail to change) status during a given year of life. Percentage distributions across the rows of this matrix yield the corresponding *transition probabilities.*

In their increment-decrement tables of working life for 1972, Schoen and Woodrow used data from a single Current Population Survey to compute transition probabilities (41). Their source was the January 1973 CPS, which included retrospective information on persons who were employed at the time of the interview. This survey gave an incomplete picture; several cells in the transition matrix had to be pieced together from external sources. The total sample for January 1973 provided information for cells ***d***, ***m***, ***p***, and ***g*** of text table 10.

Text table 10. Matrix of transitions used by Schoen and Woodrow to compute 1972 working life tables

Status of persons age x–1, January 1972	Status of persons age x, January 1973: Total	In labor force: Total	In labor force: Employed	In labor force: Unemployed	Not in labor force	Dead
Total	*a*	*d*	*m*	*p*	*g*	*j*
In labor force	*b*	*e*	*n*	*q*	*h*	*k*
Not in labor force	*c*	*f*	*o*	*r*	*i*	*l*

The proportions in and out of the labor force 1 year before (cells ***b*** and ***c***) were obtained from the January 1972 CPS. One-year flows for the employed (cells ***n*** and ***o***) were estimated from retrospective data. The same column distribution was inferred for the total and unemployed groups (cells *e* and *f*, and *q* and *r*). Mortality estimates (*k* and *l*) were derived from vital statistics, leaving cells *h* and *i* as residual values. The final 1972 worklife tables rested on the same 12 cells of information shown in text table 9 (items *a* through *l*) once again centered on exact age intervals.

Whatever the source, the transition matrix provides the driving force for increment-decrement modeling. It describes the flow of persons from state 1 at exact age x to state 2 at exact age $x+1$. Snapshots of the beginning and end of the year necessarily overlook many of the changes which occur during that period. For a more complete count of events, numbers of persons changing status must be translated into numbers of transitions occurring. This has been accomplished using the procedure outlined by Schoen and Land (39). The resulting *transfer rates* describe the full volume of movement between various cells of text table 9 during the specific age in question.

The increment-decrement working life table follows a cohort of individuals through its life cycle, exposing members of that population to the risks of movement observed for each successive age. It summarizes the number of labor force entries and exits which would occur, the average timing of these events, and the length of time beyond any given age which would be spent in labor force activities—if prevailing rates did not change.

There are few critical assumptions to this life table technique. The most important (and vulnerable) of these is the Markovian assumption:

ASSUME: 1. That for any individual the probability of transition depends solely on his or her current status, sex, and exact age. It is independent of previous statuses.

That is, worklife estimates do not attempt to reflect the impact of cumulative experience.

A second assumption follows the life table convention of holding rates at their observed levels over the foreseeable future:

ASSUME: 2. That age-specific transfer rates (i.e., of entry into and withdrawal from the labor force and of death) are constant, at levels observed in the reference population during the reference year.

The model summarizes the lifetime implications of prevailing rates. It does not attempt to project future rates.

Worklife expectancy of the general population

The model is best illustrated by the tables themselves. Tables 1 through 4, which follow this chapter, summarize male worklife experiences; tables 5 through 8 summarize female worklife behavior. In each case the tables display the lifetime mortality and labor force experiences of a stationary population into which 100,000 persons of the given sex are born each year. They spell out how this population would behave if it were exposed to the age-specific risks of death, labor force entry, and exit prevailing for that sex in the United States in 1977.

When men are first observed in the tables at exact age 16 (table 1, columns 11 through 13), there are 97,598 survivors of the original birth cohort, of which 27,059 are members of the labor force and 70,539 are economically inactive. Columns 2 through 9 of the table show the basic transition probabilities and transfer rates used to survive this cohort forward through life. The transition probabilities indicate the proportion of those in a given state (i.e., economically inactive or active) at age x who will be found in each of three states (i.e., dead, inactive, or active) one year later. Because every member of the cohort takes one of these routes, the sum of the probabilities is unity. For instance, among men inactive at age 16 (columns 2 through 4):

$$ {}^{i}p^{i}_{16} + {}^{i}p^{a}_{16} + {}^{\cdot}p^{d}_{16} = 1.000 \qquad (1)$$

$$ .703 + .296 + .001 = 1.000 $$

where:

${}^{1}p^{2}_{x}$ = the probability that a person in life status 1 at exact age x would be in life status 2 at exact age $x+1$
i = economically inactive (i.e., not in the labor force)
a = economically active
$\cdot$ = living
d = dead, and
x = any given age.

At certain ages, the likelihood of changing status during the year is relatively high. When persons do so repeatedly within a 1-year interval, all but the last of their transitions is lost in year-to-year comparisons. In such cases, the real rate of transfer per thousand persons noticeably exceeds the corresponding transition probability. Transfer rates are derived from transition probabilities using the relationship discussed by Schoen and Land (39). The rate of labor force accession or entry for men age 16, shown in column 8, is computed as:

$$ {}^{i}m^{a}_{16} = \frac{4 * {}^{i}p^{a}_{16}}{(1 + {}^{i}p^{i}_{16})\ (1 + {}^{a}p^{a}_{16}) - ({}^{i}p^{a}_{16})\ ({}^{a}p^{i}_{16})} \qquad (2)$$

where:

${}^{i}m^{a}_{16}$ = the rate of transfer of persons from the inactive to the active state during age 16.

The rate of labor force withdrawal is derived by transposing superscripts in the numerator and in the m_x term. The high volume of turnover for men age 16 is reflected in the disparity between this group's accession rate (.411) and its corresponding transition probability (.296).

Given the mortality rates of 1977, 127 of the survivors to age 16 would die before their 17th birthday (column 18). If risks of death were equal for those in and out of the labor force, 83 of these deaths would occur among inactives, 44 among labor force members. The prevailing rates of transfer in and out of the labor force would result in 26,194 entries and 12,422 exits during the 16th year of life, for a net inward flow of 13,722. These events are summarized in text table 11. The summary values for exact age 17 form the starting point for estimates of change during the next age interval. The same set of calculations is repeated for each successive year of age.

Text table 11. Changes in the size and composition of the cohort of men between exact ages 16 and 17

Item	Survivors	Inactive	Active
Total at exact age 16	97,598	70,539	27,059
Deaths during interval	-127	-83	-44
Labor force accessions	—	-26,194	+26,194
Labor force separations	—	+12,422	-12,422
Total at exact age 17	97,471	56,684	40,787

This establishes the size of the stationary labor force at each exact age, ${}^{a}l_x$ (shown in column 13). In the conventional manner this function is translated into person years of activity lived by the group passing through that interval, ${}^{\cdot}L_x^a$. For men age 16:

$$ {}^{\cdot}L_{16}^{a} = \frac{{}^{a}l_{16} + {}^{a}l_{17}}{2} = \frac{27{,}059 + 40{,}787}{2} = 33{,}923 \quad (3)$$

where:

${}^{\cdot}L_x^a$ = person years of activity lived by the group passing through age x, regardless of their labor force status at the beginning of the interval, and

$\cdot$ = persons living in all statuses (active and inactive).

Estimates of person years spent in and out of the labor force during each interval are shown in columns 20 through 25 of table 1. These summarize the experience of the entire stationary population, and can be translated into average work and nonwork expectancies in the usual manner. That is, the ${}^{\cdot}L_x^a$ and ${}^{\cdot}L_x^i$ functions are cumulated from the end of the table backward to the beginning so that, for any age:

$$ {}^{\cdot}T_x^a = \sum_{\text{age} = x}^{75+} {}^{\cdot}L_x^a \quad (4)$$

$$ {}^{\cdot}T_x^i = \sum_{\text{age} = x}^{75+} {}^{\cdot}L_x^i \quad (5)$$

where:

${}^{\cdot}T_x^1$ = remaining person years to be lived in labor force status 1 beyond exact age x, for all persons irrespective of labor force status at age x.

Remaining years in each status are averaged over persons who will contribute to the cohort's future worklife, i.e., survivors to exact age x. Continuing our example, the average man age 16 in 1977 had a worklife expectancy of:

$$ {}^{\cdot}e_{16}^{a} = \frac{{}^{\cdot}T_{16}^{a}}{{}^{\cdot}l_{16}} = \frac{3{,}759{,}317}{97{,}598} = 38.52 \text{ years} \quad (6)$$

and could expect to spend

$$ {}^{\cdot}e_{16}^{i} = \frac{{}^{\cdot}T_{16}^{i}}{{}^{\cdot}l_{16}} = \frac{1{,}604{,}555}{97{,}598} = 16.44 \text{ years} \quad (7)$$

outside the labor market. The results of this estimation procedure for men in 1977 are displayed in table 3, columns 2 through 4.

Worklife expectancies of persons in and out of the labor force

Often in liability hearings the court applies worklife expectancies to the case of real individuals. Because current and future activities are often positively related, information on labor force behavior at the time of injury or death can have a bearing on estimated worktime lost. The conventional model indicates that—at any given age—the worklife expectancy of persons in the labor force is greater than that of the general population. However, because it does not isolate expectancies for persons outside the labor force, it is difficult to apply conventional findings to cases in which the plaintiff has been economically inactive. By contrast, the categories of display in the increment-decrement model are exhaustive, allowing a clear definition of the active/inactive differential.

Recall that, in the discussion of average worklife expectancies for the population, there were three steps to the calculation. These were 1) tracing a specific cohort of individuals (i.e., 100,000 persons of the same sex born at the same time) through a lifetime of labor force entries and exits, (2) estimating how many person years this group would spend in the labor force at and beyond each age, and (3) for any given age, computing the ratio of work years remaining to persons at risk of working them (i.e., cohort members surviving to the beginning of that age).

The same process can be repeated for smaller cohorts who share not only a common sex and birth date, but also a common labor force status at age x. For instance, the worklife expectancy of a man in the labor force at age 27 can be differentiated from that of another who is inactive at the same age. To accomplish this, every age/sex/labor force status group must be modeled as a separate cohort. The increment-decrement tables repeat the entire process for each of two sexes, two initial labor force classifications, and 60 age (or birth cohort) groups. To develop the estimates shown in columns 5 through 10 of table 3, the basic process is repeated 240 times. Although there is no need to display every such calculation, table 2 illustrates how status-specific estimates are derived for one such age cohort.

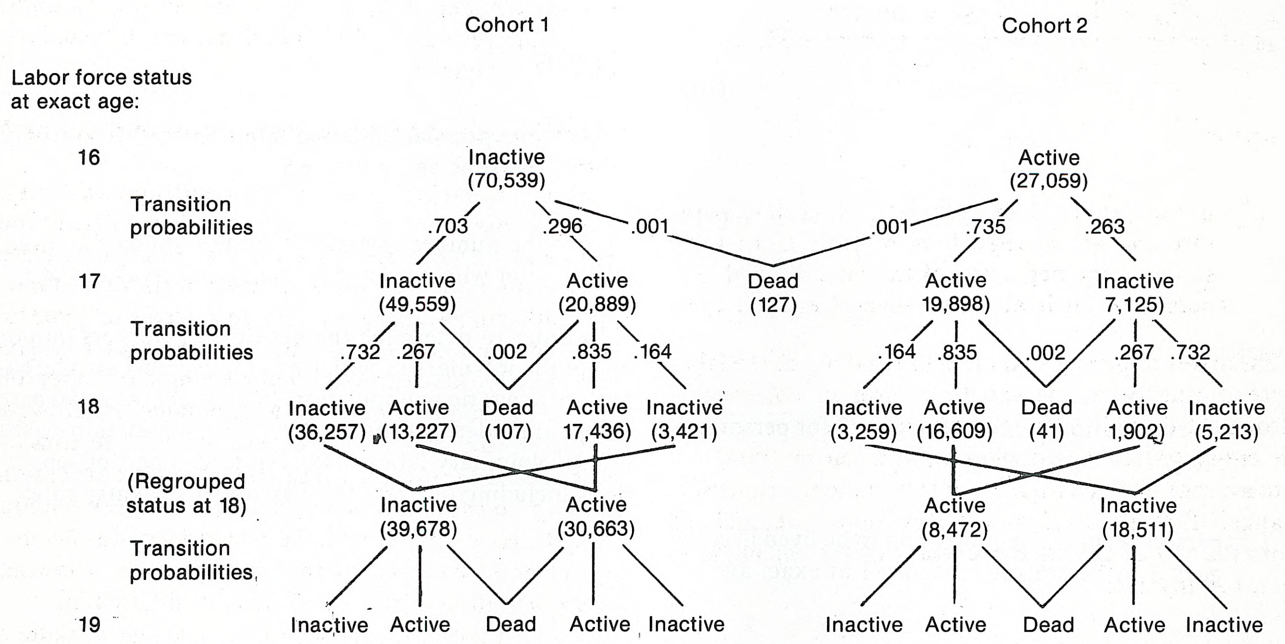
Consider the example of men age 16. In order to distinguish the worklife expectancies of those in the labor force from those of persons who were not, the two groups must be treated as separate entry cohorts. According to table 1 (columns 12 and 13), at exact age 16 the 1977 stationary population included 70,539 inactive men and another 27,059 who were members of the labor force. These figures serve as the initial cohort counts of table 2 (columns 2 and 5).

Figure 3 illustrates how cohorts are aged forward in the increment-decrement tables. Given the transition probabilities for 16-year-olds in table 1, 70.3 percent of the inactive group will remain so classified at exact age 17, 29.6 percent will have become active, and 0.1 percent will have died before that birthday. Thus the "inactive to inactive" stream will include 49,559 men; the "inactive to active" stream, 20,889. A parallel computation for those active at 16, using the probabilities in columns 5 and 6 of table 1, is also performed.

The path taken over the next age interval is a function of each person's sex, age, and labor force status at 17. Among those inactive at 17, 73.2 percent will remain so at 18, 26.7 percent will be in the labor force by that age, and about 0.2 percent will have died. The same transition probabilities apply, regardless of status at age 16. The tables do not take account of cumulative labor force experience.

There are two reasons for disregarding cumulative experience. In the first place, the number of "experience paths" increases geometrically with age. Following each stream separately would mean tracing 1,080 different paths to arrive at a single worklife expectancy for men active at 16, another 1,080 for men inactive at 16, 1,062 streams each for those active and inactive at 17, and so on. The cost and time involved would be prohibitive. A

Figure 3. **Selected portion of the labor force status-specific Markov chain for men, initial age 16**



second and more fundamental reason is that we do not know and cannot feasibly determine the probabilities for each of these experience-specific streams. Lacking this information, there is no choice but to employ the Markov assumption stated earlier.

This assumption permits us to regroup survivors by status at each successive age, identifying them only by initial cohort and labor force status at the current age. Table 2 gives a numerical illustration. Columns 2 through 4 are a "snapshot" of the cohort of men who were inactive at exact age 16, seen at each subsequent birthday. Columns 5 through 7 are a parallel series for those who were active at exact age 16. Persons in each labor force status at the precise age are used to estimate "person years lived" in that status during the age interval. These values are cumulated backward from the end of the table in the usual manner (columns 15 to 20). The worklife expectancy of men active at age 16 is then simply the ratio of work years remaining to that group, over initial members. There are four status-specific expectancies for each age, computed as follows:

$$ {}^{i}e^{i}_{x} = \frac{{}^{i}T^{i}_{x}}{{}^{i}l_{x}} \tag{8} $$

$$ {}^{i}e^{a}_{x} = \frac{{}^{i}T^{a}_{x}}{{}^{i}l_{x}} \tag{9} $$

$$ {}^{a}e^{i}_{x} = \frac{{}^{a}T^{i}_{x}}{{}^{a}l_{x}} \tag{10} $$

$$ {}^{a}e^{a}_{x} = \frac{{}^{a}T^{a}_{x}}{{}^{a}l_{x}} \tag{11} $$

where:

${}^{1}e^{2}_{x}$ = the expectation of life in category 2 for persons in category 1 at exact age x

${}^{1}T^{2}_{x}$ = person years of life remaining to be lived in category 2 by persons in category 1 at exact age x

${}^{\cdot}l_{x}$ = persons alive and in category 1 at exact age x.

Together these four indexes (equations 8-11) spell out the work- and non-work-life expectancies of all persons who survive to a given age, as a function of their behavior at that time.

Estimates of accession and separation rates

The formula for estimating accession and separation rates by single year of age has already been introduced (equation 2). When multiplied by the stationary population counts, ${}^{i}l_{x}$ and ${}^{a}l_{x}$, these rates produce estimates of the number of transfers in and out of the model labor force within each age interval (table 1, columns 14 and 15). The corresponding mortality rate is used to estimate deaths within the active and inactive model populations (columns 16 and 17).

The numbers of transfers are denoted ${}^{i}t^{a}_{x}$, ${}^{a}t^{i}_{x}$, ${}^{a}t^{d}_{x}$, and ${}^{i}t^{d}_{x}$ for accessions, separations, deaths of actives, and deaths of inactives, respectively. These values are used to determine expected labor force entries and exits beyond a given age, the mean and median age of movements, and related indexes (text table 5). They are also used to establish the labor force mobility rates of various age groups.

Several variants of the labor force accession and separation rates are shown for 5-year age groups in table 4. The first set (columns 2 through 5) are population-based rates. Entry rates are conventionally stated in this form. The entry rate is computed as:

$$ {}^{i}_{5}M^{a}_{x} = \frac{\sum_{\text{age} = x}^{x+5} {}^{i}t^{a}_{x}}{{}_{5}{}^{\cdot}L^{\cdot}_{x}} \tag{12} $$

where:

${}^{i}_{5}M^{a}_{x}$ = the population-based labor force entry rate for persons age x to $x + 5$

${}_{5}{}^{\cdot}L^{\cdot}_{x}$ = the number of persons in the stationary population who are alive in the age interval x to $x + 5$.

In order to determine the net flow of workers into or out of the job market, withdrawal rates must also be expressed as a ratio to population. (This is not the usual base for published separation rates.) The population-based rate of voluntary labor force exit (${}^{a}_{5}M^{i}_{x}$) and of separations including death (${}^{a}M^{(i,d)}_{x}$) parallel the entry rate:

$$ {}^{a}_{5}M^{i}_{x} = \frac{\sum_{\text{age} = x}^{x+5} {}^{a}t^{i}_{x}}{{}_{5}{}^{\cdot}L^{\cdot}_{x}} \tag{13} $$

$$ {}_5^aM_x^{(i,d)} = \frac{\sum_{\text{age}=x}^{x+5} \left({}^at_x^i + {}^at_x^d\right)}{{}_5\dot{L}^{\bullet}_x} \tag{14} $$

The rate of net movement for persons within the age range x to $x + 5$ (${}_5\dot{M}_x^{\cdot,d}$) is then simply a residual:

$$ {}_5\dot{M}_x^{\cdot,d} = {}_5^iM_x^a - {}_5^aM_x^{(i,d)} \tag{15} $$

This first set of rates describes the likelihood of an event occurring to the typical individual within a specific age group, during a single year.

A slightly different perspective appears in columns 6 and 7 of the table, where events are related to persons alive at the beginning of the age interval. These rates address the likelihood of an event affecting a person as he or she passes through the entire age range.

The rates in columns 8 and 9 are more focused, expressing events as a ratio to population "at risk". Entries are related to persons outside the labor force at the corresponding age, an unconventional but meaningful index. Separations are expressed in their normal form, as a ratio to persons who are economically active.

Other measures of labor force mobility

In addition to these rates, the increment-decrement table quantifies several other dimensions of labor force mobility. For instance, the average number of labor force entries likely to occur beyond a given age x (column 10) is computed as:

$$ {}^iE_x^a = \frac{\sum_{\text{age}=x}^{\infty} {}^it_x^a}{{}^{\bullet}l_x} \tag{16} $$

Expected separations are computed in a similar manner (column 11).

The number of deaths occurring to members of the stationary labor force at each successive age (${}^at_x^d$) is displayed in table 1. The age distribution of these deaths is used to derive the mean age at which workers are likely to die (text table 5). It is also used to estimate the proportion of all persons likely to die before retirement. This index is simply the ratio of deaths of workers at and beyond age x to persons alive at that exact age.

In like manner, the age profile of labor force entries and exits is used to determine the mean and median ages of such occurrences. The median age of first labor force entry is drawn from a separate Markov chain describing unidirectional flows. In this chain, survivors pass from "never active" to "ever active", on the assumption that first and subsequent entries are governed by the same transition probabilities. The age profile of transfers pinpoints the age at which half would have established their first labor force contact.

The increment-decrement model sheds new light on the whole process of labor force attachment and turnover. Many of the new indexes discussed in this study are the outgrowth of gross flow estimates, which were not available in conventional tables. As chapter 2 illustrates, their availability may change the conclusions we draw from net mobility patterns.

Table 1. Table of working life for men, 1977: Derivation of the expectation of active life for the general population

Age	Probability of transition between specified states during age interval x to x+1					Age-specific rates of transfer per 1,000 persons in initial status during age interval x to x+1		
	Living to dead	Inactive to inactive	Inactive to active	Active to inactive	Active to active	Mortality	Labor force accession	Voluntary labor force separation
x	$p_x^{\cdot d}$	p_x^{ii}	p_x^{ia}	p_x^{ai}	p_x^{aa}	$m_x^{\cdot d}$	m_x^{ia}	m_x^{ai}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
16	0.00130	0.70257	0.29613	0.26333	0.73537	1.30	411.77	366.17
17	.00152	.73158	.26690	.06377	.83471	1.52	340.73	209.08
18	.00168	.68082	.31750	.07157	.82675	1.68	421.10	227.55
19	.00179	.63115	.36706	.07734	.82087	1.79	505.42	244.18
20	.00190	.60351	.39459	.03862	.85948	1.90	539.24	189.43
21	.00200	.59326	.40474	.01331	.88469	2.00	547.50	153.27
22	.00207	.59247	.40546	.09116	.90677	2.07	540.69	121.57
23	.00208	.58035	.41757	.07084	.92708	2.08	553.83	93.96
24	.00205	.56979	.42816	.05506	.94289	2.05	565.92	72.77
25	.00201	.56253	.43546	.04323	.95476	2.01	573.81	56.97
26	.00197	.56219	.43584	.03490	.96313	1.97	571.30	45.75
27	.00193	.56209	.43598	.02942	.96865	1.93	569.47	38.43
28	.00190	.56534	.43276	.02571	.97239	1.90	562.70	33.43
29	.00188	.58105	.41707	.02382	.97430	1.88	536.15	30.62
30	.00186	.59900	.39914	.02088	.97726	1.86	506.32	26.49
31	.00186	.61817	.37997	.01914	.97900	1.86	475.70	23.97
32	.00189	.65287	.34524	.01785	.98026	1.89	422.70	21.85
33	.00197	.67166	.32637	.01702	.98101	1.97	394.88	20.59
34	.00208	.68396	.31396	.01583	.98209	2.08	376.82	18.99
35	.00222	.70656	.29122	.01452	.98326	2.22	344.61	17.18
36	.00239	.73058	.26703	.01397	.98364	2.39	311.49	16.30
37	.00257	.75729	.24014	.01352	.98391	2.57	275.79	15.53
38	.00277	.75239	.24484	.01286	.98437	2.77	281.89	14.81
39	.00300	.75525	.24175	.01367	.98333	3.00	278.04	15.72
40	.00325	.75589	.24086	.01518	.98157	3.26	277.19	17.46
41	.00355	.75147	.24498	.01606	.98039	3.56	282.83	18.54
42	.00388	.75617	.23995	.01603	.98009	3.89	276.31	18.46
43	.00425	.76275	.23300	.01698	.97877	4.26	267.50	19.49
44	.00467	.76568	.22965	.01821	.97712	4.68	263.46	20.88
45	.00512	.77441	.22047	.01879	.97609	5.13	251.81	21.46
46	.00562	.78118	.21320	.01930	.97508	5.64	242.70	21.97
47	.00618	.80524	.18858	.02150	.97232	6.20	212.09	24.18
48	.00681	.81482	.17837	.02383	.96936	6.83	199.87	26.70
49	.00751	.82414	.16835	.02452	.96797	7.54	187.80	27.36
50	.00828	.83035	.16137	.02590	.96582	8.31	179.60	28.82
51	.00910	.83867	.15223	.02764	.96326	9.14	168.88	30.66
52	.00995	.85595	.13410	.02856	.96149	10.00	147.50	31.41
53	.01081	.87234	.11685	.03049	.95870	10.87	127.58	33.28
54	.01171	.88380	.10449	.03378	.95451	11.78	113.62	36.73
55	.01263	.88826	.09911	.03807	.94930	12.71	107.82	41.42
56	.01366	.89527	.09107	.04152	.94482	13.75	98.93	45.10
57	.01491	.89801	.08708	.04936	.93573	15.02	94.92	53.80
58	.01647	.90035	.08318	.06484	.91869	16.61	91.38	71.24
59	.01826	.91071	.07103	.08345	.89829	18.43	78.46	92.18
60	.02026	.91865	.06109	.11228	.86746	20.47	68.33	125.59
61	.02231	.91958	.05811	.14231	.83538	22.56	66.12	161.95
62	.02429	.91755	.05816	.16971	.80600	24.59	67.36	196.58
63	.02611	.91666	.05723	.19580	.77809	26.46	67.39	230.57
64	.02783	.91727	.05490	.22547	.74670	28.22	65.82	270.31
65	.02958	.91484	.05558	.25680	.71362	30.02	68.05	314.42
66	.03154	.91715	.05131	.27466	.69380	32.05	63.48	339.80
67	.03388	.91926	.04686	.28195	.68417	34.46	58.23	350.35
68	.03675	.91874	.04451	.29215	.67110	37.44	55.75	365.94
69	.04013	.91945	.04042	.29252	.66735	40.95	50.71	366.96
70	.04377	.91996	.03627	.29690	.65933	44.75	45.69	374.03
71	.04761	.91783	.03456	.30124	.65115	48.77	43.80	381.78
72	.05184	.91535	.03281	.30748	.64068	53.22	41.90	392.65
73	.05649	.91348	.03003	.31581	.62770	58.13	38.68	406.84
74	.06156	.91254	.02590	.31562	.62282	63.51	33.47	407.85
75	.06703	.89659	.03622	.32675	.60606	69.35	47.75	430.75

NOTE: For explanation of notation, see appendix C.

Table 1. Continued—Table of working life for men, 1977: Derivation of the expectation of active life for the general population

Age	Stationary population living in each status at exact age x, per 100,000 persons born			Number of status transfers within stationary population during age interval x to x+1				
	Total	Labor force status		Labor force entries	Voluntary labor force exits	Deaths		
		Inactive	Active			Of actives	Of inactives	Total
x	$^{\cdot}l_x$	$^{i}l_x$	$^{a}l_x$	$^{ia}t_x$	$^{ai}t_x$	$^{ad}t_x$	$^{id}t_x$	$^{\cdot d}t_x$
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16	97,598	70,539	27,059	26,194	12,422	44	83	127
17	97,471	56,684	40,787	17,860	9,405	68	80	148
18	97,323	48,149	49,174	18,816	11,960	88	75	164
19	97,159	41,217	55,942	19,497	14,284	105	69	174
20	96,985	35,935	61,050	17,817	12,095	121	63	184
21	96,801	30,150	66,651	15,217	10,562	138	56	194
22	96,607	25,439	71,168	12,706	8,875	151	49	200
23	96,407	21,560	74,847	10,903	7,199	160	41	200
24	96,207	17,815	78,392	9,134	5,819	164	33	197
25	96,010	14,466	81,544	7,497	4,720	167	26	193
26	95,817	11,663	84,154	6,044	3,896	168	21	189
27	95,628	9,494	86,134	4,945	3,338	168	17	184
28	95,444	7,871	87,573	4,100	2,944	167	14	181
29	95,263	6,701	88,562	3,406	2,720	167	12	179
30	95,084	6,003	89,081	2,901	2,364	166	11	177
31	94,907	5,456	89,451	2,507	2,146	167	10	177
32	94,730	5,085	89,645	2,115	1,959	170	9	179
33	94,551	4,920	89,631	1,925	1,844	177	10	186
34	94,365	4,829	89,536	1,799	1,700	186	10	197
35	94,168	4,720	89,448	1,612	1,536	199	10	210
36	93,958	4,634	89,324	1,443	1,454	213	11	224
37	93,734	4,634	89,100	1,289	1,381	229	12	241
38	93,493	4,714	88,779	1,325	1,313	246	13	259
39	93,034	4,679	88,355	1,312	1,390	266	14	279
40	92,955	4,752	88,203	1,342	1,536	286	16	302
41	92,653	4,930	87,723	1,420	1,622	311	18	329
42	92,324	5,114	87,210	1,434	1,605	338	20	358
43	91,966	5,265	86,701	1,438	1,684	368	23	391
44	91,575	5,488	86,087	1,483	1,790	401	26	428
45	91,147	5,769	85,378	1,491	1,824	436	30	467
46	90,680	6,072	84,608	1,510	1,850	474	35	510
47	90,170	6,376	83,794	1,412	2,012	516	41	557
48	89,613	6,936	82,677	1,455	2,190	560	50	611
49	89,002	7,622	81,380	1,493	2,208	608	60	668
50	88,334	8,277	80,057	1,547	2,287	660	72	731
51	87,603	8,946	78,657	1,573	2,389	712	85	798
52	86,805	9,677	77,128	1,487	2,397	763	101	864
53	85,941	10,486	75,455	1,399	2,480	810	119	929
54	85,012	11,447	73,565	1,366	2,663	854	142	996
55	84,016	12,602	71,414	1,429	2,908	892	168	1,062
56	82,954	13,913	69,041	1,446	3,056	932	201	1,133
57	81,821	15,322	66,499	1,535	3,497	977	243	1,220
58	80,601	17,042	63,559	1,667	4,393	1,024	303	1,327
59	79,274	19,465	59,809	1,654	5,295	1,058	389	1,448
60	77,826	22,718	55,108	1,700	6,548	1,067	509	1,576
61	76,250	27,057	49,193	1,948	7,437	1,036	665	1,701
62	74,549	31,882	42,667	2,302	7,754	970	840	1,811
63	72,738	36,494	36,244	2,595	7,669	880	1,019	1,899
64	70,839	40,550	30,289	2,783	7,450	778	1,193	1,972
65	68,867	44,024	24,843	3,083	7,073	675	1,361	2,037
66	66,830	46,655	20,175	3,013	6,209	586	1,521	2,108
67	64,722	48,331	16,391	2,834	5,230	514	1,677	2,192
68	62,530	49,050	13,480	2,732	4,518	462	1,834	2,298
69	60,232	49,003	11,229	2,466	3,796	424	1,992	2,417
70	57,815	48,340	9,475	2,181	3,263	390	2,136	2,531
71	55,284	47,284	8,000	2,035	2,828	361	2,266	2,632
72	52,652	45,809	6,843	1,879	2,495	338	2,386	2,729
73	49,923	44,035	5,888	1,662	2,214	316	2,498	2,820
74	47,103	42,085	5,018	1,371	1,879	293	2,601	2,900
75	44,203	39,988	4,215	1,841	1,767	284	2,673	2,963

NOTE: For explanation of notation, see appendix C.

Table 1. Continued—Table of working life for men, 1977: Derivation of the expectation of active life for the general population

Age	Person years lived in each status during age x			Person years lived in each status beyond exact age x		
	Total	Inactive	Active	Total	Inactive	Active
x	$\dot{L}_x$	$\dot{L}^i_x$	$\dot{L}^a_x$	$\dot{T}_x$	$\dot{T}^i_x$	$\dot{T}^a_x$
(19)	(20)	(21)	(22)	(23)	(24)	(25)
16	97,536	63,613	33,923	5,363,872	1,604,555	3,759,317
17	97,398	52,417	44,981	5,266,336	1,540,942	3,725,394
18	97,242	44,684	52,558	5,168,938	1,488,525	3,680,413
19	97,073	38,576	58,497	5,071,696	1,443,841	3,627,855
20	96,892	33,042	63,850	4,974,623	1,405,265	3,569,358
21	96,704	27,794	68,910	4,877,731	1,372,223	3,505,508
22	96,506	23,499	73,007	4,781,027	1,344,429	3,436,598
23	96,307	19,687	76,620	4,684,521	1,320,930	3,363,591
24	96,108	16,140	79,968	4,588,214	1,301,243	3,286,971
25	95,913	13,065	82,848	4,492,106	1,285,103	3,207,003
26	95,723	10,579	85,144	4,396,193	1,272,038	3,124,155
27	95,536	8,683	86,853	4,300,470	1,261,459	3,039,011
28	95,353	7,286	88,067	4,204,934	1,252,777	2,952,157
29	95,173	6,352	88,821	4,109,581	1,245,491	2,864,090
30	95,002	5,730	89,272	4,014,408	1,239,138	2,775,270
31	94,824	5,271	89,553	3,919,406	1,233,408	2,685,998
32	94,647	5,003	89,644	3,824,582	1,228,138	2,596,444
33	94,464	4,875	89,589	3,729,935	1,223,135	2,506,800
34	94,272	4,775	89,497	3,635,471	1,218,260	2,417,211
35	94,065	4,677	89,388	3,541,199	1,213,485	2,327,714
36	93,849	4,634	89,215	3,447,134	1,208,808	2,238,326
37	93,616	4,674	88,942	3,353,285	1,204,174	2,149,111
38	93,366	4,701	88,665	3,259,669	1,199,500	2,060,169
39	93,097	4,720	88,377	3,166,303	1,194,799	1,971,504
40	92,801	4,841	87,960	3,073,206	1,190,078	1,883,128
41	92,486	5,022	87,464	2,980,405	1,185,238	1,795,167
42	92,142	5,189	86,953	2,887,919	1,180,216	1,707,703
43	91,768	5,376	86,392	2,795,777	1,175,027	1,620,750
44	91,358	5,628	85,730	2,704,009	1,169,651	1,534,358
45	90,904	5,920	84,984	2,612,651	1,164,023	1,448,628
46	90,415	6,224	84,191	2,521,747	1,158,103	1,363,644
47	89,882	6,655	83,227	2,431,332	1,151,879	1,279,453
48	89,298	7,278	82,020	2,341,450	1,145,224	1,196,226
49	88,658	7,949	80,709	2,252,152	1,137,946	1,114,206
50	87,976	8,612	79,364	2,163,494	1,129,997	1,033,497
51	87,212	9,312	77,900	2,075,518	1,121,385	954,133
52	86,380	10,082	76,298	1,988,306	1,112,072	876,234
53	85,484	10,968	74,516	1,901,926	1,101,990	799,936
54	84,522	12,026	72,496	1,816,442	1,091,023	725,419
55	83,459	13,253	70,206	1,731,920	1,078,997	652,923
56	82,361	14,613	67,748	1,648,461	1,065,744	582,717
57	81,185	16,177	65,008	1,566,100	1,051,131	514,969
58	79,911	18,247	61,664	1,484,915	1,034,954	449,961
59	78,523	21,084	57,439	1,405,004	1,016,707	388,297
60	77,024	24,883	52,141	1,326,481	995,623	330,858
61	75,386	29,465	45,921	1,249,457	970,740	278,717
62	73,625	34,180	39,445	1,174,071	941,275	232,796
63	71,775	38,515	33,260	1,100,446	907,096	193,350
64	69,839	42,278	27,561	1,028,671	868,581	160,090
65	67,811	45,314	22,497	958,832	826,303	132,529
66	65,740	47,467	18,273	891,021	780,988	110,033
67	63,589	48,662	14,927	825,281	733,521	91,760
68	61,344	48,997	12,347	761,692	684,859	76,833
69	58,986	48,640	10,346	700,348	635,862	64,486
70	56,454	47,731	8,723	641,362	587,222	54,140
71	53,873	46,464	7,409	584,908	539,491	45,417
72	51,192	44,838	6,354	531,035	493,026	38,009
73	48,417	42,975	5,442	479,843	448,188	31,655
74	45,557	40,950	4,607	431,426	405,213	26,213
75	42,644	38,542	4,102	385,869	364,262	21,607

NOTE: For explanation of notation, see appendix C.

Table 2. Table of working life for men, 1977: Sample derivation of worklife expectancies by labor force status for persons currently age 16

Age	Survivors to exact age x by labor force status at age 16 and at age x						Person years lived by cohort members in each status during age interval x to x+1					
	Persons inactive at 16			Persons active at 16			Persons inactive at age 16			Persons active at 16		
x	Total at x $l_x^{i,16\,\cdot}$	Inactive at x $l_x^{i,16\,i}$	Active at x $l_x^{i,16\,a}$	Total at x $l_x^{a,16\,\cdot}$	Inactive at x $l_x^{a,16\,i}$	Active at x $l_x^{a,16\,a}$	Total at x $L_x^{i,16\,\cdot}$	Inactive at x $L_x^{i,16\,i}$	Active at x $L_x^{i,16\,a}$	Total at x $L_x^{a,16\,\cdot}$	Inactive at x $L_x^{a,16\,i}$	Active at x $L_x^{a,16\,a}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
16	70,539	70,539	0	27,059	0	27,059	70,494	60,046	10,448	27,041	3,564	23,477
17	70,448	49,559	20,889	27,023	7,125	19,898	70,394	44,616	25,778	27,003	7,799	19,204
18	70,341	39,678	30,663	26,982	8,472	18,511	70,281	35,974	34,307	26,960	8,708	18,252
19	70,222	32,274	37,948	26,937	8,944	17,993	70,160	29,686	40,474	26,913	8,890	18,023
20	70,097	27,099	42,997	26,889	8,836	18,053	70,030	24,706	45,324	26,863	8,335	18,528
21	69,964	22,315	47,649	26,838	7,835	19,003	69,893	20,475	49,418	26,811	7,318	19,493
22	69,824	18,638	51,186	26,784	6,801	19,983	69,751	17,172	52,579	26,756	6,326	20,430
23	69,679	15,708	53,971	26,729	5,851	20,877	69,607	14,324	55,283	26,701	5,363	21,338
24	69,534	12,940	56,594	26,673	4,875	21,798	69,463	11,714	57,749	26,646	4,426	22,220
25	69,392	10,489	58,903	26,618	3,978	22,641	69,322	9,467	59,855	26,592	3,597	22,995
26	69,252	8,447	60,805	26,565	3,216	23,348	69,184	7,659	61,525	26,539	2,920	23,619
27	69,116	6,871	62,245	26,512	2,623	23,889	69,049	6,282	62,767	26,487	2,400	24,087
28	68,982	5,694	63,289	26,461	2,177	24,284	68,917	5,270	63,647	26,436	2,016	24,420
29	68,851	4,846	64,006	26,411	1,855	24,556	68,787	4,593	64,194	26,386	1,759	24,627
30	68,722	4,340	64,382	26,361	1,663	24,698	68,658	4,142	64,516	26,337	1,587	24,749
31	68,594	3,944	64,650	26,312	1,512	24,801	68,530	3,810	64,720	26,288	1,461	24,827
32	68,466	3,676	64,791	26,263	1,409	24,854	68,402	3,616	64,786	26,239	1,386	24,852
33	68,337	3,556	64,781	26,214	1,364	24,850	68,270	3,523	64,746	26,188	1,351	24,837
34	68,202	3,491	64,712	26,162	1,339	24,823	68,131	3,451	64,680	26,135	1,324	24,811
35	68,061	3,412	64,649	26,108	1,308	24,799	67,985	3,380	64,604	26,079	1,297	24,782
36	67,909	3,349	64,560	26,050	1,285	24,765	67,829	3,349	64,479	26,019	1,285	24,734
37	67,747	3,349	64,398	25,987	1,285	24,703	67,660	3,378	64,282	25,954	1,296	24,658
38	67,573	3,407	64,166	25,921	1,307	24,614	67,479	3,528	63,951	25,885	1,353	24,531
39	67,386	3,389	63,997	25,849	1,300	24,549	67,285	3,281	64,004	25,810	1,259	24,551
40	67,184	3,434	63,749	25,771	1,317	24,454	67,075	3,499	63,576	25,729	1,342	24,387
41	66,965	3,563	63,402	25,688	1,367	24,321	66,846	3,630	63,217	25,642	1,392	24,250
42	66,728	3,696	63,032	25,596	1,418	24,179	66,598	3,751	62,848	25,547	1,439	24,108
43	66,469	3,805	62,664	25,497	1,460	24,037	66,327	3,886	62,442	25,443	1,491	23,952
44	66,186	3,966	62,220	25,389	1,521	23,867	66,032	4,068	61,963	25,329	1,561	23,769
45	65,877	4,170	61,708	25,270	1,599	23,671	65,708	4,279	61,429	25,205	1,642	23,564
46	65,540	4,389	61,151	25,141	1,683	23,457	65,356	4,499	60,857	25,070	1,726	23,344
47	65,172	4,609	60,563	24,999	1,768	23,232	64,970	4,811	60,159	24,922	1,846	23,077
48	64,769	5,013	59,756	24,845	1,923	22,922	64,548	5,262	59,286	24,760	2,018	22,742
49	64,328	5,509	58,819	24,676	2,113	22,563	64,086	5,746	58,340	24,583	2,204	22,379
50	63,845	5,982	57,862	24,490	2,295	22,196	63,580	6,225	57,355	24,389	2,388	22,001
51	63,316	6,466	56,850	24,288	2,480	21,807	63,028	6,731	56,296	24,177	2,582	21,595
52	62,740	6,994	55,746	24,067	2,683	21,384	62,428	7,288	55,140	23,947	2,796	21,151
53	62,116	7,579	54,537	23,827	2,907	20,920	61,780	7,928	53,852	23,698	3,041	20,657
54	61,444	8,274	53,170	23,570	3,174	20,396	61,084	8,693	52,391	23,432	3,335	20,097
55	60,725	9,108	51,616	23,294	3,494	19,800	60,341	9,585	50,756	23,146	3,677	19,470
56	59,958	10,056	49,902	22,999	3,857	19,142	59,548	10,568	48,980	22,842	4,054	18,788
57	59,139	11,075	48,064	22,685	4,248	18,437	58,698	11,700	46,998	22,516	4,488	18,028
58	58,257	12,317	45,939	22,347	4,725	17,622	57,777	13,198	44,579	22,163	5,063	17,100
59	57,297	14,069	43,229	21,979	5,397	16,582	56,774	15,252	41,523	21,778	5,850	15,928
60	56,251	16,420	39,831	21,578	6,299	15,279	55,682	17,998	37,683	21,359	6,904	14,455
61	55,111	19,556	35,555	21,140	7,502	13,639	54,497	21,312	33,185	20,905	8,175	12,730
62	53,882	23,044	30,838	20,669	8,839	11,829	53,227	24,723	28,505	20,418	9,484	10,934
63	52,573	26,377	26,196	20,167	118	10,049	51,887	27,855	24,032	19,904	685	9,219
64	51,200	29,308	21,892	19,640	1,242	8,398	50,488	30,575	19,913	19,367	1,728	7,639
65	49,776	31,820	17,956	19,094	2,206	6,888	49,039	32,779	16,260	18,811	2,574	6,237
66	48,303	33,721	14,582	18,529	2,935	5,594	47,541	34,333	13,208	18,237	3,170	5,067
67	46,780	34,932	11,847	17,944	3,400	4,545	45,988	35,196	10,791	17,641	3,501	4,139
68	45,195	35,452	9,743	17,336	3,599	3,737	44,364	35,436	8,928	17,018	3,593	3,425
69	43,534	35,418	8,116	16,699	3,586	3,113	42,660	35,177	7,483	16,364	3,494	2,870
70	41,787	34,939	6,848	16,029	3,402	2,627	40,872	34,555	6,318	15,678	3,255	2,423
71	39,958	34,176	5,782	15,328	3,110	2,218	39,007	33,638	5,369	14,963	2,903	2,060
72	38,055	33,109	4,946	14,598	2,701	1,897	37,069	32,462	4,607	14,220	2,452	1,767
73	36,083	31,827	4,255	13,841	2,209	1,632	35,064	31,114	3,949	13,450	1,935	1,515
74	34,044	30,418	3,627	13,059	1,668	1,391	32,996	29,650	3,347	12,657	1,373	1,284
75	31,949	28,902	3,047	12,255	1,087	1,169	30,878	27,892	2,985	11,845	699	1,145

NOTE: For explanation of notation, see appendix C.

Table 2. Continued—Table of working life for men, 1977: Sample derivation of worklife expectancies by labor force status for persons currently age 16

Age	Years remaining to be lived in each status					
	By persons inactive at exact age 16			By persons active at exact age 16		
	Total years	Inactive years	Active years	Total years	Inactive years	Active years
x	$^{i,16}T_x^{\cdot}$	$^{i,16}T_x^{i}$	$^{i,16}T_x^{a}$	$^{a,16}T_x^{\cdot}$	$^{a,16}T_x^{i}$	$^{a,16}T_x^{a}$
(14)	(15)	(16)	(17)	(18)	(19)	(20)
16	3,876,765	1,187,483	2,689,282	1,487,107	416,924	1,070,183
17	3,806,272	1,127,437	2,678,835	1,460,066	413,360	1,046,706
18	3,735,877	1,082,821	2,653,057	1,433,063	405,561	1,027,502
19	3,665,596	1,046,846	2,618,750	1,406,103	396,854	1,009,250
20	3,595,436	1,017,161	2,578,276	1,379,191	387,964	991,226
21	3,525,406	992,455	2,532,951	1,352,327	379,629	972,698
22	3,455,513	971,980	2,483,533	1,325,517	372,311	953,205
23	3,385,761	954,807	2,430,954	1,298,760	365,985	932,775
24	3,316,154	940,484	2,375,671	1,272,059	360,623	911,437
25	3,246,691	928,770	2,317,921	1,245,414	356,197	889,217
26	3,177,369	919,303	2,258,067	1,218,822	352,600	866,223
27	3,108,185	911,644	2,196,541	1,192,284	349,680	842,604
28	3,039,136	905,362	2,133,774	1,165,797	347,280	818,517
29	2,970,219	900,093	2,070,127	1,139,361	345,264	794,097
30	2,901,433	895,500	2,005,933	1,112,974	343,505	769,470
31	2,832,775	891,357	1,941,417	1,086,638	341,917	744,720
32	2,764,245	887,548	1,876,697	1,060,350	340,457	719,893
33	2,695,843	883,932	1,811,911	1,034,111	339,070	695,041
34	2,627,573	880,408	1,747,165	1,007,923	337,719	670,204
35	2,559,442	876,957	1,682,485	981,789	336,396	645,393
36	2,491,457	873,577	1,617,880	955,710	335,099	620,611
37	2,423,629	870,227	1,553,401	929,691	333,814	595,877
38	2,355,969	866,849	1,489,119	903,737	332,519	571,219
39	2,288,489	863,321	1,425,168	877,852	331,165	546,687
40	2,221,204	860,040	1,361,164	852,042	329,907	522,136
41	2,154,130	856,541	1,297,589	826,313	328,565	497,748
42	2,087,283	852,911	1,234,372	800,671	327,172	473,499
43	2,020,685	849,160	1,171,525	775,124	325,733	449,391
44	1,954,357	845,274	1,109,083	749,681	324,243	425,439
45	1,888,326	841,206	1,047,120	724,352	322,682	401,670
46	1,822,617	836,927	985,691	699,147	321,041	378,106
47	1,757,262	832,428	924,834	674,077	319,315	354,762
48	1,692,292	827,616	864,675	649,154	317,469	331,685
49	1,627,744	822,355	805,389	624,394	315,451	308,943
50	1,563,657	816,608	747,049	599,811	313,247	286,564
51	1,500,077	810,383	689,694	575,422	310,859	264,563
52	1,437,049	803,652	633,397	551,245	308,277	242,968
53	1,374,622	796,364	578,258	527,298	305,481	221,817
54	1,312,842	788,436	524,406	503,599	302,440	201,159
55	1,251,758	779,743	472,015	480,168	299,105	181,063
56	1,191,417	770,158	421,259	457,021	295,429	161,593
57	1,131,869	759,590	372,279	434,179	291,375	142,804
58	1,073,171	747,891	325,281	411,663	286,887	124,776
59	1,015,394	734,692	280,702	389,500	281,824	107,676
60	958,620	719,441	239,179	367,722	275,974	91,748
61	902,938	701,442	201,496	346,362	269,070	77,293
62	848,442	680,130	168,311	325,458	260,895	64,563
63	795,214	655,408	139,807	305,040	251,411	53,629
64	743,328	627,553	115,774	285,137	240,726	44,410
65	692,840	596,978	95,861	265,770	228,998	36,772
66	643,800	564,199	79,601	246,958	216,424	30,535
67	596,259	529,866	66,393	228,722	203,254	25,468
68	550,271	494,669	55,602	211,081	189,753	21,329
69	505,907	459,233	46,674	194,063	176,159	17,904
70	463,247	424,056	39,191	177,699	162,666	15,034
71	422,375	389,501	32,873	162,021	149,411	12,610
72	383,368	355,863	27,505	147,058	136,507	10.551
73	346,299	323,402	22,897	132,838	124,055	8,783
74	311,235	292,287	18,948	119,388	112,120	7,268
75	278,239	262,638	15,601	106,731	100,747	5,984

NOTE: For explanation of notation, see appendix C.

Table 3. Table of working life for men, 1977: Expectation of active life by current labor force status

Age	Expectancies of the total population			Expectancies of persons inactive at age x			Expectancies of persons active at age x		
	Total years	Inactive years	Active years	Total years	Inactive years	Active years	Total years	Inactive years	Active years
x	$^{\cdot\cdot}e_x$	$^{\cdot i}e_x$	$^{\cdot a}e_x$	$^{i\cdot}e_x$	$^{ii}e_x$	$^{ia}e_x$	$^{a\cdot}e_x$	$^{ai}e_x$	$^{aa}e_x$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
16	55.0	16.4	38.5	55.0	16.8	38.1	55.0	15.4	39.6
17	54.0	15.8	38.2	54.0	16.5	37.5	54.0	14.9	39.2
18	53.1	15.3	37.8	53.1	16.0	37.1	53.1	14.6	38.5
19	52.2	14.9	37.3	52.2	15.6	36.6	52.2	14.3	37.9
20	51.3	14.5	36.8	51.3	15.4	35.9	51.3	14.0	37.3
21	50.4	14.2	36.2	50.4	15.2	35.2	50.4	13.7	36.7
22	49.5	13.9	35.6	49.5	15.0	34.4	49.5	13.5	36.0
23	48.6	13.7	34.9	48.6	14.9	33.7	48.6	13.3	35.2
24	47.7	13.5	34.2	47.7	14.8	32.9	47.7	13.2	34.5
25	46.8	13.4	33.4	46.8	14.8	32.0	46.8	13.1	33.7
26	45.9	13.3	32.6	45.9	14.8	31.1	45.9	13.1	32.8
27	45.0	13.2	31.8	45.0	14.8	30.2	45.0	13.0	32.0
28	44.1	13.1	30.9	44.1	14.8	29.3	44.1	13.0	31.1
29	43.1	13.1	30.1	43.1	14.9	28.2	43.1	12.9	30.2
30	42.2	13.0	29.2	42.2	15.0	27.2	42.2	12.9	29.3
31	41.3	13.0	28.3	41.3	15.2	26.1	41.3	12.9	28.4
32	40.4	13.0	27.4	40.4	15.4	25.0	40.4	12.8	27.5
33	39.4	12.9	26.5	39.4	15.5	23.9	39.4	12.8	26.7
34	38.5	12.9	25.6	38.5	15.7	22.8	38.5	12.8	25.8
35	37.6	12.9	24.7	37.6	15.9	21.7	37.6	12.7	24.9
36	36.7	12.9	23.8	36.7	16.0	20.7	36.7	12.7	24.0
37	35.8	12.8	22.9	35.8	16.1	19.7	35.8	12.7	23.1
38	34.9	12.8	22.0	34.9	16.1	18.8	34.9	12.7	22.2
39	34.0	12.8	21.2	34.0	16.2	17.8	34.0	12.7	21.3
40	33.1	12.8	20.3	33.1	16.2	16.9	33.1	12.6	20.4
41	32.2	12.8	19.4	32.2	16.2	16.0	32.2	12.6	19.6
42	31.3	12.8	18.5	31.3	16.3	15.0	31.3	12.6	18.7
43	30.4	12.8	17.6	30.4	16.4	14.0	30.4	12.6	17.8
44	29.5	12.8	16.8	29.5	16.6	13.0	29.5	12.5	17.0
45	28.7	12.8	15.9	28.7	16.7	11.9	28.7	12.5	16.2
46	27.8	12.8	15.0	27.8	16.9	10.9	27.8	12.5	15.3
47	27.0	12.8	14.2	27.0	17.1	9.9	27.0	12.4	14.5
48	26.1	12.8	13.3	26.1	17.2	8.9	26.1	12.4	13.7
49	25.3	12.8	12.5	25.3	17.3	8.0	25.3	12.4	12.9
50	24.5	12.8	11.7	24.5	17.3	7.2	24.5	12.3	12.2
51	23.7	12.8	10.9	23.7	17.4	6.3	23.7	12.3	11.4
52	22.9	12.8	10.1	22.9	17.4	5.5	22.9	12.2	10.7
53	22.1	12.8	9.3	22.1	17.4	4.8	22.1	12.2	9.9
54	21.4	12.8	8.5	21.4	17.2	4.2	21.4	12.2	9.2
55	20.6	12.8	7.8	20.6	17.0	3.6	20.6	12.1	8.5
56	19.9	12.8	7.0	19.9	16.7	3.2	19.9	12.1	7.8
57	19.1	12.8	6.3	19.1	16.4	2.8	19.1	12.0	7.1
58	18.4	12.8	5.6	18.4	16.0	2.4	18.4	12.0	6.4
59	17.7	12.8	4.9	17.7	15.6	2.1	17.7	11.9	5.8
60	17.0	12.8	4.3	17.0	15.2	1.9	17.0	11.8	5.2
61	16.4	12.7	3.7	16.4	14.7	1.7	16.4	11.6	4.7
62	15.7	12.6	3.1	15.7	14.2	1.5	15.7	11.4	4.3
63	15.1	12.5	2.7	15.1	13.8	1.4	15.1	11.2	4.0
64	14.5	12.3	2.3	14.5	13.3	1.2	14.5	10.9	3.6
65	13.9	12.0	1.9	13.9	12.8	1.1	13.9	10.5	3.4
66	13.3	11.7	1.6	13.3	12.3	1.0	13.3	10.1	3.2
67	12.8	11.3	1.4	12.8	11.9	.9	12.8	9.7	3.0
68	12.2	11.0	1.2	12.2	11.4	.8	12.2	9.3	2.9
69	11.6	10.6	1.1	11.6	10.9	.7	11.6	8.9	2.7
70	11.1	10.2	.9	11.1	10.5	.6	11.1	8.5	2.6
71	10.6	9.8	.8	10.6	10.0	.6	10.6	8.1	2.4
72	10.1	9.4	.7	10.1	9.6	.5	10.1	7.8	2.2
73	9.6	9.0	.6	9.6	9.2	.5	9.6	7.6	2.0
74	9.2	8.6	.6	9.2	8.7	.4	9.2	7.5	1.7
75	8.7	8.2	.5	8.7	8.3	.4	8.7	7.5	1.2

NOTE: For explanation of notation, see appendix C.

Table 4. Table of working life for men, 1977: Indexes of labor force accession and separation

Age	Annual population-based rates of labor force mobility				Events per person alive at exact age x		Events per person at risk during interval		Events remaining per person entering interval	
	Accessions	Total separations	Voluntary separations	Net moves	Accessions	Total separations	Accessions per inactive person	Total separations per active person	Accessions	Voluntary separations
x to x+4	${}_5^{i}M_x^{a}$	${}_5^{a}M_x^{(i,d)}$	${}_5^{a}M_x^{i}$	${}_5^{\cdot}M_x^{(\cdot,d)}$	${}_5^{(\cdot lx,i)}M_x^{a}$	${}_5^{(\cdot lx,a)}M_x^{(i,d)}$	${}_5^{i}m_x^{a}$	${}_5^{a}m_x^{(i,d)}$	${}^{i}E_x^{a}$	${}^{a}E_x^{i}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
16-19	0.2116	0.1243	0.1235	0.0873	0.8439	0.4957	0.4133	0.2547	2.6473	2.6552
20-24	.1363	.0939	.0923	.0425	.6782	.4669	.5474	.1250	1.8148	2.1764
25-29	.0544	.0386	.0369	.0158	.2707	.1922	.5654	.0427	1.1481	1.7345
30-34	.0238	.0230	.0212	.0008	.1183	.1144	.4384	.0243	.8859	1.5661
35-39	.0149	.0176	.0151	-.0027	.0741	.0874	.2983	.0185	.7751	1.4750
40-44	.0155	.0216	.0179	-.0061	.0766	.1070	.2731	.0229	.7101	1.4181
45-49	.0164	.0282	.0225	-.0118	.0807	.1391	.2163	.0305	.6461	1.3559
50-54	.0171	.0371	.0283	-.0200	.0835	.1813	.1446	.0421	.5834	1.2849
55-59	.0191	.0593	.0472	-.0402	.0920	.2860	.0927	.0746	.5256	1.2055
60-64	.0308	.1131	.1003	-.0823	.1456	.5344	.0669	.2097	.4680	1.0554
65-69	.0445	.0929	.0845	-.0484	.2052	.4282	.0591	.3762	.3644	.6574
70-74	.0357	.0563	.0496	-.0205	.1579	.2487	.0409	.4419	.1897	.3191
75+	.0432	.1420	.1353	-.0988	.0416	.1370	.0478	1.4762	.0416	.1306

NOTE: For explanation of notation, see appendix C.

Table 5. Table of working life for women, 1977: Derivation of the expectation of active life for the general population

Age	Probability of transition between specified states, age x to age x+1					Age-specific rates of transfer during age interval x to x+1 per 1,000 persons in initial status		
	Living to dead	Inactive to inactive	Inactive to active	Active to inactive	Active to active	Mortality	Labor force accession	Voluntary labor force separation
x	${}^{\cdot d}p_x$	${}^{ii}p_x$	${}^{ia}p_x$	${}^{ai}p_x$	${}^{aa}p_x$	${}^{\cdot d}m_x$	${}^{ia}m_x$	${}^{ai}m_x$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
16	0.00053	0.73236	0.26711	0.30562	0.69385	0.53	374.54	428.54
17	.00059	.75581	.24360	.17867	.82074	.59	309.00	226.64
18	.00062	.71538	.28400	.19546	.80392	.62	373.81	257.27
19	.00063	.67869	.32068	.21170	.78767	.63	437.33	288.70
20	.00064	.66272	.33664	.19141	.80795	.64	457.75	260.28
21	.00065	.66480	.33455	.17455	.82480	.65	449.13	234.33
22	.00066	.67447	.32487	.16531	.83403	.66	430.68	219.16
23	.00066	.69094	.30840	.16111	.83823	.66	403.31	210.70
24	.00067	.70834	.29099	.16039	.83894	.67	376.09	207.29
25	.00068	.72338	.27594	.15667	.84265	.68	352.38	200.06
26	.00069	.74021	.25910	.15198	.84733	.69	326.39	191.45
27	.00071	.76015	.23914	.14597	.85332	.71	296.41	180.92
28	.00073	.77631	.22296	.14114	.85813	.73	272.80	172.70
29	.00076	.78934	.20990	.13622	.86302	.76	254.04	164.87
30	.00080	.79668	.20252	.12935	.86985	.80	243.02	155.22
31	.00084	.80077	.19839	.12011	.87905	.84	236.19	142.99
32	.00089	.79942	.19969	.11070	.88841	.89	236.60	131.17
33	.00095	.80139	.19766	.10508	.89397	.95	233.15	123.95
34	.00103	.80447	.19450	.09908	.89989	1.03	228.22	116.26
35	.00111	.80776	.19113	.09690	.90199	1.11	223.56	113.34
36	.00121	.81138	.18741	.09746	.90133	1.21	218.83	113.80
37	.00132	.81302	.18566	.09655	.90213	1.32	216.47	112.57
38	.00146	.81589	.18265	.09475	.90379	1.46	212.40	110.19
39	.00162	.82036	.17802	.09266	.90572	1.62	206.24	107.36
40	.00180	.82135	.17685	.09144	.90676	1.80	204.65	105.81
41	.00199	.82523	.17278	.09075	.90726	1.99	199.43	104.75
42	.00219	.82888	.16893	.08934	.90847	2.19	194.44	102.82
43	.00240	.83601	.16159	.08883	.90877	2.40	185.20	101.81
44	.00263	.84272	.15465	.08795	.90942	2.63	176.49	100.37
45	.00287	.84581	.15132	.09038	.90675	2.87	172.65	103.13
46	.00314	.85081	.14605	.09107	.90579	3.14	166.26	103.67
47	.00343	.85729	.13928	.09144	.90513	3.44	158.02	103.74
48	.00375	.86181	.13444	.09320	.90305	3.76	152.31	105.59
49	.00409	.87281	.12310	.09353	.90238	4.10	138.65	105.35
50	.00446	.88348	.11206	.09416	.90138	4.47	125.54	105.48
51	.00486	.89035	.10479	.09449	.90065	4.87	116.99	105.49
52	.00528	.89458	.10014	.09534	.89938	5.29	111.61	106.26
53	.00570	.90099	.09331	.09523	.89907	5.72	103.64	105.78
54	.00614	.90811	.08575	.09472	.89914	6.16	94.87	104.78
55	.00659	.91553	.07788	.09756	.89585	6.61	85.96	107.68
56	.00710	.92168	.07122	.10308	.88982	7.13	78.61	113.77
57	.00771	.92796	.06433	.11402	.87827	7.74	71.20	126.20
58	.00847	.93094	.06059	.12784	.86369	8.51	67.49	142.41
59	.00934	.93496	.05570	.14252	.84814	9.38	62.44	159.77
60	.01033	.93936	.05031	.16694	.82273	10.38	57.07	189.35
61	.01135	.94498	.04367	.18998	.79867	11.41	50.05	217.74
62	.01228	.94921	.03851	.21580	.77192	12.36	44.70	250.53
63	.01304	.95159	.03537	.23774	.74922	13.13	41.55	279.26
64	.01373	.95223	.03404	.25932	.72695	13.82	40.49	308.48
65	.01443	.95367	.03190	.27737	.70820	14.53	38.34	333.34
66	.01532	.95469	.02999	.29003	.69465	15.44	36.31	351.14
67	.01650	.95654	.02696	.29913	.68437	16.64	32.80	363.96
68	.01807	.95792	.02401	.30155	.68038	18.23	29.25	367.42
69	.02001	.95890	.02109	.29901	.68098	20.21	25.67	363.92
70	.02209	.95875	.01916	.30904	.66887	22.34	23.49	378.85
71	.02433	.95840	.01727	.31371	.66196	24.63	21.26	386.18
72	.02701	.95825	.01474	.30212	.67087	27.38	18.04	369.84
73	.03023	.95920	.01057	.27706	.69271	30.69	12.76	334.47
74	.03392	.95764	.00844	.25970	.70638	34.51	10.11	311.18
75	.03798	.95900	.00299	.37001	.59199	38.72	3.84	474.73

NOTE: For explanation of notation, see appendix C.

Table 5. Continued—Table of working life for women, 1977: Derivation of the expectation of active life for the general population

Age	Stationary population living in each status at exact age x, per 100,000 persons born			Number of status transfers within stationary population during age interval x to x+1				
	Total	Labor force status		Labor force entries	Voluntary labor force exits	Deaths		
		Inactive	Active			Of actives	Of inactives	Total
x	l_x	$^{i}l_x$	$^{a}l_x$	$^{ia}t_x$	$^{ai}t_x$	$^{ad}t_x$	$^{id}t_x$	$^{d}t_x$
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16	98,210	73,943	24,267	25,378	13,040	16	36	52
17	98,158	61,569	36,589	17,712	9,249	24	34	58
18	98,100	53,072	45,028	18,661	12,388	30	31	61
19	98,039	46,768	51,271	19,541	15,396	34	28	62
20	97,977	42,595	55,382	18,636	14,897	37	26	62
21	97,915	38,829	59,086	16,833	14,155	39	24	64
22	97,851	36,127	61,724	15,224	13,691	41	23	64
23	97,787	34,571	63,216	13,842	13,365	42	23	65
24	97,722	34,071	63,651	12,865	13,160	43	23	66
25	97,656	34,342	63,314	12,176	12,618	43	24	67
26	97,589	34,761	62,828	11,431	11,972	43	24	68
27	97,521	35,279	62,242	10,550	11,199	44	25	69
28	97,452	35,903	61,549	9,884	10,567	45	26	71
29	97,381	36,559	60,822	9,362	9,973	46	28	74
30	97,307	37,143	60,164	9,055	9,315	48	30	77
31	97,230	37,374	59,856	8,797	8,571	50	31	82
32	97,148	37,117	60,031	8,687	7,921	54	33	87
33	97,061	36,318	60,743	8,371	7,575	58	34	92
34	96,969	35,487	61,482	8,002	7,191	64	36	100
35	96,869	34,640	62,229	7,674	7,083	69	38	108
36	96,761	34,011	62,750	7,410	7,151	76	41	117
37	96,644	33,712	62,932	7,273	7,090	83	44	128
38	96,516	33,484	63,032	7,092	6,948	92	49	141
39	96,375	33,292	63,083	6,852	6,771	102	54	156
40	96,219	33,157	63,062	6,769	6,671	114	60	173
41	96,046	33,000	63,046	6,576	6,596	125	66	191
42	95,855	32,954	62,901	6,405	6,458	138	72	210
43	95,645	32,934	62,711	6,115	6,364	150	79	229
44	95,416	33,104	62,312	5,866	6,228	163	88	251
45	95,165	33,378	61,787	5,800	6,335	177	97	273
46	94,892	33,816	61,076	5,665	6,289	191	107	298
47	94,594	34,333	60,261	5,473	6,203	205	119	325
48	94,269	34,944	59,325	5,375	6,208	221	133	353
49	93,916	35,644	58,272	5,005	6,070	236	148	384
50	93,532	36,561	56,971	4,659	5,929	251	166	417
51	93,115	37,665	55,450	4,471	5,767	266	186	453
52	92,662	38,775	53,887	4,386	5,644	281	208	489
53	92,176	39,826	52,350	4,181	5,454	295	231	525
54	91,648	40,867	50,781	3,927	5,236	308	255	563
55	91,085	41,921	49,164	3,657	5,193	319	281	601
56	90,484	43,176	47,308	3,452	5,259	329	313	642
57	89,842	44,672	45,170	3,249	5,534	339	353	693
58	89,149	46,604	42,545	3,220	5,846	349	406	755
59	88,394	48,824	39,570	3,125	6,058	356	470	826
60	87,568	51,288	36,280	3,012	6,507	357	548	905
61	86,663	54,234	32,429	2,795	6,610	347	637	984
62	85,679	57,411	28,268	2,638	6,553	323	729	1,052
63	84,627	60,595	24,032	2,576	6,170	290	814	1,104
64	83,523	63,375	20,148	2,611	5,701	255	892	1,146
65	82,377	65,573	16,804	2,545	5,134	224	965	1,189
66	81,188	67,195	13,993	2,459	4,518	199	1,045	1,244
67	79,944	68,209	11,735	2,247	3,932	180	1,140	1,319
68	78,625	68,755	9,870	2,013	3,351	166	1,255	1,421
69	77,204	68,838	8,366	1,763	2,824	157	1,388	1,544
70	75,660	68,511	7,149	1,601	2,507	148	1,522	1,671
71	73,989	67,895	6,094	1,432	2,180	139	1,660	1,800
72	72,189	66,982	5,207	1,196	1,790	133	1,816	1,950
73	70,239	65,759	4,480	829	1,383	127	1,995	2,123
74	68,116	64,317	3,799	641	1,092	121	2,187	2,311
75	65,805	62,579	3,226	237	1,263	103	2,395	2,499

NOTE: For explanation of notation, see appendix C.

Table 5. Continued—Table of working life for women, 1977: Derivation of the expectation of active life for the general population

Age	Person years lived in each status during age x			Person years lived in each status beyond exact age x		
	Total	Inactive	Active	Total	Inactive	Active
x	L_x	L^i_x	L^a_x	T_x	T^i_x	T^a_x
(19)	(20)	(21)	(22)	(23)	(24)	(25)
16	98,185	67,757	30,428	6,133,675	3,411,047	2,722,628
17	98,130	57,321	40,809	6,035,490	3,343,290	2,692,200
18	98,070	49,920	48,150	5,937,360	3,285,969	2,651,391
19	98,008	44,681	53,327	5,839,290	3,236,049	2,603,241
20	97,947	40,712	57,235	5,741,282	3,191,367	2,549,915
21	97,884	37,479	60,405	5,643,335	3,150,655	2,492,680
22	97,820	35,349	62,471	5,545,451	3,113,176	2,432,275
23	97,755	34,321	63,434	5,447,631	3,077,827	2,369,804
24	97,690	34,207	63,483	5,349,876	3,043,506	2,306,370
25	97,625	34,553	63,072	5,252,186	3,009,299	2,242,887
26	97,557	35,021	62,536	5,154,561	2,974,746	2,179,815
27	97,489	35,592	61,897	5,057,004	2,939,725	2,117,279
28	97,419	36,232	61,187	4,959,515	2,904,134	2,055,381
29	97,346	36,852	60,494	4,862,096	2,867,902	1,994,194
30	97,271	37,259	60,012	4,764,750	2,831,050	1,933,700
31	97,191	37,246	59,945	4,667,479	2,793,791	1,873,688
32	97,107	36,718	60,389	4,570,288	2,756,545	1,813,743
33	97,018	35,904	61,114	4,473,181	2,719,827	1,753,354
34	96,921	35,064	61,857	4,376,163	2,683,924	1,692,239
35	96,813	34,325	62,488	4,279,242	2,648,859	1,630,383
36	96,701	33,861	62,840	4,182,429	2,614,534	1,567,895
37	96,578	33,597	62,981	4,085,728	2,580,673	1,505,055
38	96,444	33,388	63,056	3,989,150	2,547,076	1,442,074
39	96,295	33,224	63,071	3,892,706	2,513,688	1,379,018
40	96,128	33,077	63,051	3,796,411	2,480,465	1,315,946
41	95,945	32,975	62,970	3,700,283	2,447,388	1,252,895
42	95,746	32,943	62,803	3,604,338	2,414,413	1,189,925
43	95,526	33,018	62,508	3,508,592	2,381,470	1,127,122
44	95,285	33,239	62,046	3,413,066	2,348,453	1,064,613
45	95,021	33,594	61,427	3,317,781	2,315,214	1,002,567
46	94,736	34,072	60,664	3,222,760	2,281,619	941,141
47	94,424	34,636	59,788	3,128,024	2,247,547	880,477
48	94,085	35,291	58,794	3,033,600	2,212,911	820,689
49	93,717	36,100	57,617	2,939,515	2,177,620	761,895
50	93,320	37,112	56,208	2,845,798	2,141,520	704,278
51	92,885	38,218	54,667	2,752,478	2,104,408	648,070
52	92,414	39,298	53,116	2,659,593	2,066,190	593,403
53	91,907	40,344	51,563	2,567,179	2,026,892	540,287
54	91,363	41,393	49,970	2,475,272	1,986,547	488,725
55	90,764	42,539	48,225	2,383,909	1,945,155	438,754
56	90,143	43,914	46,229	2,293,145	1,902,616	390,529
57	89,475	45,627	43,848	2,203,002	1,858,701	344,301
58	88,752	47,703	41,049	2,113,527	1,813,074	300,453
59	87,960	50,044	37,916	2,024,775	1,765,371	259,404
60	87,137	52,774	34,363	1,936,815	1,715,327	221,488
61	86,192	55,836	30,356	1,849,678	1,662,552	187,126
62	85,174	59,018	26,156	1,763,486	1,606,716	156,770
63	84,097	62,001	22,096	1,678,312	1,547,699	130,613
64	82,971	64,490	18,481	1,594,215	1,485,698	108,517
65	81,795	66,394	15,401	1,511,244	1,421,208	90,036
66	80,578	67,712	12,866	1,429,449	1,354,813	74,636
67	79,297	68,493	10,804	1,348,871	1,287,101	61,770
68	77,927	68,807	9,120	1,269,574	1,218,608	50,966
69	76,445	68,686	7,759	1,191,647	1,149,801	41,846
70	74,768	68,151	6,617	1,115,202	1,081,115	34,087
71	73,033	67,387	5,646	1,040,434	1,012,964	27,470
72	71,157	66,318	4,839	967,401	945,577	21,824
73	69,121	64,985	4,136	896,244	879,259	16,985
74	66,904	63,395	3,509	827,123	814,274	12,849
75	64,531	61,870	2,661	760,219	750,880	9,339

NOTE: For explanation of notation, see appendix C.

Table 6. Table of working life for women, 1977: Sample derivation of worklife expectancies by labor force status for persons currently age 16

Age	Survivors to exact age x by labor force status at age 16 and at age x						Person years lived by cohort members in each status during age interval x to x+1					
	Persons inactive at 16			Persons active at 16			Persons inactive at age 16			Persons active at 16		
x	Total at x $^{i,16}l_x^{.}$	Inactive at x $^{i,16}l_x^{i}$	Active at x $^{i,16}l_x^{a}$	Total at x $^{a,16}l_x^{.}$	Inactive at x $^{a,16}l_x^{i}$	Active at x $^{a,16}l_x^{a}$	Total at x $^{i,16}L_x^{.}$	Inactive at x $^{i,16}L_x^{i}$	Active at x $^{i,16}L_x^{a}$	Total at x $^{a,16}L_x^{.}$	Inactive at x $^{a,16}L_x^{i}$	Active at x $^{a,16}L_x^{a}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
16	73,943	73,943	0	24,267	0	24,267	73,924	64,047	9,877	24,260	3,709	20,551
17	73,904	54,153	9,751	24,254	7,416	16,837	73,882	49,305	4,577	24,247	8,015	16,231
18	73,861	44,458	9,402	24,239	8,614	15,626	73,838	41,005	2,833	24,232	8,915	15,317
19	73,815	37,552	6,263	24,224	9,216	15,008	73,791	35,357	8,435	24,217	9,324	14,893
20	73,768	33,163	606	24,209	9,432	14,777	73,745	31,456	2,289	24,201	9,256	14,946
21	73,721	29,750	3,971	24,194	9,079	15,114	73,697	28,601	5,096	24,186	8,877	15,309
22	73,673	27,453	6,220	24,178	8,674	15,504	73,649	26,805	6,844	24,170	8,544	15,626
23	73,625	26,157	7,468	24,162	8,413	15,748	73,600	25,939	7,661	24,154	8,382	15,772
24	73,576	25,721	7,855	24,146	8,350	15,796	73,551	25,807	7,744	24,138	8,399	15,738
25	73,527	25,894	7,632	24,130	8,448	15,681	73,501	26,044	7,458	24,122	8,508	15,613
26	73,477	26,194	7,283	24,113	8,568	15,545	73,451	26,384	7,067	24,105	8,636	15,469
27	73,426	26,575	6,851	24,097	8,705	15,392	73,400	26,807	6,593	24,088	8,784	15,304
28	73,374	27,039	6,334	24,080	8,864	15,216	73,347	27,285	6,062	24,071	8,946	15,125
29	73,320	27,531	5,789	24,062	9,029	15,033	73,292	27,750	5,543	24,053	9,102	14,951
30	73,265	27,969	5,296	24,044	9,174	14,869	73,236	28,055	5,180	24,034	9,204	14,831
31	73,206	28,141	5,065	24,025	9,233	14,792	73,175	28,044	5,131	24,014	9,201	14,813
32	73,144	27,947	5,197	24,004	9,170	14,835	73,112	27,646	5,466	23,994	9,071	14,922
33	73,079	27,345	5,734	23,983	8,973	15,010	73,045	27,033	6,012	23,972	8,870	15,101
34	73,010	26,720	6,290	23,960	8,768	15,192	72,972	26,401	6,572	23,948	8,663	15,285
35	72,935	26,082	6,853	23,936	8,559	15,377	72,894	25,845	7,049	23,922	8,481	15,441
36	72,854	25,608	7,246	23,909	8,404	15,505	72,810	25,495	7,314	23,895	8,367	15,528
37	72,766	25,383	7,383	23,880	8,330	15,550	72,717	25,297	7,420	23,864	8,302	15,563
38	72,670	25,212	7,458	23,849	8,274	15,575	72,617	25,139	7,477	23,831	8,250	15,581
39	72,563	25,067	7,497	23,814	8,226	15,588	72,505	25,016	7,489	23,794	8,209	15,585
40	72,446	24,965	7,481	23,775	8,193	15,582	72,381	24,906	7,475	23,754	8,173	15,580
41	72,316	24,846	7,469	23,732	8,154	15,578	72,244	24,829	7,414	23,709	8,148	15,560
42	72,172	24,812	7,360	23,685	8,143	15,542	72,093	24,804	7,288	23,659	8,140	15,519
43	72,014	24,797	7,217	23,633	8,138	15,495	71,927	24,861	7,066	23,605	8,159	15,446
44	71,841	24,925	6,916	23,577	8,180	15,397	71,746	25,028	6,718	23,546	8,214	15,332
45	71,652	25,131	6,521	23,515	8,247	15,267	71,549	25,296	6,253	23,481	8,302	15,179
46	71,446	25,461	5,985	23,447	8,356	15,091	71,334	25,656	5,678	23,410	8,420	14,991
47	71,222	25,850	5,372	23,373	8,483	14,890	71,099	26,080	5,019	23,333	8,559	14,774
48	70,978	26,310	4,668	23,293	8,634	14,659	70,845	26,574	4,271	23,250	8,721	14,529
49	70,711	26,837	3,874	23,206	8,807	14,398	70,567	27,183	3,384	23,158	8,921	14,238
50	70,422	27,528	2,895	23,111	9,034	14,077	70,265	27,944	2,321	23,059	9,171	13,889
51	70,108	28,359	1,749	23,008	9,307	13,701	69,938	28,777	1,160	22,952	9,444	13,508
52	69,767	29,194	573	22,896	9,581	13,315	69,583	29,590	9,993	22,836	9,711	13,125
53	69,399	29,985	9,414	22,775	9,840	12,935	69,201	30,378	8,823	22,710	9,969	12,741
54	69,003	30,770	8,234	22,645	10,098	12,547	68,791	31,167	7,624	22,576	10,228	12,347
55	68,580	31,563	7,016	22,506	10,358	12,148	68,353	32,037	6,317	22,432	10,514	11,918
56	68,128	32,509	5,619	22,358	10,669	11,689	67,886	33,073	4,813	22,279	10,854	11,425
57	67,644	33,634	4,010	22,199	11,038	11,161	67,383	34,363	3,020	22,114	11,277	10,836
58	67,123	35,089	2,034	22,028	11,515	10,513	66,838	35,927	911	21,935	11,790	10,144
59	66,554	36,761	9,793	21,842	12,064	9,777	66,243	37,691	8,552	21,739	12,369	9,370
60	65,932	38,616	7,316	21,638	12,673	8,965	65,592	39,729	5,863	21,526	13,038	8,488
61	65,251	40,835	4,417	21,414	13,401	8,013	64,881	42,034	2,847	21,292	13,795	7,498
62	64,511	43,226	1,284	21,171	14,186	6,985	64,115	44,430	9,685	21,041	14,581	6,460
63	63,719	45,624	8,094	20,911	14,973	5,938	63,303	46,674	6,628	20,775	15,317	5,457
64	62,888	47,717	5,170	20,638	15,660	4,979	62,456	48,548	3,908	20,497	15,932	4,564
65	62,024	49,372	2,652	20,355	16,203	4,152	61,577	49,985	1,591	20,208	16,404	3,804
66	61,129	50,594	535	20,061	16,604	3,457	60,661	50,977	9,684	19,908	16,730	3,178
67	60,193	51,357	8,836	19,754	16,854	2,900	59,696	51,564	8,133	19,591	16,922	2,669
68	59,199	51,768	7,432	19,428	16,989	2,439	58,665	51,800	6,865	19,252	16,999	2,253
69	58,130	51,830	6,299	19,077	17,010	2,067	57,548	51,707	5,841	18,886	16,969	1,917
70	56,967	51,584	5,383	18,695	16,929	1,767	56,338	51,351	4,987	18,489	16,852	1,637
71	55,708	51,120	4,589	18,282	16,776	1,506	55,031	50,774	4,256	18,060	16,663	1,397
72	54,353	50,433	3,920	17,837	16,551	1,287	53,619	49,969	3,649	17,596	16,399	1,198
73	52,885	49,512	3,373	17,356	16,249	1,107	52,086	48,965	3,120	17,093	16,069	1,024
74	51,286	48,426	2,860	16,831	15,892	939	50,416	47,766	2,650	16,545	15,676	870
75	49,546	47,117	2,429	16,260	15,463	797	48,606	46,597	2,008	15,951	15,292	659

NOTE: For explanation of notation, see appendix C.

Table 6. Continued—Table of working life for women, 1977: Sample derivation of worklife expectancies by labor force status for persons currently age 16

Age	Years remaining to be lived in each status					
	By persons inactive at exact age 16			By persons active at exact age 16		
	Total years	Inactive years	Active years	Total years	Inactive years	Active years
x	${}^{i,16}T_x^{\cdot}$	${}^{i,16}T_x^{i}$	${}^{i,16}T_x^{a}$	${}^{a,16}T_x^{\cdot}$	${}^{a,16}T_x^{i}$	${}^{a,16}T_x^{a}$
(14)	(15)	(16)	(17)	(18)	(19)	(20)
16	4,618,114	2,594,080	2,024,034	1,515,561	816,892	698,669
17	4,544,190	2,530,033	2,014,157	1,491,301	813,184	678,118
18	4,470,307	2,480,728	1,989,579	1,467,055	805,168	661,886
19	4,396,470	2,439,724	1,956,746	1,442,823	796,253	646,569
20	4,322,678	2,404,367	1,918,312	1,418,606	786,929	631,677
21	4,248,933	2,372,911	1,876,023	1,394,405	777,673	616,731
22	4,175,236	2,344,309	1,830,927	1,370,219	768,797	601,422
23	4,101,587	2,317,504	1,784,083	1,346,049	760,253	585,796
24	4,027,987	2,291,566	1,736,421	1,321,895	751,871	570,024
25	3,954,436	2,265,758	1,688,678	1,297,757	743,472	554,286
26	3,880,934	2,239,714	1,641,220	1,273,636	734,963	538,672
27	3,807,483	2,213,330	1,594,153	1,249,531	726,327	523,204
28	3,734,083	2,186,523	1,547,560	1,225,442	717,543	507,900
29	3,660,736	2,159,238	1,501,499	1,201,372	708,597	492,775
30	3,587,444	2,131,488	1,455,956	1,177,319	699,495	477,824
31	3,514,208	2,103,433	1,410,776	1,153,284	690,292	462,993
32	3,441,033	2,075,388	1,365,645	1,129,270	681,090	448,179
33	3,367,921	2,047,742	1,320,179	1,105,276	672,019	433,257
34	3,294,877	2,020,710	1,274,167	1,081,305	663,149	418,156
35	3,221,904	1,994,309	1,227,595	1,057,357	654,485	402,871
36	3,149,010	1,968,464	1,180,546	1,033,435	646,004	387,430
37	3,076,200	1,942,969	1,133,232	1,009,540	637,638	371,902
38	3,003,483	1,917,672	1,085,811	985,676	629,336	356,340
39	2,930,866	1,892,533	1,038,334	961,845	621,086	340,758
40	2,858,362	1,867,517	990,845	938,050	612,877	325,173
41	2,785,981	1,842,611	943,370	914,296	604,703	309,593
42	2,713,737	1,817,782	895,955	890,588	596,555	294,033
43	2,641,645	1,792,978	848,667	866,929	588,415	278,514
44	2,569,717	1,768,117	801,601	843,324	580,256	263,067
45	2,497,971	1,743,089	754,882	819,778	572,043	247,736
46	2,426,422	1,717,793	708,629	796,297	563,741	232,556
47	2,355,088	1,692,137	662,951	772,887	555,321	217,566
48	2,283,989	1,666,057	617,932	749,554	546,762	202,791
49	2,213,144	1,639,482	573,662	726,304	538,041	188,263
50	2,142,577	1,612,300	530,278	703,146	529,121	174,025
51	2,072,312	1,584,356	487,956	680,086	519,950	160,136
52	2,002,375	1,555,579	446,796	657,134	510,506	146,628
53	1,932,791	1,525,989	406,803	634,299	500,795	133,504
54	1,863,590	1,495,610	367,980	611,588	490,826	120,763
55	1,794,798	1,464,443	330,355	589,013	480,597	108,415
56	1,726,445	1,432,406	294,039	566,581	470,084	96,497
57	1,658,559	1,399,333	259,225	544,302	459,230	85,072
58	1,591,176	1,364,970	226,205	522,188	447,953	74,236
59	1,524,337	1,329,043	195,294	500,253	436,162	64,091
60	1,458,094	1,291,352	166,742	478,514	423,793	54,721
61	1,392,503	1,251,624	140,879	456,988	410,755	46,233
62	1,327,622	1,209,589	118,033	435,696	396,960	38,736
63	1,263,507	1,165,160	98,347	414,655	382,379	32,275
64	1,200,204	1,118,485	81,719	393,880	367,062	26,818
65	1,137,748	1,069,938	67,811	373,383	351,130	22,254
66	1,076,172	1,019,952	56,219	353,175	334,725	18,450
67	1,015,511	968,975	46,535	333,268	317,996	15,272
68	955,815	917,412	38,403	313,677	301,074	12,603
69	897,150	865,612	31,538	294,425	284,075	10,350
70	839,602	813,905	25,697	275,538	267,105	8,433
71	783,264	762,554	20,710	257,050	250,253	6,797
72	728,234	711,780	16,454	238,990	233,590	5,400
73	674,615	661,811	12,804	221,393	217,191	4,202
74	622,529	612,845	9,684	204,300	201,122	3,178
75	572,113	565,079	7,034	187,755	185,446	2,308

NOTE: For explanation of notation, see appendix C.

Table 7. Table of working life for women, 1977: Expectation of active life by current labor force status

Age	Expectancies of the total population			Expectancies of persons inactive at age x			Expectancies of persons active at age x		
	Total years	Inactive years	Active years	Total years	Inactive years	Active years	Total years	Inactive years	Active years
x	$^{\cdot\cdot}e_x$	$^{\cdot i}e_x$	$^{\cdot a}e_x$	$^{i\cdot}e_x$	$^{ii}e_x$	$^{ia}e_x$	$^{a\cdot}e_x$	$^{ai}e_x$	$^{aa}e_x$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
16	62.5	34.7	27.7	62.5	35.1	27.4	62.5	33.7	28.8
17	61.5	34.1	27.4	61.5	34.7	26.8	61.5	33.0	28.5
18	60.5	33.5	27.0	60.5	34.2	26.3	60.5	32.7	27.8
19	59.6	33.0	26.6	59.6	33.7	25.8	59.6	32.3	27.2
20	58.6	32.6	26.0	58.6	33.4	25.2	58.6	31.9	26.7
21	57.6	32.2	25.5	57.6	33.1	24.5	57.6	31.6	26.1
22	56.7	31.8	24.9	56.7	32.9	23.8	56.7	31.2	25.5
23	55.7	31.5	24.2	55.7	32.6	23.1	55.7	30.9	24.9
24	54.7	31.1	23.6	54.7	32.4	22.4	54.7	30.5	24.3
25	53.8	30.8	23.0	53.8	32.1	21.7	53.8	30.1	23.7
26	52.8	30.5	22.3	52.8	31.9	20.9	52.8	29.7	23.1
27	51.9	30.1	21.7	51.9	31.6	20.2	51.9	29.3	22.6
28	50.9	29.8	21.1	50.9	31.4	19.5	50.9	28.9	22.0
29	49.9	29.5	20.5	49.9	31.1	18.9	49.9	28.5	21.5
30	49.0	29.1	19.9	49.0	30.8	18.2	49.0	28.1	20.9
31	48.0	28.7	19.3	48.0	30.5	17.5	48.0	27.7	20.3
32	47.0	28.4	18.7	47.0	30.2	16.9	47.0	27.3	19.8
33	46.1	28.0	18.1	46.1	29.9	16.2	46.1	26.9	19.2
34	45.1	27.7	17.5	45.1	29.6	15.5	45.1	26.6	18.6
35	44.2	27.3	16.8	44.2	29.3	14.8	44.2	26.2	17.9
36	43.2	27.0	16.2	43.2	29.1	14.2	43.2	25.9	17.3
37	42.3	26.7	15.6	42.3	28.8	13.5	42.3	25.6	16.7
38	41.3	26.4	14.9	41.3	28.5	12.8	41.3	25.2	16.1
39	40.4	26.1	14.3	40.4	28.3	12.1	40.4	24.9	15.5
40	39.5	25.8	13.7	39.5	28.0	11.4	39.5	24.6	14.9
41	38.5	25.5	13.0	38.5	27.8	10.7	38.5	24.3	14.3
42	37.6	25.2	12.4	37.6	27.6	10.0	37.6	23.9	13.7
43	36.7	24.9	11.8	36.7	27.3	9.3	36.7	23.6	13.1
44	35.8	24.6	11.2	35.8	27.1	8.7	35.8	23.3	12.5
45	34.9	24.3	10.5	34.9	26.9	8.0	34.9	23.0	11.9
46	34.0	24.0	9.9	34.0	26.6	7.3	34.0	22.6	11.3
47	33.1	23.8	9.3	33.1	26.4	6.7	33.1	22.3	10.8
48	32.2	23.5	8.7	32.2	26.1	6.1	32.2	21.9	10.3
49	31.3	23.2	8.1	31.3	25.9	5.4	31.3	21.6	9.7
50	30.4	22.9	7.5	30.4	25.6	4.9	30.4	21.2	9.2
51	29.6	22.6	7.0	29.6	25.2	4.3	29.6	20.8	8.8
52	28.7	22.3	6.4	28.7	24.9	3.8	28.7	20.4	8.3
53	27.9	22.0	5.9	27.9	24.5	3.3	27.9	20.1	7.8
54	27.0	21.7	5.3	27.0	24.1	2.9	27.0	19.7	7.3
55	26.2	21.4	4.8	26.2	23.7	2.5	26.2	19.4	6.8
56	25.3	21.0	4.3	25.3	23.2	2.2	25.3	19.1	6.3
57	24.5	20.7	3.8	24.5	22.6	1.9	24.5	18.8	5.8
58	23.7	20.3	3.4	23.7	22.1	1.6	23.7	18.4	5.3
59	22.9	20.0	2.9	22.9	21.5	1.4	22.9	18.1	4.8
60	22.1	19.6	2.5	22.1	20.9	1.2	22.1	17.7	4.4
61	21.3	19.2	2.2	21.3	20.3	1.0	21.3	17.3	4.0
62	20.6	18.8	1.8	20.6	19.7	.9	20.6	16.9	3.7
63	19.8	18.3	1.5	19.8	19.0	.8	19.8	16.4	3.5
64	19.1	17.8	1.3	19.1	18.4	.7	19.1	15.9	3.2
65	18.3	17.3	1.1	18.3	17.8	.6	18.3	15.3	3.1
66	17.6	16.7	.9	17.6	17.1	.5	17.6	14.7	2.9
67	16.9	16.1	.8	16.9	16.4	.4	16.9	14.1	2.8
68	16.1	15.5	.6	16.1	15.8	.4	16.1	13.5	2.7
69	15.4	14.9	.5	15.4	15.1	.3	15.4	12.9	2.6
70	14.7	14.3	.5	14.7	14.5	.2	14.7	12.3	2.4
71	14.1	13.7	.4	14.1	13.9	.2	14.1	11.8	2.3
72	13.4	13.1	.3	13.4	13.2	.2	13.4	11.2	2.2
73	12.8	12.5	.2	12.8	12.6	.1	12.8	10.8	1.9
74	12.1	12.0	.2	12.1	12.0	.1	12.1	10.6	1.5
75	11.6	11.4	.1	11.6	11.4	.1	11.6	10.7	.9

NOTE: For explanation of notation, see appendix C.

Table 8. Table of working life for women, 1977: Indexes of labor force accession and separation

Age	Annual population-based rates of labor force mobility				Events per person alive at exact age x		Events per person at risk during interval		Events remaining per person entering interval	
	Accessions	Total separations	Voluntary separations	Net moves	Accessions	Total separations	Accessions per inactive person	Total separations per active person	Accessions	Voluntary separations
x to x+4	${}_5M_x^{i\;a}$	${}_5M_x^{a\;(i,d)}$	${}_5M_x^{a\;i}$	${}_5M_x^{.\;(.,d)}$	${}_5M_x^{('lx,i)\;a}$	${}_5M_x^{('lx,a)\;(i,d)}$	${}_5m_x^{i\;a}$	${}_5m_x^{a\;(i,d)}$	$E_x^{i\;a}$	$E_x^{a\;i}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
16-19	0.2072	0.1279	0.1276	0.0793	0.8277	0.5109	0.3700	0.2905	4.2692	4.4215
20-24	.1583	.1420	.1416	.0162	.7900	.7090	.4251	.2263	3.4497	3.9210
25-29	.1096	.1160	.1156	-.0065	.5468	.5791	.2996	.1829	2.6684	3.2246
30-34	.0884	.0841	.0836	.0043	.4410	.4198	.2355	.1347	2.1292	2.6573
35-39	.0752	.0735	.0726	.0017	.3747	.3661	.2156	.1128	1.6958	2.2504
40-44	.0663	.0690	.0675	-.0027	.3298	.3430	.1920	.1053	1.3300	1.9014
45-49	.0579	.0681	.0659	-.0102	.2871	.3377	.1573	.1077	1.0113	1.5829
50-54	.0468	.0637	.0607	-.0169	.2312	.3147	.1101	.1108	.7369	1.2780
55-59	.0374	.0662	.0624	-.0288	.1834	.3248	.0727	.1362	.5193	1.0046
60-64	.0320	.0778	.0741	-.0458	.1557	.3781	.0464	.2519	.3494	.7264
65-69	.0278	.0522	.0499	-.0244	.1339	.2511	.0324	.3697	.2059	.3893
70-74	.0161	.0271	.0252	-.0110	.0753	.1271	.0173	.3887	.0785	.1627
75+	.0037	.0537	.0521	-.500	.0036	.0526	.0038	1.3017	.0036	.0511

NOTE: For explanation of notation, see appendix C.

Chapter 4. Evaluation of the Increment-Decrement Worklife Model

There are three key sets of information which any working life table must produce:

1. Estimates of the rate at which people enter and leave the labor force,
2. Estimates of the number of people likely to work at or beyond each age, and
3. Estimates of the number of person years these people will spend in the labor force.

The quality of each of these estimates is important, since together they determine the outcome of the model. Even though the increment-decrement technique still requires some fine-tuning on one of these variables, its estimates have been shown to be much better than those of the conventional model.

Estimates of labor force mobility rates

In the past, rates of "net" labor force accession or separation have been derived from age-to-age comparisons of labor force participation rates. Because these rates were cross-sectional, they provided no direct information about changes in status. Age effects were confounded by cohort effects, so that it was impossible to interpret the "net changes" implied.

The increment-decrement model replaces this inferential approach with direct observations. Tables rest on longitudinal records of real people living through various age intervals. Observed changes in their labor force status are used to determine both net and gross mobility rates.

The conventional model included no standard formula for computing accession or separation rates. Instead, the formula varied with the age, sex, and/or marital and parental status of the group in question. There was no single model for all women, nor were the female tables which were published an exhaustive set. Because the estimation procedure varied from group to group, age and sex differentials in mobility rates were difficult to identify, interpret, or apply.

The increment-decrement technique uses a single formula for any given rate, regardless of age or sex. The resulting differences in group rates can be attributed to real differences in labor force behavior, rather than model bias. Provision of a summary table for all women greatly simplifies comparisons between the sexes.

The conventional model used stocks of workers at each age to determine flows within the age interval. Mobility estimates were a byproduct, having no relationship to worklife expectancies. The increment-decrement technique actually uses observed patterns of movement to determine how long people remain in the labor force.

The original model included a few very crude estimates of labor force mobility, which purported to describe "net" flows. It was not clear that they did so successfully. The multistate model quantifies both net and gross labor force mobility, giving a full picture of the process of labor turnover.

Estimates of number of people likely to work at or beyond age *x*

As the denominator of the worklife expectancy index, this function is inversely related to worklife duration. Understatement of the size of the active population results in overstatement of worklife expectancy.

The conventional model defined the size of its active population very narrowly. Only persons in the labor force at the age of peak labor force participation were viewed as workers. All others were treated as "lifetime inactives." The high rate of turnover among working women guarantees that in any reference week or year a large number of women with work experience will be excluded from the current labor force count. The magnitude of this exclusion is striking. For instance, the 1978 Current Population Survey indicated that 91.5 percent of all American women, and 96.5 percent of those between the ages of 25 and 34, had some work experience. But because the highest single participation rate for women in 1977 was 67.3 percent, the conventional working life table for that year treated one-third of the female population as permanently inactive. This huge understatement of the size of the active group—by nearly one-half—cast a serious upward bias to the worklife expectancy of active women.

By contrast, the increment-decrement model treats every member of the population as a potential worker. Even those inactive at a specific age are viewed as having some future worklife. A separate Markov chain is computed for each age/activity status group, to estimate its future labor force involvement. Drawing a larger number of individuals into the denominator of the index necessarily lowers average worklife durations.

Estimates of person years of labor force attachment

As the numerator of the worklife expectancy index, this function is equally important to meaningful results. Unfortunately, because there is no standard definition for "1 person year of labor force attachment", this concept is difficult to quantify. The life table "person year of life" is intuitively meaningful: 365 days, each lasting 24 hours, or 8,760 hours of life. Developers of the original worklife model adapted this idea to their own calculations. They assumed that labor force attachment was continuous from age of entry to age of permanent labor force withdrawal. Every year survived by a worker was translated into an equivalent person year of labor force attachment. There was no attempt to discount these years for periods of part-year or part-time work.

The increment-decrement tables discussed in this report correct for part of this shortcoming. Moves in and out of the job market at midlife have been identified. People who change status during the year are debited for the portion of the year spent outside the labor force, on the crude assumption that they changed status at midyear. Because a large number of women report part-year activity, this adjustment further depresses their average worklife durations.

However, the tables still sidestep the issue of what a person year of labor force attachment really means. Worklife duration is a function not only of weeks (or years) of continuous activity, but also of hours worked during the week. A fully satisfactory definition of a "person year of activity" would specify a standard unit of time, such as the 2,080-hour year (i.e., 52 weeks at 40 hours per week). Each group's time in the labor force could then be expressed in full-year equivalents, by employing information on normal work patterns for various age/sex groups of the population.

Such an adjustment would greatly improve the quality of worklife expectancy data. Consider text table 12, in which average annual hours of labor force involvement are shown as a ratio to this 2,080-hour standard.[9] Note that the amount of time actually spent in the labor force during the year varies tremendously by age and sex. In 1977 the average teenager worked no more than one-fifth of a standard year. Women averaged less than three-fifths of a full year, even at ages of peak activity. But men 30 to 45 normally worked more than 2,080 hours. If worklife durations were made to reflect the extent of these differences, estimates for men and women would be much more comparable. The disparity between their worklife expectancies would undoubtedly increase. It is also likely that the worklife expectancies of older workers would decrease. The increment-decrement model is flexible enough to accommodate such an adjustment.

Text table 12. Proportion of a standard 2,080-hour year worked by the average individual by sex, selected ages, 1977

Age	Men	Women
16	21.3	13.4
20	71.2	50.9
25	95.0	57.1
30	102.3	49.0
35	106.1	48.6
40	103.3	52.1
45	100.7	51.1
50	97.5	47.9
55	91.2	43.8
60	72.9	34.1
65	31.7	13.7

Other considerations

The multistate model is attractive to labor analysts for a number of other reasons. Its flexibility opens up the chance to explore other aspects of worklife. For instance, it would be possible to look at other labor force statuses, such as time spent employed and unemployed. It should also be possible to see how differentials in mortality rates (for those in and out of the job market) would affect worklife durations.

Another attraction of this model is the simplicity of the premise on which it rests—the model simply spells out what would happen if people continued to enter and leave the labor force at present rates. The few assumptions underlying this technique are easy to understand and explain. And, because the mechanics of the model are straightforward, its results are both predictable and credible.

Finally, the multistate model makes the "bottom line" estimates more accessible to users. It provides one summary set of estimates for all women, and for both sexes gives a full array of work and nonworklife expectancies, by present labor force status.

Areas for further research

Future worklife studies at the Bureau of Labor Statistics will concentrate on the following possible extensions to this model:

1. Introduction of an annual hours index, or some refinement to discount worklife for part-time employment.
2. Development of tables by educational attainment.

[9] Hours of labor force involvement per year have been estimated from data collected in the March 1978 Current Population Survey supplement on work experience during 1977. Each adult's labor force experience during that year has been summarized in an annual hours index, as follows:

$$AH = (W_w + W_u - W_o) * H_u + (W_o * H_p^o)$$

where:

AH = annual hours estimate

W_w = weeks of work reported

W_u = weeks of unemployment or layoff reported

W_o = weeks in "other" time status (i.e. part-time for those normally working full-time, or full-time for those normally working part-time)

H_u = usual hours per week reported, and

H_p^o = usual hours in other status, a proxy value drawn from usual hours of persons with same age, race and sex, who normally worked the other schedule.

3. Extension of the tables to include differential mortality rates.

A final topic which needs to be explored is the relationship between data sources and model outcome. As mentioned earlier, the Current Population Survey offers two sets of information from which to develop transition probabilities: A year-to-year match of individual records (available for any period), and a retrospective questionnaire (used only once every 5 years). Each data set has its own advantages and disadvantages.

Sample size and migration selectivity argue in favor of using retrospective data. Because of the rotation pattern of the CPS sample, only half of all respondents are eligible for a given year-to-year matched file. Of these, some are lost to follow-up due to changes in residence during the interval. On the other hand, retrospective questions are addressed to all members of the full sample who are employed at the time of the survey. Even those who have moved in the past year are interviewed in this questionnaire. The Schoen and Woodrow tables show a heavier volume of labor turnover in 1972 than is apparent in the BLS tables for 1970 and 1977. The difference is particularly evident for young people, the group we are most likely to have lost through migration.

It is possible to expand the size of the matched sample simply by pooling data for several successive months. However, this does not correct for the bias of migration selectivity. Other biases are also likely to affect the data. Both retrospective and matched files are subject to response bias, particularly from those who have been reinterviewed a number of times. The retrospective data are also affected by problems of recall.

A practical consideration in selecting a data source is its availability. While the retrospective file is more complete than the matched data set, it is available at best once every 5 years. Availability of these data is contingent on continued inclusion of the relevant questions in the CPS supplemental questionnaire. On the other hand, matched tapes can be used to develop transition probabilities for any time interval, without collecting any additional information. This facilitates timely reestimation of worklife indexes, a desirable feature in periods of rapid behavioral change. A comparison of transition probabilities from the two data sources for a single time period would probably by quite useful.

Multistate models can be tailored to labor force issues in a number of ways not yet explored. They are highly adaptable and, imaginatively used, should continue to expand our understanding of labor force dynamics.

Appendix A. Revised Tables of Working Life for Men and Women, 1970

Table A-1. Table of working life for men, 1970: Derivation of the expectation of active life for the general population

Age	Probability of transition between specified states during age interval x to x+1					Age-specific rates of transfer per 1,000 persons in initial status during age interval x to x+1		
	Living to dead	Inactive to inactive	Inactive to active	Active to inactive	Active to active	Mortality	Labor force accession	Voluntary labor force separation
x	${}_{\cdot}^{d}p_x$	${}^{i\,i}p_x$	${}^{i\,a}p_x$	${}^{a\,i}p_x$	${}^{a\,a}p_x$	${}^{d}m_x$	${}^{i\,a}m_x$	${}^{a\,i}m_x$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
16	0.00138	0.75996	0.23866	0.29309	0.70553	1.38	325.63	399.88
17	.00161	.78286	.21553	.19653	.80186	1.61	271.96	247.97
18	.00180	.74054	.25766	.20917	.78903	1.80	336.82	273.43
19	.00196	.70178	.29626	.21784	.78020	1.96	399.68	293.89
20	.00211	.68297	.31492	.17897	.81892	2.11	419.23	238.24
21	.00226	.67598	.32176	.15106	.84668	2.26	422.48	198.35
22	.00234	.67286	.32480	.12170	.87596	2.34	419.27	157.10
23	.00232	.67955	.31813	.09802	.89966	2.32	402.77	124.10
24	.00224	.67989	.31787	.07739	.92037	2.24	397.16	96.70
25	.00213	.67061	.32726	.05924	.93863	2.13	406.62	73.61
26	.00202	.65627	.34171	.04457	.95341	2.02	424.46	55.36
27	.00198	.63150	.36652	.03332	.96470	1.98	459.13	41.75
28	.00198	.60380	.39422	.02600	.97202	1.98	500.21	32.99
29	.00203	.58912	.40885	.02076	.97721	2.03	521.90	26.51
30	.00210	.57453	.42337	.01706	.98084	2.10	544.23	21.93
31	.00218	.56240	.43542	.01479	.98303	2.18	563.31	19.13
32	.00228	.53976	.45796	.01314	.98458	2.28	600.66	17.23
33	.00240	.53763	.45997	.01270	.98490	2.40	603.99	16.68
34	.00253	.54563	.45184	.01251	.98496	2.53	590.19	16.35
35	.00269	.56011	.43720	.01331	.98400	2.69	566.06	17.23
36	.00288	.59979	.39733	.01363	.98349	2.88	501.71	17.22
37	.00310	.63615	.36075	.01382	.98308	3.10	445.42	17.07
38	.00347	.66983	.32670	.01408	.98245	3.48	395.32	17.04
39	.00356	.70058	.29586	.01576	.98068	3.57	351.83	18.75
40	.00402	.72859	.26739	.01647	.97951	4.03	312.98	19.28
41	.00440	.75556	.24004	.01671	.97889	4.41	276.70	19.27
42	.00480	.77719	.21801	.01703	.97817	4.81	248.32	19.40
43	.00526	.79208	.20266	.01759	.97715	5.27	229.02	19.88
44	.00574	.79853	.19573	.01705	.97721	5.76	220.37	19.20
45	.00628	.80520	.18852	.01778	.97594	6.30	211.60	19.96
46	.00686	.81948	.17366	.01852	.97462	6.88	193.52	20.63
47	.00749	.81677	.17574	.01825	.97426	7.52	196.17	20.37
48	.00839	.82156	.17005	.01739	.97422	8.43	189.30	19.35
49	.00874	.83295	.15831	.01807	.97319	8.78	175.23	20.00
50	.00974	.84490	.14536	.01944	.97082	9.79	160.04	21.40
51	.01062	.84514	.14424	.02034	.96904	10.68	158.93	22.41
52	.01161	.85166	.13673	.02163	.96676	11.68	150.31	23.78
53	.01276	.86515	.12209	.02260	.96464	12.84	133.38	24.69
54	.01403	.87048	.11549	.02336	.96261	14.13	125.93	25.47
55	.01541	.87161	.11298	.02617	.95842	15.53	123.39	28.59
56	.01686	.87448	.10866	.03166	.95148	17.00	118.93	34.65
57	.01839	.86932	.11229	.03645	.94516	18.56	123.67	40.15
58	.01998	.86572	.11430	.04165	.93837	20.18	126.59	46.12
59	.02168	.86582	.11250	.04841	.92991	21.92	125.16	53.85
60	.02346	.86965	.10689	.06343	.91311	23.74	119.76	71.07
61	.02535	.87154	.10311	.08042	.89423	25.68	116.61	90.95
62	.02742	.87320	.09938	.09865	.87393	27.80	113.57	112.73
63	.02968	.87856	.09176	.11743	.85289	30.13	105.78	135.36
64	.03214	.88353	.08433	.13762	.83024	32.66	98.18	160.22
65	.03480	.89221	.07299	.15614	.80906	35.42	85.57	183.07
66	.03760	.90131	.06109	.17896	.78344	38.32	72.30	211.79
67	.04049	.90471	.05480	.19861	.76090	41.33	65.57	237.64
68	.04349	.90761	.04890	.21224	.74427	44.46	58.97	255.94
69	.04658	.90728	.04614	.22256	.73086	47.69	56.08	270.51
70	.04984	.90743	.04273	.22551	.72465	51.11	52.11	275.00
71	.05334	.90746	.03920	.23067	.71599	54.80	48.04	282.67
72	.05722	.90551	.03727	.23227	.71051	58.91	45.86	285.80
73	.06166	.90220	.03614	.23863	.69971	63.62	44.83	296.01
74	.06663	.89871	.03466	.23728	.69609	68.93	43.16	295.47
75	.07205	.90156	.02619	.23410	.69366	74.74	32.59	291.31

NOTE: For explanation of notation, see appendix C.

Table A-1. Continued—Table of working life for men, 1970: Derivation of the expectation of active life for the general population

Age	Stationary population living in each status at exact age x, per 100,000 persons born			Number of status transfers within stationary population during age interval x to x+1				
	Total	Labor force status		Labor force entries	Voluntary labor force exits	Deaths		
		Inactive	Active			Of actives	Of inactives	Total
x	${}^{.}l_x$	${}^{i}l_x$	${}^{a}l_x$	${}^{ia}t_x$	${}^{ai}t_x$	${}^{ad}t_x$	${}^{id}t_x$	${}^{.d}t_x$
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16	96,781	71,421	25,360	21,675	12,056	42	92	134
17	96,647	61,710	34,937	15,894	9,454	61	94	156
18	96,491	55,176	41,315	17,629	12,049	79	94	174
19	96,317	49,501	46,816	18,07[illegible]	14,402	96	93	189
20	96,128	44,938	51,190	17,773	12,777	113	90	203
21	95,925	39,852	56,073	15,899	11,541	132	85	217
22	95,708	35,410	60,298	13,956	9,789	146	78	224
23	95,484	31,164	64,320	11,811	8,196	153	68	222
24	95,262	27,482	67,780	10,210	6,716	156	58	213
25	95,049	23,931	71,118	8,985	5,362	155	47	202
26	94,847	20,261	74,586	7,828	4,225	154	37	192
27	94,655	16,621	78,034	6,822	3,327	158	29	187
28	94,468	13,097	81,371	5,782	2,732	164	23	187
29	94,281	10,023	84,258	4,613	2,262	173	18	191
30	94,090	7,654	86,436	3,681	1,913	183	14	198
31	93,892	5,872	88,020	2,951	1,694	193	11	205
32	93,687	4,604	89,083	2,481	1,542	204	9	214
33	93,473	3,656	89,817	2,042	1,501	216	8	224
34	93,249	3,106	90,143	1,750	1,474	228	8	236
35	93,013	2,823	90,190	1,586	1,553	243	8	250
36	92,763	2,782	89,981	1,424	1,546	259	8	267
37	92,496	2,895	89,601	1,331	1,525	277	9	287
38	92,209	3,080	89,129	1,265	1,514	309	11	320
39	91,889	3,318	88,571	1,238	1,654	315	13	327
40	91,562	3,721	87,841	1,233	1,685	352	16	368
41	91,194	4,158	87,036	1,211	1,669	382	19	401
42	90,793	4,596	86,197	1,196	1,663	413	23	436
43	90,357	5,040	85,317	1,206	1,687	448	28	475
44	89,882	5,493	84,389	1,247	1,612	483	33	516
45	89,366	5,825	83,541	1,270	1,659	523	38	561
46	88,805	6,176	82,629	1,235	1,694	565	44	609
47	88,196	6,591	81,605	1,321	1,653	610	51	661
48	87,535	6,873	80,662	1,318	1,552	676	59	734
49	86,801	7,049	79,752	1,258	1,585	696	63	759
50	86,042	7,312	78,730	1,202	1,671	765	74	838
51	85,204	7,708	77,496	1,255	1,722	821	84	905
52	84,299	8,091	76,208	1,250	1,795	882	97	979
53	83,320	8,539	74,781	1,175	1,827	950	113	1,063
54	82,257	9,078	73,179	1,177	1,843	1,022	132	1,154
55	81,103	9,612	71,491	1,225	2,017	1,096	154	1,250
56	79,853	10,249	69,604	1,274	2,373	1,164	182	1,346
57	78,507	11,166	67,341	1,442	2,654	1,227	216	1,444
58	77,063	12,162	64,901	1,607	2,933	1,283	256	1,540
59	75,523	13,232	62,291	1,734	3,277	1,334	304	1,637
60	73,886	14,471	59,415	1,846	4,094	1,368	366	1,733
61	72,153	16,354	55,799	2,046	4,883	1,379	451	1,829
62	70,324	18,740	51,584	2,282	5,553	1,370	559	1,928
63	68,396	21,453	46,943	2,423	6,020	1,340	690	2,030
64	66,366	24,360	42,006	2,536	6,323	1,289	844	2,133
65	64,233	27,303	36,930	2,457	6,298	1,218	1,017	2,235
66	61,998	30,127	31,871	2,277	6,214	1,124	1,207	2,331
67	59,667	32,857	26,810	2,226	5,823	1,013	1,403	2,416
68	57,251	35,051	22,200	2,110	5,175	899	1,591	2,490
69	54,761	36,524	18,237	2,067	4,497	793	1,758	2,551
70	52,210	37,196	15,014	1,937	3,779	702	1,900	2,602
71	49,608	37,139	12,469	1,771	3,230	626	2,020	2,646
72	46,962	36,578	10,384	1,654	2,733	563	2,124	2,687
73	44,275	35,534	8,741	1,562	2,389	513	2,217	2,730
74	41,545	34,145	7,400	1,437	2,029	473	2,295	2,768
75	38,777	32,442	6,335	1,030	1,687	433	2,361	2,794

NOTE: For explanation of notation, see appendix C.

Table A-1. Continued—Table of working life for men, 1970: Derivation of the expectation of active life for the general population

Age	Person years lived in each status during age x			Person years lived in each status beyond exact age x		
	Total	Inactive	Active	Total	Inactive	Active
x	L_x	L^i_x	L^a_x	T_x	T^i_x	T^a_x
(19)	(20)	(21)	(22)	(23)	(24)	(25)
16	96,714	66,565	30,149	5,154,552	1,410,537	3,744,015
17	96,569	58,443	38,126	5,057,838	1,343,972	3,713,866
18	96,404	52,339	44,065	4,961,269	1,285,529	3,675,740
19	96,223	47,220	49,003	4,864,865	1,233,191	3,631,674
20	96,027	42,395	53,632	4,768,642	1,185,971	3,582,671
21	95,817	37,631	58,186	4,672,615	1,143,576	3,529,039
22	95,596	33,287	62,309	4,576,798	1,105,944	3,470,854
23	95,373	29,323	66,050	4,481,202	1,072,657	3,408,545
24	95,156	25,707	69,449	4,385,829	1,043,334	3,342,495
25	94,948	22,096	72,852	4,290,673	1,017,627	3,273,046
26	94,751	18,441	76,310	4,195,725	995,531	3,200,194
27	94,562	14,859	79,703	4,100,974	977,090	3,123,884
28	94,375	11,560	82,815	4,006,412	962,231	3,044,181
29	94,186	8,839	85,347	3,912,037	950,671	2,961,366
30	93,991	6,763	87,228	3,817,851	941,832	2,876,019
31	93,790	5,238	88,552	3,723,860	935,069	2,788,791
32	93,580	4,130	89,450	3,630,070	929,831	2,700,239
33	93,361	3,381	89,980	3,536,490	925,701	2,610,789
34	93,131	2,965	90,166	3,443,129	922,320	2,520,809
35	92,888	2,802	90,086	3,349,998	919,355	2,430,643
36	92,630	2,838	89,792	3,257,110	916,553	2,340,557
37	92,353	2,988	89,365	3,164,480	913,714	2,250,766
38	92,049	3,199	88,850	3,072,127	910,727	2,161,400
39	91,726	3,520	88,206	2,980,078	907,527	2,072,551
40	91,378	3,939	87,439	2,888,352	904,008	1,984,344
41	90,994	4,377	86,617	2,796,974	900,068	1,896,906
42	90,575	4,818	85,757	2,705,980	895,691	1,810,289
43	90,120	5,266	84,854	2,615,405	890,873	1,724,532
44	89,624	5,659	83,965	2,525,285	885,607	1,639,678
45	89,086	6,001	83,085	2,435,661	879,948	1,555,713
46	88,501	6,384	82,117	2,346,575	873,947	1,472,628
47	87,866	6,732	81,134	2,258,074	867,563	1,390,511
48	87,168	6,961	80,207	2,170,208	860,831	1,309,377
49	86,422	7,181	79,241	2,083,040	853,870	1,229,170
50	85,623	7,510	78,113	1,996,618	846,689	1,149,929
51	84,752	7,899	76,853	1,910,995	839,179	1,071,816
52	83,810	8,315	75,495	1,826,243	831,279	994,964
53	82,789	8,809	73,980	1,742,433	822,964	919,469
54	81,680	9,345	72,335	1,659,644	814,156	845,488
55	80,478	9,930	70,548	1,577,964	804,811	773,153
56	79,180	10,708	68,472	1,497,486	794,881	702,605
57	77,785	11,664	66,121	1,418,306	784,173	634,133
58	76,293	12,697	63,596	1,340,521	772,509	568,012
59	74,705	13,852	60,853	1,264,228	759,813	504,415
60	73,020	15,413	57,607	1,189,523	745,961	443,562
61	71,239	17,547	53,692	1,116,503	730,548	385,955
62	69,360	20,097	49,263	1,045,264	713,001	332,263
63	67,381	22,906	44,475	975,904	692,904	283,000
64	65,300	25,832	39,468	908,523	669,998	238,525
65	63,116	28,715	34,401	843,223	644,166	199,057
66	60,833	31,492	29,341	780,107	615,451	164,656
67	58,459	33,954	24,505	719,274	583,958	135,316
68	56,006	35,788	20,218	660,815	550,004	110,811
69	53,486	36,861	16,625	604,809	514,217	90,592
70	50,909	37,167	13,742	551,323	477,356	73,967
71	48,285	36,858	11,427	500,414	440,189	60,225
72	45,619	36,057	9,562	452,129	403,330	48,799
73	42,910	34,839	8,071	406,510	367,274	39,236
74	40,161	33,293	6,868	363,600	332,434	31,166
75	37,380	31,590	5,790	323,439	299,141	24,298

NOTE: For explanation of notation, see appendix C.

Table A-2. Table of working life for men, 1970: Expectation of active life by current labor force status

Age	Expectancies of the total population			Expectancies of persons inactive at age x			Expectancies of persons active at age x		
	Total years	Inactive years	Active years	Total years	Inactive years	Active years	Total years	Inactive years	Active years
x	$e_x^{\cdot\,\cdot}$	$e_x^{\cdot\,i}$	$e_x^{\cdot\,a}$	$e_x^{i\,\cdot}$	$e_x^{i\,i}$	$e_x^{i\,a}$	$e_x^{a\,\cdot}$	$e_x^{a\,i}$	$e_x^{a\,a}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
16	53.3	14.6	38.7	53.3	15.0	38.3	53.3	13.4	39.8
17	52.3	13.9	38.4	52.3	14.5	37.8	52.3	12.8	39.5
18	51.4	13.3	38.1	51.4	14.0	37.4	51.4	12.4	39.0
19	50.5	12.8	37.7	50.5	13.5	37.0	50.5	12.0	38.5
20	49.6	12.3	37.3	49.6	13.2	36.4	49.6	11.6	38.0
21	48.7	11.9	36.8	48.7	12.9	35.8	48.7	11.2	37.5
22	47.8	11.6	36.3	47.8	12.7	35.1	47.8	10.9	36.9
23	46.9	11.2	35.7	46.9	12.6	34.4	46.9	10.6	36.3
24	46.0	11.0	35.1	46.0	12.4	33.7	46.0	10.4	35.7
25	45.1	10.7	34.4	45.1	12.2	32.9	45.1	10.2	34.9
26	44.2	10.5	33.7	44.2	12.0	32.2	44.2	10.1	34.2
27	43.3	10.3	33.0	43.3	11.9	31.5	43.3	10.0	33.3
28	42.4	10.2	32.2	42.4	11.7	30.7	42.4	9.9	32.5
29	41.5	10.1	31.4	41.5	11.7	29.8	41.5	9.9	31.6
30	40.6	10.0	30.6	40.6	11.6	29.0	40.6	9.9	30.7
31	39.7	10.0	29.7	39.7	11.5	28.1	39.7	9.9	29.8
32	38.7	9.9	28.8	38.7	11.5	27.2	38.7	9.8	28.9
33	37.8	9.9	27.9	37.8	11.6	26.3	37.8	9.8	28.0
34	36.9	9.9	27.0	36.9	11.7	25.2	36.9	9.8	27.1
35	36.0	9.9	26.1	36.0	11.9	24.1	36.0	9.8	26.2
36	35.1	9.9	25.2	35.1	12.2	22.9	35.1	9.8	25.3
37	34.2	9.9	24.3	34.2	12.5	21.7	34.2	9.8	24.4
38	33.3	9.9	23.4	33.3	12.8	20.5	33.3	9.8	23.5
39	32.4	9.9	22.6	32.4	13.1	19.3	32.4	9.8	22.7
40	31.5	9.9	21.7	31.5	13.4	18.1	31.5	9.7	21.8
41	30.7	9.9	20.8	30.7	13.7	17.0	30.7	9.7	21.0
42	29.8	9.9	19.9	29.8	13.9	15.9	29.8	9.7	20.2
43	28.9	9.9	19.1	28.9	14.0	14.9	28.9	9.6	19.3
44	28.1	9.9	18.2	28.1	14.1	14.0	28.1	9.6	18.5
45	27.3	9.8	17.4	27.3	14.2	13.0	27.3	9.5	17.7
46	26.4	9.8	16.6	26.4	14.4	12.1	26.4	9.5	16.9
47	25.6	9.8	15.8	25.6	14.4	11.2	25.6	9.5	16.1
48	24.8	9.8	15.0	24.8	14.5	10.3	24.8	9.4	15.4
49	24.0	9.8	14.2	24.0	14.6	9.4	24.0	9.4	14.6
50	23.2	9.8	13.4	23.2	14.6	8.6	23.2	9.4	13.8
51	22.4	9.8	12.6	22.4	14.6	7.9	22.4	9.4	13.0
52	21.7	9.9	11.8	21.7	14.6	7.1	21.7	9.4	12.3
53	20.9	9.9	11.0	20.9	14.5	6.4	20.9	9.4	11.6
54	20.2	9.9	10.3	20.2	14.4	5.8	20.2	9.3	10.8
55	19.5	9.9	9.5	19.5	14.2	5.3	19.5	9.4	10.1
56	18.8	10.0	8.8	18.8	14.0	4.8	18.8	9.4	9.4
57	18.1	10.0	8.1	18.1	13.8	4.3	18.1	9.4	8.7
58	17.4	10.0	7.4	17.4	13.6	3.8	17.4	9.4	8.0
59	16.7	10.1	6.7	16.7	13.4	3.4	16.7	9.4	7.4
60	16.1	10.1	6.0	16.1	13.1	3.0	16.1	9.4	6.7
61	15.5	10.1	5.3	15.5	12.9	2.6	15.5	9.3	6.2
62	14.9	10.1	4.7	14.9	12.6	2.3	14.9	9.2	5.6
63	14.3	10.1	4.1	14.3	12.3	1.9	14.3	9.1	5.1
64	13.7	10.1	3.6	13.7	12.0	1.7	13.7	9.0	4.7
65	13.1	10.0	3.1	13.1	11.7	1.4	13.1	8.8	4.3
66	12.6	9.9	2.7	12.6	11.4	1.2	12.6	8.6	4.0
67	12.1	9.8	2.3	12.1	11.0	1.1	12.1	8.3	3.7
68	11.5	9.6	1.9	11.5	10.6	1.0	11.5	8.1	3.5
69	11.0	9.4	1.7	11.0	10.2	.8	11.0	7.8	3.3
70	10.6	9.1	1.4	10.6	9.8	.7	10.6	7.5	3.1
71	10.1	8.9	1.2	10.1	9.4	.7	10.1	7.2	2.9
72	9.6	8.6	1.0	9.6	9.0	.6	9.6	7.0	2.6
73	9.2	8.3	.9	9.2	8.6	.5	9.2	6.9	2.3
74	8.8	8.0	.8	8.8	8.2	.5	8.8	6.9	1.9
75	8.3	7.7	.6	8.3	7.8	.5	8.3	7.0	1.3

NOTE: For explanation of notation, see appendix C.

Table A-3. Table of working life for men, 1970: Indexes of labor force accession and separation

Age	Annual population-based rates of labor force mobility				Events per person alive at exact age x		Events per person at risk during interval		Events remaining per person entering interval	
	Accessions	Total separations	Voluntary separations	Net moves	Accessions	Total separations	Accessions per inactive person	Total separations per active person	Accessions	Voluntary separations
x to x+4	${}_5M_x^{ia}$	${}_5M_x^{a(i,d)}$	${}_5M_x^{ai}$	${}_5M_x^{(.,d)}$	${}_5M_x^{(lx,i)\,a}$	${}_5M_x^{(lx,a)\,(i,d)}$	${}_5m_x^{ia}$	${}_5m_x^{a(i,d)}$	E_x^{ia}	E_x^{ai}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
16-19	0.1919	0.1250	0.1243	0.0669	0.7653	0.4984	0.3298	0.2990	2.6348	2.5351
20-24	.1457	.1040	.1026	.0417	.7245	.5172	.4137	.1606	1.8821	2.0534
25-29	.0720	.0396	.0379	.0324	.3580	.1969	.4490	.0471	1.1707	1.5610
30-34	.0276	.0196	.0174	.0080	.1371	.0972	.5741	.0205	.8210	1.3865
35-39	.0148	.0199	.0169	-.0051	.0736	.0988	.4460	.0206	.6917	1.3153
40-44	.0135	.0230	.0184	-.0095	.0666	.1135	.2533	.0242	.6280	1.2510
45-49	.0146	.0255	.0185	-.0110	.0716	.1255	.1925	.0276	.5752	1.1887
50-54	.0145	.0318	.0212	-.0173	.0704	.1545	.1447	.0353	.5230	1.1400
55-59	.0187	.0498	.0341	-.0311	.0898	.2387	.1237	.0587	.4802	1.1002
60-64	.0321	.0971	.0776	-.0649	.1507	.4550	.1094	.1375	.4285	1.0282
65-69	.0382	.1132	.0959	-.0751	.1734	.5146	.0668	.2642	.3196	.7644
70-74	.0367	.0748	.0621	-.0381	.1601	.3264	.0469	.3430	.1798	.4040
75+	.0275	.1970	.1854	-.1695	.0266	.1899	.0326	1.2719	.0266	.1788

NOTE: For explanation of notation, see appendix C.

Table A-4. Table of working life for women, 1970: Derivation of the expectation of active life for the general population

Age	Probability of transition between specified states during age interval x to x+1					Age-specific rates of transfer per 1,000 persons in initial status during age interval x to x+1		
	Living to dead	Inactive to inactive	Inactive to active	Active to inactive	Active to active	Mortality	Labor force accession	Voluntary labor force separation
x	$p_x^{\cdot d}$	p_x^{ii}	p_x^{ia}	p_x^{ai}	p_x^{aa}	$m_x^{\cdot d}$	m_x^{ia}	m_x^{ai}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
16	0.00057	0.79044	0.20899	0.43084	0.56859	0.57	307.51	633.95
17	.00065	.80352	.19583	.27929	.72006	.65	257.04	366.58
18	.00068	.77437	.22495	.30289	.69643	.68	305.86	411.82
19	.00070	.74897	.25033	.32496	.67434	.70	351.71	456.56
20	.00071	.74191	.25738	.28862	.71067	.71	354.33	397.34
21	.00074	.74797	.25129	.26142	.73784	.74	338.20	351.84
22	.00075	.76209	.23716	.23762	.76163	.75	311.26	311.86
23	.00077	.78084	.21839	.22179	.77744	.77	280.27	284.63
24	.00079	.79759	.20162	.21114	.78807	.79	254.28	266.28
25	.00081	.81290	.18629	.19907	.80012	.81	230.96	246.80
26	.00084	.82888	.17028	.19089	.80827	.84	208.00	233.17
27	.00087	.84239	.15674	.18767	.81146	.87	189.53	226.93
28	.00091	.85181	.14728	.18569	.81340	.91	176.88	223.00
29	.00095	.85754	.14151	.18461	.81444	.95	169.25	220.81
30	.00100	.85992	.13908	.18495	.81405	1.00	166.15	220.95
31	.00108	.86169	.13723	.17932	.81960	1.08	163.23	213.29
32	.00116	.86163	.13721	.17485	.82399	1.16	162.78	207.44
33	.00127	.86151	.13722	.16623	.83250	1.27	161.99	196.24
34	.00138	.86056	.13806	.15921	.83941	1.38	162.41	187.28
35	.00153	.86094	.13753	.15151	.84696	1.53	161.03	177.40
36	.00168	.86088	.13744	.14494	.85338	1.68	160.32	169.08
37	.00183	.85981	.13836	.13803	.86014	1.83	160.86	160.48
38	.00199	.86336	.13465	.13316	.86485	1.99	155.80	154.07
39	.00214	.86572	.13214	.12503	.87283	2.14	151.98	143.81
40	.00231	.86706	.13063	.11880	.87889	2.31	149.61	136.07
41	.00250	.86617	.13133	.11376	.88374	2.50	150.07	129.99
42	.00272	.86732	.12996	.11194	.88534	2.72	148.27	127.71
43	.00297	.86869	.12834	.11245	.88458	2.97	146.37	128.25
44	.00325	.87201	.12474	.11217	.88458	3.26	142.00	127.69
45	.00356	.87672	.11972	.11051	.88593	3.57	135.81	125.36
46	.00388	.88244	.11368	.10788	.88824	3.89	128.37	121.82
47	.00421	.88483	.11096	.10359	.89220	4.22	124.84	116.56
48	.00455	.88778	.10767	.10129	.89416	4.56	120.81	113.66
49	.00491	.89010	.10499	.09882	.89627	4.92	117.52	110.60
50	.00529	.89403	.10068	.09771	.89700	5.30	112.39	109.07
51	.00569	.89762	.09669	.09941	.89490	5.71	107.84	110.88
52	.00614	.90430	.08956	.09832	.89554	6.16	99.49	109.22
53	.00664	.90839	.08497	.09731	.89605	6.66	94.15	107.82
54	.00717	.91144	.08139	.09831	.89452	7.20	90.11	108.84
55	.00775	.91364	.07861	.10071	.89154	7.78	87.05	111.53
56	.00838	.91582	.07580	.10276	.88886	8.42	83.97	113.84
57	.00903	.91719	.07378	.10884	.88213	9.07	81.97	120.92
58	.00969	.92060	.06971	.11636	.87395	9.74	77.65	129.61
59	.01038	.92498	.06464	.12442	.86520	10.43	72.18	138.92
60	.01113	.92871	.06016	.13392	.85495	11.19	67.42	150.06
61	.01198	.93150	.05652	.14972	.83830	12.05	63.83	169.07
62	.01296	.93304	.05400	.16837	.81867	13.04	61.60	192.07
63	.01410	.93534	.05056	.18369	.80221	14.20	58.13	211.22
64	.01539	.93912	.04549	.20365	.78096	15.51	52.83	236.51
65	.01684	.94216	.04100	.22665	.75651	16.98	48.21	266.49
66	.01839	.94590	.03571	.23616	.74545	18.56	42.16	278.82
67	.02012	.94899	.03089	.24884	.73104	20.32	36.71	295.70
68	.02202	.95194	.02604	.25635	.72163	22.27	31.06	305.74
69	.02410	.95307	.02283	.26689	.70901	24.39	27.41	320.42
70	.02632	.95359	.02009	.27589	.69779	26.67	24.27	333.28
71	.02878	.95493	.01629	.29190	.67932	29.20	19.87	356.18
72	.03163	.95470	.01367	.31285	.65552	32.14	16.92	387.22
73	.03501	.95372	.01127	.32738	.63761	35.63	14.10	409.77
74	.03886	.95158	.00956	.33708	.62406	39.63	12.08	425.84
75	.04311	.94783	.00902	.41978	.53707	44.06	12.07	561.54

NOTE: For explanation of notation, see appendix C.

Table A-4. Continued—Table of working life for women, 1970: Derivation of the expectation of active life for the general population

Age	Stationary population living in each status at exact age x, per 100,000 persons born			Number of status transfers within stationary population during age interval x to x+1				
	Total	Labor force status		Labor force entries	Voluntary labor force exits	Deaths		
		Inactive	Active			Of actives	Of inactives	Total
x	$^{\cdot}l_x$	$^{i}l_x$	$^{a}l_x$	$^{ia}t_x$	$^{ai}t_x$	$^{ad}t_x$	$^{id}t_x$	$^{\cdot d}t_x$
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
16	97,581	78,389	19,192	22,851	14,735	13	42	56
17	97,525	70,230	27,295	17,258	11,126	20	44	63
18	97,462	64,055	33,407	18,929	14,637	24	42	66
19	97,396	59,720	37,676	20,521	17,813	27	41	68
20	97,328	56,972	40,356	19,645	16,629	30	39	69
21	97,259	53,916	43,343	17,853	15,634	33	39	72
22	97,187	51,658	45,529	15,850	14,417	35	38	73
23	97,114	50,187	46,927	13,983	13,430	36	38	75
24	97,039	49,596	47,443	12,608	12,626	37	39	77
25	96,962	49,574	47,388	11,468	11,666	38	40	79
26	96,883	49,732	47,151	10,395	10,928	39	42	81
27	96,802	50,223	46,579	9,597	10,467	40	44	84
28	96,718	51,049	45,669	9,110	10,072	41	47	88
29	96,630	51,964	44,666	8,866	9,760	42	50	92
30	96,538	52,807	43,731	8,832	9,575	43	53	97
31	96,441	53,498	42,943	8,757	9,116	46	58	104
32	96,337	53,799	42,538	8,757	8,813	49	62	112
33	96,225	53,793	42,432	8,682	8,354	54	68	122
34	96,103	53,397	42,706	8,620	8,046	59	73	133
35	95,970	52,750	43,220	8,431	7,724	67	80	147
36	95,823	51,962	43,861	8,261	7,476	74	87	161
37	95,662	51,091	44,571	8,137	7,220	82	93	175
38	95,487	50,081	45,406	7,741	7,043	91	99	190
39	95,297	49,284	46,013	7,425	6,665	99	105	204
40	95,093	48,419	46,674	7,177	6,397	109	111	220
41	94,873	47,527	47,346	7,060	6,203	119	118	237
42	94,636	46,553	48,083	6,844	6,175	132	126	257
43	94,379	45,759	48,620	6,658	6,252	145	135	280
44	94,099	45,217	48,882	6,399	6,242	159	147	306
45	93,793	44,913	48,880	6,090	6,115	174	160	334
46	93,459	44,778	48,681	5,747	5,909	189	174	363
47	93,096	44,765	48,331	5,579	5,619	203	189	392
48	92,704	44,616	48,088	5,382	5,449	219	203	422
49	92,282	44,480	47,802	5,218	5,271	235	219	453
50	91,829	44,315	47,514	4,978	5,159	251	235	486
51	91,343	44,262	47,081	4,781	5,183	267	253	520
52	90,823	44,411	46,412	4,434	5,022	283	274	558
53	90,265	44,723	45,542	4,226	4,860	300	299	599
54	89,666	45,058	44,608	4,078	4,799	317	326	643
55	89,023	45,453	43,570	3,977	4,795	334	355	690
56	88,333	45,916	42,417	3,876	4,758	352	388	740
57	87,593	46,410	41,183	3,831	4,894	367	424	791
58	86,802	47,049	39,753	3,688	5,040	379	462	841
59	85,961	47,939	38,022	3,501	5,141	386	506	892
60	85,069	49,073	35,996	3,353	5,232	390	557	947
61	84,122	50,395	33,727	3,268	5,482	391	617	1,008
62	83,114	51,992	31,122	3,257	5,705	387	690	1,077
63	82,037	53,751	28,286	3,175	5,671	381	775	1,157
64	80,880	55,471	25,409	2,978	5,650	370	874	1,245
65	79,635	57,269	22,366	2,803	5,548	354	988	1,341
66	78,294	59,026	19,268	2,517	4,983	332	1,108	1,440
67	76,854	60,382	16,472	2,236	4,492	309	1,238	1,546
68	75,308	61,401	13,907	1,917	3,905	284	1,374	1,658
69	73,650	62,015	11,635	1,702	3,412	260	1,515	1,775
70	71,875	62,210	9,665	1,507	2,943	235	1,656	1,892
71	69,983	61,989	7,994	1,227	2,570	211	1,803	2,014
72	67,969	61,529	6,440	1,034	2,227	185	1,965	2,150
73	65,819	60,756	5,063	849	1,839	160	2,144	2,304
74	63,515	59,603	3,912	710	1,474	137	2,331	2,468
75	61,047	58,036	3,011	690	1,447	114	2,518	2,632

NOTE: For explanation of notation, see appendix C.

Table A-4. Continued—Table of working life for women, 1970: Derivation of the expectation of active life for the general population

Age	Person years lived in each status during age x			Person years lived in each status beyond exact age x		
	Total	Inactive	Active	Total	Inactive	Active
x	L_x	L^i_x	L^a_x	T_x	T^i_x	T^a_x
(19)	(20)	(21)	(22)	(23)	(24)	(25)
16	97,553	74,309	23,244	5,912,732	3,715,185	2,197,547
17	97,494	67,143	30,351	5,815,179	3,640,876	2,174,303
18	97,429	61,887	35,542	5,717,685	3,573,734	2,143,951
19	97,362	58,346	39,016	5,620,256	3,511,846	2,108,410
20	97,294	55,444	41,850	5,522,894	3,453,500	2,069,394
21	97,223	52,787	44,436	5,425,600	3,398,056	2,027,544
22	97,151	50,923	46,228	5,328,377	3,345,269	1,983,108
23	97,077	49,891	47,186	5,231,226	3,294,346	1,936,880
24	97,001	49,585	47,416	5,134,149	3,244,455	1,889,694
25	96,923	49,653	47,270	5,037,148	3,194,870	1,842,278
26	96,843	49,977	46,866	4,940,225	3,145,217	1,795,008
27	96,760	50,636	46,124	4,843,382	3,095,240	1,748,142
28	96,674	51,506	45,168	4,746,622	3,044,604	1,702,018
29	96,584	52,386	44,198	4,649,948	2,993,098	1,656,850
30	96,490	53,153	43,337	4,553,364	2,940,712	1,612,652
31	96,389	53,648	42,741	4,456,874	2,887,559	1,569,315
32	96,281	53,796	42,485	4,360,485	2,833,911	1,526,574
33	96,164	53,595	42,569	4,264,204	2,780,115	1,484,089
34	96,037	53,073	42,964	4,168,040	2,726,521	1,441,519
35	95,897	52,356	43,541	4,072,003	2,673,447	1,398,556
36	95,743	51,527	44,216	3,976,106	2,621,091	1,355,015
37	95,575	50,586	44,989	3,880,363	2,569,564	1,310,799
38	95,392	49,682	45,710	3,784,788	2,518,978	1,265,810
39	95,195	48,851	46,344	3,689,396	2,469,296	1,220,100
40	94,983	47,973	47,010	3,594,201	2,420,445	1,173,756
41	94,755	47,040	47,715	3,499,218	2,372,472	1,126,746
42	94,508	46,156	48,352	3,404,463	2,325,431	1,079,032
43	94,239	45,488	48,751	3,309,955	2,279,276	1,030,679
44	93,946	45,065	48,881	3,215,716	2,233,788	981,928
45	93,626	44,845	48,781	3,121,770	2,188,723	933,047
46	93,278	44,772	48,506	3,028,144	2,143,877	884,267
47	92,900	44,691	48,209	2,934,866	2,099,105	835,761
48	92,493	44,548	47,945	2,841,966	2,054,414	787,552
49	92,056	44,398	47,658	2,749,473	2,009,866	739,607
50	91,586	44,289	47,297	2,657,417	1,965,468	691,949
51	91,083	44,336	46,747	2,565,831	1,921,179	644,652
52	90,544	44,567	45,977	2,474,748	1,876,843	597,905
53	89,966	44,891	45,075	2,384,204	1,832,276	551,928
54	89,345	45,256	44,089	2,294,238	1,787,385	506,853
55	88,678	45,685	42,993	2,204,893	1,742,129	462,764
56	87,963	46,163	41,800	2,116,215	1,696,445	419,770
57	87,198	46,729	40,469	2,028,252	1,650,282	377,970
58	86,382	47,494	38,888	1,941,054	1,603,553	337,501
59	85,515	48,506	37,009	1,854,672	1,556,059	298,613
60	84,596	49,734	34,862	1,769,157	1,507,553	261,604
61	83,618	51,193	32,425	1,684,561	1,457,819	226,742
62	82,576	52,872	29,704	1,600,943	1,406,625	194,318
63	81,459	54,611	26,848	1,518,367	1,353,753	164,614
64	80,258	56,370	23,888	1,436,908	1,299,142	137,766
65	78,965	58,147	20,818	1,356,650	1,242,772	113,878
66	77,574	59,704	17,870	1,277,685	1,184,624	93,061
67	76,081	60,892	15,189	1,200,111	1,124,920	75,191
68	74,479	61,708	12,771	1,124,030	1,064,029	60,001
69	72,763	62,113	10,650	1,049,551	1,002,320	47,231
70	70,929	62,100	8,829	976,788	940,207	36,581
71	68,976	61,759	7,217	905,859	878,107	27,752
72	66,894	61,143	5,751	836,883	816,348	20,535
73	64,667	60,180	4,487	769,989	755,205	14,784
74	62,281	58,819	3,462	705,322	695,026	10,296
75	59,731	57,155	2,576	643,041	636,207	6,834

NOTE: For explanation of notation, see appendix C.

Table A-5. Table of working life for women, 1970: Expectation of active life by current labor force status

Age	Expectancies of the total population			Expectancies of persons inactive at age x			Expectancies of persons active at age x		
	Total years	Inactive years	Active years	Total years	Inactive years	Active years	Total years	Inactive years	Active years
x	$^{..}e_x$	$^{.i}e_x$	$^{.a}e_x$	$^{i.}e_x$	$^{ii}e_x$	$^{ia}e_x$	$^{a.}e_x$	$^{ai}e_x$	$^{aa}e_x$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
16	60.6	38.1	22.5	60.6	38.3	22.3	60.6	37.1	23.5
17	59.6	37.3	22.3	59.6	37.7	21.9	59.6	36.3	23.4
18	58.7	36.7	22.0	58.7	37.1	21.5	58.7	35.8	22.9
19	57.7	36.1	21.6	57.7	36.6	21.1	57.7	35.2	22.5
20	56.7	35.5	21.3	56.7	36.1	20.7	56.7	34.6	22.1
21	55.8	34.9	20.8	55.8	35.7	20.1	55.8	34.0	21.7
22	54.8	34.4	20.4	54.8	35.3	19.6	54.8	33.5	21.4
23	53.9	33.9	19.9	53.9	34.9	19.0	53.9	32.9	21.0
24	52.9	33.4	19.5	52.9	34.5	18.4	52.9	32.3	20.6
25	51.9	32.9	19.0	51.9	34.1	17.9	51.9	31.8	20.2
26	51.0	32.5	18.5	51.0	33.7	17.3	51.0	31.2	19.8
27	50.0	32.0	18.1	50.0	33.2	16.8	50.0	30.7	19.4
28	49.1	31.5	17.6	49.1	32.7	16.4	49.1	30.1	19.0
29	48.1	31.0	17.1	48.1	32.2	15.9	48.1	29.5	18.6
30	47.2	30.5	16.7	47.2	31.7	15.5	47.2	29.0	18.2
31	46.2	29.9	16.3	46.2	31.2	15.0	46.2	28.4	17.8
32	45.3	29.4	15.8	45.3	30.7	14.6	45.3	27.8	17.5
33	44.3	28.9	15.4	44.3	30.2	14.1	44.3	27.2	17.1
34	43.4	28.4	15.0	43.4	29.7	13.6	43.4	26.7	16.7
35	42.4	27.9	14.6	42.4	29.3	13.1	42.4	26.1	16.3
36	41.5	27.4	14.1	41.5	28.9	12.6	41.5	25.6	15.9
37	40.6	26.9	13.7	40.6	28.4	12.1	40.6	25.1	15.5
38	39.6	26.4	13.3	39.6	28.0	11.6	39.6	24.5	15.1
39	38.7	25.9	12.8	38.7	27.7	11.1	38.7	24.0	14.7
40	37.8	25.5	12.3	37.8	27.3	10.5	37.8	23.6	14.2
41	36.9	25.0	11.9	36.9	26.9	10.0	36.9	23.1	13.8
42	36.0	24.6	11.4	36.0	26.5	9.5	36.0	22.7	13.3
43	35.1	24.2	10.9	35.1	26.2	8.9	35.1	22.3	12.8
44	34.2	23.7	10.4	34.2	25.8	8.3	34.2	21.8	12.4
45	33.3	23.3	9.9	33.3	25.5	7.8	33.3	21.4	11.9
46	32.4	22.9	9.5	32.4	25.1	7.3	32.4	20.9	11.5
47	31.5	22.5	9.0	31.5	24.8	6.7	31.5	20.5	11.1
48	30.7	22.2	8.5	30.7	24.4	6.2	30.7	20.0	10.6
49	29.8	21.8	8.0	29.8	24.1	5.7	29.8	19.6	10.2
50	28.9	21.4	7.5	28.9	23.7	5.2	28.9	19.2	9.7
51	28.1	21.0	7.1	28.1	23.4	4.7	28.1	18.8	9.2
52	27.2	20.7	6.6	27.2	23.0	4.3	27.2	18.4	8.8
53	26.4	20.3	6.1	26.4	22.6	3.8	26.4	18.1	8.3
54	25.6	19.9	5.7	25.6	22.1	3.4	25.6	17.7	7.9
55	24.8	19.6	5.2	24.8	21.7	3.1	24.8	17.3	7.4
56	24.0	19.2	4.8	24.0	21.2	2.7	24.0	17.0	7.0
57	23.2	18.8	4.3	23.2	20.8	2.4	23.2	16.7	6.5
58	22.4	18.5	3.9	22.4	20.3	2.1	22.4	16.3	6.0
59	21.6	18.1	3.5	21.6	19.8	1.8	21.6	16.0	5.6
60	20.8	17.7	3.1	20.8	19.2	1.5	20.8	15.6	5.2
61	20.0	17.3	2.7	20.0	18.7	1.3	20.0	15.3	4.7
62	19.3	16.9	2.3	19.3	18.1	1.1	19.3	14.9	4.4
63	18.5	16.5	2.0	18.5	17.6	.9	18.5	14.5	4.0
64	17.8	16.1	1.7	17.8	17.0	.8	17.8	14.1	3.7
65	17.0	15.6	1.4	17.0	16.4	.6	17.0	13.6	3.4
66	16.3	15.1	1.2	16.3	15.8	.5	16.3	13.1	3.2
67	15.6	14.6	1.0	15.6	15.2	.4	15.6	12.6	3.0
68	14.9	14.1	.8	14.9	14.6	.3	14.9	12.1	2.8
69	14.3	13.6	.6	14.3	14.0	.3	14.3	11.6	2.6
70	13.6	13.1	.5	13.6	13.4	.2	13.6	11.1	2.4
71	12.9	12.5	.4	12.9	12.8	.2	12.9	10.7	2.2
72	12.3	12.0	.3	12.3	12.2	.1	12.3	10.3	2.0
73	11.7	11.5	.2	11.7	11.6	.1	11.7	10.0	1.7
74	11.1	10.9	.2	11.1	11.0	.1	11.1	9.7	1.4
75	10.5	10.4	.1	10.5	10.5	.1	10.5	9.7	.8

NOTE: For explanation of notation, see appendix C.

Table A-6. Table of working life for women, 1970: Indexes of labor force accession and separation

Age	Annual population-based rates of labor force mobility				Events per person alive at exact age x		Events per person at risk during interval		Events remaining per person entering interval	
	Accessions	Total separations	Voluntary separations	Net moves	Accessions	Total separations	Accessions per inactive person	Total separations per active person	Accessions	Voluntary separations
x to x+4	${}_5M_x^{ia}$	${}_5M_x^{a(i,d)}$	${}_5M_x^{ai}$	${}_5M_x^{\cdot(\cdot,d)}$	${}_5\dot{M}_x^{(lx,i)\,a}$	${}_5\dot{M}_x^{(lx,a)\,(i,d)}$	${}_5m_x^{ia}$	${}_5m_x^{a(i,d)}$	E_x^{ia}	E_x^{ai}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
16-19	0.2041	0.1498	0.1496	0.0543	0.8153	0.5984	0.3040	0.4557	4.3997	4.4883
20-24	.1646	.1501	.1497	.0145	.8213	.7491	.3091	.3210	3.5937	3.9009
25-29	.1022	.1097	.1093	-.0076	.5099	.5476	.1945	.2312	2.7828	3.1654
30-34	.0907	.0917	.0912	-.0011	.4521	.4574	.1633	.2062	2.2829	2.6314
35-39	.0837	.0765	.0756	.0072	.4167	.3808	.1581	.1625	1.8416	2.1895
40-44	.0723	.0676	.0662	.0047	.3590	.3358	.1473	.1327	1.4380	1.8298
45-49	.0603	.0633	.0611	-.0029	.2987	.3133	.1255	.1219	1.0940	1.5218
50-54	.0497	.0584	.0553	-.0087	.2450	.2879	.1007	.1154	.8123	1.2455
55-59	.0433	.0607	.0565	-.0174	.2120	.2971	.0805	.1315	.5852	1.0036
60-64	.0389	.0719	.0672	-.0330	.1884	.3487	.0605	.2008	.3905	.7608
65-69	.0294	.0629	.0588	-.0334	.1403	.2998	.0369	.3089	.2159	.4644
70-74	.0160	.0359	.0331	-.0199	.0741	.1667	.0175	.4028	.0837	.2037
75+	.0116	.0620	.0601	-.0504	.0113	.0606	.0121	1.4367	.0113	.0588

NOTE: For explanation of notation, see appendix C.

Appendix B. The Conventional Working Life Table

Viewed from the vantage point of the 1980's, the conventional working life table seems to rest on several unwarranted assumptions. Among these are the following:

- That age-specific labor force participation rates never change.
- That in any birth cohort, all members who will ever work have entered the labor force before any voluntarily withdraw.
- That every man enters and leaves the labor force only once.
- That all entries and exits of women are due to changes in marital or parental status, and that apart from final retirement they occur for no other reason.
- (In a separate portion of the model) that the marital and parental status of women is fixed for life.

However questionable they may seem, none of these assumptions was introduced arbitrarily. Each performs a specific function in the conventional worklife model. The following discussion should clarify why these assumptions are necessary to that model, and how they affect its outcome.

Actuarial tables: The prototype for worklife models

The purpose of an actuarial or "life" table is to illustrate the long-term implications of prevailing mortality rates. The first such table was published in 1693, making this the oldest demographic model in use today.[1] Life tables translate the mortality rates of a real population into average life expectancy values for a model population. The expectancy function indicates how much longer the typical x-year-old would live, given no change in age-specific death rates during his or her lifetime.

The basic life table functions are shown in table B-1. These functions underlie not only actuarial, but also working life tables. A quick review of their interrelationships will facilitate the discussion which follows.

The stationary population. Central to all life table methodology is the concept of a stationary population. This hypothetical population is characterized by several important features:

ASSUME:
1. That each year 100,000 persons of the same sex are born into this population.
2. Each birth cohort lives through its lifespan, at every age facing age-specific mortality risks observed in the corresponding base population during the reference year.
3. These age-specific mortality rates do not change over time. Every birth cohort loses the same number of members as it passes through the age interval x to $x + 1$.
4. Each birth cohort is a *closed population*: Entrances occur only at birth, exits only through death. There are no migrants.
5. In the population as a whole, deaths exactly offset births. The size of the total population and the numbers in each age group are constant over time.

Every life table rests on this same set of assumptions, differing only with respect to the specific mortality rates introduced.

Because there are no immigrants or emigrants in this stationary world, the age structure of this standard population is completely determined by the age pattern of deaths. Population and vital statistics from the reference population are used to develop a schedule of death rates, denoted m_x for any age x. These are computed as:

$$m_x = \frac{D_x}{P_x} \qquad (1)$$

where:

D_x = deaths of persons age x during a given year

P_x = midyear population of persons age x during the same reference year.

The popular convention for identifying age is to cite the age reached at one's last birthday. Consequently, in survey or vital statistics, the average "x year old" is actually $x + .5$ years of age. Thus the observed rate is really a "central death rate," describing the incidence of deaths between the ages of $x + .5$ and $x + 1.5$.

Life tables model changes in behavior from one exact age to the next, or from age x to age $x + 1$. Central death rates are centered on the appropriate interval, and thereby converted into life table mortality rates, denoted q_x, using the following formula:

$$q_x = \frac{2m_x}{2 - m_x}. \qquad (2)$$

The life table mortality rates are displayed in column 1 of table B-1.

These rates are applied sequentially to survivors of a birth cohort of 100,000 to "age" it through its lifespan until the last remaining member dies. In the life table, the function l_x represents survivors alive at the beginning of each age. Deaths in that age group, denoted d_x, are the product of these survivors and the probability of death during the interval:

$$d_x = l_x * q_x. \qquad (3)$$

Deaths are subtracted from persons alive at the beginning of the age to determine persons alive at the beginning of the next age:

$$l_{x+1} = l_x - d_x. \qquad (4)$$

Repeating this process for each pair of ages, the life table generates a profile of survivors (l_x) from a schedule of events (d_x). The l_x function has as its time reference the beginning of each age. For many purposes it is useful to look at survivors to the middle of each age, L_x. This function is a simple variant of the l_x value, recentered on age $x + .5$. Assuming that deaths are evenly distributed throughout the age, half should have occurred by the midpoint of the interval.[2] Therefore the average number of "*x* year olds" should be:

$$L_x = \frac{(l_x + l_{x+1})}{2}. \qquad (5)$$

Both the l_x and the L_x functions describe the stationary population. They differ only with respect to precise age reference.

The L_x function is especially powerful, because it lends itself to multiple interpretations. It is first of all a *population* function, indicating the number of cohort survivors alive during each successive age interval. As such it provides a *longitudinal profile* of the cohort's life experience. But, in an unchanging population, the number of persons alive in each age group is permanently fixed. Hence, L_x is also a *cross-sectional profile* of the full stationary population at any given moment. Perhaps its most interesting application is as a measure of *time*. Each individual who survives through an age is said to live *1 person year of life* at that age. Those who die during the age are assumed to live an average of a half-year. Hence L_x quantifies not only the average number of persons alive in the age group, but also total person years lived by the group passing through that age.

It is this time interpretation which enables us to estimate the average life expectancy.[3] The L_x function can be summed from any given age to the end of the table, to determine the collective number of years left to be lived by the birth cohort now aged *x*. Symbolically, T_x or remaining person years of life at age *x* is computed as:

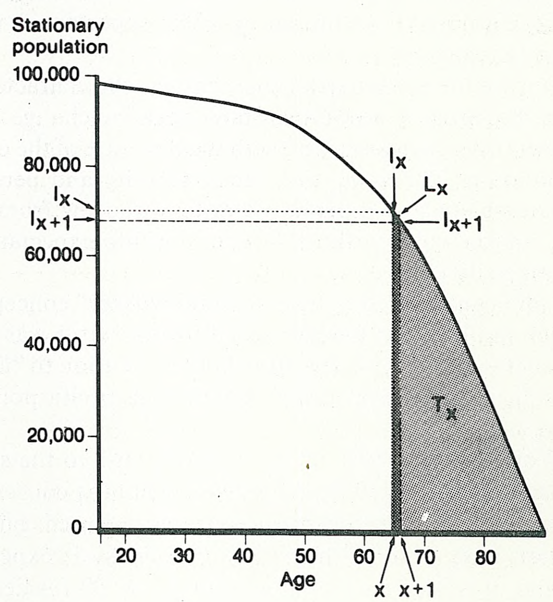
$$T_x = \sum_{\text{age} = 85+}^{x} L_x. \qquad (6)$$

Life expectancy. The expectation of life at age *x* is then simply the average number of years remaining to be lived per person alive at the beginning of the age.

$$e_x = \frac{T_x}{l_x}. \qquad (7)$$

Figure B-1 shows these functions graphically. Points along the descending survivorship curve represent survivors to each exact age (l_x), and within the corresponding

Figure B-1. **Life table functions, men, 1977**



age interval (L_x). The area beneath the curve represents time lived by the surviving population. The heavily shaded area represents person years lived by the cohort passing through the xth interval, (L_x). The entire shaded area denotes years left to be lived by the group beyond that exact age, (T_x).

This calculation is possible because of the restrictive nature of the stationary population. It is closed to entries beyond birth. Everyone who will live beyond a given age is alive and counted at that precise age. Remaining person years are directly attributable to these persons.

Three key life table functions. The three key variables in the basic life table are: 1) T_x, person years of life left to be lived beyond exact age x, 2) l_x, the number of persons who will collectively live these years and 3) q_x, the rate of withdrawal from the life table population through death. The ratio of the first two establishes life expectancy for members of the stationary population. The third is an index of mobility between alternative states (i.e., alive or dead).

Evolution of the working life table

Although this relationship between events and time (i.e., deaths and life expectancy) was modeled nearly three centuries ago, it remains the basis for life table estimation today.

Until the middle of the 20th century, researchers saw no connection between the actuarial model and labor force issues. It could be argued that it had no relevance until the human lifespan lengthened sufficiently, and the economic support system broadened enough, to facilitate retirement. Until that time, life and worklife expectancies were nearly identical.

During the early part of this century, the character of work patterns in the United States began to change. Life expectancies increased, and with them the size of the older population. The advent of social security and pension programs enabled older workers to withdraw from the job market voluntarily. Life and worklife expectancies began to diverge.

Labor analysts found the "gainful worker" concept—which implied that the individual's work status was permanent—obsolete. They shifted their attention to "labor force" variables, measuring behavior at a specific point in time.

Working life tables emerged in response to the same considerations. In 1938, Woytinsky, who was concerned with the "old age dependency problem," used gainful worker data to develop the first estimates of "expected period of work." (See Bibliography, entry 60.) A decade later, Durand employed the newer concept to measure the "average number of years in the labor force" (2). The connection between these indexes and life tables was finally bridged by Seymour Wolfbein of the Bureau of Labor Statistics in 1950. In that year, BLS released its first Tables of Working Life for Men, based on the labor force participation rates observed in 1940 and 1947 (48).

The working life table grafted labor force participation rates (themselves new data) onto the stationary population, to obtain a stationary labor force from which to estimate worklife expectancies. The objectives were initially modest. BLS economists intended the model to reveal trends in old-age dependency, to show the impact of age structure on labor force replacement needs, and to measure rates of labor force growth. The expectancy values would serve as "social indicators," documenting change. Wolfbein's study warned that: "the table of working life... shows what might be expected for men of a given age, if the prevailing rates of mortality and of labor force participation should remain unchanged over their life span. Like the standard life table, it is not a forecast of future trends."

Users quickly overlooked this caveat. Because there were no official forecasts of individual work duration, the worklife expectancy index quickly filled that void. Today their primary use is in the estimation of lost earnings associated with liability claims. This application takes the index well beyond its intended meaning, and assumes a higher degree of accuracy than was initially claimed. Pressure from a growing forensic market has stimulated continual research in this area, and has led to many modifications and extensions of the model.

The Department of Labor has published working life tables for both sexes, based on decennial census activity rates for 1940, 1950, and 1960 (7, 8, 9, 11). The accelerated pace of change in these rates first led to mid-decade estimates, based on Current Population Survey (CPS) data in 1968 (4). Pooled CPS data for 1969 to 1971 formed the basis for the 1970 tables of working life (6).

The basic worklife model has been used to explore a variety of labor force issues. Garfinkle employed it to examine trends in worklife duration since 1900, and—in conjunction with CPS data—to examine patterns of job mobility (9, 10). Fullerton adapted the model to real cohort data in his Generational Working Life Tables (5). He also used it to explore the implications of projected labor force participation rates.[4] Although potential applications are numerous, a growing disparity between patterns of behavior described in the original model and those observed in real populations has prevented full exploitation of these tables.

Mechanics of the conventional working life table

The conventional working life table for men for 1977 appears as table B-2. This male model is a direct extension of the actuarial model, with objectives and terms paralleling those in the basic life table. There are two distinct sections to the actuarial table. One deals with mobility rates between life statuses (i.e., alive or dead), while the second deals with life expectancy. The worklife model also has two sections, one focusing on rates of labor force mobility and a second on worklife expectancies. In the conventional working life table, these two sections are independent of one another, resting on somewhat contradictory assumptions about labor force behavior. However, both build on the premises that:

ASSUME: 6. The age-specific labor force participation rates observed in the base population during the reference period (denoted w_x) accurately reflect

a. the individual's probability of labor force attachment at each age *x*, and

b. the average portion of the year spent in the labor force by persons alive at age *x*.

Assuming these to be true, a complete worklife model can be derived from the schedule of activity and death rates observed in the real world.

The basic life table functions of table B-1 are repeated in the first eight columns of the working life table. However, the death function, d_x, and the mortality rate, q_x, also appear in a new form. Whereas the life table expressed these functions as changes between birthdays ($d_x = l_x - l_{x+1}$), the conventional model restates them (and other functions) in terms of changes between age groups ($D_x = L_x - L_{x+1}$).

Actual worklife functions begin in column 10. The population of interest in this model is the stationary labor force. It follows from assumption 6a above that this labor force must be the product of survivors to any given age and the corresponding age-specific activity rate (w_x). Just as there are two survival functions, l_x and L_x, there are also two labor force functions, lw_x and Lw_x. At exact age *x*:

$$lw_x = l_x * w_x \tag{8}$$

whereas in the age interval *x* to *x + 1*:

$$Lw_x = L_x * w_x . \tag{9}$$

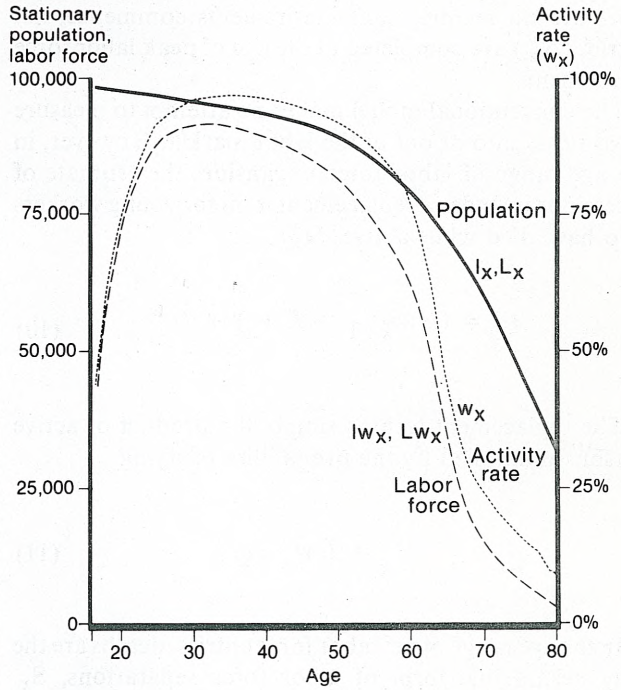
As figure B-2 illustrates, the activity rate function w_x is parabolic. When multiplied by the monotonic survival functions, it produces stationary labor force values which are also parabolic in form. That is, although the population as a whole gains no entrants except through birth, the stationary labor force acquires its entire membership after the age of 16. In its phase of expansion, it is an *open* labor force.

In fact, designers of the model constrained it to a *limited entry* labor force by making the following assumptions:

ASSUME: 7. That there is no turnover of male workers. Every man who enters the labor force does so only once, remaining continuously active from entry until permanent retirement or death.

8. That in any given birth cohort, movement into or out of the labor force is basically unidirectional. Prior to the age of peak labor force involvement, men enter but do not voluntarily withdraw. (A few die.) After that age, workers retire or die, but none reenters the job market.

Figure B-2. **Working life table functions, men, 1977**



Labor force mobility rates of men. With the addition of a third premise, these assumptions establish a stationary (i.e., unchanging) labor force. This premise is:

ASSUME: 9. That the rate of labor force participation at each age is constant over time.

In an unchanging world, the Lw_x curve of figure B-2 can be interpreted both as a cross-section of the entire labor force, and as a lifetime activity profile for a single birth cohort. Playing these two interpretations against one another, estimates of the net flow of workers into and out of the labor force are derived from cross-sectional comparisons of the stock of workers at successive ages. (Flows are *not* estimated from data on observed changes in labor force status.)

For *young male workers*, columns 21 through 28 illustrate the estimation procedure for labor force mobility rates. In this limited entry labor force, all age-to-age increases in the Lw_x function are interpreted as net accessions to the labor market. Since it is assumed that all workers are active before any begin to retire and that there are no reentries once retirements commence, net entries (A^*_x) are completed at the age of peak labor force attachment.

The conventional model makes no attempt to measure gross flows into or out of the labor market. However, in the age range of labor force expansion, the estimate of accessions includes a replacement term for young workers who have died while active, D^w_x.

$$A^*_x = (Lw_{x+1} - Lw_x) + D^w_x \tag{10}$$

The replacement term is simply the product of active persons multiplied by the probability of dying.

$$D^w_x = Lw_x * Q_x \tag{11}$$

In the age range of net labor force entries, deaths are the only permissible form of labor force separations, S_x. Therefore:

$$S_x = D^w_x. \tag{12}$$

For the same reason, the labor force separation rate (Q^s_x) at pre-peak ages is exactly equal to the death rate for the same age.

$$Q^s_x = Q_x \tag{13}$$

The rate of labor force entries (A_x) is computed as a ratio of entries to persons alive in the given age range:

$$A_x = \frac{A^*_x}{L_x}. \tag{14}$$

For *older men*—beyond the peak age of labor force involvement—the stationary labor force changes from an expanding to a contracting body. The way in which it contracts resembles, but is more complex than, the contraction process for the population as a whole.

Recall that, in the actuarial model, population losses occurred only through death. The rate of such losses was denoted q_x (for events between birthdays) or Q_x (between age intervals). Among older workers, the worklife model shows two forms of labor force loss: Death and retirement. Each is measured between age intervals, paralleling the Q_x term. Separation functions are integrated into the notational system as follows:

Q^s_x = rate of total labor force separations between age intervals x and $x+1$

Q^d_x = rate of separations due to death, and

Q^r_x = rate of separations due to permanent retirement.

From the age of peak labor force involvement to the end of the lifespan, the Lw_x function gradually declines. All age-to-age drops are interpreted as labor force separations.

$$S_x = (Lw_x - Lw_{x+1}) \tag{15}$$

The ratio of these separations to persons alive and active in the interval is the corresponding separation rate.

$$Q^s_x = \frac{S_x}{Lw_x} \tag{16}$$

Since the denominator of this ratio includes everyone at risk of leaving the labor force in the interval, Q^s_x is also the probability of labor force separation.

By definition, total separations (S_x) are the sum of deaths of workers (D^w_x) and retirements (R_x). Once the appropriate separation and death rates are established, the retirement rate follows as a residual. Because we have no statistical evidence to the contrary, it is assumed that:

ASSUME: 10. The age-specific death rate for persons in the labor force is the same as that for the population as a whole.

The death rate of workers is a ratio of events (i.e., deaths of workers) to persons at risk of this event (i.e., the active population). However, certain members of the active population are not at risk of death, while working for the full year. Assuming retirements to be evenly spaced over the interval, the average retiree would be at risk of so doing for just half of the year during which he or she retired. Therefore the rate of deaths among workers, Q^d_x, is:

$$Q^d_x = \frac{D^w_x}{Lw_x - .5R_x}. \tag{17}$$

For the same reason, the rate of retirement, Q^r_x, excludes half of the workers who die during the interval from the "at risk" base:

$$Q_x^r = \frac{R_x}{L\,w_x - .5D_x^w} \qquad (18)$$

Solving algebraically, the computational formulas for these two probabilities are:

$$Q_x^d = \frac{Q_x(2-Q_x^s)}{2-Q_x}, \text{ and} \qquad (19)$$

$$Q_x^r = Q_x^s - Q_x^d . \qquad (20)$$

Labor force mobility rates of women. The assumption of continuous labor force attachment was never well suited to estimates of female labor force behavior. Therefore the designers of the model devised an alternative procedure for quantifying female labor force entries and exits:

ASSUME: 11. That women may enter (or reenter) the labor force in response to any of the following demographic changes in their lives: Their own aging, that of their children (reaching school age), or the loss of a husband.

12. That women may leave the labor force temporarily or permanently for any of the following reasons: Marriage, the birth of a first child, retirement, or death.

Under these conditions, rates of entry and withdrawal depend not only on age—the motivating factor for men—but also on changes in marital and parental status, and corresponding status differentials in the propensity to work.

The conventional model for women estimates the number who flow between various marital and parental groupings, from one age to the next. The groups considered are the never-married; the ever-married (never a mother); the ever-married (children under 5); the ever-married (no children under 5); and the separated, widowed, and divorced. Transitions between these states carry with them certain implied probabilities of labor force entry or withdrawal.

In regard to *accessions*, the model identifies just three situations associated with a woman's entry into the labor force: Her own age, the age of her children, and the loss of a husband. There exists some differential in labor force participation between the age/status group from which a woman passes and that into which she moves. The number of transitions between these two states is weighted by the magnitude of this differential to infer total changes in labor force status. For instance, in the case of a loss of a husband:

$$A_x^{lh} = (L_x^h)(1-Q_x) * W_x^o{+1} - W_x^h \qquad (21)$$

where:

A_x^{lh} = accession of women age ***x***, due to the loss of a husband

L_x^h = the stationary population of women age ***x*** with a husband present

W_{x+1}^o = the activity rate of women in all other marital statuses at age ***x+1***

W_x^h = the activity rate of women age ***x*** with husbands present.

The other formulas used to estimate female labor force accessions are outlined in the *Tables of Working Life for Women, 1950* (7). The three separate estimates of entry by cause are combined to arrive at a model estimate of the total number of labor force entries for women of the given age.

Similarly, for *separations*, differential rates of labor force participation are used to infer numbers of labor force withdrawals associated with marriage, childbearing, retirement, and death. For example, separations due to childbirth would be estimated as:

$$S_x^c = BR_x\left(1 - \frac{W_{x+1}^{m_c<5}}{W_x^{mcn}}\right) \qquad (22)$$

where:

S_x^c = separations due to childbearing among women age ***x***

BR_x = the birth rate for the married, never-mother population age ***x***

$W_x^{mc<5}$ = the activity rate for ever-married women with children under 5 years of age, when they themselves are age ***x***

W_x^{mcn} = the activity rate for ever-married women with no children.

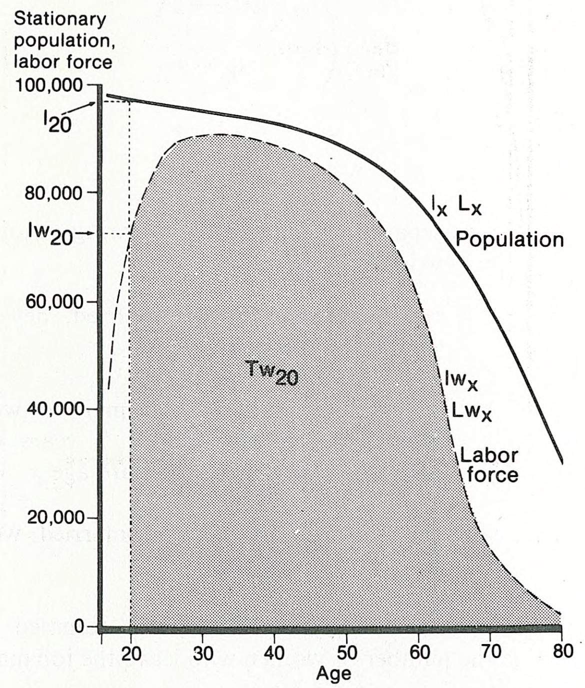
Here, too, the various types of exits are summed to determine the number of women who leave the job market at each age.

As these equations suggest, the conventional model is both more complex and more demanding of data for women than it is for men. In both cases the flow of workers is estimated from cross-sectional comparisons of stocks of workers in successive age groups. However, because of the difference in procedures used, estimates for women are not directly comparable with those for men.

The average worklife expectancy of the population. The limited entry labor force variable lw_x is useful not only in the study of accessions, but also as a clue to the average worklife duration of the total population. Recall that life expectancy is a ratio of total years of life remaining to the persons at risk of living them (equation 7, above). The worklife model includes a similar ratio, the worklife expectancy of the population alive at age x.[5] In both instances the base of the ratio over which time is to be averaged is persons alive at the beginning of the appropriate age, l_x.

The numerator of the worklife ratio is an extension of the T_x concept introduced above. Just as a person living through the year contributes 1 person year of life to the group total, a worker surviving the year in the labor force contributes 1 person year of work. L_x summarizes person years of life lived by the group in the interval, Lw_x the aggregate worklife experience of the age. The latter function is summed from any age x to the end of the table to derive Tw_x, total person years of work remaining to be lived by the group in its lifetime. The worklife expectancy of the typical person age x, ew_x, is then a simple average.

Figure B-3. **Life table functions underlying worklife expectancy of the total population, men, 1977**



The procedure is shown graphically in figure B-3. The stationary population (l_x) is comprised of two groups: Those active at age x (lw_x) and those not active at that age ($l_x - lw_x$). As a typical birth cohort passes through its lifespan, it traces out the labor force curve shown in figure B-3. Between any age x and the end of that lifespan, members of the group will live Tw_x person years of economic activity. Thus the average worklife expectancy for any person surviving to exact age x is simply:

$$ew_x = \frac{Tw_x}{l_x} \quad \text{years.} \qquad (23)$$

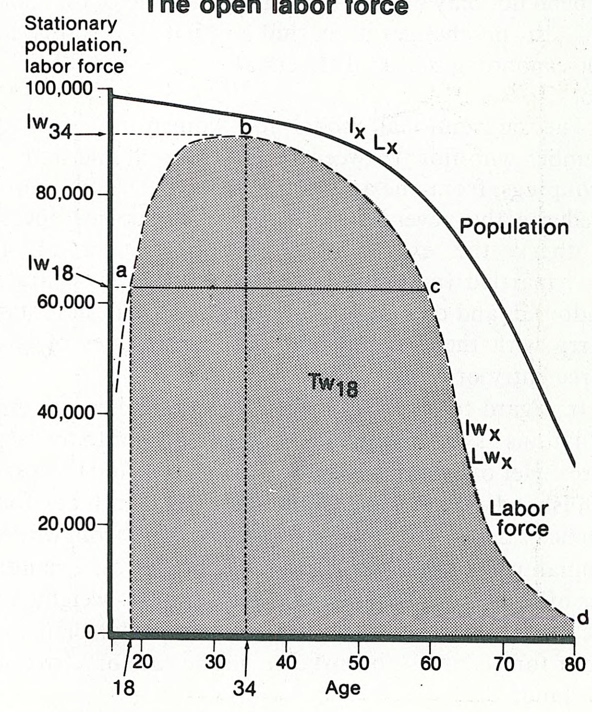
The worklife expectancy of the active population: The closed stationary labor force. Courtroom applications of these data frequently involve adults who have or have not been working. When serious injury cuts short a worker's economically active life, users normally want to identify a more focused value—the worklife expectancy of active persons.

This index is computed by relating total worktime remaining, the Tw_x function, to persons likely to work now or in the future. In life table terms, the worklife expectancy of the active population is:

$$ew'_x = \frac{Tw_x}{lw_x}. \qquad (24)$$

Beyond the age at which participation rates peak and net accessions end (e.g., 34 in figure B-4), the calculation is straightforward. The denominator lw_x includes everyone who will ever work again, and the ratio is substantively meaningful.

Figure B-4. **Life table functions underlying worklife expectancy of the active population, men, 1977: The open labor force**



However, the same ratio makes less sense when applied to the pre-peak ages. For instance, at age 18 many of the eventual workers ($lw_{34} - lw_{18}$) are not yet active. The total worktime circumscribed by the Lw curve beyond this age (***abcd***) includes a large component of worktime (***abc***) to be contributed by persons still outside the labor force. Computing a ratio of work years remaining (the entire shaded area Tw_{18}) to persons actually in the labor force at 18, lw_{18}, would necessarily overstate the average duration of active life for this group. The numerator and denominator must be reconciled before a meaningful average can be computed for these younger workers.

The developers of the worklife model reconciled the two by devising a "closed labor force" variable, lw'_x. This "closed" labor force was defined to include everyone who would ever work during his or her lifetime.

ASSUME: 13. That every person who will eventually work can be identified as a member of the "closed" labor force from age 16 until the age of permanent retirement or death.

Assumption 8 implied that nearly every member of the ever-active population would be working simultaneously at the age of peak labor force attachment. If one accepts this premise, it is a simple matter to survive the peak labor force backward to age 16. This is done by multiplying the peak participation rate, w'_x by survivors to each pre-peak age. The product, lw'_x is an estimate of the "closed labor force," or the eventually active population (figure B-5). The Lw'_x and Tw'_x functions follow directly from lw'_x. For pre-peak ages[6] equation 24 is restated as:

$$ew'_x = \frac{Tw'_x}{lw'_x} \qquad (25)$$

Closing the stationary labor force in this way resolves the conflict between terms in equation 24. The adjusted functions are now read from a smoothly descending survivorship curve. Worktime is now averaged over the model's best estimate of the number responsible for these years of economic activity.

Figure B-5. **Life table functions underlying worklife expectancy of the active population: The closed labor force**

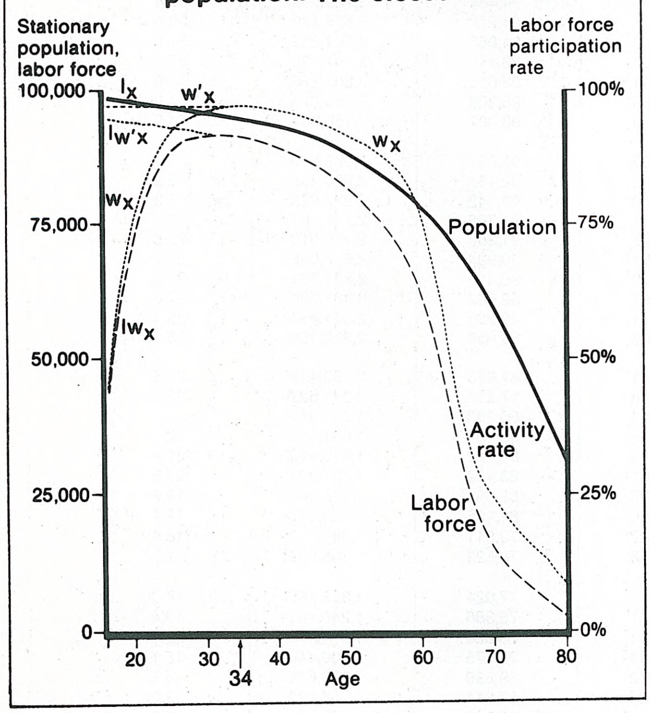
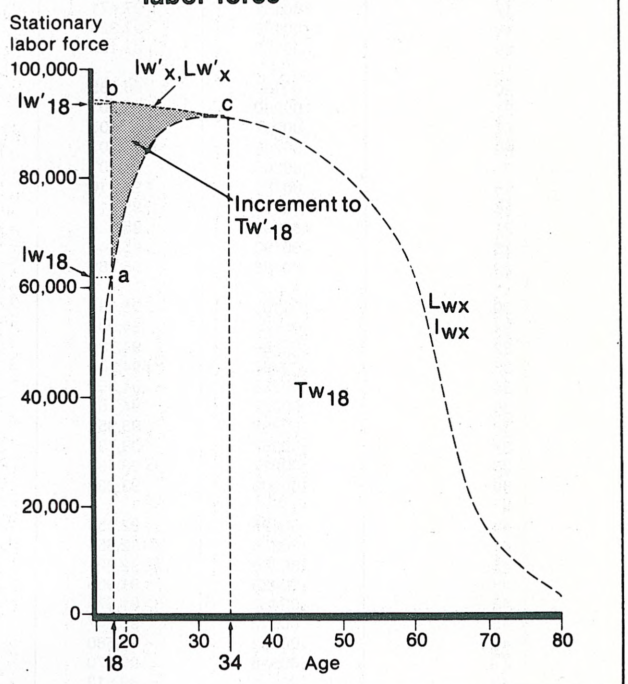


Figure B-6. **Changes in life table functions due to closing of the stationary labor force**



This solution imposes a clear order on the data. It does not, however, guarantee good worklife estimates for active young men. In modifying both the numerator and the denominator of equation 24, it is not clear how the ratio has been affected. The lw_x and Lw_x values have been inflated (from ***ac*** to ***bc*** in figure B-6). At age 18 this means ***ab*** inactive men added to the ever-active population. The shift to the Lw'_x function means that Tw'_x is also inflated. At age 18, Tw'_{18} includes ***abc*** additional person years of labor force attachment, "work years" which don't really occur. The shifts in lw'_x and Tw'_x need not—and prob-

Table B-1. Interpolated abridged life table for men, 1977

Age x	Mortality rate at exact age x q_x	Stationary population at exact age x l_x	Deaths between exact ages x and x+1 d_x	Stationary population in age x L_x	Person-years of life remaining at age x T_x	Life expectancy of the population e_x
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	0.01586	100,000	1,586	98,606	6,932,304	69.3
1	.00104	98,414	102	98,361	6,833,698	69.4
2	.00080	98,312	79	98,270	6,735,337	68.5
3	.00064	98,233	63	98,200	6,637,067	67.6
4	.00054	98,170	53	98,142	6,538,867	66.6
5	.00048	98,117	48	98,095	6,440,725	65.6
6	.00045	98,069	44	98,048	6,342,630	64.7
7	.00041	98,025	41	98,007	6,244,582	63.7
8	.00037	97,984	36	97,968	6,146,575	62.7
9	.00032	97,948	31	97,934	6,048,607	61.8
10	.00028	97,917	27	97,900	5,950,673	60.8
11	.00028	97,890	27	97,873	5,852,773	59.8
12	.00036	97,863	35	97,841	5,754,900	58.8
13	.00053	97,828	52	97,798	5,657,059	57.8
14	.00077	97,776	76	97,735	5,559,261	56.9
15	.00105	97,700	102	97,650	5,461,526	55.9
16	.00130	97,598	127	97,536	5,363,876	55.0
17	.00152	97,471	148	97,398	5,266,340	54.0
18	.00168	97,323	164	97,242	5,168,942	53.1
19	.00179	97,159	174	97,073	5,071,700	52.2
20	.00190	96,985	184	96,892	4,974,627	51.3
21	.00200	96,801	194	96,704	4,877,735	50.4
22	.00207	96,607	200	96,506	4,781,031	49.5
23	.00208	96,407	200	96,307	4,684,525	48.6
24	.00205	96,207	197	96,108	4,588,218	47.7
25	.00201	96,010	193	95,913	4,492,110	46.8
26	.00197	95,817	189	95,723	4,396,197	45.9
27	.00193	95,628	184	95,536	4,300,474	45.0
28	.00190	95,444	181	95,353	4,204,938	44.1
29	.00188	95,263	179	95,173	4,109,585	43.1
30	.00186	95,084	177	95,002	4,014,412	42.2
31	.00186	94,907	177	94,824	3,919,410	41.3
32	.00189	94,730	179	94,647	3,824,586	40.4
33	.00197	94,551	186	94,464	3,729,939	39.4
34	.00208	94,365	197	94,272	3,635,475	38.5
35	.00222	94,168	210	94,065	3,541,203	37.6
36	.00239	93,958	224	93,849	3,447,138	36.7
37	.00257	93,734	241	93,616	3,353,289	35.8
38	.00277	93,493	259	93,366	3,259,673	34.9
39	.00300	93,234	279	93,097	3,166,307	34.0
40	.00325	92,955	302	92,801	3,073,210	33.1
41	.00355	92,653	329	92,486	2,980,409	32.2
42	.00388	92,324	358	92,142	2,887,923	31.3
43	.00425	91,966	391	91,768	2,795,781	30.4
44	.00467	91,575	428	91,358	2,704,013	29.5
45	.00512	91,147	467	90,904	2,612,655	28.7
46	.00562	90,680	510	90,415	2,521,751	27.8
47	.00618	90,170	557	89,882	2,431,336	27.0
48	.00681	89,613	611	89,298	2,341,454	26.1
49	.00751	89,002	668	88,658	2,252,156	25.3
50	.00828	88,334	731	87,976	2,163,498	24.5
51	.00910	87,603	798	87,212	2,075,522	23.7
52	.00995	86,805	864	86,380	1,988,310	22.9
53	.01081	85,941	929	85,484	1,901,930	22.1
54	.01171	85,012	996	84,522	1,816,446	21.4
55	.01263	84,016	1,062	83,459	1,731,924	20.6
56	.01366	82,954	1,133	82,361	1,648,465	19.9
57	.01491	81,821	1,220	81,185	1,566,104	19.1
58	.01647	80,601	1,327	79,911	1,484,919	18.4
59	.01826	79,274	1,448	78,523	1,405,008	17.7
60	.02026	77,826	1,576	77,024	1,326,485	17.0
61	.02231	76,250	1,701	75,386	1,249,461	16.4
62	.02429	74,549	1,811	73,629	1,174,075	15.7
63	.02611	72,738	1,899	71,775	1,100,446	15.1
64	.02783	70,839	1,972	69,839	1,028,671	14.5
65	.02958	68,867	2,037	67,811	958,832	13.9
66	.03154	66,830	2,108	65,740	891,021	13.3
67	.03388	64,722	2,192	63,589	825,281	12.8
68	.03675	62,530	2,298	61,344	761,692	12.2
69	.04013	60,232	2,417	58,986	700,348	11.6

Table B-1. Continued—Interpolated abridged life table for men, 1977

Age x	Mortality rate at exact age x q_x	Stationary population at exact age x l_x	Deaths between exact ages x and x+1 d_x	Stationary population in age x L_x	Person-years of life remaining at age x T_x	Life expectancy of the population e_x
70	0.04377	57,815	2,531	56,454	641,362	11.1
71	.04761	55,284	2,632	53,873	584,908	10.6
72	.05184	52,652	2,729	51,192	531,035	10.1
73	.05649	49,923	2,820	48,417	479,843	9.6
74	.06156	47,103	2,900	45,557	431,426	9.2
75	.06703	44,203	2,963	42,644	385,869	8.7
76	.07286	41,240	3,005	39,660	343,225	8.3
77	.07900	38,235	3,021	36,647	303,565	7.9
78	.08539	35,214	3,007	33,633	266,918	7.6
79	.09195	32,207	2,961	30,649	233,285	7.2
80	.09852	29,246	2,881	27,885	202,636	6.9
81	.10487	26,365	2,765	25,062	174,751	6.6
82	.11057	23,600	2,610	22,375	149,689	6.3
83	.11497	20,990	2,413	19,863	127,314	6.1
84	.11702	18,577	2,174	17,570	107,451	5.8
85	1.00000	16,403	16,403	89,881	89,881	5.5

NOTE: For explanation of notation, see appendix C.

SOURCE: U.S. Department of Health and Human Services, National Center for Health Statistics, Division of Vital Statistics.

Table B-2. Table of working life for men, 1977: Conventional model

Age	Mortality rate at exact age x	Stationary population		Deaths of x year olds	Mortality rate for persons at age x	Person years of life remaining at age x	Life expectancy of the population (in years)
		At exact age x	Within age x				
x	q_x	l_x	L_x	D_x	Q_x	T_x	e_x
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
16	0.00130	97,598	97,536	138	0.00141	5,363,876	55.0
17	.00152	97,471	97,398	156	.00160	5,266,340	54.0
18	.00168	97,323	97,242	169	.00174	1,698,942	53.1
19	.00179	97,159	97,073	181	.00186	1,811,700	52.2
20	.00190	96,985	96,892	188	.00194	1,884,627	51.3
21	.00200	96,801	96,704	198	.00205	1,987,735	50.4
22	.00207	96,607	96,506	199	.00206	1,991,031	49.5
23	.00208	96,407	96,307	199	.00207	1,994,525	48.6
24	.00205	96,207	96,108	195	.00203	1,958,218	47.7
25	.00201	96,010	95,913	190	.00198	1,902,110	46.8
26	.00197	95,817	95,723	187	.00195	1,876,197	45.9
27	.00193	95,628	95,536	183	.00192	1,830,474	45.0
28	.00190	95,444	95,353	180	.00189	1,804,938	44.1
29	.00188	95,263	95,173	171	.00180	1,719,585	43.1
30	.00186	95,084	95,002	178	.00187	1,784,412	42.2
31	.00186	94,907	94,824	177	.00187	1,779,410	41.3
32	.00189	94,730	94,647	183	.00193	1,834,586	40.4
33	.00197	94,551	94,464	192	.00203	1,929,939	39.4
34	.00208	94,365	94,272	207	.00220	2,075,475	38.5
35	.00222	94,168	94,065	216	.00230	2,161,203	37.6
36	.00239	93,958	93,849	233	.00248	2,337,138	36.7
37	.00257	93,734	93,616	250	.00267	2,503,289	35.8
38	.00277	93,493	93,366	269	.00288	2,699,673	34.9
39	.00300	93,234	93,097	296	.00318	2,966,307	34.0
40	.00325	92,955	92,801	315	.00339	3,153,210	33.1
41	.00355	92,653	92,486	344	.00372	3,440,409	32.2
42	.00388	92,324	92,142	374	.00406	3,747,923	31.3
43	.00425	91,966	91,768	410	.00447	4,105,781	30.4
44	.00467	91,575	91,358	454	.00497	4,544,013	29.5
45	.00512	91,147	90,904	489	.00538	4,892,655	28.7
46	.00562	90,680	90,415	533	.00590	5,331,751	27.8
47	.00618	90,170	89,882	584	.00650	5,841,336	27.0
48	.00681	89,613	89,298	640	.00717	6,401,454	26.1
49	.00751	89,002	88,658	682	.00769	6,822,156	25.3
50	.00828	88,334	87,976	764	.00868	7,643,498	24.5
51	.00910	87,603	87,212	832	.00954	8,325,522	23.7
52	.00995	86,805	86,380	896	.01037	8,968,310	22.9
53	.01081	85,941	85,484	962	.01125	9,621,930	22.1
54	.01171	85,012	84,522	63	.01258	10,636,446	21.4
55	.01263	84,016	83,459	98	.01316	10,981,924	20.6
56	.01366	82,954	82,361	176	.01428	11,768,465	19.9
57	.01491	81,821	81,185	274	.01569	12,746,104	19.1
58	.01647	80,601	79,911	388	.01737	13,884,919	18.4
59	.01826	79,274	78,523	499	.01909	14,995,008	17.7
60	.02026	77,826	77,024	638	.02127	16,386,485	17.0
61	.02231	76,250	75,386	757	.02331	17,579,461	16.4
62	.02429	74,549	73,629	854	.02518	18,544,075	15.7
63	.02611	72,738	71,775	936	.02697	19,360,446	15.1
64	.02783	70,839	69,839	28	.02904	20,288,671	14.5
65	.02958	68,867	67,811	71	.03054	20,718,832	13.9
66	.03154	66,830	65,740	151	.03272	21,511,021	13.3
67	.03388	64,722	63,589	245	.03530	22,455,281	12.8
68	.03675	62,530	61,344	358	.03844	23,581,692	12.2
69	.04013	60,232	58,986	532	.04293	25,320,348	11.6
70	.04377	57,815	56,454	581	.04572	25,811,362	11.1
71	.04761	55,284	53,873	681	.04977	26,814,908	10.6
72	.05184	52,652	51,192	775	.05421	27,751,035	10.1
73	.05649	49,923	48,417	860	.05907	28,609,843	9.6
74	.06156	47,103	45,557	913	.06394	29,131,426	9.2
75	.06703	44,203	42,644	984	.06997	29,845,869	8.7

NOTE: For explanation of notation, see appendix C.

Table B-2. Continued—Table of working life for men, 1977: Conventional model

Age	Worklife duration of the total population					Worklife duration of the economically active				
	Activity rate	Stationary population		Person yrs. of work remaining in the population at age x	Worklife expectancy of the population (in years)	Adjusted activity rate	Closed stationary labor force		Person yrs. of work remaining in closed labor force at age x	Worklife expectancy of the active population (in years)
		At exact age x	Within age x				At exact age x	Within age x		
x	w_x	lw_x	Lw_x	Tw_x	ew_x	w'_x	lw'_x	Lw'_x	Tw'_x	ew'_x
(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
16	0.445	43,451	43,423	3,980,044	40.8	0.964	94,124	94,064	4,186,145	44.5
17	.584	56,933	56,890	3,936,621	40.4	.964	93,997	93,931	4,092,082	43.5
18	.651	63,396	63,343	3,879,731	39.9	.964	93,855	93,780	3,998,152	42.6
19	.728	70,683	70,621	3,816,388	39.3	.964	93,699	93,617	3,904,372	41.7
20	.784	76,056	75,983	3,745,768	38.6	.964	93,530	93,443	3,810,755	40.7
21	.826	79,977	79,897	3,669,786	37.9	.964	93,352	93,261	3,717,313	39.8
22	.857	82,792	82,706	3,589,890	37.2	.964	93,166	93,070	3,624,052	38.9
23	.886	85,407	85,318	3,507,185	36.4	.964	92,974	92,878	3,530,982	38.0
24	.912	87,722	87,631	3,421,867	35.6	.964	92,783	92,687	3,438,104	37.1
25	.928	89,088	88,998	3,334,236	34.7	.964	92,593	92,498	3,345,418	36.1
26	.938	89,867	89,779	3,245,239	33.9	.964	92,407	92,315	3,252,920	35.2
27	.945	90,388	90,301	3,155,461	33.0	.964	92,225	92,135	3,160,605	34.3
28	.951	90,786	90,700	3,065,161	32.1	.964	92,047	91,958	3,068,471	33.3
29	.955	90,957	90,871	2,974,462	31.2	.964	91,872	91,785	2,976,513	32.4
30	.959	91,157	91,078	2,883,591	30.3	.964	91,702	91,620	2,884,729	31.5
31	.960	91,092	91,012	2,792,513	29.4	.964	91,534	91,448	2,793,110	30.5
32	.963	91,197	91,117	2,701,501	28.5	.964	91,363	91,278	2,701,662	29.6
33	.964	91,185	91,101	2,610,385	27.6	.964	91,189	91,101	2,610,385	28.6
34	.964	90,977	90,888	2,519,284	26.7	.964	90,994	90,888	2,519,284	27.7
35	.963	90,693	90,594	2,428,397	25.8	.963	90,741	90,594	2,428,397	26.8
36	.963	90,444	90,339	2,337,803	24.9	.963	90,467	90,339	2,337,803	25.8
37	.962	90,135	90,021	2,247,464	24.0	.962	90,180	90,021	2,247,464	24.9
38	.959	89,697	89,575	2,157,443	23.1	.959	89,798	89,575	2,157,443	24.0
39	.959	89,383	89,252	2,067,868	22.2	.959	89,414	89,252	2,067,868	23.1
40	.957	88,958	88,811	1,978,616	21.3	.957	89,031	88,811	1,978,616	22.2
41	.954	88,354	88,195	1,889,806	20.4	.954	88,503	88,195	1,889,806	21.4
42	.952	87,874	87,701	1,801,612	19.5	.952	87,948	87,701	1,801,612	20.5
43	.948	87,193	87,005	1,713,912	18.6	.948	87,353	87,005	1,713,912	19.6
44	.943	86,383	86,178	1,626,907	17.8	.943	86,592	86,178	1,626,907	18.8
45	.940	85,678	85,450	1,540,729	16.9	.940	85,814	85,450	1,540,729	18.0
46	.937	84,958	84,710	1,455,280	16.0	.937	85,080	84,710	1,455,280	17.1
47	.932	84,029	83,761	1,370,571	15.2	.932	84,235	83,761	1,370,571	16.3
48	.927	83,026	82,735	1,286,810	14.4	.927	83,248	82,735	1,286,810	15.5
49	.921	81,935	81,619	1,204,076	13.5	.921	82,177	81,619	1,204,076	14.7
50	.910	80,393	80,067	1,122,458	12.7	.910	80,843	80,067	1,122,458	13.9
51	.903	79,079	78,726	1,042,391	11.9	.903	79,397	78,726	1,042,391	13.1
52	.893	77,500	77,120	963,665	11.1	.893	77,923	77,120	963,665	12.4
53	.883	75,929	75,525	886,545	10.3	.883	76,323	75,525	886,545	11.6
54	.875	74,360	73,931	811,020	9.5	.875	74,728	73,931	811,020	10.9
55	.864	72,623	72,142	737,089	8.8	.864	73,037	72,142	737,089	10.1
56	.847	70,287	69,784	664,947	8.0	.847	70,963	69,784	664,947	9.4
57	.832	68,100	67,570	595,162	7.3	.832	68,677	67,570	595,162	8.7
58	.813	65,537	64,976	527,592	6.5	.813	66,273	64,976	527,592	8.0
59	.786	62,301	61,711	462,616	5.8	.786	63,343	61,711	462,616	7.3
60	.738	57,436	56,844	400,905	5.2	.738	59,277	56,844	400,905	6.8
61	.687	52,414	51,820	344,062	4.5	.687	54,332	51,820	344,062	6.3
62	.628	46,839	46,261	292,241	3.9	.628	49,041	46,261	292,241	6.0
63	.546	39,729	39,204	245,980	3.4	.546	42,732	39,204	245,980	5.8
64	.464	32,869	32,405	206,777	2.9	.464	35,804	32,405	206,777	5.8
65	.404	27,850	27,423	174,371	2.5	.404	29,914	27,423	174,371	5.8
66	.349	23,290	22,910	146,949	2.2	.349	25,167	22,910	146,949	5.8
67	.298	19,268	18,930	124,038	1.9	.298	20,920	18,930	124,038	5.9
68	.271	16,946	16,624	105,108	1.7	.271	17,777	16,624	105,108	5.9
69	.250	15,052	14,741	88,484	1.5	.250	15,682	14,741	88,484	5.6
70	.232	13,413	13,097	73,743	1.3	.232	13,919	13,097	73,743	5.3
71	.212	11,704	11,405	60,646	1.1	.212	12,251	11,405	60,646	5.0
72	.195	10,241	9,957	49,241	.9	.195	10,681	9,957	49,241	4.6
73	.179	8,921	8,652	39,284	.8	.179	9,304	8,652	39,284	4.2
74	.165	7,786	7,531	30,632	.7	.165	8,091	7,531	30,632	3.8
75	.149	6,600	6,367	23,101	.5	.149	6,949	6,367	23,101	3.3

NOTE: For explanation of notation, see appendix C.

Table B-2. Continued—Table of working life for men, 1977: Conventional model

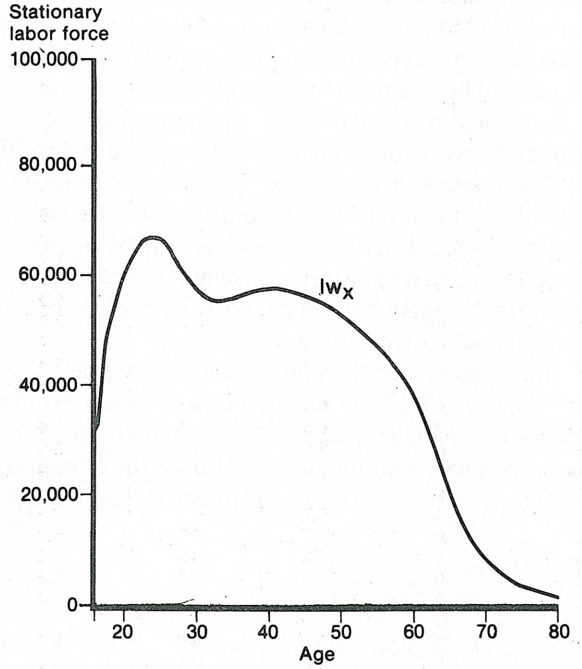
Age	Net events in the stationary population				Net rates per 1,000 in the stationary population			
		Labor force separations				Labor force separation		
	Labor force accessions	Total	Deaths	Voluntary retirements	Labor force accessions	Total	Deaths	Voluntary retirement
x	A^{*}_{x}	S_x	D^{w}_{x}	R_x	A_x	Q^{s}_{x}	Q^{d}_{x}	Q^{r}_{x}
(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
16	13,529	133	133	0	138.7	1.4	1.4	0.0
17	6,544	150	150	0	67.2	1.6	1.6	.0
18	7,387	163	163	0	76.0	1.7	1.7	.0
19	5,494	175	175	0	56.6	1.9	1.9	.0
20	4,062	181	181	0	41.9	1.9	1.9	.0
21	2,972	191	191	0	30.7	2.0	2.0	.0
22	2,783	192	192	0	28.8	2.1	2.1	.0
23	2,489	192	192	0	25.8	2.1	2.1	.0
24	1,544	188	188	0	16.1	2.0	2.0	.0
25	957	183	183	0	10.0	2.0	2.0	.0
26	697	180	180	0	7.3	2.0	2.0	.0
27	572	176	176	0	6.0	1.9	1.9	.0
28	343	174	174	0	3.6	1.9	1.9	.0
29	371	165	165	0	3.9	1.8	1.8	.0
30	104	172	172	0	1.1	1.9	1.9	.0
31	274	171	171	0	2.9	1.9	1.9	.0
32	161	176	176	0	1.7	1.9	1.9	.0
33	0	185	185	0	.0	2.0	2.0	.0
34	0	294	199	94	.0	3.2	2.2	1.0
35	0	255	208	47	.0	2.8	2.3	.5
36	0	318	224	94	.0	3.5	2.5	1.0
37	0	446	240	206	.0	5.0	2.7	2.3
38	0	323	258	65	.0	3.6	2.9	.7
39	0	442	284	158	.0	4.9	3.2	1.8
40	0	616	301	315	.0	6.9	3.4	3.5
41	0	494	328	166	.0	5.6	3.7	1.9
42	0	696	355	340	.0	7.9	4.1	3.9
43	0	827	388	439	.0	9.5	4.5	5.1
44	0	728	428	301	.0	8.5	5.0	3.5
45	0	740	459	281	.0	8.7	5.4	3.3
46	0	949	498	451	.0	11.2	5.9	5.3
47	0	1,026	543	484	.0	12.3	6.5	5.8
48	0	1,116	591	525	.0	13.5	7.1	6.3
49	0	1,552	624	927	.0	19.0	7.6	11.4
50	0	1,341	693	648	.0	16.7	8.6	8.1
51	0	1,606	747	859	.0	20.4	9.5	10.9
52	0	1,595	796	799	.0	20.7	10.3	10.4
53	0	1,594	846	748	.0	21.1	11.2	9.9
54	0	1,789	924	865	.0	24.2	12.5	11.7
55	0	2,357	940	1,418	.0	32.7	13.0	19.7
56	0	2,214	988	1,227	.0	31.7	14.2	17.6
57	0	2,595	1,048	1,546	.0	38.4	15.5	22.9
58	0	3,264	1,110	2,155	.0	50.2	17.1	33.2
59	0	4,868	1,143	3,725	.0	78.9	18.5	60.4
60	0	5,023	1,168	3,856	.0	88.4	20.5	67.8
61	0	5,559	1,156	4,403	.0	107.3	22.3	85.0
62	0	7,058	1,090	5,968	.0	152.6	23.6	129.0
63	0	6,798	979	5,819	.0	173.4	25.0	148.4
64	0	4,983	881	4,101	.0	153.8	27.2	126.6
65	0	4,512	781	3,732	.0	164.5	28.5	136.1
66	0	3,980	696	3,284	.0	173.7	30.4	143.3
67	0	2,306	639	1,667	.0	121.8	33.8	88.1
68	0	1,884	615	1,269	.0	113.3	37.0	76.3
69	0	1,643	611	1,033	.0	111.5	41.4	70.1
70	0	1,692	573	1,119	.0	129.2	43.8	85.5
71	0	1,448	545	903	.0	127.0	47.8	79.2
72	0	1,305	518	786	.0	131.0	52.1	79.0
73	0	1,122	493	629	.0	129.6	56.9	72.7
74	0	1,164	459	705	.0	154.5	60.9	93.6
75	0	822	432	390	.0	129.2	67.8	61.3

NOTE: For explanation of notation, see appendix C.

ably do not — offset one another. The slower the group's true entry into the labor force (or the more gradual the *ac* slope) the more fictitious worktime is likely to be added to the numerator. This tends to narrow real group or temporal differentials in worklife behavior.

The worklife expectancy of active women. The extension of the model to active women is still more complex. The "fertility trough" of the female age profile (figure B-7) implies that, assumptions 7 and 8 notwithstanding, women do leave and reenter the job market during midlife. Smoothing this function into a simple monotonic curve would totally distort the information which it conveys.

Figure B-7. **Age profile of the stationary labor force, women, 1977**



Therefore Garfinkle devised an alternative procedure for estimating the worklife expectancy of active women. He broke the female population into marital and parental classes, many of which (e.g., the single, the separated, the widowed or divorced, and the ever-married without children) had unimodal age profiles of participation, like those of men. For each such group he replicated the male model, closing the stationary labor force as in figure B-5. No worklife estimates were prepared for the total female population, or for groups which failed to pass the unimodality test.

Limitations of the conventional worklife model

Many of the assumptions underlying this model have adversely affected its findings. The most troublesome has been that of continuous labor force attachment. Every age-sex group experiences some amount of disallowed turnover during the year. The greater the volume of turnover, the more seriously the annual average participation rate, w_x, understates the proportion active during the year. The discrepancy between these two indexes is as much as 10 percentage points or more for young men and women of most ages (table B-3, columns 2 and 3).

Table B-3. Comparison of labor force participation rates, proportions active during the year, and the average proportion of a year spent active, by sex, selected ages, 1977

Sex and age	Annual average labor force participation rate	Proportion active during year	Average percent of year[1] spent active by the group
(1)	(2)	(3)	(4)
Men			
16	44.5	66.8	21.3
20	78.4	91.2	71.2
25	92.8	95.9	95.0
30	95.9	97.7	102.3
35	96.3	96.9	106.1
40	95.7	96.9	103.3
45	94.0	94.0	100.7
50	91.0	93.1	97.5
55	86.4	87.8	91.2
60	73.8	78.5	72.9
65	40.4	43.5	31.7
Women			
16	36.4	56.0	13.4
20	64.2	79.7	50.9
25	65.6	74.1	57.1
30	57.9	66.0	49.0
35	58.5	68.1	48.6
40	60.3	68.3	52.1
45	58.8	67.3	51.1
50	55.8	61.9	47.9
55	50.6	54.1	43.8
60	40.7	42.9	34.1
65	20.1	23.4	13.7

[1]Proportion of a 2080-hour year.

This bias leads to undercount of the stationary labor force, lw'_x, which in turn upwardly biases the worklife expectancy of the active population, ew'_x (equation 25). The looser the group's labor force attachment, the more its worklife expectancy is overstated.

The steady influx of women into the job market — often in part-yearly capacities — has upwardly biased the worklife duration estimates for active women. The sex differential in worklife expectancy has been unduly narrowed by this bias, to the point where the worklife durations of men and certain groups of women appear to be nearly identical. External evidence refutes this conclusion and indicates that the conventional measures are a misleading basis for such comparisons.

A second assumption which has discredited model findings is that of constant participation rates over time. In reality these rates are continually changing, yet the expected durations are based on behavior as it was in a specific year.

Furthermore, even the yearly summaries are unpredictable. A change in the age profile of participation can result in illogical, unwarranted findings. Conventional tables for women in 1977 are a case in point. Between 1970 and 1977, the total female participation rate rose by more than 5 percentage points. Yet because young women were responsible for a disproportionate share of this increase, the worklife expectancy of active women appeared to *drop* by more than 3 years! As an illustration, consider women active at age 25. In 1970 their worklife duration was estimated to be:

$$ew'_{25} = \frac{Tw'_{25}}{lw'_{25}} = \frac{2,046,385}{57,237} = 35.8 \text{ years.}$$

During the next 7 years the size of this young active population increased by 13 percent, while the estimate of worklife years remaining grew by just 4 percent. Hence in 1977 the corresponding expectancy was:

$$ew'_{25} = \frac{2,128,185}{64,738} = 32.9 \text{ years.}$$

Although mathematically correct, these findings are substantively meaningless. They illustrate the dangers of using a static model to describe a dynamic system, and point to the need for a more flexible worklife model.

So too do the gaps in the female worklife record. The conventional model shows no summary table for all women, and omits one of the largest groups in the population—those with small children. The estimates it does present are difficult to interpret, since they rest on an assumption of constant marital status. Given present rates of divorce, remarriage, and widowhood, they have little practical application.

A final problem also stems from overreliance on participation rates. The conventional model uses these rates as a proxy for time spent in the labor force (i.e., a 60-percent rate is interpreted as meaning that 60 percent of the group's time was spent active). External data sources show no such consistent relationship between these functions. Table B-3 juxtaposes the active rates for 1977 with an index of time in the labor force (columns 2 and 4, respectively). This time index is a ratio of the group's average annual hours of participation to a standard 2080-hour work year.[7] The CPS records for 1977 indicate that at that time prime-age men tended to work more than the conventional 52 week, 40 hour per week schedule. Activity rates understated their average "person year" contribution to the labor force. On the other hand, the average time commitment for women was less than 60 percent of the standard. Activity rates consistently overstated their contribution. Together, these biases further obscured the sex differential in worklife duration.

In sum, recent trends in labor force attachment have violated nearly all of the underlying assumptions of the conventional worklife model. In the absence of these conditions, the model cannot accurately describe or contrast the work patterns of various groups of the population.

FOOTNOTES TO APPENDIX B

[1]The first life table was developed by Halley on the basis of birth and death registration data for the city of Breslau during the years 1687 to 1691.

[2]Table B-1, from the National Center for Health Statistics, uses a nonlinear distribution for certain age groups. However, equation 5 closely approximates the normal relationship among these functions.

[3]The term "expectancy" can be misleading. This index summarizes death patterns in a single year. It is derived without regard to projected mortality rates. Expectancy values can only be interpreted as a projection if one assumes present conditions will continue indefinitely.

[4]These data were used to estimate projected openings in various occupations, under the Occupational Outlook program at BLS.

[5]The term "worklife expectancy" is somewhat misleading on two counts. As noted earlier, the "expectancies" are merely a summary of behavior at various ages in a given year—they are not projections of what will actually occur. Secondly, the phrase "worklife" is conveniently used to describe a broader state of economic activity, including periods of unemployment.

[6]Beyond the age of peak participation, $w'_x = w_x$, $Lw'_x = Lw_x$, and $Tw'_x = Tw_x$ at all ages.

[7]For an explanation of this index, see footnote 9 of chapter 4.

Appendix C. Notation

The notation system used in the increment-decrement tables is an extension of basic life table notation. Whereever possible, standard conventions have been maintained. Where changes have been called for, the following principles govern the development of new symbols.

Trailing subscripts. Subscripts following the basic variable identify current age. The subscript x denotes any age.

Leading subscripts. For variables having an interval reference, a numerical subscript preceding the variable indicates the length of the interval in question (in years). When no leading subscript is shown, the implied interval is 1 year.

Leading superscripts. The superscript preceding the variable indicates the status of persons in question at the beginning of the interval. When the variable is preceded by two superscripts, the first indicates the base of the rate.

Trailing superscripts. One or more superscripts following the variable indicate the status of the group in question during or at the conclusion of the interval.

Subscripts and superscripts used. The characters used to indicate these states are as follows:

- x = any age x
- a = economically active
- i = economically inactive
- d = dead
- · = all survivors (active or inactive)
- r = retirement (voluntary)
- s = separation
- w = workers
- nw = nonworkers

Table C-1. Notational systems for increment-decrement and conventional models

Worklife variable	Increment-decrement notation	Conventional model notation	Comments
Transition probabilities:[1]			
Probability of:			
Dying	${}^{\cdot}p_x^{d}$	q_x	Values are exactly equal in the two models.
Surviving	${}^{\cdot}p_x^{(a,i)}$	p_x	Values are exactly equal.
Remaining inactive	${}^{i}p_x^{i}$		No equivalent variables in conventional model, but these two values sum to p_x.
Becoming active	${}^{i}p_x^{a}$		
Becoming inactive	${}^{a}p_x^{i}$		No equivalent variables in conventional model, but these two values sum to p_x.
Remaining active	${}^{a}p_x^{a}$		
Rates of transfer:			
Population-based rates of:			
Labor force accession[2]	${}^{i}M_x^{a}$	A_x	Increment-decrement estimate is gross; conventional estimate is net.
Total labor force separation[1]	${}^{a}M_x^{(i,d)}$		No equivalent variable in conventional model.
Voluntary labor force separation[1]	${}^{a}M_x^{i}$		No equivalent variable.
Net labor force mobility[1]	${}^{\cdot}M_x^{(\cdot,d)}$		No equivalent variable.
Rates per person alive at exact age x:[1]			
Accessions	${}^{(\cdot lx,i)}M_x^{a}$		No equivalent variable.
Total separations	${}^{(\cdot lx,a)}M_x^{(i,d)}$		No equivalent variable.
Labor force status-based rates:[2]			
Accession[3]	${}^{i}m_x^{a}$		No equivalent variable.
Total separation[4]	${}^{a}m_x^{(i,d)}$	Q_x^{s}	Increment-decrement estimate is gross; conventional estimate is net.

See footnotes at end of table.

Table C-1. Continued —Notational systems for increment-decrement and conventional models

Worklife variable	Increment-decrement notation	Conventional model notation	Comments
Voluntary separation[4]	${}^{a}m^{i}_{x}$	Q^{r}_{x}	Increment-decrement estimate is gross; conventional estimate is net.
Deaths of active persons[4]	${}^{a}m^{d}_{x}$	Q^{d}_{x}	This value exactly equals the total death rate in both models.
Deaths of all persons[4]	${}^{\cdot}m^{d}_{x}$	Q_{x}	Values are exactly equal.
Labor force participation rate[5]		w_{x}	No equivalent variable in increment-decrement model.
Number of transfers in the stationary population:			
Accessions[2]	${}^{i}t^{a}_{x}$	A^{*}_{x}	Increment-decrement estimate is gross; conventional estimate is net.
Total separations[2]	${}^{a}t^{(i,d)}_{x}$	S_{x}	Increment-decrement estimate is gross; conventional estimate is net.
Voluntary separations[2]	${}^{a}t^{i}_{x}$	R_{x}	Increment-decrement estimate is gross; conventional estimate is net.
Deaths of actives[2]	${}^{a}t^{d}_{x}$	D^{w}_{x}	Increment-decrement estimate is gross; conventional estimate is net.
Deaths of inactives[2]	${}^{i}t^{d}_{x}$	D^{nw}_{x}	Increment-decrement estimate is gross; conventional estimate is net.
Total deaths between exact ages[1]	${}^{\cdot}t^{d}_{x}$	d_{x}	Values are exactly equal.
Total deaths of *x* year olds[6]		D_{x}	No equivalent variable shown in the increment-decrement model.
Stationary population:			
At exact age *x* by labor force status: [1]			
Total	${}^{\cdot}l_{x}$	l_{x}	Values are exactly equal.
Inactive	${}^{i}l_{x}$	lnw_{x}	These terms are functionally similar to but numerically different from one another.
Active	${}^{a}l_{x}$	lw_{x}	Terms are functionally similar but numerically different.
Closed labor force		lw'_{x}	No equivalent variable in increment-decrement model.
During age *x* (persons alive and person years lived) by labor force status:[6]			
Total (persons, years)	${}^{\cdot}L^{\cdot}_{x}$	L_{x}	Values are exactly equal.

See footnotes at end of table.

Table C-1. Continued —Notational systems for increment-decrement and conventional models

Worklife variable	Increment-decrement notation	Conventional model notation	Comments
Inactive (years lived by all persons)	${}^{\cdot}L_x^{i}$	Lnw_x	Terms are functionally similar but numerically different.
Active (years lived by all persons)	${}^{\cdot}L_x^{a}$	Lw_x	Terms are functionally similar but numerically different.
Closed labor force estimate		Lw_x'	No equivalent variable in increment-decrement model.
At and beyond exact age x (persons alive and person years lived) by labor force status:[6]			
Total (persons, years)	${}^{\cdot}T_x^{\cdot}$	T_x	Values are virtually equal.
Inactive (years lived by all persons)	${}^{\cdot}T_x^{i}$	Tnw_x	Terms are functionally similar but numerically different.
Active (years lived by all persons)	${}^{\cdot}T_x^{a}$	Tw_x	Terms are functionally similar but numerically different.
Closed labor force estimate		Tw_x'	No equivalent variable in increment-decrement model.
Survival chain for persons in status 1 at exact age y:[7]			
Survivors in status 2 at exact age x[1]	${}^{1,y}l_x^{2}$		No equivalent variable in conventional model.
Person years lived by group in status 2 during age x[6]	${}^{1,y}L_x^{2}$		No equivalent variable.
Person years lived in status 2 at and beyond exact age x[6]	${}^{1,y}T_x^{2}$		No equivalent variable.
Expectancies for:			
Total population alive at exact age x:[1]			
Life	${}^{\cdot}e_x^{\cdot}$	e_x	Values are exactly equal.
Inactive life	${}^{\cdot}e_x^{i}$	enw_x	Terms are functionally similar but numerically different.
Active life	${}^{\cdot}e_x^{a}$	ew_x	Terms are functionally similar but numerically different.
Population economically inactive at exact age x:[1]			
Life	${}^{i}e_x^{\cdot}$	e_x	Values are exactly equal.

See footnotes at end of table.

Table C-1. Continued —Notational systems for increment-decrement and conventional models

Worklife variable	Increment-decrement notation	Conventional model notation	Comments
Inactive life	$^{i}e^{i}_{x}$		No equivalent variable in conventional model.
Active life	$^{i}e^{a}_{x}$		No equivalent variable.
Population economically active at exact age x: [1]			
Life	$^{a}e^{\cdot}_{x}$	e_x	Values are exactly equal.
Inactive life	$^{a}e^{i}_{x}$	enw'_x	Terms are functionally similar but numerically different.
Active life	$^{a}e^{a}_{x}$	ew'_x	Terms are functionally similar but numerically different.
Events remaining per person alive at exact age x: [1]			
Accessions	$^{i}E^{a}_{x}$		No equivalent variable in conventional model.
Voluntary separations	$^{a}E^{i}_{x}$		No equivalent variable.

[1] Changes stated in terms of the l_x function, or over the interval between exact ages x and $x+1$.

[2] The age or time reference for this variable differs between models. Increment-decrement values are stated in terms of change between exact ages x and $x+1$ (using the l_x term). Conventional values describe changes in the stationary population, L_x, from the midpoint of one age to the midpoint of the next.

[3] The base of this rate is the stationary inactive population.

[4] The base of this rate is the stationary labor force.

[5] In the conventional model the same function is applied to the interval between exact ages and that between (the midpoint of) successive ages to obtain stationary labor force values, lw_x and Lw_x respectively.

[6] This variable is stated in terms of the interval between (the midpoint of) successive ages, or in terms of the L_x function.

[7] The age interval referred to is retrospective, beginning at age y (where $y<x$) and ending at current age x.

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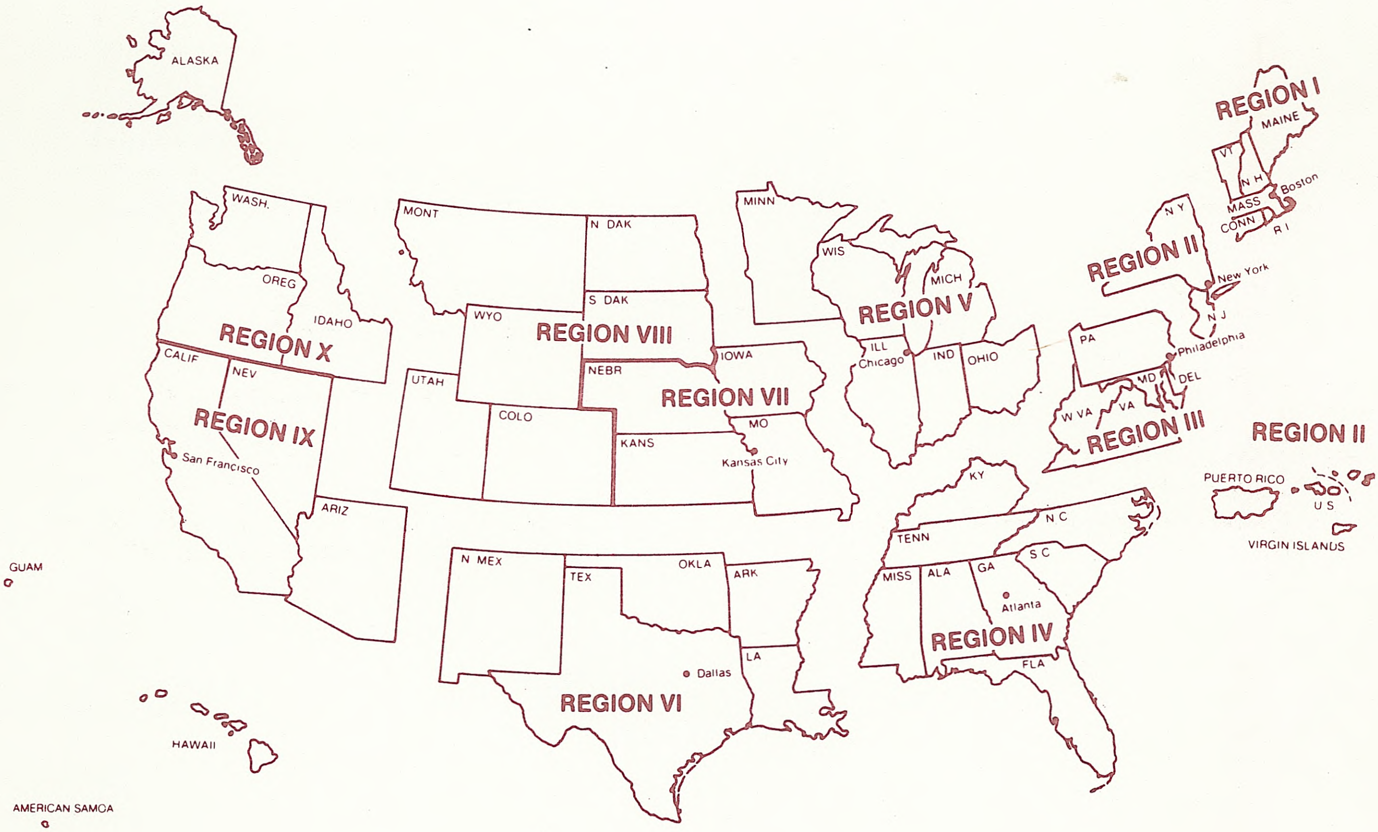

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