THE SURVEY OF INCOME AND PROGRAM PARTICIPATION

# ANALYZING SPELLS OF PROGRAM PARTICIPATION IN THE SIPP

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# INTRODUCTION

This report presents the findings of research conducted to investigate the effects of nonsampling errors in analyzing data related to participation in various government transfer programs obtained in the Survey of Income and Program Participation (SIPP). The research was conducted under a Joint Statistical Agreement between the U.S. Bureau of the Census and the Survey Research Center at the University of Michigan. The Joint Statistical Agreement (JSA-90-36), which was entitled "Some Nonsampling Error Considerations in Analyzing Program Participation in the SIPP", ran from September 1990 until February 1992.

The SIPP is a continuing panel survey of the U.S. population. A new panel is started each year with a national sample of households. Members of these households are followed for a period of around 2⅔ years, with interviews being conducted with them at four-monthly intervals. At each wave of data collection, information is collected on many income sources on a monthly basis. The research reported here was conducted with the 1987 SIPP panel, which started with a sample of around 12,000 households, and involved 7 waves of data collection. The 1987 SIPP panel thus produced data on program participation for 28 months for sample members who remained in the panel for its full duration. It is these 28 monthly observations that are the basis of the analyses in this report.

The focus of the research is on the estimation of durations of spells of participation in various transfer programs from the 1987 SIPP panel, and on the extent to which the duration estimates are affected by three factors: nonsampling errors (in particular the seam effect); the definition adopted for a spell; and the form of duration estimate employed. The transfer programs studied are food stamps, Aid to Families with Dependent Children (AFDC), general assistance, Social Security, Federal Supplemental Security Income (SSI), Veterans compensation, Women, Infants and Children Nutrition program (WIC), and State unemployment

compensation. Durations of spells on either AFDC or general assistance and of spells without health insurance are also examined.

A major type of nonsampling error identified in the SIPP is known as the "seam effect". This effect describes the finding that changes between two consecutive months in program recipiency and in income amounts received are reported much more frequently in the SIPP when information for the two months is collected in different waves of the panel (i.e., when the initial month is the last month of one wave and the subsequent month is the first month of the next wave) than when the information for the two months is collected in the same wave. Thus changes are reported more often between months 4 and 5, 8 and 9, 12 and 13, etc., than between months 1 and 2, 2 and 3, 3 and 4, 5 and 6, etc. The effect has been termed the seam effect because the changes occur more frequently at the seam between waves of data collection. The research reported here examines the effect of the seam effect on the estimation of spell durations.

The second factor influencing spell duration examined in this report is the definition of a spell that is adopted. For instance, is a single month off a program in the middle of a set of months on the program sufficient to distinguish two separate spells, or should such a pattern be treated as a single spell? The report compares the distributions of spell durations obtained under alternative definitions of what constitutes a spell.

The third factor investigated concerns the form of estimation used to obtain spell durations. The usual method applied for estimating spell durations from the SIPP is to analyze only the new spells that start during the life of the panel (often confining the analysis to the first new spell that each program participant experiences). This method ignores spells that were in existence at the start of the panel, some of which are completed during the course of the panel and others of which are still continuing at the end of the panel. Two alternative methods are examined. One analyzes all spells that stop during the life of the panel and the other analyzes all spells reported during the life of the panel.

The report is organized in four chapters as follows. Chapter 1 provides evidence on the magnitude of the seam effect, and demonstrates how it affects Kaplan-Meier estimates of spell durations for several welfare programs. Chapter 2 introduces a simple model that attempts to compensate for the seam effect, and examines the effect of the application of this model on estimates of spell durations. Chapter 2 also examines the effect of using an alternative definition of a spell on the distributions of spell durations. Chapter 3 focuses on the food stamp program. It presents more detailed analyses of the effects of the seam effect, of alternative choices for the definition of a spell, and of the method of estimation on the estimates of spell duration. It includes an analysis of spell durations based on spells that end during the life of a panel. Chapter 4 introduces a method for estimating durations from a panel survey like SIPP that employs all spells observed during the life of the panel, that is, it employs spells existing at the start of the panel as well as new spells.

# CHAPTER 1

# ESTIMATING DURATIONS OF SPELLS ON WELFARE PROGRAMS FROM THE SURVEY OF INCOME AND PROGRAM PARTICIPATION

## 1.1 Introduction

The Survey of Income and Program Participation (SIPP) is an ongoing household panel survey program of the US Bureau of the Census. A new SIPP panel is introduced each year and remains in operation for a period of about 2½ years. Each panel starts with a national probability sample of households. Adults aged 15 and over living in these households at the time of first interview become panel members who are followed for the life of the panel. They are interviewed at four-month intervals about income amounts received, participation in income maintenance programs, and other factors that may affect their income and economic welfare. The data on many income sources and on program participation are collected on a monthly basis for each of the four months in the period since the last interview. Interviews are not conducted with panel members who enter an institution, but such individuals are interviewed again if they leave the institution during the life of the panel.

In addition to the data collected from panel members, data are also collected about children under 15 living with panel members, and interviews are conducted with other adults who are found to be living with panel members during the course of the panel. Data are collected for these individuals only while they live with panel members.

To facilitate the fieldwork, the initial SIPP household sample is divided into four groups, termed rotation groups. The rotation groups are assigned to different, consecutive, months for interview. With a four-month interval between interviews, this scheme provides an even distribution of interviewer workload across months of the panel. Since the interviews ask for information about the preceding four months, sample members in different rotation groups provide data on different months at a particular wave of data collection. However, over the course of the panel, all sample members provide data on each month (apart that is from the three start-up and three ending months).

The focus of the research reported here is on the estimation of durations of spells on various welfare programs from the SIPP. The data analyzed come from the 1987 SIPP panel, which had seven waves of data collection, yielding monthly data on program participation for a period of 28 months for panel members who were interviewed on all waves. The analyses are conducted using the 1987 SIPP panel file. They are restricted to persons living in the original sample households at the time of the first wave of data collection who cooperated in each wave of data collection for which they were eligible. The group of persons covered by the analyses thus comprises those who provided data for all seven waves of the 1987 panel together with those who provided data for all waves until the time they left the survey universe (through death, institutionalization, entering an armed forces barracks, or leaving the country). Excluded are nonrespondents at one or more waves and persons who were not members of the original sample households. Often children are excluded from analyses of SIPP data. Here, however, they are included provided that data were collected on them for all seven waves.

This methodological research focuses on the estimation of spell durations for the larger welfare programs reported in SIPP, namely:

1. Food stamps
2. Aid to Families with Dependent Children (AFDC)
3. General assistance or general relief
4. Social Security

5. Federal Supplemental Security Income (SSI)
6. State unemployment compensation
7. Veterans compensation or pensions
8. Women, Infants and Children Nutrition program (WIC).

In addition, a combination of either AFDC or general assistance has been examined because research has shown that some participants appear to confuse these two programs (Marquis and Moore, 1989; Long, 1990). Finally, durations of spells without private health insurance are also investigated.

For six of the programs (food stamps, AFDC, general assistance, Social Security, Veterans compensation, and WIC) sample members were asked whether or not they were covered by the program in each of the preceding four months. In addition they were asked the monthly amounts they received from the program. Participation in these programs for a given month is defined here to be either that the sample member reported that he or she was covered by the program or that he or she received a positive amount of income from the program in that month. For the other two programs (SSI and State unemployment compensation), no coverage question was asked. Participation for these programs was therefore defined to be simply receiving a positive amount from the program in the given month. Information on private health coverage was obtained from three questions that determined whether the individual was covered by private health insurance in his or her own name, by private health insurance in someone else's name, or by private health insurance through an employer. Lack of health insurance is defined here to be a negative answer to each of these questions.

Original sample persons who responded for all waves for which they were eligible are assigned positive weights in the 1987 SIPP panel file. (These weights include compensation for panel nonresponse.) There are records for 24,428 sample members with positive panel weights in the file. The second column of Table 1.1 shows the numbers of these sample members who were on each of the welfare programs, or were without health insurance, for at least one of the 28 months of the 1987 SIPP panel. These numbers can be seen to range from a high of 8535 persons

**Table 1.1**
**Numbers of Persons Experiencing Spells on Various Welfare Programs in the 1987 SIPP Panel, and Distributions of the Numbers of Spells Experienced**

| Program | Number of persons having one or more spells | Number of spells | | | | | Total number of spells | Percentage of participants with more than one spell |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 or more | | |
| AFDC | 1232 | 989 | 209 | 27 | 7 | 0 | 1516 | 19.7 |
| General Assistance | 306 | 275 | 23 | 8 | 0 | 0 | 345 | 10.1 |
| AFDC or Gen. Assist. | 1455 | 1177 | 237 | 30 | 7 | 4 | 1789 | 19.1 |
| Food Stamps | 2664 | 2018 | 491 | 128 | 18 | 9 | 3501 | 24.2 |
| SSI | 497 | 471 | 22 | 3 | 1 | 0 | 528 | 5.2 |
| Social Security | 4556 | 4344 | 180 | 28 | 4 | 0 | 4804 | 4.7 |
| State Unemployment | 1207 | 864 | 221 | 79 | 22 | 21 | 1736 | 28.4 |
| Veterans Compensation | 616 | 529 | 74 | 13 | 0 | 0 | 716 | 14.1 |
| WIC | 418 | 337 | 71 | 7 | 2 | 1 | 513 | 19.4 |
| No Health Insurance | 8535 | 6495 | 1777 | 245 | 18 | 0 | 10856 | 23.9 |

who experienced at least one month without health insurance, and 4556 persons who were on Social Security in at least one month, down to 306 persons who were on general assistance in at least one month.

One way to specify an end of a spell of program participation is to define a spell to be completed when the individual goes off the program for one or more months. Thus a new spell starts whenever an individual is on a program in one month but was not on the program in the previous month. Using this definition of a spell, Table 1.1 gives the distribution of numbers of spells per individual for all those who were on a program in at least one month during the panel's life. This distribution includes spells existing at the start of the panel and new spells beginning during the course of the panel. The numbers in this table are unweighted counts and percentages. The frequency of multiple spells varies by program. Some 28.4% of those receiving State unemployment compensation, 24.2% of those receiving food stamps, and 23.9% of those without health insurance had more than one spell, whereas only 5.2% of those receiving Federal SSI and 4.7% of those receiving Social Security payments had more than one spell. Half of the spells of State unemployment compensation, 42.4% of the spells on the food stamp program and 40.2% of the spells without private health insurance occurred with individuals with more than one spell during the life of the panel.

As a background for the analyses that follow, Table 1.2 presents some demographic characteristics for persons who were on the various programs at some time during the life of the 1987 SIPP panel. The percentages in this table are weighted estimates. The table shows that, apart from State unemployment compensation and Veterans compensation, most program participants are female and that there is a high representation of Black participants in all the programs except for Social Security, State unemployment compensation and Veterans compensation. The sizeable proportions of children on many of the welfare programs should be noted. With the WIC program, as many as three out of five recipients are under 15 years old: most are under 5, but a few are 13 and 14. Since children under 15 are generally excluded from analyses of SIPP data, but are included in the analyses

**Table 1.2**
**Sex, Race, and Age Distribution of Program Participants**

| Program | Female | Black | Age* | | | | | Number of participants |
|---|---|---|---|---|---|---|---|---|
| | | | <15 | 15-24 | 25-44 | 45-64 | >64 | |
| | % | % | % | % | % | % | % | |
| AFDC | 61.3 | 39.7 | 53.9 | 18.1 | 23.4 | 4.2 | 0.4 | 1232 |
| General Assistance | 56.0 | 30.2 | 29.5 | 24.5 | 23.5 | 18.1 | 4.4 | 306 |
| AFDC or Gen. Assist. | 60.1 | 38.4 | 48.8 | 19.2 | 23.8 | 7.0 | 1.2 | 1455 |
| Food Stamps | 57.5 | 35.4 | 42.0 | 17.0 | 25.1 | 9.9 | 5.9 | 2664 |
| Federal SSI | 64.1 | 31.7 | 0.4 | 7.6 | 22.3 | 25.9 | 43.9 | 497 |
| Social Security | 56.9 | 10.8 | 5.3 | 3.5 | 4.9 | 23.9 | 62.5 | 2617 |
| State Unemployment | 41.1 | 13.1 | 0.0 | 16.5 | 61.7 | 21.1 | 0.8 | 1207 |
| Veterans Compensation | 43.3 | 9.9 | 11.7 | 3.8 | 17.0 | 38.7 | 28.8 | 616 |
| WIC | 69.7 | 28.5 | 60.4 | 23.5 | 15.7 | 0.2 | 0.2 | 418 |
| No Health Insurance | 51.5 | 20.5 | 26.0 | 21.7 | 27.7 | 12.8 | 11.8 | 8535 |

*At the start of the panel.

presented in this report, the results reported here may differ appreciably from those reported elsewhere.

Although Table 1.1 indicates that the 1987 SIPP panel collected data relating to many spells of program participation, in most cases the spells were not completely observed. To be completely observed, a spell must have both an identifiable start and an identifiable end that occurred during the life of the panel. It is necessary to observe a transition from not being on the program one month to being on the program the next month to identify the start of a spell, and a transition from being on the program one month to not being on it the next month to identify the end of a spell (assuming that a spell is defined as having ended with the occurrence of one month off the program). Spells with identified starts and ends are said to be uncensored.

Table 1.3 presents unweighted counts and percentages of spells on the different programs, classified according to whether their starting and ending dates occurred in the life of the panel. The second column of the table shows that, with the exceptions of State unemployment compensation and the WIC program, only a minority of program spells in the 1987 SIPP panel were uncensored. Other spells lacked either an identified starting point, ending point, or both. Spells with an identified starting point but no identified ending point are termed *right censored*, those with an identified ending point but no identified starting point are termed *initial censored* (the term "left censored" is avoided because it has a different meaning in the survival analysis literature), and spells without identified starting and ending points are termed *doubly censored*. As Table 1.3 shows, doubly censored spells, that is spells already existing at the start of the panel and still existing at the end of the panel, are very common for Social Security and Federal SSI payments.

The standard methods of survival analysis used for estimating durations of spells employ only uncensored and right censored spells. Many of the analyses described in this report will be restricted to such spells. However, this restriction eliminates more than half the spells for many programs. A method that utilizes data for all spells is presented in Chapter 4.

**Table 1.3**
**Spells reported in the 1987 SIPP panel by type of censoring***

| Program | Uncensored | | Right censored | | Initial censored | | Doubly censored | | Total spells |
|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n |
| AFDC | 390 | 25.7 | 283 | 18.7 | 430 | 28.4 | 413 | 27.2 | 1516 |
| General Assistance | 126 | 36.5 | 67 | 19.4 | 98 | 28.4 | 54 | 15.7 | 345 |
| AFDC or Gen. Assist. | 477 | 26.7 | 325 | 18.2 | 507 | 28.3 | 480 | 26.8 | 1789 |
| Food Stamps | 1052 | 30.0 | 716 | 20.5 | 930 | 26.6 | 803 | 22.9 | 3501 |
| Federal SSI | 65 | 12.3 | 91 | 17.2 | 82 | 15.5 | 290 | 54.9 | 528 |
| Social Security | 239 | 5.0 | 724 | 15.1 | 278 | 5.8 | 3563 | 74.2 | 4804 |
| State Unemployment | 1309 | 75.4 | 186 | 10.7 | 241 | 13.9 | 0 | 0.0 | 1736 |
| Veterans Compensation | 153 | 21.4 | 154 | 21.5 | 128 | 17.9 | 281 | 39.2 | 716 |
| WIC | 260 | 50.7 | 92 | 17.9 | 135 | 26.3 | 26 | 5.1 | 513 |
| No Health Insurance | 3191 | 29.4 | 2271 | 20.9 | 2743 | 25.3 | 2651 | 24.4 | 10856 |

*Deaths, institutionalization, military service, and other legitimate reasons for leaving the panel are treated as censored for the purpose of this table.

## 1.2 The Seam Effect

Analyses of month-to-month variation in recipiency of various income and transfer program sources, and in the amounts received, have identified the presence of a pervasive type of nonsampling error in the SIPP, termed the seam effect. The seam effect refers to the finding that changes in recipiency and in amounts received are much greater between months for which the data are collected in different waves than between months for which the data are collected in the same wave. Thus the changes between months 4 and 5, 8 and 9, 12 and 13, etc., are much greater than the changes between months 1 and 2, 2 and 3, 3 and 4, 5 and 6, etc. Findings on the seam effect are reported by Burkhead and Coder (1985), Coder *et al.* (1987), Weidman (1986) and Kalton and Miller (1991), and in the SIPP quality profile (Jabine *et al.*, 1990).

The current concern with the seam effect is the effect that it may have on the estimation of the distribution of spell durations. The effects of the seam effect on the reporting of spell starts and stops are illustrated in the weighted distributions in Tables 1.4 and 1.5. Taking into account the rotation group design in SIPP, after the first wave the expected distribution for reported starts by month of recall is a uniform distribution, with 25% of starts being reported at each month of recall. The same uniform distribution is expected for stops after the first wave (where a stop is defined as the first month off the program, and is thus equivalent to the start of a spell off the program). Since spell starts and stops cannot be observed for four months recall at the first wave, the overall expected proportions of starts and stops at four months recall is somewhat less than one quarter. However, Tables 1.4 and 1.5 show that many more than one quarter of starts and stops are reported with a four-month recall, that is transitions from off the program to on the program and from on the program to off the program occur much more than expected between the last month of one wave and the first month of the following wave.

The magnitudes of the seam effect on starts and stops vary appreciably by program. At one extreme, 85% of starts and 93% of stops of Veterans compensation

**Table 1.4**
**Spell Starts by Months of Recall**

| Program | Months of recall | | | | Total spell starts |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| | % | % | % | % | |
| AFDC | 20.7 | 16.4 | 16.7 | 46.1 | 673 |
| General Assistance | 11.1 | 14.6 | 11.8 | 62.5 | 193 |
| AFDC or Gen. Assist. | 19.5 | 16.2 | 16.9 | 47.5 | 802 |
| Food Stamps | 18.8 | 20.7 | 15.5 | 45.0 | 1768 |
| Federal SSI | 12.9 | 9.8 | 16.1 | 61.6 | 156 |
| Social Security | 11.9 | 17.3 | 12.8 | 58.0 | 963 |
| State Unemployment | 21.0 | 25.1 | 22.7 | 31.2 | 1495 |
| Veterans Compensation | 3.5 | 7.5 | 3.9 | 85.2 | 307 |
| WIC | 19.1 | 8.5 | 11.0 | 61.4 | 352 |
| No Health Insurance | 7.8 | 8.2 | 5.5 | 78.6 | 5462 |

**Table 1.5**
**Spell Stops by Months of Recall***

| Program | Months of recall | | | | Total spell starts |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| | % | % | % | % | |
| AFDC | 11.8 | 16.3 | 13.3 | 58.7 | 820 |
| General Assistance | 12.3 | 9.1 | 12.0 | 66.7 | 224 |
| AFDC or Gen. Assist. | 12.4 | 14.8 | 13.8 | 59.0 | 984 |
| Food Stamps | 17.6 | 15.9 | 12.6 | 54.0 | 1982 |
| Federal SSI | 7.6 | 18.5 | 8.2 | 65.7 | 147 |
| Social Security | 6.6 | 7.5 | 7.2 | 78.8 | 517 |
| State Unemployment | 24.1 | 19.8 | 19.7 | 36.4 | 1550 |
| Veterans Compensation | 2.2 | 0.2 | 4.6 | 92.9 | 281 |
| WIC | 9.2 | 10.4 | 4.7 | 75.7 | 395 |
| No Health Insurance | 10.5 | 8.7 | 6.9 | 73.9 | 5934 |

*Deaths, institutionalization, military service, and other legitimate reasons for leaving the panel are treated as censored observations rather than spell stops for the purpose of this table.

occurred in the fourth month of recall, whereas at the other extreme only 31% of starts and 36% of stops of State unemployment compensation occurred in that month. Apart from lack of health insurance, for each program the percentage of starts on the seam is always slightly smaller than the percentage of stops.

The results in Tables 1.4 and 1.5 clearly demonstrate the existence of the seam effect across the range of programs, and show that in many cases it is a very sizeable effect. Before considering how the seam effect affects estimates of spell durations, we will first describe the procedure we employ for estimating durations in the presence of censored spells.

## 1.3 Estimation of Spell Lengths

This section briefly describes the Kaplan-Meier product-limit method for estimating the distributions of lengths of spells on programs that is used in much of this report. For further details on this nonparametric method for estimating survival functions, see, for example, Lee (1992) or Kalbfleisch and Prentice (1980). The method is applicable to new spells starting during the life of the panel. (For many analyses we apply it to only the first new spells for the given program for the individuals involved.) The method is thus applicable to the uncensored and right censored spells in Table 1.3, but excludes the initial censored and doubly censored spells. Since the starts and ends of spells occur on a monthly basis, rather than continuously through time, an analysis for discrete time is applied.

The three key functions to be estimated in this analysis are:

- $f(t) = P(T = t)$, the distribution of spell length, $T$, or the probability density function (PDF);
- $S(t) = P(T > t)$, the survival function representing the probability that a spell will last for more than $t$ months;

- $h(t) = P(T = t \mid T \geq t)$, the hazard function representing the probability that a spell ends in month $t$, given that it lasts for $t$ months or more.[1]

These three functions are interrelated: knowing one, the other two can be derived. Thus

$$f(t) = S(t-1)h(t) \tag{1.3.1}$$

and

$$f(t) = S(t-1) - S(t). \tag{1.3.2}$$

From (1.3.1) and (1.3.2) it follows that

$$S(t) = S(t-1)[1-h(t)]. \tag{1.3.3}$$

Since all spells last for at least one month, $S(0) = 1$. Hence, it may be proved by induction from (1.3.3) that

$$S(t) = \prod_{x=1}^{t}[1-h(x)]. \tag{1.3.4}$$

The procedure adopted for estimating the three survival functions is first to estimate $h(t)$ by $\hat{h}(t)$, and then to estimate $S(t)$ and $f(t)$ in turn using equations (1.3.4) and (1.3.1), replacing $h(t)$ by $\hat{h}(t)$. Recalling that $h(t)$ represents the probability that a spell ends at $t$ months, given that it lasts for at least $t$ months, $h(t)$ may be estimated by the proportion of spells that end at $t$ months among all spells known to last for $t$ or more months, excluding those for which it cannot be determined whether or not they ended at $t$ months. The estimation of $h(t)$ can thus include both uncensored spells and right censored spells that are observed for at least $(t+1)$ months. Right censored spells that are observed for $t$ months cannot be employed in estimating $h(t)$ since it cannot be determined whether they ended at $t$

[1]Note that here, and throughout the report, references to month $t$ relate to month $t$ of the spell, not to month $t$ of the panel.

months or continued for a longer period. In a standard application of the discrete time Kaplan-Meier estimation procedure, $h(t)$ is thus estimated by

$$\hat{h}(t) = \frac{d_t}{\sum_{x=t}^{\infty} d_x + \sum_{x=t+1}^{\infty} c_x} \qquad (1.3.5)$$

where $d_t$ is the number of spells ending at time $t$ (i.e., at a duration of $t$ months)

and $c_t$ is the number of spells censored at time $t$.

The above approach needs some modification for estimating spell durations from the SIPP panel file. First, it should be noted that each spell of program participation may involve several household members, and it is possible that the spell durations could differ for different members. The analyses reported here are conducted at the person level, so that spells are counted separately for each individual. Thus one spell on a program may be counted several times in the analyses.

Second, the estimator $\hat{h}(t)$ in (1.3.5) needs to be adjusted to take account of the panel weights in the SIPP panel file. Some additional notation is required to describe this adjustment: let $w_j$ be the panel weight for sample person $j$; let $x_{tj} = 1$ if person $j$ has an uncensored spell of length $t$ months or greater or a censored spell that was observed for $(t+1)$ months or more, and $x_{tj} = 0$ otherwise; and let $y_{tj} = 1$ if the spell for person $j$ is completed at time $t$, and $y_{tj} = 0$ otherwise. Then $h(t)$ may be estimated by

$$\hat{h}^*(t) = \sum w_j y_{tj} / \sum w_j x_{tj}. \qquad (1.3.6)$$

If $w_j = 1$ for all $j$, $\hat{h}^*(t)$ is equivalent to $\hat{h}(t)$ in (1.3.5).

The 1987 SIPP panel collected data for 28 months. The longest completed spell of program participation that can be observed in this period is one of 26

months, since a month off the program is needed in the first month to identify a start in the second month, and a month off the program is needed in the last month to identify the end in the 27th month. Thus the survival distribution can be computed only up to a maximum duration of 26 months. (This implies that $d_x = 0$ for $x > 26$ in equation (1.3.5). Similarly no right censored spell can be observed for more than 27 months. Hence $c_x = 0$ for $x > 27$.)

An issue to be considered in estimating spell durations from the SIPP panel is how to treat panel members who left the survey universe while on a spell during the course of the panel, through death, institutionalization, entering an armed forces barracks, or leaving the country. In some cases it may be appropriate to treat leaving the universe as constituting the end of the spell (e.g., death ending a spell on SSI), whereas in other cases leaving the universe may not necessarily imply the end of a spell (e.g., entering an institution and receiving Social Security payments). In practice, the numbers leaving the survey universe while on a spell for a particular program are mostly negligible, so that they have no appreciable effect on the estimates of the survival distributions (see Chapter 2). In the next section, they are treated as right censored.

Since the survival distributions computed from the 1987 SIPP panel file are based on data collected with a complex sample design, and since panel weights are employed in the estimation procedures, the standard errors of the resultant estimators cannot be computed in the routine manner that assumes that the observations are independently and identically distributed. The standard errors presented in this report are obtained using balanced repeated replications (BRR). Further details are given in Chapter 3.

## 1.4 The Effect of the Seam Effect on the Estimation of Spell Lengths

Section 1.2 has demonstrated the existence of the seam effect for both spell starts and spell endings. The effect is evident for all programs, although it is larger for some than others. This section presents survival functions for all the programs,

computed as described in Section 1.3. The results, given in Tables 1.6 through 1.15, clearly show how the seam effect affects estimates of spell durations.

Each table gives the estimated hazard function, computed according to equation (1.3.6), the survival function, and the probability density function (PDF). The analyses are conducted using only the first spells starting in the life of the panel for each person. The seam effect shows up in the estimated hazard function in the form of large hazard rates in months that are multiples of 4 (months 4, 8, 12, etc.). These large hazard rates translate into large drops in the survival function from months 4 to 5, months 8 to 9, etc., and into spikes in the PDF at months 4, 8, 12, etc. These effects are to be found in all the tables.

Consider Table 1.6, which relates to spells of AFDC, as an example. The estimates show that 24% of spells that last for 4 or more months in fact end in 4 months. This hazard rate is much higher than any other in the table. As a consequence, although 73% of spells last for 4 or more months, only 56% last for 5 or more months. Thus 17% last for exactly four months. The spike of 17% at month 4 in the PDF is a clear indication of the seam effect. Spikes also occur at months 8, 12, 16, and 20, although they are much smaller.

Similar results are to be found in the other tables. The spikes in the estimated PDF at months that are multiples of 4 occur in all programs. The only case where the spike is not clearly evident is State unemployment compensation, where spells tend to be of short duration. The PDF for spell length of State unemployment compensation declines rapidly with length of spell, and there is no obvious spike at 4 months. However, even here, the PDF at 4 months is greater than would be expected. Given the high proportions of spells of Veterans compensation that start and stop at a seam, as shown in Tables 1.4 and 1.5, it is not surprising that the PDF of spell lengths for this program has the largest spikes at seam months. In fact, more than half of the spells of Veterans compensation last for either 4 or 8 months. Spells without health insurance also exhibit larger than average seam effects.

**Table 1.6**

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of AFDC**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.1473 | 0.8527 | 0.1473 |
| 2 | 0.0643 | 0.7979 | 0.0548 |
| 3 | 0.0829 | 0.7317 | 0.0662 |
| 4 | 0.2379 | 0.5577 | 0.1741 |
| 5 | 0.0396 | 0.5356 | 0.0221 |
| 6 | 0.0380 | 0.5153 | 0.0203 |
| 7 | 0.0702 | 0.4791 | 0.0362 |
| 8 | 0.1217 | 0.4208 | 0.0583 |
| 9 | 0.0116 | 0.4159 | 0.0049 |
| 10 | 0.0407 | 0.3990 | 0.0169 |
| 11 | 0.0487 | 0.3796 | 0.0194 |
| 12 | 0.0864 | 0.3468 | 0.0328 |
| 13 | 0.0000 | 0.3468 | 0.0000 |
| 14 | 0.0263 | 0.3376 | 0.0091 |
| 15 | 0.0000 | 0.3376 | 0.0000 |
| 16 | 0.0759 | 0.3120 | 0.0256 |
| 17 | 0.0000 | 0.3120 | 0.0000 |
| 18 | 0.0129 | 0.3080 | 0.0040 |
| 19 | 0.0160 | 0.3031 | 0.0049 |
| 20 | 0.0284 | 0.2945 | 0.0086 |
| 21 | 0.0000 | 0.2945 | 0.0000 |
| 22 | 0.0702 | 0.2738 | 0.0207 |
| 23 | 0.0000 | 0.2738 | 0.0000 |
| 24 | 0.0000 | 0.2738 | 0.0000 |
| 25 | 0.0000 | 0.2738 | 0.0000 |
| 26 | 0.0000 | 0.2738 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.7

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of General Assistance**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.1175 | 0.8825 | 0.1175 |
| 2 | 0.1343 | 0.7639 | 0.1185 |
| 3 | 0.0113 | 0.7553 | 0.0086 |
| 4 | 0.3672 | 0.4779 | 0.2774 |
| 5 | 0.0801 | 0.4396 | 0.0383 |
| 6 | 0.0829 | 0.4032 | 0.0364 |
| 7 | 0.0000 | 0.4032 | 0.0000 |
| 8 | 0.1534 | 0.3413 | 0.0619 |
| 9 | 0.0590 | 0.3212 | 0.0202 |
| 10 | 0.0206 | 0.3145 | 0.0066 |
| 11 | 0.0536 | 0.2977 | 0.0169 |
| 12 | 0.1429 | 0.2551 | 0.0425 |
| 13 | 0.0000 | 0.2551 | 0.0000 |
| 14 | 0.0000 | 0.2551 | 0.0000 |
| 15 | 0.0000 | 0.2551 | 0.0000 |
| 16 | 0.0000 | 0.2551 | 0.0000 |
| 17 | 0.0000 | 0.2551 | 0.0000 |
| 18 | 0.0000 | 0.2551 | 0.0000 |
| 19 | 0.0000 | 0.2551 | 0.0000 |
| 20 | 0.4685 | 0.1356 | 0.1195 |
| 21 | 0.0000 | 0.1356 | 0.0000 |
| 22 | 0.2866 | 0.0967 | 0.0389 |
| 23 | 0.0000 | 0.0967 | 0.0000 |
| 24 | 0.0000 | 0.0967 | 0.0000 |
| 25 | 0.0000 | 0.0967 | 0.0000 |
| 26 | 0.0000 | 0.0967 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.8

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of AFDC or General Assistance**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.1432 | 0.8568 | 0.1432 |
| 2 | 0.0690 | 0.7976 | 0.0591 |
| 3 | 0.0704 | 0.7415 | 0.0561 |
| 4 | 0.2568 | 0.5511 | 0.1904 |
| 5 | 0.0482 | 0.5245 | 0.0266 |
| 6 | 0.0508 | 0.4979 | 0.0267 |
| 7 | 0.0603 | 0.4678 | 0.0300 |
| 8 | 0.1275 | 0.4082 | 0.0596 |
| 9 | 0.0199 | 0.4001 | 0.0081 |
| 10 | 0.0396 | 0.3842 | 0.0158 |
| 11 | 0.0443 | 0.3672 | 0.0170 |
| 12 | 0.1045 | 0.3288 | 0.0384 |
| 13 | 0.0000 | 0.3288 | 0.0000 |
| 14 | 0.0239 | 0.3210 | 0.0079 |
| 15 | 0.0000 | 0.3210 | 0.0000 |
| 16 | 0.0719 | 0.2979 | 0.0231 |
| 17 | 0.0000 | 0.2979 | 0.0000 |
| 18 | 0.0125 | 0.2942 | 0.0037 |
| 19 | 0.0158 | 0.2895 | 0.0047 |
| 20 | 0.0840 | 0.2652 | 0.0243 |
| 21 | 0.0000 | 0.2652 | 0.0000 |
| 22 | 0.0972 | 0.2394 | 0.0258 |
| 23 | 0.0000 | 0.2394 | 0.0000 |
| 24 | 0.0000 | 0.2394 | 0.0000 |
| 25 | 0.0000 | 0.2394 | 0.0000 |
| 26 | 0.0000 | 0.2394 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.9

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of Food Stamps**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.1257 | 0.8743 | 0.1257 |
| 2 | 0.0873 | 0.7980 | 0.0763 |
| 3 | 0.0902 | 0.7260 | 0.0720 |
| 4 | 0.2067 | 0.5759 | 0.1501 |
| 5 | 0.1020 | 0.5172 | 0.0588 |
| 6 | 0.0493 | 0.4917 | 0.0255 |
| 7 | 0.0662 | 0.4591 | 0.0325 |
| 8 | 0.0740 | 0.4252 | 0.0340 |
| 9 | 0.0504 | 0.4037 | 0.0214 |
| 10 | 0.0869 | 0.3686 | 0.0351 |
| 11 | 0.0570 | 0.3476 | 0.0210 |
| 12 | 0.0630 | 0.3257 | 0.0219 |
| 13 | 0.0129 | 0.3215 | 0.0042 |
| 14 | 0.0717 | 0.2985 | 0.0230 |
| 15 | 0.0074 | 0.2963 | 0.0022 |
| 16 | 0.0158 | 0.2916 | 0.0047 |
| 17 | 0.0124 | 0.2880 | 0.0036 |
| 18 | 0.0000 | 0.2880 | 0.0000 |
| 19 | 0.0069 | 0.2860 | 0.0020 |
| 20 | 0.0064 | 0.2842 | 0.0018 |
| 21 | 0.0000 | 0.2842 | 0.0000 |
| 22 | 0.0000 | 0.2842 | 0.0000 |
| 23 | 0.0613 | 0.2667 | 0.0174 |
| 24 | 0.0240 | 0.2603 | 0.0064 |
| 25 | 0.0000 | 0.2603 | 0.0000 |
| 26 | 0.0000 | 0.2603 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.10

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of Federal SSI**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.0493 | 0.9507 | 0.0493 |
| 2 | 0.0655 | 0.8884 | 0.0622 |
| 3 | 0.0494 | 0.8445 | 0.0439 |
| 4 | 0.1282 | 0.7363 | 0.1083 |
| 5 | 0.0096 | 0.7292 | 0.0071 |
| 6 | 0.0258 | 0.7104 | 0.0188 |
| 7 | 0.0000 | 0.7104 | 0.0000 |
| 8 | 0.0957 | 0.6424 | 0.0680 |
| 9 | 0.0000 | 0.6424 | 0.0000 |
| 10 | 0.0000 | 0.6424 | 0.0000 |
| 11 | 0.0000 | 0.6424 | 0.0000 |
| 12 | 0.0578 | 0.6053 | 0.0372 |
| 13 | 0.0000 | 0.6053 | 0.0000 |
| 14 | 0.0000 | 0.6053 | 0.0000 |
| 15 | 0.0676 | 0.5644 | 0.0409 |
| 16 | 0.0330 | 0.5458 | 0.0186 |
| 17 | 0.0478 | 0.5197 | 0.0261 |
| 18 | 0.0000 | 0.5197 | 0.0000 |
| 19 | 0.0603 | 0.4883 | 0.0314 |
| 20 | 0.0000 | 0.4883 | 0.0000 |
| 21 | 0.0000 | 0.4883 | 0.0000 |
| 22 | 0.0000 | 0.4883 | 0.0000 |
| 23 | 0.0000 | 0.4883 | 0.0000 |
| 24 | 0.0000 | 0.4883 | 0.0000 |
| 25 | 0.0000 | 0.4883 | 0.0000 |
| 26 | 0.0000 | 0.4883 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.11

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of Social Security**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.0336 | 0.9664 | 0.0336 |
| 2 | 0.0144 | 0.9524 | 0.0139 |
| 3 | 0.0037 | 0.9489 | 0.0035 |
| 4 | 0.1327 | 0.8230 | 0.1260 |
| 5 | 0.0096 | 0.8151 | 0.0079 |
| 6 | 0.0092 | 0.8076 | 0.0075 |
| 7 | 0.0060 | 0.8028 | 0.0048 |
| 8 | 0.0673 | 0.7487 | 0.0540 |
| 9 | 0.0031 | 0.7464 | 0.0023 |
| 10 | 0.0045 | 0.7431 | 0.0033 |
| 11 | 0.0091 | 0.7363 | 0.0068 |
| 12 | 0.0347 | 0.7107 | 0.0256 |
| 13 | 0.0063 | 0.7063 | 0.0045 |
| 14 | 0.0109 | 0.6985 | 0.0077 |
| 15 | 0.0096 | 0.6918 | 0.0067 |
| 16 | 0.0403 | 0.6639 | 0.0279 |
| 17 | 0.0000 | 0.6639 | 0.0000 |
| 18 | 0.0000 | 0.6639 | 0.0000 |
| 19 | 0.0137 | 0.6548 | 0.0091 |
| 20 | 0.0041 | 0.6521 | 0.0027 |
| 21 | 0.0000 | 0.6521 | 0.0000 |
| 22 | 0.0000 | 0.6521 | 0.0000 |
| 23 | 0.0087 | 0.6464 | 0.0057 |
| 24 | 0.0000 | 0.6464 | 0.0000 |
| 25 | 0.0000 | 0.6464 | 0.0000 |
| 26 | 0.0000 | 0.6464 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.12

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of State Unemployment Compensation**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.2978 | 0.7022 | 0.2978 |
| 2 | 0.2438 | 0.5311 | 0.1712 |
| 3 | 0.2702 | 0.3876 | 0.1435 |
| 4 | 0.3611 | 0.2476 | 0.1399 |
| 5 | 0.3202 | 0.1684 | 0.0793 |
| 6 | 0.3848 | 0.1036 | 0.0648 |
| 7 | 0.6080 | 0.0406 | 0.0630 |
| 8 | 0.4541 | 0.0222 | 0.0184 |
| 9 | 0.3887 | 0.0135 | 0.0086 |
| 10 | 0.2958 | 0.0095 | 0.0040 |
| 11 | 0.3190 | 0.0065 | 0.0030 |
| 12 | 0.0000 | 0.0065 | 0.0000 |
| 13 | 0.4577 | 0.0035 | 0.0030 |
| 14 | 0.4373 | 0.0020 | 0.0015 |
| 15 | 0.0000 | 0.0020 | 0.0000 |
| 16 | 0.0000 | 0.0020 | 0.0000 |
| 17 | 1.0000 | 0.0000 | 0.0020 |
| 18 | 0.0000 | 0.0000 | 0.0000 |
| 19 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 0.0000 | 0.0000 | 0.0000 |
| 21 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 0.0000 | 0.0000 | 0.0000 |
| 23 | 0.0000 | 0.0000 | 0.0000 |
| 24 | 0.0000 | 0.0000 | 0.0000 |
| 25 | 0.0000 | 0.0000 | 0.0000 |
| 26 | 0.0000 | 0.0000 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## Table 1.13

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of Veterans Compensation**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.0183 | 0.9817 | 0.0183 |
| 2 | 0.0035 | 0.9783 | 0.0034 |
| 3 | 0.0114 | 0.9671 | 0.0112 |
| 4 | 0.4201 | 0.5608 | 0.4063 |
| 5 | 0.0000 | 0.5608 | 0.0000 |
| 6 | 0.0160 | 0.5518 | 0.0090 |
| 7 | 0.0058 | 0.5486 | 0.0032 |
| 8 | 0.2303 | 0.4223 | 0.1264 |
| 9 | 0.0272 | 0.4108 | 0.0115 |
| 10 | 0.0000 | 0.4108 | 0.0000 |
| 11 | 0.0000 | 0.4108 | 0.0000 |
| 12 | 0.1375 | 0.3543 | 0.0565 |
| 13 | 0.0000 | 0.3543 | 0.0000 |
| 14 | 0.0000 | 0.3543 | 0.0000 |
| 15 | 0.0000 | 0.3543 | 0.0000 |
| 16 | 0.0000 | 0.3543 | 0.0000 |
| 17 | 0.0429 | 0.3391 | 0.0152 |
| 18 | 0.0000 | 0.3391 | 0.0000 |
| 19 | 0.0000 | 0.3391 | 0.0000 |
| 20 | 0.0000 | 0.3391 | 0.0000 |
| 21 | 0.0000 | 0.3391 | 0.0000 |
| 22 | 0.0000 | 0.3391 | 0.0000 |
| 23 | 0.0000 | 0.3391 | 0.0000 |
| 24 | 0.0000 | 0.3391 | 0.0000 |
| 25 | 0.0000 | 0.3391 | 0.0000 |
| 26 | 0.0000 | 0.3391 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

**Table 1.14**

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of WIC**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.0722 | 0.9278 | 0.0722 |
| 2 | 0.0564 | 0.8755 | 0.0523 |
| 3 | 0.0328 | 0.8468 | 0.0287 |
| 4 | 0.2634 | 0.6237 | 0.2231 |
| 5 | 0.0993 | 0.5618 | 0.0619 |
| 6 | 0.1276 | 0.4901 | 0.0717 |
| 7 | 0.0893 | 0.4463 | 0.0438 |
| 8 | 0.2415 | 0.3386 | 0.1078 |
| 9 | 0.1157 | 0.2994 | 0.0392 |
| 10 | 0.0137 | 0.2953 | 0.0041 |
| 11 | 0.1532 | 0.2501 | 0.0452 |
| 12 | 0.1621 | 0.2095 | 0.0405 |
| 13 | 0.1092 | 0.1867 | 0.0229 |
| 14 | 0.0854 | 0.1707 | 0.0159 |
| 15 | 0.0174 | 0.1677 | 0.0030 |
| 16 | 0.2555 | 0.1249 | 0.0429 |
| 17 | 0.0663 | 0.1166 | 0.0083 |
| 18 | 0.0711 | 0.1083 | 0.0083 |
| 19 | 0.0000 | 0.1083 | 0.0000 |
| 20 | 0.1274 | 0.0945 | 0.0138 |
| 21 | 0.0000 | 0.0945 | 0.0000 |
| 22 | 0.0000 | 0.0945 | 0.0000 |
| 23 | 0.1210 | 0.0831 | 0.0114 |
| 24 | 0.0000 | 0.0831 | 0.0000 |
| 25 | 0.0000 | 0.0831 | 0.0000 |
| 26 | 0.0000 | 0.0831 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

**Table 1.15**

**Kaplan-Meier Estimates of the Survival Functions for all Panel Members of the 1987 SIPP*: Spells of No Health Insurance**

| Month $t$ | Hazard function $\hat{h}^*(t)$ | Survival function $\hat{S}^*(t)$ | PDF $\hat{f}^*(t)$ |
|---|---|---|---|
| 1 | 0.0684 | 0.9316 | 0.0684 |
| 2 | 0.0641 | 0.8719 | 0.0597 |
| 3 | 0.0604 | 0.8193 | 0.0526 |
| 4 | 0.3561 | 0.5275 | 0.2918 |
| 5 | 0.0271 | 0.5132 | 0.0143 |
| 6 | 0.0363 | 0.4946 | 0.0187 |
| 7 | 0.0271 | 0.4811 | 0.0134 |
| 8 | 0.1766 | 0.3962 | 0.0850 |
| 9 | 0.0279 | 0.3851 | 0.0110 |
| 10 | 0.0349 | 0.3717 | 0.0134 |
| 11 | 0.0106 | 0.3678 | 0.0039 |
| 12 | 0.1424 | 0.3154 | 0.0524 |
| 13 | 0.0182 | 0.3097 | 0.0057 |
| 14 | 0.0325 | 0.2996 | 0.0101 |
| 15 | 0.0211 | 0.2933 | 0.0063 |
| 16 | 0.0962 | 0.2651 | 0.0282 |
| 17 | 0.0163 | 0.2607 | 0.0043 |
| 18 | 0.0270 | 0.2537 | 0.0070 |
| 19 | 0.0193 | 0.2488 | 0.0049 |
| 20 | 0.0687 | 0.2317 | 0.0171 |
| 21 | 0.0036 | 0.2309 | 0.0008 |
| 22 | 0.0057 | 0.2296 | 0.0013 |
| 23 | 0.0000 | 0.2296 | 0.0000 |
| 24 | 0.0466 | 0.2189 | 0.0107 |
| 25 | 0.1352 | 0.1893 | 0.0296 |
| 26 | 0.0000 | 0.1893 | 0.0000 |

*Based on only the first spell starting in the life of the panel for each participant.

## 1.5 Concluding Remarks

This chapter has provided some background on the issues involved in estimating spell durations for welfare programs from the SIPP. The results in Table 1.1 show that for many programs sizeable proportions of participants have more than one spell during the life of a SIPP panel, when a gap of one month or more off the program is taken to define the end of one spell and the beginning of another. Table 1.3 shows that many of the program spells observed in the SIPP were in existence at the start of the panel. Tables 1.4 and 1.5 demonstrate the presence of the seam effect, and Tables 1.6 through 1.15 show how the seam effect distorts estimates of the survival functions. Later chapters consider modifications to the methods for analyzing the durations of program spells from the SIPP in order to take account of these findings.

The presence of a sizeable number of multiple spells raises two issues. One is the use of all starting spells, rather than only the first starting spells, in the estimation of the survival functions. The other is the possibility of adopting an alternative definition of a spell, one that allows for a gap of one or more months of nonparticipation during a spell, thus converting, say, two spells with a short gap in between into a single extended spell. Both these issues are addressed in Chapters 2 and 3.

The existence of a sizeable number of spells that were in existence at the start of the panel, that is, initial censored and doubly censored spells, raises the issue of whether such spells can also be used in the estimation of the survival functions. This topic is treated in Chapter 3, which shows how such spells can be used on their own, and Chapter 4, which considers how they can be combined with spells starting during the life of the panel, to estimate the survival functions.

The distortion to the survival distributions caused by the seam effect raises the issue of how an adjustment might be made in the analysis to remove this effect. One form of adjustment is described in Chapter 2, and a modification to it is described in Chapter 3.

# CHAPTER 2

# ALTERNATIVE ESTIMATES OF SPELL DURATIONS

## 2.1 Introduction

This chapter examines the effects of three factors on the estimation of durations of spells on welfare programs from the SIPP. One factor concerns the seam effect. A method that attempts to make adjustments for the seam effect is described, and the effects of the adjustments on estimates of spell durations are examined. A second factor relates to the definition of spell adopted. An alternative definition that defines a spell in a way that permits a gap of one month off the program in the middle of the spell is considered, and its effect on estimates of spell durations is examined. The third factor concerns panel members who leave the survey universe while on a welfare program during the life of the panel. Estimates of spell durations obtained under alternative ways of treating such persons are compared.

## 2.2 An Adjustment for the Seam Effect

As noted in Tables 1.4 and 1.5, unduly high proportions of spell starts and stops occur at 4 months of recall, that is at the seam between the previous wave and the current wave of data collection. In Section 1.3, this seam effect is shown to distort the survival functions for spell durations. This section outlines a simple model for the seam effect, and suggests a method for adjusting for the effect. The results obtained by the application of this adjustment are presented in Section 2.4.

The simple model employed here assumes that changes onto or off programs reported at 1, 2 and 3 months of recall are reported accurately, but that some changes reported at 4 months of recall (i.e., at the seam) should have been reported at one of the later months within the wave. The underlying assumption is that some respondents report their program status for all four months as the same as their status for the most recent month. Young (1989) terms this type of response a constant wave response. Under the constant wave response process, a respondent who starts a spell on a program in the middle of a wave would report being on the program for the whole of the wave, and the program start would appear to have occurred at 4 months of recall. The adjustment procedure proposed reallocates a proportion of the starts and stops reported at 4 months of recall to other months within the wave. It should be noted that this adjustment fails to deal with response errors in reporting starts and stops off the seam. It also fails to make an allowance for short spells of program participation, or of spells off a program, that would be missed under the constant wave response process because both a change onto and a change off the program occurred within the wave.

An examination of the wave specific distributions of month of recall for starts and stops on the various programs shows no marked variation in these distributions across waves. The adjustment developed here is therefore applied across the whole panel. In view of the even spread of the SIPP sample across the four rotation groups, each of which is interviewed in a different month, the effect of any uneven distribution of actual spell starts or stops across months should be smoothed out across months of recall. Thus the expected proportion of spell starts or stops at any month of recall should be the same. Over the panel, however, the expected proportions are not quite the same because neither a start nor a stop can be observed in the first month of the panel. Thus, only 6 of the 7 waves can identify a start or stop in the fourth month of recall, whereas all 7 waves can identify a start or stop in the first, second and third months of recall.

Let $P_i$ be the probability of an actual start (stop) at the $i$ th month of recall, let $R_i$ be the probability of a reported start (stop) at the $i$ th month of recall, and let

$\pi_{i|j}$ be the probability that the actual month of recall is $i$ given that the report month is $j$. Then

$$P_i = \sum_{j=1}^{4} \pi_{i|j} R_j.$$

For the simple model discussed here, for $i = 1, 2$ or 3

$$\pi_{i|j} = \begin{cases} 1 & \text{if } i = j \\ 0 & \text{if } i \neq j. \end{cases}$$

Thus

$$P_1 = R_1 + \pi_{1|4} R_4$$

$$P_2 = R_2 + \pi_{2|4} R_4$$

$$P_3 = R_3 + \pi_{3|4} R_4$$

$$P_4 = \pi_{4|4} R_4.$$

Solving for $\pi_{i|4}$ gives,

$$\pi_{i|4} = \frac{P_i - R_i}{R_4} \qquad i = 1, 2, 3 \qquad (2.1)$$

$$\pi_{4|4} = 1 - \pi_{1|4} - \pi_{2|4} - \pi_{3|4}.$$

Based on the earlier discussion, for both stops and starts, $P_1 = P_2 = P_3 = 7/27$ and $P_4 = 6/27$. The quantities $R_i$ may be estimated from the observed distributions of months of recall, $\hat{R}_i$, and these values substituted in (2.1) to produce estimates of the $\pi_{i|4}$.

Having estimated the $\pi_{i|4}$, the next step is to redistribute the spell starts (stops) from recall month 4 to other months according to these estimated probabilities. One method of performing this redistribution would be to allocate

some spells chosen at random from those starting (stopping) in month 4 to other months. An alternative method, and the one adopted here, is to divide the record for each person with a spell starting (stopping) in month 4 into four parts, one for each month of recall, and to divide the person's weight between the parts according to the $\pi_{i|4}$.

To illustrate the procedure, consider a person with a weight of 4500 who reported the start of a spell on the food stamp program in the fifth month of the panel, that is, in the first month of the second wave, with a recall of 4 months. Table 2.1 below shows how the weight of that person is redistributed across the various months of recall. The second column, $\hat{R}_i$, gives the reported distribution of starts on the food stamp program by month of recall, taken from Table 1.4, the third column gives the expected distribution, $P_i$, with $P_i = 7/27$ for $i = 1,2,3$ and $P_4 = 6/27$, and the fourth column gives $\hat{\pi}_{i|4}$ obtained from equation (2.1) with $\hat{R}_i$ substituted for $R_i$. The final column, which gives the redistribution of the weights for the person across the months of recall, is obtained by calculating the weight for person $j$ assigned to month of recall $i$ as $w_{j(i)} = 4500\pi_{i|4}$. Thus, the person's record is divided into 4 records, one with a weight of 700 with a spell start in the first month of recall, one with a weight of 500 with a start in the second month of recall, one with a weight of 1100 with a start in the third month of recall, and one with a weight of 2200 with a start in the fourth month of recall.

**Table 2.1**

**Redistribution of the Weight of 4500 for a Person Starting a Spell on the Food Stamp Program in the 4th Month of Recall**

| Month of recall | $\hat{R}_i$ | $P_i$ | $\hat{\pi}_{i\|4}$ | $w_{j(i)}$ |
|---|---|---|---|---|
| 1 | 0.19 | 0.26 | 0.16 | 700 |
| 2 | 0.21 | 0.26 | 0.11 | 500 |
| 3 | 0.15 | 0.26 | 0.24 | 1100 |
| 4 | 0.45 | 0.22 | 0.49 | 2200 |
| | 1.00 | 1.00 | 1.00 | 4500 |

The same procedure is also applied for spell stops. The records for persons who report both a spell start and a spell stop on the seam are divided into 16 records representing the combinations of 4 possible true starts and 4 possible true stops. Table 2.2 gives the unweighted percentages of uncensored spells that are reported to start on a seam, to end on a seam, and to do both, for the various programs. The final column of the table presents the expected percentages of spells both starting and ending on a seam under an assumption that these two events are independent. In all cases these expected percentages are close to the actual percentages. The table shows that, with the exception of State unemployment compensation, sizeable percentages of records containing uncensored spells need to be divided into 16 parts. Indeed, in the case of Veterans compensation, about 7 out of 8 uncensored spells need to be so divided.

A complication arises when a spell starts on a seam and lasts for three months or less. In this case, the redistribution can lead to a negative or zero spell length. In such a case, it may be best to assume that the spell start is correctly reported, noting that the constant wave response mechanism does not apply since one change has been reported. However, in view of the rarity of such cases, in this chapter we have adopted the simpler solution of treating all nonpositive spell lengths as spells of one month's duration (see Chapter 3 for an alternative procedure).

Besides making a separate seam adjustment for each program, as described above, there is also the possibility of making separate adjustments for different subgroups of the population. However, the research on the seam effect with recipiency status conducted to date has not established the existence of identifiable population subgroups that are more prone or less prone to this effect. Moreover, some logistic regression analyses conducted as part of this research to investigate sex, age, race and length of spell as predictors of a spell starting or stopping on a seam yielded no consistent patterns (see Appendix A). The possibility of making separate adjustments for different population subgroups has therefore not been pursued here.

**Table 2.2**
**Uncensored Spells Starting and Stopping at the Seam***

| | Number of uncensored spells | Spells starting at the seam | Spells stopping at the seam | Spells starting and stopping at the seam | Expected percentage of spells starting and stopping at the seam assuming independence |
|---|---|---|---|---|---|
| | | % | % | % | % |
| AFDC | 390 | 44.9 | 55.6 | 26.4 | 25.0 |
| General Assistance | 126 | 56.3 | 64.3 | 42.1 | 36.2 |
| AFDC or Gen. Assist. | 477 | 44.9 | 56.2 | 28.5 | 25.2 |
| Food Stamps | 1052 | 38.7 | 54.4 | 20.2 | 21.0 |
| SSI | 65 | 69.2 | 55.4 | 41.5 | 38.3 |
| Social Security | 239 | 73.2 | 77.0 | 62.8 | 56.4 |
| State Unemployment | 1309 | 31.3 | 35.9 | 8.3 | 11.2 |
| Veterans Compensation | 153 | 92.8 | 94.1 | 88.2 | 87.4 |
| WIC | 260 | 58.8 | 74.2 | 44.2 | 43.7 |
| No Health Insurance | 3191 | 77.1 | 71.6 | 56.6 | 55.2 |

*Unweighted percentages.

## 2.3 Alternative Definition of a Spell and Handling Panel Members Who Leave the Survey Universe

For food stamps, AFDC, general assistance, Social Security, Veterans compensation and WIC, panel members are considered in this report to be program participants in a given month if they reported either that they were covered by the program or that they received income from the program in that month. In the cases of SSI and State unemployment compensation, no coverage questions were asked, and hence receipt of income from these programs in a given month is used to identify participation. In Chapter 1 program spells were treated as having ended when respondents reported one month off the program. In practice, however, a gap in participation of a month or so may occur for administrative reasons (especially when participation is determined by the receipt of income) in what would otherwise be considered to be a continuous spell. For this reason, alternative definitions of a spell that allow for short gaps have been proposed. (See Ruggles and Williams, 1989, for a related discussion of alternative definitions of spells of poverty based on the monthly data from the SIPP.)

Here we consider a broadening of the definition of a spell to allow for a gap of one month off the program during the spell. For example, a food stamp participant who is on the program for four months, off for one month, and back on for three months is now treated as having one spell of 8 months' duration, rather than two spells, one of 4 months' duration and the other of 3 months' duration. For analyses that are based on only first starting spells during the panel, the effect of this new definition is to replace a short spell by a longer one, whereas for analyses based on all starting spells, its effect is to replace two short spells by one longer one. The effect of this alternative definition of a spell on the distribution of spell lengths is examined in the next section.

Another issue taken up in the next section is how alternative ways of handling panel members who leave the survey universe affect estimates of spell durations. These individuals may leave the survey universe through death, institutionalization,

entering an armed forces barracks, or leaving the country.[2] For estimating the durations of program spells, the only leavers from the survey universe of concern are those who are program participants at the times of their departures. There are three alternative ways in which the ongoing spells of these leavers may be handled:

- They may be treated as censored spells, and analyzed in the same way as spells that are ongoing at the end of the panel;
- The participants' departures from the survey universe may be taken to indicate the ends of the spells;
- They may be eliminated from the analysis.

The choice between these three alternatives should be made in the light of the objectives of the specific analysis and the form of the departure from the survey universe. The purpose here is not to consider the appropriateness of the various alternatives for different analyses, but simply to investigate the effects of using the three alternatives on estimates of durations. As is demonstrated in the next section, because the numbers of panel members who leave the survey universe while participating in particular programs are very small, the estimates of spell durations obtained under the three alternatives are very similar.

## 2.4 Comparisons of Survival Functions

Survival functions have been computed using weighted Kaplan-Meier estimation procedures for six different combinations of ways of handling the seam

[2]Some original sample members are also lost from the panel through nonresponse. Our analyses are conducted with panel members who responded at all waves for which they were eligible, with weighting adjustments for the nonrespondents. Hence we do not consider nonresponse as a source of departure from the sample here. However, other analysts have estimated spell durations from SIPP data by treating panel nonresponse as another source of departure from the sample.

## Table 2.3

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell†: AFDC**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted | No | Yes | No | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes |
| Censoring‡ | C | C | C | C | O | U | C | C | C | C | O | U |
| One month gap | No | No | Yes | Yes | No | No | No | No | Yes | Yes | No | No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.85 | 0.88 | 0.90 | 0.92 | 0.88 | 0.88 | 0.15 | 0.12 | 0.10 | 0.08 | 0.12 | 0.12 |
| 2 | 0.80 | 0.82 | 0.86 | 0.87 | 0.82 | 0.82 | 0.05 | 0.06 | 0.04 | 0.05 | 0.06 | 0.06 |
| 3 | 0.73 | 0.74 | 0.77 | 0.78 | 0.75 | 0.74 | 0.07 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 |
| 4 | 0.56 | 0.62 | 0.60 | 0.68 | 0.63 | 0.62 | 0.17 | 0.12 | 0.18 | 0.10 | 0.12 | 0.12 |
| 5 | 0.54 | 0.56 | 0.57 | 0.61 | 0.57 | 0.56 | 0.02 | 0.06 | 0.03 | 0.07 | 0.06 | 0.06 |
| 6 | 0.52 | 0.51 | 0.54 | 0.56 | 0.52 | 0.51 | 0.02 | 0.05 | 0.02 | 0.05 | 0.05 | 0.05 |
| 7 | 0.48 | 0.47 | 0.53 | 0.51 | 0.47 | 0.46 | 0.04 | 0.05 | 0.02 | 0.05 | 0.05 | 0.05 |
| 8 | 0.42 | 0.44 | 0.46 | 0.48 | 0.45 | 0.44 | 0.06 | 0.03 | 0.07 | 0.03 | 0.03 | 0.03 |
| 9 | 0.42 | 0.42 | 0.45 | 0.46 | 0.42 | 0.42 | 0.00 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| 10 | 0.40 | 0.40 | 0.43 | 0.43 | 0.40 | 0.39 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 |
| 11 | 0.38 | 0.37 | 0.41 | 0.41 | 0.38 | 0.37 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 |
| 12 | 0.35 | 0.35 | 0.36 | 0.37 | 0.35 | 0.35 | 0.03 | 0.02 | 0.05 | 0.03 | 0.02 | 0.02 |
| 13 | 0.35 | 0.34 | 0.36 | 0.36 | 0.35 | 0.34 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.34 | 0.33 | 0.35 | 0.35 | 0.34 | 0.33 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 15 | 0.34 | 0.33 | 0.35 | 0.34 | 0.33 | 0.33 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 16 | 0.31 | 0.30 | 0.33 | 0.31 | 0.31 | 0.30 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 17 | 0.31 | 0.30 | 0.33 | 0.30 | 0.30 | 0.30 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 18 | 0.31 | 0.30 | 0.30 | 0.29 | 0.30 | 0.30 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 0.00 |
| 19 | 0.30 | 0.29 | 0.30 | 0.29 | 0.30 | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0.29 | 0.29 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| 21 | 0.29 | 0.29 | 0.29 | 0.28 | 0.29 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.27 | 0.26 | 0.27 | 0.25 | 0.27 | 0.26 | 0.02 | 0.02 | 0.03 | 0.04 | 0.02 | 0.02 |
| 23 | 0.27 | 0.26 | 0.27 | 0.24 | 0.26 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.27 | 0.26 | 0.27 | 0.24 | 0.26 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.27 | 0.26 | 0.27 | 0.24 | 0.26 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.27 | 0.26 | 0.27 | 0.24 | 0.26 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

†Based on only the first spell starting in the life of the panel for each participant.

‡Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

problem, of handling participants leaving the survey universe, and of defining spells. The six combinations are:

| Combination | Seam adjustment | Leavers | End of spell definition |
|---|---|---|---|
| A | Unadjusted | Censored | One month off |
| B | Adjusted | Censored | One month off |
| C | Unadjusted | Censored | Two months off |
| D | Adjusted | Censored | Two months off |
| E | Adjusted | Omitted | One month off |
| F | Adjusted | Ended | One month off |

The estimated survival functions $\hat{S}^*(t)$ and PDFs $\hat{f}^*(t)$ for these six combinations, computed from the weighted estimated hazard functions $\hat{h}^*(t)$ based on first spells starting during the panel, are displayed for the ten programs in Tables 2.3 through 2.12.

The results presented in these tables may be compared in several ways:

- Comparisons of the results of A with B and C with D show the effects of the adjustment for the seam effect, holding constant the other two factors;

- Comparisons of the results of B, E and F show the effects of the different methods of handling leavers, holding constant the other two factors;

- Comparisons of the results of A with C and B with D show the effects of the alternative definitions of spells, holding constant the other two factors.

## Table 2.5

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: AFDC or General Assistance**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted<br>Censoring[‡]<br>One month gap | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.86 | 0.89 | 0.90 | 0.92 | 0.89 | 0.89 | 0.14 | 0.11 | 0.10 | 0.08 | 0.11 | 0.11 |
| 2 | 0.80 | 0.82 | 0.86 | 0.87 | 0.82 | 0.82 | 0.06 | 0.07 | 0.04 | 0.05 | 0.07 | 0.07 |
| 3 | 0.74 | 0.74 | 0.79 | 0.78 | 0.74 | 0.74 | 0.06 | 0.08 | 0.07 | 0.09 | 0.08 | 0.08 |
| 4 | 0.55 | 0.62 | 0.59 | 0.68 | 0.63 | 0.62 | 0.19 | 0.12 | 0.20 | 0.10 | 0.12 | 0.12 |
| 5 | 0.52 | 0.56 | 0.56 | 0.60 | 0.56 | 0.56 | 0.03 | 0.06 | 0.03 | 0.07 | 0.06 | 0.06 |
| 6 | 0.50 | 0.50 | 0.53 | 0.55 | 0.51 | 0.50 | 0.03 | 0.06 | 0.03 | 0.06 | 0.06 | 0.06 |
| 7 | 0.47 | 0.45 | 0.52 | 0.50 | 0.46 | 0.45 | 0.03 | 0.05 | 0.01 | 0.05 | 0.05 | 0.05 |
| 8 | 0.41 | 0.43 | 0.45 | 0.47 | 0.43 | 0.42 | 0.06 | 0.03 | 0.07 | 0.03 | 0.03 | 0.03 |
| 9 | 0.40 | 0.41 | 0.44 | 0.45 | 0.41 | 0.40 | 0.01 | 0.02 | 0.01 | 0.03 | 0.02 | 0.02 |
| 10 | 0.38 | 0.38 | 0.42 | 0.42 | 0.39 | 0.38 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 |
| 11 | 0.37 | 0.36 | 0.40 | 0.40 | 0.36 | 0.36 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 |
| 12 | 0.33 | 0.33 | 0.35 | 0.36 | 0.34 | 0.33 | 0.04 | 0.03 | 0.05 | 0.04 | 0.03 | 0.03 |
| 13 | 0.33 | 0.33 | 0.35 | 0.35 | 0.33 | 0.32 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.32 | 0.32 | 0.34 | 0.34 | 0.32 | 0.31 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 15 | 0.32 | 0.31 | 0.34 | 0.33 | 0.31 | 0.31 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 16 | 0.30 | 0.29 | 0.32 | 0.30 | 0.29 | 0.29 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.02 |
| 17 | 0.30 | 0.29 | 0.32 | 0.29 | 0.29 | 0.28 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 18 | 0.29 | 0.28 | 0.29 | 0.28 | 0.28 | 0.28 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 0.00 |
| 19 | 0.29 | 0.27 | 0.29 | 0.27 | 0.28 | 0.27 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 20 | 0.27 | 0.27 | 0.26 | 0.26 | 0.27 | 0.26 | 0.02 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 |
| 21 | 0.27 | 0.26 | 0.26 | 0.25 | 0.26 | 0.26 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 22 | 0.24 | 0.23 | 0.23 | 0.20 | 0.23 | 0.23 | 0.03 | 0.03 | 0.03 | 0.05 | 0.03 | 0.03 |
| 23 | 0.24 | 0.22 | 0.23 | 0.19 | 0.23 | 0.22 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 24 | 0.24 | 0.22 | 0.23 | 0.19 | 0.23 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.24 | 0.22 | 0.23 | 0.19 | 0.23 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.24 | 0.22 | 0.23 | 0.19 | 0.23 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

Table 2.4

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: General Assistance**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted<br>Censoring[‡]<br>One month gap | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.88 | 0.88 | 0.89 | 0.89 | 0.88 | 0.88 | 0.12 | 0.12 | 0.11 | 0.11 | 0.12 | 0.12 |
| 2 | 0.76 | 0.78 | 0.81 | 0.82 | 0.78 | 0.77 | 0.12 | 0.11 | 0.08 | 0.07 | 0.10 | 0.10 |
| 3 | 0.76 | 0.71 | 0.80 | 0.74 | 0.71 | 0.70 | 0.01 | 0.07 | 0.02 | 0.08 | 0.07 | 0.07 |
| 4 | 0.48 | 0.59 | 0.52 | 0.63 | 0.59 | 0.58 | 0.28 | 0.12 | 0.28 | 0.11 | 0.12 | 0.12 |
| 5 | 0.44 | 0.50 | 0.48 | 0.54 | 0.50 | 0.50 | 0.04 | 0.09 | 0.04 | 0.09 | 0.08 | 0.08 |
| 6 | 0.40 | 0.42 | 0.43 | 0.45 | 0.42 | 0.42 | 0.04 | 0.08 | 0.05 | 0.09 | 0.08 | 0.08 |
| 7 | 0.40 | 0.38 | 0.43 | 0.40 | 0.38 | 0.37 | 0.00 | 0.04 | 0.00 | 0.05 | 0.04 | 0.04 |
| 8 | 0.34 | 0.35 | 0.36 | 0.37 | 0.35 | 0.35 | 0.06 | 0.03 | 0.07 | 0.04 | 0.03 | 0.03 |
| 9 | 0.32 | 0.33 | 0.34 | 0.34 | 0.33 | 0.32 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 |
| 10 | 0.31 | 0.31 | 0.33 | 0.32 | 0.31 | 0.31 | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| 11 | 0.30 | 0.29 | 0 31 | 0.30 | 0.29 | 0.29 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 12 | 0.26 | 0.26 | 0.27 | 0.26 | 0.26 | 0.26 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 |
| 13 | 0.26 | 0.25 | 0.27 | 0.26 | 0.25 | 0.25 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.26 | 0.25 | 0.27 | 0.25 | 0.25 | 0.24 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 15 | 0.26 | 0.25 | 0.27 | 0.25 | 0.24 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | 0.26 | 0.25 | 0.27 | 0.25 | 0.24 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | 0.26 | 0.24 | 0.27 | 0.24 | 0.24 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | 0.26 | 0.24 | 0.27 | 0.24 | 0.24 | 0.23 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 |
| 19 | 0.26 | 0.22 | 0.27 | 0.21 | 0.22 | 0.22 | 0.00 | 0.02 | 0.00 | 0.03 | 0.02 | 0.02 |
| 20 | 0.14 | 0.18 | 0.14 | 0.16 | 0.19 | 0.18 | 0.12 | 0.04 | 0.13 | 0.04 | 0.03 | 0.04 |
| 21 | 0.14 | 0.14 | 0.14 | 0.12 | 0.16 | 0.14 | 0.00 | 0.04 | 0.00 | 0.04 | 0.03 | 0.04 |
| 22 | 0.10 | 0.10 | 0.10 | 0.07 | 0.11 | 0.10 | 0.04 | 0.04 | 0.04 | 0.05 | 0.04 | 0.04 |
| 23 | 0.10 | 0.08 | 0.10 | 0.00 | 0.10 | 0.08 | 0.00 | 0.02 | 0.00 | 0.07 | 0.01 | 0.02 |
| 24 | 0.10 | 0.08 | 0.10 | 0.00 | 0.10 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.10 | 0.08 | 0.10 | 0.00 | 0.10 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.10 | 0.08 | 0.10 | 0.00 | 0.10 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

Table 2.7

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell†: Federal SSI**

| Combination | A | B | C | D* | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted | No | Yes | No | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes |
| Censoring‡ | C | C | C | C | O | U | C | C | C | C | O | U |
| One month gap | No | No | Yes | Yes | No | No | No | No | Yes | Yes | No | No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.95 | 0.90 | 0.96 | 0.90 | 0.90 | 0.90 | 0.05 | 0.10 | 0.04 | 0.10 | 0.10 | 0.10 |
| 2 | 0.89 | 0.85 | 0.90 | 0.85 | 0.85 | 0.85 | 0.06 | 0.05 | 0.06 | 0.05 | 0.05 | 0.05 |
| 3 | 0.84 | 0.80 | 0.84 | 0.80 | 0.80 | 0.80 | 0.04 | 0.04 | 0.06 | 0.05 | 0.04 | 0.04 |
| 4 | 0.74 | 0.77 | 0.72 | 0.76 | 0.77 | 0.77 | 0.11 | 0.03 | 0.12 | 0.04 | 0.03 | 0.03 |
| 5 | 0.73 | 0.74 | 0.71 | 0.73 | 0.74 | 0.74 | 0.01 | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 |
| 6 | 0.71 | 0.71 | 0.69 | 0.69 | 0.71 | 0.71 | 0.02 | 0.03 | 0.02 | 0.04 | 0.03 | 0.03 |
| 7 | 0.71 | 0.69 | 0.69 | 0.67 | 0.69 | 0.69 | 0.00 | 0.03 | 0.00 | 0.03 | 0.03 | 0.03 |
| 8 | 0.64 | 0.67 | 0.62 | 0.64 | 0.67 | 0.67 | 0.07 | 0.02 | 0.07 | 0.02 | 0.02 | 0.02 |
| 9 | 0.64 | 0.65 | 0.62 | 0.62 | 0.65 | 0.65 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 10 | 0.64 | 0.64 | 0.62 | 0.61 | 0.64 | 0.64 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 11 | 0.64 | 0.63 | 0.62 | 0.60 | 0.63 | 0.63 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 12 | 0.61 | 0.61 | 0.59 | 0.59 | 0.61 | 0.61 | 0.04 | 0.02 | 0.03 | 0.01 | 0.02 | 0.02 |
| 13 | 0.61 | 0.60 | 0.59 | 0.58 | 0.60 | 0.60 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.61 | 0.60 | 0.59 | 0.58 | 0.60 | 0.60 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 15 | 0.56 | 0.58 | 0.54 | 0.55 | 0.58 | 0.58 | 0.04 | 0.02 | 0.05 | 0.02 | 0.02 | 0.02 |
| 16 | 0.55 | 0.56 | 0.52 | 0.54 | 0.56 | 0.56 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 17 | 0.52 | 0.54 | 0.49 | 0.51 | 0.54 | 0.54 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 18 | 0.52 | 0.52 | 0.49 | 0.48 | 0.52 | 0.52 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 19 | 0.49 | 0.48 | 0.45 | 0.44 | 0.48 | 0.48 | 0.03 | 0.04 | 0.04 | 0.05 | 0.04 | 0.04 |
| 20 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 21 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.49 | 0.47 | 0.45 | 0.43 | 0.47 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

†Based on only the first spell starting in the life of the panel for each participant.

‡Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

**Table 2.6**

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: Food Stamps**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted<br>Censoring[‡]<br>One month gap | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.87 | 0.88 | 0.90 | 0.91 | 0.88 | 0.88 | 0.13 | 0.12 | 0.10 | 0.09 | 0.12 | 0.12 |
| 2 | 0.80 | 0.81 | 0.82 | 0.84 | 0.81 | 0.81 | 0.08 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| 3 | 0.73 | 0.72 | 0.77 | 0.76 | 0.72 | 0.72 | 0.07 | 0.09 | 0.06 | 0.08 | 0.09 | 0.09 |
| 4 | 0.58 | 0.63 | 0.60 | 0.65 | 0.63 | 0.63 | 0.15 | 0.10 | 0.17 | 0.10 | 0.10 | 0.10 |
| 5 | 0.52 | 0.55 | 0.54 | 0.57 | 0.55 | 0.54 | 0.06 | 0.08 | 0.05 | 0.08 | 0.08 | 0.08 |
| 6 | 0.49 | 0.50 | 0.51 | 0.53 | 0.50 | 0.50 | 0.03 | 0.04 | 0.03 | 0.05 | 0.04 | 0.04 |
| 7 | 0.46 | 0.46 | 0.50 | 0.49 | 0.46 | 0.46 | 0.03 | 0.04 | 0.01 | 0.04 | 0.04 | 0.04 |
| 8 | 0.43 | 0.43 | 0.45 | 0.45 | 0.43 | 0.43 | 0.03 | 0.04 | 0.05 | 0.04 | 0.04 | 0.04 |
| 9 | 0.40 | 0.40 | 0.43 | 0.42 | 0.40 | 0.39 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 10 | 0.37 | 0.36 | 0.41 | 0.40 | 0.36 | 0.36 | 0.04 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 |
| 11 | 0.35 | 0.34 | 0.39 | 0.38 | 0.34 | 0.34 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| 12 | 0.33 | 0.32 | 0.37 | 0.36 | 0.32 | 0.32 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 13 | 0.32 | 0.31 | 0.37 | 0.35 | 0.31 | 0.31 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.30 | 0.29 | 0.34 | 0.33 | 0.29 | 0.29 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 |
| 15 | 0.30 | 0.29 | 0.33 | 0.32 | 0.29 | 0.29 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| 16 | 0.29 | 0.28 | 0.32 | 0.32 | 0.29 | 0.28 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| 17 | 0.29 | 0.28 | 0.32 | 0.31 | 0.28 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | 0.29 | 0.28 | 0.32 | 0.31 | 0.28 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 0.29 | 0.28 | 0.32 | 0.31 | 0.28 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0.28 | 0.27 | 0.32 | 0.31 | 0.27 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.28 | 0.27 | 0.32 | 0.31 | 0.27 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.28 | 0.27 | 0.32 | 0.31 | 0.27 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.27 | 0.26 | 0.32 | 0.31 | 0.26 | 0.26 | 0.02 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| 24 | 0.26 | 0.25 | 0.32 | 0.31 | 0.25 | 0.25 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| 25 | 0.26 | 0.24 | 0.32 | 0.31 | 0.24 | 0.24 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| 26 | 0.26 | 0.22 | 0.32 | 0.31 | 0.22 | 0.22 | 0.00 | 0.02 | 0.00 | 0.00 | 0.02 | 0.02 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

**Table 2.9**

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell†: State Unemployment Compensation**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted<br>Censoring‡<br>One month gap | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.70 | 0.71 | 0.71 | 0.72 | 0.71 | 0.71 | 0.30 | 0.29 | 0.29 | 0.28 | 0.29 | 0.29 |
| 2 | 0.53 | 0.55 | 0.55 | 0.57 | 0.55 | 0.55 | 0.17 | 0.16 | 0.17 | 0.16 | 0.16 | 0.16 |
| 3 | 0.39 | 0.40 | 0.42 | 0.43 | 0.40 | 0.40 | 0.14 | 0.15 | 0.12 | 0.14 | 0.15 | 0.15 |
| 4 | 0.25 | 0.28 | 0.27 | 0.30 | 0.28 | 0.28 | 0.14 | 0.12 | 0.15 | 0.13 | 0.12 | 0.12 |
| 5 | 0.17 | 0.18 | 0.20 | 0.21 | 0.18 | 0.18 | 0.08 | 0.10 | 0.07 | 0.09 | 0.10 | 0.10 |
| 6 | 0.10 | 0.11 | 0.12 | 0.13 | 0.11 | 0.11 | 0.06 | 0.07 | 0.07 | 0.08 | 0.07 | 0.07 |
| 7 | 0.04 | 0.05 | 0.06 | 0.07 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.07 | 0.06 | 0.06 |
| 8 | 0.02 | 0.03 | 0.04 | 0.05 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 9 | 0.01 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 |
| 10 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 11 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| 12 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

†Based on only the first spell starting in the life of the panel for each participant.

‡Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

**Table 2.8**

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: Social Security**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted<br>Censoring[‡]<br>One month gap | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No | No<br>C<br>No | Yes<br>C<br>No | No<br>C<br>Yes | Yes<br>C<br>Yes | Yes<br>O<br>No | Yes<br>U<br>No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.97 | 0.96 | 0.98 | 0.97 | 0.96 | 0.96 | 0.03 | 0.04 | 0.02 | 0.03 | 0.04 | 0.04 |
| 2 | 0.95 | 0.94 | 0.96 | 0.95 | 0.94 | 0.94 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| 3 | 0.95 | 0.92 | 0.96 | 0.92 | 0.92 | 0.91 | 0.00 | 0.03 | 0.00 | 0.03 | 0.03 | 0.03 |
| 4 | 0.82 | 0.87 | 0.82 | 0.88 | 0.87 | 0.86 | 0.13 | 0.04 | 0.13 | 0.04 | 0.04 | 0.04 |
| 5 | 0.82 | 0.84 | 0.82 | 0.84 | 0.84 | 0.83 | 0.01 | 0.03 | 0.01 | 0.03 | 0.03 | 0.04 |
| 6 | 0.81 | 0.81 | 0.81 | 0.81 | 0.81 | 0.80 | 0.01 | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 |
| 7 | 0.80 | 0.79 | 0.81 | 0.79 | 0.79 | 0.77 | 0.00 | 0.02 | 0.00 | 0.03 | 0.02 | 0.03 |
| 8 | 0.75 | 0.77 | 0.75 | 0.77 | 0.77 | 0.75 | 0.05 | 0.02 | 0.06 | 0.02 | 0.02 | 0.02 |
| 9 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.72 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 10 | 0.74 | 0.74 | 0.75 | 0.74 | 0.74 | 0.71 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 |
| 11 | 0.74 | 0.72 | 0.74 | 0.72 | 0.72 | 0.69 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 |
| 12 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.68 | 0.03 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 |
| 13 | 0.71 | 0.70 | 0.71 | 0.70 | 0.70 | 0.67 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.70 | 0.69 | 0.71 | 0.69 | 0.69 | 0.65 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 15 | 0.69 | 0.68 | 0.70 | 0.68 | 0.68 | 0.64 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 16 | 0.66 | 0.67 | 0.67 | 0.67 | 0.67 | 0.63 | 0.03 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 |
| 17 | 0.66 | 0.66 | 0.67 | 0.66 | 0.66 | 0.63 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 18 | 0.66 | 0.66 | 0.67 | 0.66 | 0.66 | 0.62 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 19 | 0.65 | 0.65 | 0.67 | 0.65 | 0.65 | 0.61 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| 20 | 0.65 | 0.65 | 0.66 | 0.65 | 0.64 | 0.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.65 | 0.64 | 0.66 | 0.65 | 0.64 | 0.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.65 | 0.64 | 0.66 | 0.65 | 0.64 | 0.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.65 | 0.64 | 0.66 | 0.65 | 0.63 | 0.60 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.65 | 0.63 | 0.66 | 0.65 | 0.63 | 0.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| 25 | 0.65 | 0.63 | 0.66 | 0.65 | 0.63 | 0.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.65 | 0.62 | 0.66 | 0.65 | 0.62 | 0.57 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

## Table 2.11

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: WIC**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted | No | Yes | No | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes |
| Censoring[‡] | C | C | C | C | O | U | C | C | C | C | O | U |
| One month gap | No | No | Yes | Yes | No | No | No | No | Yes | Yes | No | No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.93 | 0.93 | 0.94 | 0.95 | 0.93 | 0.93 | 0.07 | 0.07 | 0.06 | 0.05 | 0.07 | 0.07 |
| 2 | 0.88 | 0.87 | 0.90 | 0.90 | 0.87 | 0.86 | 0.05 | 0.07 | 0.04 | 0.05 | 0.07 | 0.07 |
| 3 | 0.85 | 0.80 | 0.88 | 0.82 | 0.80 | 0.79 | 0.03 | 0.07 | 0.02 | 0.07 | 0.07 | 0.07 |
| 4 | 0.62 | 0.70 | 0.64 | 0.73 | 0.71 | 0.70 | 0.22 | 0.09 | 0.24 | 0.10 | 0.09 | 0.09 |
| 5 | 0.56 | 0.61 | 0.58 | 0.62 | 0.61 | 0.60 | 0.06 | 0.10 | 0.07 | 0.10 | 0.10 | 0.10 |
| 6 | 0.49 | 0.51 | 0.49 | 0.52 | 0.51 | 0.51 | 0.07 | 0.10 | 0.09 | 0.11 | 0.10 | 0.10 |
| 7 | 0.45 | 0.44 | 0.45 | 0.44 | 0.44 | 0.43 | 0.04 | 0.08 | 0.04 | 0.08 | 0.08 | 0.08 |
| 8 | 0.34 | 0.39 | 0.33 | 0.38 | 0.39 | 0.38 | 0.11 | 0.05 | 0.12 | 0.05 | 0.05 | 0.05 |
| 9 | 0.30 | 0.34 | 0.30 | 0.33 | 0.34 | 0.33 | 0.04 | 0.05 | 0.04 | 0.05 | 0.05 | 0.05 |
| 10 | 0.30 | 0.30 | 0.29 | 0.30 | 0.30 | 0.30 | 0.00 | 0.04 | 0.01 | 0.04 | 0.04 | 0.04 |
| 11 | 0.25 | 0.26 | 0.25 | 0.25 | 0.26 | 0.25 | 0.05 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| 12 | 0.21 | 0.23 | 0.21 | 0.23 | 0.23 | 0.23 | 0.04 | 0.03 | 0.04 | 0.03 | 0.03 | 0.03 |
| 13 | 0.19 | 0.20 | 0.19 | 0.20 | 0.20 | 0.20 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 14 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| 15 | 0.17 | 0.15 | 0.17 | 0.15 | 0.16 | 0.15 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 16 | 0.12 | 0.14 | 0.12 | 0.13 | 0.14 | 0.13 | 0.04 | 0.02 | 0.05 | 0.02 | 0.02 | 0.02 |
| 17 | 0.12 | 0.12 | 0.11 | 0.11 | 0.12 | 0.12 | 0.01 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 18 | 0.11 | 0.11 | 0.10 | 0.10 | 0.11 | 0.11 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 19 | 0.11 | 0.10 | 0.10 | 0.09 | 0.10 | 0.10 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 20 | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 |
| 21 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 22 | 0.09 | 0.07 | 0.09 | 0.07 | 0.07 | 0.07 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| 23 | 0.08 | 0.07 | 0.09 | 0.07 | 0.07 | 0.07 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 |
| 24 | 0.08 | 0.07 | 0.09 | 0.07 | 0.07 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.08 | 0.07 | 0.09 | 0.07 | 0.07 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.08 | 0.07 | 0.09 | 0.07 | 0.07 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

## Table 2.10

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: Veterans Compensation**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted | No | Yes | No | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes |
| Censoring[‡] | C | C | C | C | O | U | C | C | C | C | O | U |
| One month gap | No | No | Yes | Yes | No | No | No | No | Yes | Yes | No | No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.98 | 0.96 | 0.99 | 0.97 | 0.96 | 0.94 | 0.02 | 0.04 | 0.01 | 0.03 | 0.04 | 0.06 |
| 2 | 0.98 | 0.92 | 0.98 | 0.92 | 0.92 | 0.89 | 0.00 | 0.04 | 0.00 | 0.05 | 0.04 | 0.05 |
| 3 | 0.97 | 0.84 | 0.97 | 0.84 | 0.84 | 0.81 | 0.01 | 0.08 | 0.01 | 0.08 | 0.08 | 0.08 |
| 4 | 0.56 | 0.73 | 0.56 | 0.73 | 0.73 | 0.70 | 0.41 | 0.11 | 0.41 | 0.11 | 0.11 | 0.11 |
| 5 | 0.56 | 0.64 | 0.56 | 0.64 | 0.64 | 0.61 | 0.00 | 0.09 | 0.00 | 0.09 | 0.09 | 0.09 |
| 6 | 0.55 | 0.56 | 0.55 | 0.56 | 0.56 | 0.53 | 0.01 | 0.08 | 0.01 | 0.08 | 0.08 | 0.08 |
| 7 | 0.55 | 0.50 | 0.55 | 0.50 | 0.50 | 0.48 | 0.00 | 0.06 | 0.00 | 0.06 | 0.06 | 0.06 |
| 8 | 0.42 | 0.47 | 0.42 | 0.47 | 0.47 | 0.44 | 0.13 | 0.04 | 0.13 | 0.04 | 0.04 | 0.04 |
| 9 | 0.41 | 0.43 | 0.42 | 0.43 | 0.43 | 0.41 | 0.01 | 0.03 | 0.00 | 0.03 | 0.03 | 0.03 |
| 10 | 0.41 | 0.41 | 0.42 | 0.41 | 0.41 | 0.38 | 0.00 | 0.03 | 0.00 | 0.03 | 0.03 | 0.02 |
| 11 | 0.41 | 0.39 | 0.42 | 0.39 | 0.39 | 0.36 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 12 | 0.35 | 0.37 | 0.37 | 0.37 | 0.37 | 0.35 | 0.06 | 0.01 | 0.06 | 0.01 | 0.01 | 0.01 |
| 13 | 0.35 | 0.36 | 0.37 | 0.36 | 0.36 | 0.34 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 14 | 0.35 | 0.35 | 0.37 | 0.35 | 0.35 | 0.33 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 15 | 0.35 | 0.34 | 0.37 | 0.34 | 0.34 | 0.32 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 16 | 0.35 | 0.34 | 0.37 | 0.34 | 0.34 | 0.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.02 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| 18 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 24 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 25 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 26 | 0.34 | 0.33 | 0.36 | 0.34 | 0.34 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

## Table 2.12

**Survival Functions Computed Under Six Different Combinations of Seam Adjustment, Method of Censoring, and Definition of a Spell[†]: No Health Insurance**

| Combination | A | B | C | D | E | F | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Seam adjusted | No | Yes | No | Yes | Yes | Yes | No | Yes | No | Yes | Yes | Yes |
| Censoring[‡] | C | C | C | C | O | U | C | C | C | C | O | U |
| One month gap | No | No | Yes | Yes | No | No | No | No | Yes | Yes | No | No |
| Month ($t$) | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ | $\hat{f}^*(t)$ |
| 1 | 0.93 | 0.90 | 0.93 | 0.90 | 0.89 | 0.89 | 0.07 | 0.10 | 0.07 | 0.10 | 0.11 | 0.11 |
| 2 | 0.87 | 0.82 | 0.88 | 0.82 | 0.82 | 0.81 | 0.06 | 0.08 | 0.05 | 0.08 | 0.08 | 0.08 |
| 3 | 0.82 | 0.73 | 0.83 | 0.74 | 0.73 | 0.72 | 0.05 | 0.09 | 0.05 | 0.09 | 0.09 | 0.09 |
| 4 | 0.53 | 0.63 | 0.53 | 0.63 | 0.63 | 0.63 | 0.29 | 0.10 | 0.30 | 0.10 | 0.10 | 0.10 |
| 5 | 0.51 | 0.56 | 0.52 | 0.55 | 0.56 | 0.55 | 0.01 | 0.08 | 0.02 | 0.08 | 0.08 | 0.08 |
| 6 | 0.49 | 0.49 | 0.50 | 0.49 | 0.49 | 0.48 | 0.02 | 0.06 | 0.02 | 0.06 | 0.06 | 0.06 |
| 7 | 0.48 | 0.45 | 0.48 | 0.44 | 0.45 | 0.44 | 0.01 | 0.05 | 0.02 | 0.05 | 0.05 | 0.05 |
| 8 | 0.40 | 0.41 | 0.40 | 0.41 | 0.42 | 0.41 | 0.09 | 0.03 | 0.09 | 0.03 | 0.03 | 0.03 |
| 9 | 0.39 | 0.39 | 0.39 | 0.38 | 0.39 | 0.38 | 0.01 | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 |
| 10 | 0.37 | 0.36 | 0.38 | 0.36 | 0.36 | 0.35 | 0.01 | 0.03 | 0.01 | 0.03 | 0.02 | 0.02 |
| 11 | 0.37 | 0.34 | 0.37 | 0.34 | 0.34 | 0.33 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | 0.02 |
| 12 | 0.32 | 0.32 | 0.32 | 0.32 | 0.32 | 0.31 | 0.05 | 0.02 | 0.05 | 0.02 | 0.02 | 0.02 |
| 13 | 0.31 | 0.31 | 0.31 | 0.30 | 0.31 | 0.30 | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| 14 | 0.30 | 0.29 | 0.30 | 0.28 | 0.29 | 0.28 | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| 15 | 0.29 | 0.27 | 0.30 | 0.27 | 0.28 | 0.27 | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 |
| 16 | 0.27 | 0.26 | 0.26 | 0.25 | 0.26 | 0.26 | 0.03 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 |
| 17 | 0.26 | 0.25 | 0.26 | 0.24 | 0.25 | 0.24 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 18 | 0.25 | 0.24 | 0.25 | 0.23 | 0.24 | 0.23 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 19 | 0.25 | 0.23 | 0.25 | 0.22 | 0.23 | 0.22 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 20 | 0.23 | 0.23 | 0.23 | 0.21 | 0.23 | 0.22 | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 |
| 21 | 0.23 | 0.22 | 0.23 | 0.21 | 0.22 | 0.21 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 22 | 0.23 | 0.21 | 0.23 | 0.20 | 0.21 | 0.20 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 23 | 0.23 | 0.21 | 0.23 | 0.18 | 0.21 | 0.20 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 |
| 24 | 0.22 | 0.19 | 0.23 | 0.17 | 0.20 | 0.19 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| 25 | 0.19 | 0.16 | 0.23 | 0.00 | 0.17 | 0.16 | 0.03 | 0.03 | 0.00 | 0.17 | 0.03 | 0.03 |
| 26 | 0.19 | 0.16 | 0.23 | 0.00 | 0.17 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

[†]Based on only the first spell starting in the life of the panel for each participant.

[‡]Spells of leavers from the survey universe treated as censored, C; treated as uncensored, U; omitted from the analysis, O.

The first set of comparisons, of A with B and C with D, shows that the seam effect adjustment has largely removed the spikes in the PDFs in all programs. There remains, however, a small spike at month 4. The main effect of the adjustment is to increase the proportion of spells lasting for more than 4 months. Thus, for example, with spells of no health insurance, for which there is a large spike at 4 months in the unadjusted PDF, the adjustment leads to a 10% increase, from 53% to 63%, in the percentage of spells lasting more than 4 months (see Table 2.12). For most programs, the adjustment reduces the percentage of spells lasting over 2 years by about 2%.

Comparisons of the results obtained under combinations B, D and F, which differ in the methods employed to handle participants leaving the survey universe, generally demonstrate minimal differences in the results obtained. For most programs the survival functions as a rule differ by at most 1%. The two programs that exhibit the greatest sensitivity to the method of handling leavers are Social Security and Veterans compensation. Even for these cases the differences in $\hat{S}(t)$ are at most 4%.

The change of definition of a spell to allow for a one month gap of nonparticipation in a spell necessarily causes a shift in the distribution of spell lengths towards longer spells. Comparisons of combinations A with C and B with D show, however, that for many programs the shift is small. The larger shifts are for AFDC, general assistance and food stamps, where some of the differences between the $\hat{S}(t)$'s for the two definitions are 4% to 5%. We examine the differences for food stamps further in Chapter 3.

# CHAPTER 3

# FURTHER ANALYSES OF SPELL DURATIONS FOR THE FOOD STAMP PROGRAM

## 3.1 Introduction

This chapter presents some further analyses of spell durations for the food stamp program. It contains more detailed analyses of some of the issues already discussed and also briefly examines some other issues. The following issues are treated in subsequent sections:

- The inclusion of all spells for people who have multiple spells in the estimation of the survival functions.
- A refinement to the seam adjustment discussed in Chapter 2.
- The use of further alternative definitions of a spell, allowing for gaps of various months off the program during the spell.
- The computation of the survival functions based on spells that end, rather than begin, during the life of the panel, and the use of information collected in the second wave of the panel on the starting dates of such spells that began before the panel commenced.
- Possible interactions between alternative methods of estimating the survival functions and subgroups of the population.
- A proportional hazards analysis for various demographic and other covariates.

Two major differences between the analyses reported in this chapter and those reported in previous chapters should be noted. First, throughout this chapter, the analyses are conducted for all spells starting during the life of the panel, not just first spells. Second, after Section 3.3 in which a modified seam adjustment is introduced, subsequent analyses employ this modified adjustment. For these reasons, the results presented here will differ from those presented in Chapters 1 and 2.

Estimates of standard errors are included with the results presented in this chapter. These standard errors were computed using balanced repeated replications (BRR), a technique designed to provide valid standard error estimates for estimates derived from surveys, like SIPP, that employ complex stratified multi-stage sample designs (Kish and Frankel, 1970; Wolter, 1985). The technique has the attraction of great generality in the survey estimates for which it can provide standard error estimates. It can readily handle multiple spells for some sampled persons. In the current applications, 72 balanced replicates and their complements have been used in computing the standard error estimates.

## 3.2 Multiple Spells

During the course of a SIPP panel some panel members experience more than one spell of participation in a given program. Ruggles and Williams (1989) estimated survival functions based on only the first spells starting during the life of the panel for participants having more than one spell, and that is the approach adopted in Chapters 1 and 2. The population of spells to which the resultant survival function estimates apply is thus only first spells on a given program starting during the life of the panel. An alternative population of inference comprises all spells starting during the life of the panel. For this population, all new spells of participants with multiple spells should be included in the analysis, with each spell being given the participant's weight. As Table 1.1 shows, multiple spells are common in many programs. The inclusion of all spells starting in the life of the panel in the estimation of the survival functions may therefore lead to appreciably different results from those obtained from the inclusion of only first spells.

Table 3.1 presents the survival functions for spells on the food stamp program based on all spells starting during the course of the 1987 SIPP panel. Although the estimates in this table are based on many more spells than Table 1.9, which is based on first spells only, the survival functions in these two tables are very similar. For the food stamp program it thus appears that the distribution of the durations of first spells is similar to that of all spells.

## 3.3 A Refinement to the Seam Adjustment

The adjustment for the seam effect employed in Chapter 2 redistributed weights of starts and stops occurring at the seam in order to produce smooth distributions of starts and stops across the four months of recall. As discussed in Section 2.4, in general the adjustment worked well in removing the spikes in the PDFs caused by the seam effect, but small spikes remained at 4 months of recall for all the programs. Here we make a small refinement to the original adjustment to see if that will remove the residual spikes at 4 months of recall.

The model underlying the original adjustment is that of a constant wave response, that is, some respondents report their program status for all four months of recall as the same as their status for the most recent month. The adjustment is applied to all starts and stops at the seam. However, the constant wave response model is not applicable for two types of seam cases. With one type, the spell starts on the seam and is completed within the wave. With the other type, the spell ends on the seam and a new spell starts within the wave. The first type represents about 5% of spell starts and the second type represents about 5% of spell stops. It is clear that the constant wave response model is not operating in these cases, since the monthly responses do change during the wave. The refinement to the adjustment is to treat these two types as correct responses, and perform the redistribution of weights only for the remaining seam cases.

Table 3.2 presents the survival functions for the food stamp program based on the refined adjustment, together with standard errors of the estimates computed

**Table 3.1**

**Kaplan-Meier Estimates of the Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, and all Spells starting during the Panel**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.1234 | 0.0160 | 0.8766 | 0.0160 | 0.1234 | 0.0160 |
| 2 | 0.0997 | 0.0170 | 0.7892 | 0.0216 | 0.0874 | 0.0148 |
| 3 | 0.0959 | 0.0124 | 0.7135 | 0.0229 | 0.0757 | 0.0097 |
| 4 | 0.2124 | 0.0208 | 0.5620 | 0.0266 | 0.1515 | 0.0142 |
| 5 | 0.0980 | 0.0211 | 0.5069 | 0.0279 | 0.0551 | 0.0118 |
| 6 | 0.0506 | 0.0184 | 0.4812 | 0.0263 | 0.0256 | 0.0097 |
| 7 | 0.0551 | 0.0175 | 0.4547 | 0.0267 | 0.0265 | 0.0084 |
| 8 | 0.0698 | 0.0223 | 0.4230 | 0.0223 | 0.0317 | 0.0110 |
| 9 | 0.0473 | 0.0146 | 0.4030 | 0.0224 | 0.0200 | 0.0062 |
| 10 | 0.0790 | 0.0262 | 0.3711 | 0.0209 | 0.0318 | 0.0111 |
| 11 | 0.0465 | 0.0171 | 0.3539 | 0.0211 | 0.0173 | 0.0064 |
| 12 | 0.0720 | 0.0234 | 0.3284 | 0.0212 | 0.0255 | 0.0084 |
| 13 | 0.0129 | 0.0085 | 0.3241 | 0.0210 | 0.0042 | 0.0028 |
| 14 | 0.0612 | 0.0257 | 0.3043 | 0.0211 | 0.0198 | 0.0085 |
| 15 | 0.0065 | 0.0045 | 0.3023 | 0.0210 | 0.0020 | 0.0014 |
| 16 | 0.0179 | 0.0121 | 0.2969 | 0.0209 | 0.0054 | 0.0037 |
| 17 | 0.0112 | 0.0112 | 0.2936 | 0.0204 | 0.0033 | 0.0033 |
| 18 | 0.0000 | 0.0000 | 0.2936 | 0.0204 | 0.0000 | 0.0000 |
| 19 | 0.0065 | 0.0070 | 0.2917 | 0.0208 | 0.0019 | 0.0020 |
| 20 | 0.0060 | 0.0063 | 0.2899 | 0.0208 | 0.0018 | 0.0018 |
| 21 | 0.0000 | 0.0000 | 0.2899 | 0.0208 | 0.0000 | 0.0000 |
| 22 | 0.0000 | 0.0000 | 0.2899 | 0.0208 | 0.0000 | 0.0000 |
| 23 | 0.0567 | 0.0447 | 0.2735 | 0.0257 | 0.0164 | 0.0125 |
| 24 | 0.0240 | 0.0266 | 0.2669 | 0.0270 | 0.0066 | 0.0071 |
| 25 | 0.0000 | 0.0000 | 0.2669 | 0.0270 | 0.0000 | 0.0000 |
| 26 | 0.0000 | 0.0000 | 0.2669 | 0.0270 | 0.0000 | 0.0000 |

## Table 3.2

**Kaplan-Meier Estimates of the Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, all Spells starting during the Panel, and with the Modified Seam Adjustment**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.1042 | 0.0143 | 0.8958 | 0.0143 | 0.1042 | 0.0143 |
| 2 | 0.1016 | 0.0146 | 0.8048 | 0.0196 | 0.0910 | 0.0129 |
| 3 | 0.1262 | 0.0131 | 0.7032 | 0.0226 | 0.1016 | 0.0101 |
| 4 | 0.1339 | 0.0121 | 0.6091 | 0.0257 | 0.0941 | 0.0070 |
| 5 | 0.1290 | 0.0177 | 0.5305 | 0.0265 | 0.0786 | 0.0107 |
| 6 | 0.0807 | 0.0103 | 0.4877 | 0.0260 | 0.0428 | 0.0054 |
| 7 | 0.0696 | 0.0097 | 0.4538 | 0.0256 | 0.0339 | 0.0047 |
| 8 | 0.0711 | 0.0201 | 0.4215 | 0.0214 | 0.0322 | 0.0100 |
| 9 | 0.0734 | 0.0127 | 0.3906 | 0.0211 | 0.0310 | 0.0054 |
| 10 | 0.0859 | 0.0217 | 0.3570 | 0.0207 | 0.0336 | 0.0087 |
| 11 | 0.0478 | 0.0092 | 0.3400 | 0.0202 | 0.0171 | 0.0033 |
| 12 | 0.0604 | 0.0154 | 0.3194 | 0.0204 | 0.0205 | 0.0052 |
| 13 | 0.0320 | 0.0084 | 0.3092 | 0.0205 | 0.0102 | 0.0026 |
| 14 | 0.0429 | 0.0137 | 0.2959 | 0.0211 | 0.0133 | 0.0041 |
| 15 | 0.0167 | 0.0058 | 0.2910 | 0.0210 | 0.0050 | 0.0017 |
| 16 | 0.0128 | 0.0053 | 0.2872 | 0.0210 | 0.0037 | 0.0015 |
| 17 | 0.0222 | 0.0123 | 0.2809 | 0.0205 | 0.0064 | 0.0036 |
| 18 | 0.0047 | 0.0024 | 0.2795 | 0.0205 | 0.0013 | 0.0007 |
| 19 | 0.0053 | 0.0036 | 0.2781 | 0.0207 | 0.0015 | 0.0010 |
| 20 | 0.0045 | 0.0037 | 0.2768 | 0.0209 | 0.0013 | 0.0010 |
| 21 | 0.0038 | 0.0032 | 0.2757 | 0.0211 | 0.0011 | 0.0008 |
| 22 | 0.0035 | 0.0030 | 0.2748 | 0.0213 | 0.0010 | 0.0008 |
| 23 | 0.0489 | 0.0399 | 0.2613 | 0.0261 | 0.0134 | 0.0105 |
| 24 | 0.0429 | 0.0335 | 0.2501 | 0.0283 | 0.0112 | 0.0083 |
| 25 | 0.0265 | 0.0444 | 0.2435 | 0.0322 | 0.0066 | 0.0108 |
| 26 | 0.0462 | 0.1366 | 0.2323 | 0.0491 | 0.0112 | 0.0290 |

using balanced repeated replications. When a panel member left the survey universe while on the food stamp program, the spell is treated as right censored. A gap of one month off the program defines the end of a spell. The distributions in Table 3.2 may be compared with those in the columns headed B in Table 2.6, obtained under the original adjustment. It should be noted that the distributions may differ because of the different adjustments and also because the results in Table 3.2 are based on all spells and those in Table 2.6 on only first spells starting during the panel. The results are, however, generally similar. Nevertheless, there is some indication that the modified adjustment may be more effective in removing the spikes in the PDF.

### 3.4 Alternative Definitions of a Spell

Related to the issue of multiple spells is the question of how spells should be defined. Should an individual's multiple spells be treated as separate spells, or should at least some of them be combined into single spells? How many months, if any, should be permitted for a gap in participation on a program before the gap is deemed to distinguish two separate spells, rather than being part of one ongoing spell?

Evidence on the gaps in participation on a program can be obtained by computing survival functions for the time off the program for those persons who leave the program during the course of the panel. Table 3.3 presents these functions for the food stamp program, computed for all spells ending during the panel (with one month off the program defining the end). As the survival function shows, about 11% of those completing a spell on the food stamp program return to the program in two months or less, about 19% return in 4 months or less, and about 25% return in 12 months or less.

The effects of alternative definitions of a spell on spell durations can be examined by computing survival functions under the various definitions. Tables for the survival functions for the food stamp program with allowances for gaps of 1, 2, ..., 6 months off the program in the middle of a spell are presented in Appendix

## Table 3.3

**Kaplan-Meier Estimates of the Survival Functions for Time Off Spells of the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, on all Spells stopping during the Panel, and with the Modified Seam Adjustment**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0740 | 0.0104 | 0.9260 | 0.0104 | 0.0740 | 0.0104 |
| 2 | 0.0423 | 0.0069 | 0.8869 | 0.0111 | 0.0391 | 0.0065 |
| 3 | 0.0260 | 0.0064 | 0.8638 | 0.0116 | 0.0231 | 0.0057 |
| 4 | 0.0578 | 0.0083 | 0.8139 | 0.0144 | 0.0499 | 0.0070 |
| 5 | 0.0186 | 0.0059 | 0.7988 | 0.0148 | 0.0151 | 0.0048 |
| 6 | 0.0088 | 0.0031 | 0.7917 | 0.0150 | 0.0070 | 0.0024 |
| 7 | 0.0072 | 0.0026 | 0.7860 | 0.0154 | 0.0057 | 0.0021 |
| 8 | 0.0145 | 0.0040 | 0.7746 | 0.0159 | 0.0114 | 0.0031 |
| 9 | 0.0039 | 0.0020 | 0.7717 | 0.0159 | 0.0030 | 0.0016 |
| 10 | 0.0092 | 0.0040 | 0.7646 | 0.0163 | 0.0071 | 0.0031 |
| 11 | 0.0014 | 0.0014 | 0.7635 | 0.0163 | 0.0011 | 0.0011 |
| 12 | 0.0129 | 0.0059 | 0.7536 | 0.0151 | 0.0099 | 0.0046 |
| 13 | 0.0022 | 0.0011 | 0.7520 | 0.0151 | 0.0016 | 0.0008 |
| 14 | 0.0066 | 0.0045 | 0.7471 | 0.0161 | 0.0049 | 0.0034 |
| 15 | 0.0000 | 0.0000 | 0.7471 | 0.0161 | 0.0000 | 0.0000 |
| 16 | 0.0054 | 0.0025 | 0.7430 | 0.0159 | 0.0040 | 0.0019 |
| 17 | 0.0029 | 0.0022 | 0.7409 | 0.0158 | 0.0022 | 0.0016 |
| 18 | 0.0026 | 0.0018 | 0.7390 | 0.0157 | 0.0019 | 0.0014 |
| 19 | 0.0010 | 0.0007 | 0.7382 | 0.0156 | 0.0008 | 0.0005 |
| 20 | 0.0019 | 0.0015 | 0.7368 | 0.0155 | 0.0014 | 0.0011 |
| 21 | 0.0000 | 0.0000 | 0.7368 | 0.0155 | 0.0000 | 0.0000 |
| 22 | 0.0000 | 0.0000 | 0.7368 | 0.0155 | 0.0000 | 0.0000 |
| 23 | 0.0000 | 0.0000 | 0.7368 | 0.0155 | 0.0000 | 0.0000 |
| 24 | 0.0000 | 0.0000 | 0.7368 | 0.0155 | 0.0000 | 0.0000 |
| 25 | 0.0000 | 0.0000 | 0.7368 | 0.0155 | 0.0000 | 0.0000 |
| 26 | 0.0000 | 0.0000 | 0.7368 | 0.0155 | 0.0000 | 0.0000 |

B. It should be noted that these tables are computed from different sets of spells. Consider a definition of a spell that permits a gap of $g$ months inside the spell. With this definition, observations of at least $(g+1)$ months off the program prior to the start of the spell are needed to establish that it is a new spell, and observations of at least $(g+1)$ months off the program after the end of the spell are needed to establish that the spell has ended. Spells starting before month $(g+2)$ of the panel are therefore excluded from the analysis, and spells that end after month $[29-(g+2)]$ are treated as right censored at month $[29-(g+1)]$.

The allowance for a gap in a spell has the effect of lengthening some spells and reducing the number of spells. Consider, for instance, a person who experiences a period of 4 months on a program, followed by a gap of 2 months off the program, followed by a period of 5 months back on the program. With no gap allowed, or a gap of only one month allowed, this person's program participation is characterized as two spells, one of 4 months and one of 5 months. With a gap of 2 months allowed (or any larger gap), the person's participation is treated as a single spell of 11 months. Thus one longer spell replaces two shorter ones.

The effects of alternative allowances for gaps in a spell on durations of food stamp spells are illustrated in Table 3.4. The table summarizes the survival functions presented in Appendix B for definitions of a spell that allow for no gap, and for gaps of 1, 2, 4 and 6 months within the spell. As can be seen from the table, the percentages of spells lasting for a given number of months increases across the columns of the table. For instance, the percentage of spells lasting for more than a year increases from 33% with no gap allowed to 66% with a gap of 6 months allowed. In practice, for most purposes the allowable gap within a spell is likely to be restricted to a short period, perhaps one or two months. Even with such small allowable gaps, the survival function is appreciably shifted towards longer durations, compared with the strict definition of a spell that permits no gaps. For instance, the percentage of spells lasting for more than 4 months increases from 56% with no gap allowed to 69% with a gap of 2 months allowed.

**Table 3.4**

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members in the 1987 SIPP Panel, all Spells starting during the Panel, with the Modified Seam Adjustment, and with Different Allowances for the Gap permitted in a Spell (Percentages)**

| Length of spell $t$ | Gap permitted in a spell | | | | |
|---|---|---|---|---|---|
| | None | 1 month | 2 months | 4 months | 6 months |
| | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ | $\hat{S}^*(t)$ |
| 1 month | 89.6 | 92.1 | 93.2 | 94.3 | 95.2 |
| 3 months | 70.3 | 75.5 | 77.9 | 83.9 | 87.2 |
| 6 months | 48.8 | 53.8 | 58.0 | 69.5 | 74.8 |
| 12 months | 31.9 | 38.1 | 43.4 | 60.0 | 65.9 |
| 18 months | 28.0 | 33.1 | 38.2 | 56.6 | - |

## 3.5 Analyses of Spells that End During the Panel

The standard way to analyze spell durations from SIPP is to take all the spells starting during the life of the panel (or some specified shorter period within the life of the panel, e.g. the first year) and follow them forward in time until they end or until the panel ends. This approach relates to the conceptually clear population of spells starting in the defined period.

An alternative approach is to reverse the time direction, following spells that end during the life of the panel backwards to their start or to the start of the panel. In the same way that spells already in existence at the start of the panel are excluded from an analysis when proceeding forward in time, so spells that are still in existence at the end of the panel are excluded from an analysis that goes backward in time. The application of the Kaplan-Meier procedures for estimating the survival functions is the same for backward analysis as for the forward analysis. The difference in the approaches relates to the population of inference. The population of inference for

the backward procedure is the spells stopping in the defined period, a less naturally appealing population than that for the forward procedure.

As described above, the analysis of spell durations for spell stops is the mirror image of that for spell starts. Spells that are followed backward from their stops and are found to be still in existence at the start of the panel are equivalent to the right censored cases that occur when analyzing spell starts. However, when analyzing spell stops, there is the possibility of finding out about the start of a reverse time right censored spell from the Personal History topical module that is administered in the second wave of a SIPP panel. That module collects dates of the starts of spells that existed at the start of the panel, and this information can be used to determine the lengths of the reverse time right censored spells. The analysis of spell durations for spell stops can be conducted either by using this information to determine spell lengths for spells starting before the beginning of the panel or by ignoring this information and treating the spells as right censored. Provided that the recall information on starting dates collected in the Personal History module is sufficiently accurate, it is clearly better to employ it in the survival analysis. There is, however, a question as to the quality of this information. If it is of poor quality, it may be preferable to discard it, and treat the spells involved as reverse time right censored.

The Personal History topical module asks those who are on a program at the start of the panel for the month and year that the spell began. For the 1986, 1987 and 1988 SIPP panels, Short and Eargle (1991) report that many respondents were unable to provide the dates required. For example, for the food stamp program, in 14.8% of cases both year and month were missing and needed to be imputed, in 32.0% of cases only month needed to be imputed, and in 2.4% of cases only year needed to be imputed. If the imputed values are used in the analysis of spell durations, there is an issue of the quality of the imputations.

When respondents report starting dates for spells existing at the beginning of the panel, the question of the accuracy of their responses arises. This involves not only a matter of recall error, but also a cognitive issue of their understandings of the meaning of a spell. For instance, what gaps of nonparticipation do respondents use

to identify the beginning of new spells, and how well do these gaps conform to the gap that an analyst would want to employ in defining a spell? Miller and Martini (1991), in an analysis of the quality of the recipiency data collected in the Personal History module of the 1986 SIPP panel, compared the distribution of durations of AFDC spells derived from administrative records with that obtained from analyzing spell stops in the panel, using starting dates from the Personal History module for spells in existence at the beginning of the panel. They found the two distributions to be closely similar. Since gaps of less than three months off the AFDC program are ignored in the administrative data, they suggest that respondents might also be forgetting or ignoring gaps of this size.

The Personal History module collects starting dates for program spells existing at the start of the panel only for persons legally authorized to receive the program benefits. Thus a starting date is obtained only for one member of each food stamp unit. In the analyses reported here, the Personal History module has been used to determine starting dates only for persons authorized to receive the food stamps. No assignment of starting dates has been made for other members of the food stamp unit; rather, the spells for such persons have been treated as reverse time right censored.

This section simply examines the estimated survival functions for the food stamp program computed from all spell stops in the life of the 1987 SIPP panel (1) for the case where all spells existing at the start of the panel are treated as right censored and (2) for the case where the length of an individual's spell that existed at the start of the panel is determined from information provided in that individual's Personal History module (obtained from actual or imputed responses) where possible, and where such a spell is otherwise treated as right censored. Tables 3.5 and 3.6 present the survival functions for these two cases. The modified seam adjustment is applied in both tables. The results in these tables may be compared with those in Table 3.2, which presents the estimated survival functions for the food stamp program based on an analysis of all spell starts during the life of the panel. That analysis also incorporates the modified seam adjustment.

## Table 3.5

**Kaplan-Meier Estimates of the Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, and on all Spells stopping during the Panel, with the Modified Seam Adjustment, and with Spells existing at the Start of the Panel treated as Right Censored**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0911 | 0.0127 | 0.9089 | 0.0127 | 0.0911 | 0.0127 |
| 2 | 0.0866 | 0.0125 | 0.8301 | 0.0176 | 0.0787 | 0.0112 |
| 3 | 0.1043 | 0.0109 | 0.7435 | 0.0203 | 0.0866 | 0.0086 |
| 4 | 0.1188 | 0.0119 | 0.6552 | 0.0245 | 0.0883 | 0.0076 |
| 5 | 0.1081 | 0.0143 | 0.5844 | 0.0251 | 0.0708 | 0.0093 |
| 6 | 0.0670 | 0.0083 | 0.5453 | 0.0248 | 0.0392 | 0.0048 |
| 7 | 0.0578 | 0.0087 | 0.5137 | 0.0249 | 0.0315 | 0.0046 |
| 8 | 0.0681 | 0.0195 | 0.4788 | 0.0224 | 0.0350 | 0.0106 |
| 9 | 0.0701 | 0.0124 | 0.4452 | 0.0229 | 0.0336 | 0.0058 |
| 10 | 0.0842 | 0.0200 | 0.4077 | 0.0214 | 0.0375 | 0.0094 |
| 11 | 0.0444 | 0.0084 | 0.3896 | 0.0207 | 0.0181 | 0.0036 |
| 12 | 0.0638 | 0.0161 | 0.3648 | 0.0203 | 0.0248 | 0.0064 |
| 13 | 0.0335 | 0.0088 | 0.3526 | 0.0206 | 0.0122 | 0.0031 |
| 14 | 0.0429 | 0.0136 | 0.3374 | 0.0214 | 0.0151 | 0.0046 |
| 15 | 0.0161 | 0.0061 | 0.3320 | 0.0217 | 0.0054 | 0.0020 |
| 16 | 0.0135 | 0.0062 | 0.3275 | 0.0220 | 0.0045 | 0.0020 |
| 17 | 0.0220 | 0.0133 | 0.3203 | 0.0226 | 0.0072 | 0.0043 |
| 18 | 0.0042 | 0.0022 | 0.3190 | 0.0226 | 0.0013 | 0.0007 |
| 19 | 0.0043 | 0.0027 | 0.3176 | 0.0225 | 0.0014 | 0.0009 |
| 20 | 0.0043 | 0.0033 | 0.3162 | 0.0224 | 0.0014 | 0.0010 |
| 21 | 0.0036 | 0.0028 | 0.3151 | 0.0224 | 0.0011 | 0.0009 |
| 22 | 0.0031 | 0.0025 | 0.3141 | 0.0224 | 0.0010 | 0.0008 |
| 23 | 0.0407 | 0.0308 | 0.3013 | 0.0245 | 0.0128 | 0.0095 |
| 24 | 0.0708 | 0.0881 | 0.2800 | 0.0407 | 0.0213 | 0.0252 |
| 25 | 0.0581 | 0.1006 | 0.2637 | 0.0556 | 0.0163 | 0.0235 |
| 26 | 0.0655 | 0.2197 | 0.2465 | 0.0857 | 0.0173 | 0.0363 |

## Table 3.6

**Kaplan-Meier Estimates of the Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, and on all Spells stopping during the Panel, with the Modified Seam Adjustment, and with Lengths of Spells existing at the Start of the Panel obtained from the Personal History Module where possible**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0990 | 0.0128 | 0.9010 | 0.0128 | 0.0990 | 0.0128 |
| 2 | 0.0967 | 0.0123 | 0.8139 | 0.0176 | 0.0871 | 0.0108 |
| 3 | 0.1112 | 0.0111 | 0.7234 | 0.0204 | 0.0905 | 0.0086 |
| 4 | **0.1191** | **0.0116** | **0.6373** | **0.0242** | **0.0862** | **0.0070** |
| 5 | 0.1097 | 0.0135 | 0.5673 | 0.0247 | 0.0699 | 0.0085 |
| 6 | 0.0791 | 0.0081 | 0.5225 | 0.0238 | 0.0449 | 0.0047 |
| 7 | 0.0690 | 0.0091 | 0.4864 | 0.0238 | 0.0361 | 0.0047 |
| 8 | **0.0696** | **0.0177** | **0.4525** | **0.0213** | **0.0339** | **0.0092** |
| 9 | 0.0711 | 0.0111 | 0.4204 | 0.0213 | 0.0322 | 0.0049 |
| 10 | 0.0826 | 0.0183 | 0.3856 | 0.0198 | 0.0347 | 0.0082 |
| 11 | 0.0475 | 0.0076 | 0.3673 | 0.0192 | 0.0183 | 0.0030 |
| 12 | **0.0560** | **0.0128** | **0.3468** | **0.0187** | **0.0206** | **0.0048** |
| 13 | 0.0449 | 0.0082 | 0.3312 | 0.0182 | 0.0156 | 0.0029 |
| 14 | 0.0437 | 0.0111 | 0.3167 | 0.0186 | 0.0145 | 0.0036 |
| 15 | 0.0352 | 0.0097 | 0.3056 | 0.0189 | 0.0112 | 0.0030 |
| 16 | **0.0217** | **0.0056** | **0.2990** | **0.0191** | **0.0066** | **0.0016** |
| 17 | 0.0427 | 0.0128 | 0.2862 | 0.0193 | 0.0128 | 0.0038 |
| 18 | 0.0179 | 0.0052 | 0.2811 | 0.0195 | 0.0051 | 0.0014 |
| 19 | 0.0215 | 0.0085 | 0.2750 | 0.0198 | 0.0060 | 0.0023 |
| 20 | **0.0107** | **0.0036** | **0.2721** | **0.0199** | **0.0030** | **0.0010** |
| 21 | 0.0309 | 0.0140 | 0.2637 | 0.0198 | 0.0084 | 0.0038 |
| 22 | 0.0221 | 0.0080 | 0.2578 | 0.0196 | 0.0058 | 0.0021 |
| 23 | 0.0386 | 0.0186 | 0.2479 | 0.0195 | 0.0100 | 0.0048 |
| 24 | **0.0206** | **0.0109** | **0.2428** | **0.0199** | **0.0051** | **0.0026** |
| 25 | 0.0348 | 0.0146 | 0.2343 | 0.0193 | 0.0084 | 0.0036 |
| 26 | 0.0199 | 0.0075 | 0.2297 | 0.0192 | 0.0047 | 0.0017 |

Comparisons of the survival functions in Tables 3.2 and 3.5 show that the spell durations based on spell starts tend to be shorter than those based on spell stops. For instance, 48.8% of spells last for more than 6 months and 31.9% last for more than one year based on spell starts, whereas the corresponding percentages are 54.5% and 36.5% based on spell stops (treating the spells existing at the start of the panel as censored). The explanation for this difference may lie in the different populations of inference.

Comparisons of the survival functions in Tables 3.5 and 3.6 show the effect of the alternative methods of handling spells that existed at the start of the panel when analyzing spells that stopped during the life of the panel. The spell durations obtained by treating such spells as reverse time right censored tend to be slightly longer than those when the lengths of such spells are determined when possible from the Personal History module. The differences are, however, not great. For instance, 54.5% of food stamp spells last for more than 6 months and 36.5% last for more than one year when these spells are treated as right censored, as compared with 52.2% and 34.7% when the lengths of some reverse time right censored spells are obtained from the Personal History module.

An apparent advantage to the use of the Personal History module data is that the estimates of the standard errors of the survival function estimates at longer durations are often appreciably lower when these data are used than when the spells are treated as right censored. For example, for $t = 20$ months, the standard error of $\hat{S}^*(t)$ is 1.99% when the Personal History module data are employed to determine the lengths of some of these spells, as compared with 2.24% when all these spells are treated as right censored. However, the standard errors for the survival function estimates based on the Personal History module are underestimated because they fail to take into account the sizeable amount of imputation involved in the determination of spell lengths for spells existing at the start of the panel. The gains in precision for the duration estimates derived from using data from the Personal History module are therefore overstated. It should be recalled that the Personal History data have been used here to determine lengths of spells existing at the start of the panel only for persons authorized to receive food stamps. Greater gains in precision might be

obtained if these data were also used to determine the lengths of such spells for other members of food stamp units.

## 3.6 Effect of Alternative Methods for Estimating Spell Durations on Subgroups of the Population

Several alternative methods for estimating spell durations have been employed in this report, and their results have been compared for the total population experiencing the spells. In a number of cases systematic differences in the distributions of spell durations have been observed between different methods. For instance, the adjustment for the seam effect tends to increase the proportion of spells lasting for more than 4 months, and the allowance for a gap of one, or more, months of nonparticipation in the middle of a spell increases the length of spells. In addition to simply producing the survival functions for spells on a particular program, another common type of analysis is to compare the survival functions for different subgroups of the population (for instance, to compare the survival functions for males and females). For this type of analysis, it is important to know whether the comparisons are affected by the methods used to compute the survival functions. This issue is not examined in depth here, but rather a few examples are given for illustrative purposes.

Table 3.7 presents survival functions $\hat{S}^*(t)$ for the food stamp program for sex, race, and level of education subgroups of the population based on alternative definitions of a spell that allow different gaps of nonparticipation during the spell. The results show that females tend to have longer spells than males, and this result holds for all the alternative definitions. However, there is a possible reduction in the difference in the duration distributions as the allowable gap of nonparticipation during a spell increases. For instance, the 18.3% difference in the percentages of males and females having spells of over 6 months with the definition that allows for no gaps decreases to 11.4%, 12.3% and 3.3% with definitions that allow for gaps of 1 month, 4 months, and 6 months, respectively. The distributions of spell durations for Blacks and non-Blacks are similar with the definition that allows for no gaps, and

## Table 3.7

**Survival Functions for all Spells on the Food Stamp Program for various Population Subgroups, with Different Allowances for Gaps in the Spells (Percentages)**

| Population | Mo. | Gap permitted in a spell | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None | | 1 month | | 2 months | | 4 months | | 6 months | |
| | | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| Male | 3 | 64.4 | 2.7 | 71.4 | 2.3 | 74.3 | 2.5 | 80.2 | 2.4 | 85.4 | 2.3 |
| | 6 | 42.7 | 3.0 | 50.1 | 2.9 | 54.8 | 3.4 | 65.3 | 3.0 | 73.6 | 2.9 |
| | 12 | 25.1 | 2.5 | 32.3 | 2.7 | 37.9 | 3.3 | 54.2 | 3.6 | 62.8 | 3.7 |
| Female | 3 | 82.2 | 3.0 | 83.9 | 2.6 | 85.4 | 2.3 | 91.2 | 2.1 | 90.7 | 2.1 |
| | 6 | 61.0 | 4.3 | 61.5 | 4.2 | 64.5 | 3.9 | 77.6 | 4.6 | 76.9 | 4.8 |
| | 12 | 45.7 | 3.1 | 50.2 | 3.9 | 54.8 | 3.7 | 71.1 | 4.5 | 72.0 | 4.8 |
| Black | 3 | 69.5 | 2.3 | 75.2 | 1.9 | 77.8 | 2.0 | 83.2 | 2.1 | 86.4 | 2.0 |
| | 6 | 48.3 | 2.6 | 54.1 | 2.5 | 58.4 | 2.8 | 68.8 | 2.9 | 74.2 | 2.7 |
| | 12 | 34.1 | 2.3 | 40.1 | 2.7 | 45.6 | 2.9 | 60.4 | 3.3 | 66.7 | 3.3 |
| Non-Black | 3 | 71.4 | 2.5 | 75.9 | 2.2 | 78.2 | 2.1 | 84.9 | 1.9 | 88.2 | 1.6 |
| | 6 | 49.4 | 3.2 | 53.5 | 3.1 | 57.4 | 3.3 | 70.3 | 2.9 | 75.5 | 2.7 |
| | 12 | 29.1 | 2.5 | 35.7 | 2.8 | 40.7 | 3.1 | 59.5 | 3.3 | 65.1 | 3.3 |
| Less than 12 years of education completed | 3 | 76.6 | 2.2 | 80.9 | 2.0 | 81.4 | 2.2 | 86.6 | 2.0 | 88.1 | 2.0 |
| | 6 | 52.6 | 2.8 | 56.1 | 3.3 | 59.5 | 3.4 | 68.4 | 3.6 | 71.5 | 3.4 |
| | 12 | 35.2 | 2.7 | 40.5 | 3.3 | 45.6 | 3.4 | 59.6 | 3.9 | 64.0 | 3.8 |
| 12 years of education | 3 | 64.6 | 2.9 | 70.9 | 2.5 | 74.9 | 2.4 | 82.9 | 2.2 | 86.6 | 2.0 |
| | 6 | 42.3 | 3.2 | 49.6 | 3.3 | 54.1 | 3.1 | 70.0 | 3.0 | 76..9 | 2.6 |
| | 12 | 27.6 | 3.0 | 33.2 | 3.0 | 37.8 | 3.0 | 59.5 | 3.6 | 68.8 | 3.7 |
| More than 12 years of education | 3 | 64.4 | 2.9 | 66.7 | 3.2 | 69.8 | 3.3 | 76.1 | 3.5 | 79.9 | 4.0 |
| | 6 | 42.0 | 3.7 | 44.7 | 4.1 | 48.7 | 4.8 | 61.6 | 5.2 | 66.2 | 5.5 |
| | 12 | 16.7 | 4.4 | 22.7 | 4.9 | 27.3 | 5.7 | 41.6 | 7.5 | 46.6 | 7.6 |

this similarity is maintained under all the definitions. Under the definition that permits no gaps of nonparticipation during a spell, the spell durations of those with less than 12 years of education tend to be longer than those with 12 years of education. However, this tendency is not found when spell definitions that allow for gaps of 4 or 6 months are employed.

Table 3.8 presents the survival functions for the same subgroups as Table 3.7, based now on some alternative approaches to estimating spell durations. A spell is defined for all approaches as one that allows for no gap of nonparticipation. Characteristics of the approaches are as follows:

A: All spells starting during the life of the panel, with no adjustment for the seam effect.

B: All spells starting during the life of the panel, with the modified seam adjustment described in Section 3.3.

C: All spells completed during the life of the panel, using the time-reversal methodology and treating those spells existing at the start of the panel as right censored, with the modified seam adjustment (see Section 3.5).

D: All spells completed during the life of the panel, using the time-reversal methodology and where possible using the wave 2 Personal History module to provide data on the lengths of spells that existed at the start of the panel, with the modified seam adjustment (see Section 3.5).

E: All spells observed during the life of the panel, using the methodology described in Chapter 4, with the modified seam adjustment.

In general, the subgroup survival functions computed under approaches A and B are very similar for the 3, 6, and 12 months' durations. The seam adjustment does

## Table 3.8

**Survival Functions for all Spells on the Food Stamp Program for various Population Subgroups, with Different Estimation Approaches (Percentages)**

| Population | Mo. | Estimation approaches† | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | | B | | C | | D | | E | |
| | | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| Male | 3 | 64.5 | 2.7 | 64.4 | 2.7 | 70.7 | 2.4 | 68.7 | 2.4 | 68.1 | 2.5 |
| | 6 | 42.4 | 3.1 | 42.7 | 3.0 | 53.0 | 2.7 | 50.3 | 2.7 | 48.8 | 2.8 |
| | 12 | 25.8 | 2.6 | 25.1 | 2.5 | 35.8 | 2.3 | 32.7 | 2.1 | 31.8 | 2.4 |
| Female | 3 | 85.0 | 3.0 | 82.2 | 3.0 | 83.0 | 3.1 | 80.0 | 3.2 | 82.9 | 2.9 |
| | 6 | 59.4 | 4.3 | 61.0 | 4.3 | 62.2 | 4.5 | 57.6 | 4.4 | 62.4 | 4.0 |
| | 12 | 46.7 | 2.8 | 45.7 | 3.1 | 44.1 | 4.3 | 37.9 | 4.5 | 46.6 | 3.2 |
| Black | 3 | 70.3 | 2.4 | 69.5 | 2.3 | 72.6 | 2.3 | 70.1 | 2.3 | 71.5 | 2.3 |
| | 6 | 47.5 | 2.7 | 48.3 | 2.6 | 53.6 | 2.7 | 50.0 | 2.5 | 51.8 | 2.5 |
| | 12 | 35.4 | 2.4 | 34.1 | 2.3 | 38.0 | 2.4 | 33.7 | 2.1 | 37.4 | 2.3 |
| Non-Black | 3 | 72.7 | 2.6 | 71.4 | 2.5 | 76.4 | 2.0 | 74.4 | 2.1 | 74.4 | 2.1 |
| | 6 | 49.0 | 3.2 | 49.4 | 3.2 | 58.3 | 2.6 | 55.7 | 2.6 | 54.8 | 2.7 |
| | 12 | 29.4 | 2.6 | 29.1 | 2.5 | 38.6 | 2.2 | 34.8 | 2.2 | 35.3 | 2.2 |
| Less than 12 years of education completed | 3 | 77.4 | 2.5 | 76.6 | 2.2 | 81.2 | 2.1 | 77.9 | 2.3 | 79.1 | 2.1 |
| | 6 | 52.4 | 3.0 | 52.6 | 2.8 | 62.1 | 2.8 | 57.0 | 2.9 | 57.9 | 2.8 |
| | 12 | 35.7 | 2.8 | 35.2 | 2.7 | 46.0 | 2.7 | 38.6 | 2.7 | 41.1 | 2.6 |
| 12 years of education | 3 | 65.9 | 3.0 | 64.6 | 2.9 | 66.4 | 2.8 | 61.6 | 2.9 | 66.3 | 2.7 |
| | 6 | 41.5 | 3.1 | 42.3 | 3.2 | 45.4 | 2.9 | 38.1 | 2.8 | 45.3 | 2.8 |
| | 12 | 28.9 | 3.2 | 27.6 | 3.0 | 28.8 | 2.8 | 19.6 | 2.7 | 30.4 | 2.7 |
| More than 12 years of education | 3 | 66.5 | 3.4 | 64.4 | 2.9 | 71.8 | 2.9 | 64.9 | 2.8 | 68.8 | 2.8 |
| | 6 | 42.0 | 3.9 | 42.0 | 3.7 | 53.9 | 4.0 | 45.2 | 4.0 | 49.0 | 3.7 |
| | 12 | 16.0 | 4.7 | 16.7 | 4.4 | 32.6 | 4.1 | 18.4 | 5.9 | 26.2 | 4.0 |

†See text for descriptions of these approaches.

not affect the survival function for these durations to any real extent, although it does affect the survival function for other durations markedly (especially the 4 month duration). The two reverse time approaches also yield similar results to one another, with approach C (in which spells beginning before the start of the panel are treated as reverse time right censored) estimating greater proportions of longer spells than approach D (which employed the Personal History module to determine the lengths of such spells when possible). By using all spells existing during the panel, approach E combines aspects of the forward and reverse time approaches, and hence the survival functions it produces tend to fall between those produced by A and B on the one hand and by C and D on the other.

The major differences in the comparisons between subgroups for the different approaches occur between the forward and reverse time approaches. Thus, approaches A and B show that women tend to have much longer spell durations than men, but this difference is reduced with approaches C and D. For example, 20.9% more females than males have spells of over 12 months with approach A, whereas only 8.3% do so with approach C. The survival functions for those with 12 years of education are not sensitive to the approach adopted. However, the survival functions for those with less than 12 years of education do differ between approaches. As a result, comparisons between the survival functions for these two subgroups are affected by the approach used. For example, if approach A is used, 6.8% more spells exceed one year for persons with less than 12 years of education than for persons with 12 years of education. If approach C is used, the comparable figure is 17.2%. Although these examples demonstrate that the approach used for estimating the survival function can affect subgroup comparisons of durations, this does not always happen. Comparisons of the survival functions of Blacks and non-Blacks, for instance, yield generally similar conclusions under all the approaches.

### 3.7 Proportional Hazards Analysis

An important form of spell analysis for SIPP is to develop models that relate the length of spell (termed survival time in the survival analysis literature) to possible

predictor variables (such as age, sex, race, and education). Regression models for such analyses typically depend on an assumption of proportional hazard functions, as is the case with the widely-used Cox's proportional hazard model (see, for instance, Lee, 1992; Cox and Oakes, 1984). Here we examine the effect of the seam effect on a simple measure of proportional hazards, obtained as a Mantel-Haenszel estimate.

To illustrate the approach, consider the estimation of the proportional hazard of leaving the food stamp program for men versus women. This hazard can be estimated from the numbers of men and women leaving the program between months $k$ and $(k+1)$ among all such persons on the program in month $k$ (i.e., persons with spells of $k$ months or greater). The data for all $n_k$ persons on the program in month $k$ can be laid out in the following 2×2 table:

| | On in month $(k+1)$ | Off in month $(k+1)$ |
|---|---|---|
| Male | $n_{11k}$ | $n_{12k}$ |
| Female | $n_{21k}$ | $n_{22k}$ |

For this table, the estimator of the odds ratio of males leaving to females leaving the program is

$$\hat{\theta}_k = \frac{n_{11k}n_{22k}}{n_{12k}n_{21k}}.$$

An odds ratio can be calculated for each month ($k$ = 1, 2, ..., 26) and, under an assumption that the odds ratios are equal across months, the common odds ratio may be estimated by a weighted average. We use the Mantel-Haenszel estimate for this weighted average:

$$\hat{\theta}_{MH} = \frac{\Sigma n_{11k}n_{22k}/n_k}{\Sigma n_{12k}n_{21k}/n_k}. \qquad (3.1)$$

**Table 3.9**

**Proportional Hazard Estimates, $\hat{\theta}^{*}_{MH}$, for all Spells on the Food Stamp Program for various Population Subgroups, without a Seam Adjustment**

| Subgroups | $\hat{\theta}^{*}_{MH}$ | 95% confidence interval |
|---|---|---|
| Female vs. male | | |
| Seam months | 1.00 | (0.83, 1.20) |
| Non-seam months | 0.83 | (0.68, 1.02) |
| All months | 0.92 | (0.82, 1.04) |
| Blacks vs. non-Blacks | | |
| Seam months | 0.32 | (0.18, 0.58) |
| Non-seam months | 0.82 | (0.58, 1.15) |
| All months | 0.53 | (0.42, 0.67) |
| 12 years of education vs. less | | |
| Seam months | 1.67 | (1.21, 2.30) |
| Non-seam months | 1.18 | (0.88, 1.59) |
| All months | 1.38 | (1.13, 1.69) |
| More than 12 years of education vs. 12 years | | |
| Seam months | 0.89 | (0.59, 1.35) |
| Non-seam months | 1.66 | (1.04, 2.67) |
| All months | 1.20 | (0.93, 1.55) |

surprising. The confidence intervals are also almost identical. Based on these examples, and some others not reported here, it appears that there is generally little need to make this kind of seam adjustment for computing a Mantel-Haenszel type of proportional hazards estimate.

(See, for instance, Agresti, 1990, for a description of the conventional use of the Mantel-Haenszel estimate.)

The analyses reported here incorporate the panel weights, so that the $n_{ijk}$ in (3.1) are replaced by weighted sums. Let the Mantel-Haenszel estimate from the weighted analysis be $\hat{\theta}^*_{MH}$. A 95% confidence interval is obtained as follows. First the standard error of $\log(\hat{\theta}^*_{MH})$ is obtained using BRR, and then a 95% confidence interval for $\log(\hat{\theta}^*_{MH})$ is calculated as $\log(\hat{\theta}^*_{MH}) \pm 1.96 se(\hat{\theta}^*_{MH})$. Then the confidence limits for $\log(\hat{\theta}^*_{MH})$ are exponentiated to give the confidence limits for $\hat{\theta}^*_{MH}$.

To investigate the effect of the seam effect on the estimates of the proportional hazards, computations of $\hat{\theta}_{MH}$ have been performed separately for months $k$ where the seam occurs between $k$ and $(k+1)$ (seam months), for months $k$ where $k$ and $(k+1)$ are within a wave (non-seam months), and for seam and non-seam months combined. The results for four examples are displayed in Table 3.9. No seam adjustments have been applied for this analysis.

As Table 3.9 shows, the estimates $\hat{\theta}^*_{MH}$ do differ appreciably according to whether the calculations are performed for seam months or non-seam months. However, the differences between the estimates for seam and non-seam months are not significant, except in the case of the Black vs. non-Black contrast.

Table 3.10 presents proportional hazards for the same examples as in Table 3.9, but here the calculations have been performed after the modified seam adjustment has been applied. For comparison purposes, the table also contains the proportional hazards obtained without the seam adjustment, repeated from Table 3.9.

Although Table 3.9 shows some differences between the estimates of the proportional hazards for seam and non-seam months, it turns out that the pooled non-adjusted estimates over all months are very close to those obtained from the modified seam adjustment described in Section 3.3. Since the seam adjustment operates fairly uniformly across population subgroups, this finding is perhaps not

## Table 3.10

**Proportional Hazard Estimates, $\hat{\theta}^{*}_{MH}$, for all Spells on the Food Stamp Program for various Population Subgroups, with the Modified Seam Adjustment**

| Subgroups | Without seam adjustment | With seam adjustment | |
|---|---|---|---|
| | $\hat{\theta}^{*}_{MH}$ | $\hat{\theta}^{*}_{MH}$ | 95% confidence interval |
| Male vs. Female | 0.92 | 0.92 | (0.82, 1.03) |
| Blacks vs. non-Blacks | 0.53 | 0.53 | (0.42, 0.67) |
| 12 years of education vs. less | 1.38 | 1.37 | (1.12, 1.68) |
| More than 12 years of education vs. 12 years | 1.20 | 1.17 | (0.91, 1.50) |

# CHAPTER 4

# A TECHNIQUE FOR INCLUDING ALL OBSERVED SPELLS IN ESTIMATING SPELL DURATIONS

## 4.1 Introduction

As noted in several places earlier in this report, spells on programs reported in a SIPP panel may be observed in their entirety (uncensored), may start during the panel and be still ongoing at the end of the panel (right censored), start before the beginning of the panel and end during the panel (initial censored), or start before the beginning of the panel and be still ongoing at the end of the panel (doubly censored). In addition, there is the possibility of employing the responses to the Personal History module to date the starts of spells that began before the beginning of the panel. In estimating spell durations, the question is how to use the data on spells available from a SIPP panel in the most effective manner.

The most commonly used approach is to restrict analyses to spells starting during the panel, thus ignoring the initial censored and doubly censored cases. This approach corresponds to the standard procedures used in survival analysis, and has the attraction of a clearly identified and meaningful population of inference. Another approach, investigated in Section 3.5, reverses the time dimension, and applies the standard survival methodology to spells that end during the life of the panel, treating the initial censored spells as right censored. A variant on this approach, also investigated in Section 3.5, uses responses to the Personal History module to determine the lengths of initial censored spells. The first approach employs uncensored and right censored spells, whereas the second approach employs uncensored and initial censored spells. Both approaches ignore doubly censored spells.

This chapter describes a technique that makes use of data on all spells in a single estimation procedure. The technique is developed in Section 4.2 and it is applied to spells of program participation in the 1987 SIPP panel in Section 4.3. The chapter ends with some concluding remarks in Section 4.4.

## 4.2 Estimating Survival Functions from All Spells Observed in a SIPP Panel

A technique for incorporating all spells observed during a SIPP panel in the estimation of the survival functions for spell durations is, for simplicity of presentation, developed in unweighted form. The modification to take account of the panel weights is readily made.

Consider first the standard Kaplan-Meier estimation approach that is applicable for spells that start during the life of the panel. In this case, the survival function $S(t)$ (representing the probability that a spell will last for more than $t$ months) is related to the hazard function $h(t)$ (representing the probability that a spell will end in month $t$ given that it lasts for $t$ months or more) by

$$S(t) = \prod_{x=1}^{t} [1-h(x)] \tag{4.1}$$

(see equation 1.3.4). The hazard function may be estimated (see equation 1.3.5) by

$$\hat{h}(t) = \frac{d_t}{\sum_{x=t}^{M-2} d_x + \sum_{x=t+1}^{M-1} c_x} \tag{4.2}$$

where $d_t$ is the number of spells ending at time $t$

$c_t$ is the number of spells right censored at time $t$

and $M$ is the panel length in months (with the 1987 panel, $M = 28$).

The numerator of $\hat{h}(t)$ comprises all spells ending at $t$ months, and the denominator is the sum of all uncensored spells lasting for $t$ or more months together with all right censored spells observed for $(t+1)$ or more months. (Since it is not known whether right censored cells observed for $t$ months end at $t$ months or continue for longer, they are not included in the denominator.)

The denominator of $\hat{h}(t)$ includes all uncensored and right censored spells that meet the criterion that they last for $t$ or more months, excluding only spells for which it is not known whether they last for exactly $t$ months or for longer. When considering incorporating initial and double censored spells into the estimation procedure, it is natural to consider adding such spells that satisfy this criterion to the denominator of $\hat{h}(t)$. This leads to a modified hazard estimate

$$\hat{h}_{\lambda}(t) = \frac{d_t}{\sum_{x=t}^{M-2} d_x + \sum_{x=t+1}^{M-1} (c_x + a_x) + b} \qquad (4.3)$$

where $a_t$ is the number of initial censored spells observed for $t$ months
and $b$ is the number of doubly censored spells (observed for $M$ months).

Given that $\hat{h}(t)$ is the standard estimator of $h(t)$, it is clear that $\hat{h}_{\lambda}(t)$ underestimates $h(t)$. The approach adopted is to find a correction factor to apply to $\hat{h}_{\lambda}(t)$ to make it approximately unbiased for $h(t)$. In order to develop this correction factor, two stringent stationarity assumptions are made:

1. The expected proportion of persons starting on the program is constant across months, and the population size is constant. Hence the expected number of persons starting on the program is constant across months, say $E(N)$. This includes the period prior to the panel.

2. The length of a spell is independent of the month that the spell starts.

Under these assumptions, $E(d_x)$ can be readily expressed as:

$$E(d_x) = \sum_{m=2}^{M-x} E(N)P(T=x|S=m)$$

where $S$ denotes the panel month in which the spell starts, $M$ denotes the length of the panel, and the summation starts at $m = 2$ because spell starts cannot be observed in the first month. Given the stationarity condition, $P(T=x|S=m) = P(T=x)$, $E(d_x)$ reduces to

$$E(d_x) = (M-x-1)E(N)P(T=x). \tag{4.4}$$

Right censored spells of length $x$ start in month $(M-x)$ and last for $x$ or more months. Thus

$$E(c_x) = E(N)P(T>x-1) = E(N)\sum_{z=x}^{\infty} P(T=z). \tag{4.5}$$

Similarly, initial censored spells of length $x$ end in month $x$, and last for $x$ or more months. Hence

$$E(a_x) = E(c_x) = E(N)P(T>x-1) = E(N)\sum_{z=x}^{\infty} P(T=z). \tag{4.6}$$

Doubly censored spells start before the beginning of the panel, or in the first month of the panel, and last at least until the end of the panel. The probability of a spell starting $m$ months before the start of the panel lasting to the end of the panel or beyond is $P(T>M+m-1)$. Thus

$$E(b) = E(N)\sum_{m=0}^{\infty} P(T>M+m-1) = E(N)\sum_{t=M}^{\infty} P(T>t-1). \tag{4.7}$$

The expected value of the denominator of $\hat{h}(t)$ is thus

$$E[y(t)] = \sum_{x=t}^{M-2} E(d_x) + \sum_{x=t+1}^{M-1} E(c_x) = E(N)\left[\sum_{x=t}^{M-2}(M-x-1)P(T=x) + \sum_{x=t+1}^{M-1} P(T>x-1)\right]. \tag{4.8}$$

Now $$\sum_{x=t+1}^{M-1} P(T>x-1) = \sum_{x=t}^{M-2}(x-t)P(T=x) + \sum_{x=M-1}^{\infty}(M-t-1)P(T=x). \tag{4.9}$$

Thus $$E[y(t)] = E(N)\left[\sum_{x=t}^{\infty}(M-t-1)P(T=x)\right] = E(N)(M-t-1)S(t-1). \tag{4.10}$$

Consider now the denominator of $\hat{h}_\lambda(t)$, say $y_\lambda(t)$.

$$y_\lambda(t) = y(t) + \sum_{x=t+1}^{M-1} a_x + b.$$

Using equation (4.9) with $\sum_{x=t+1}^{M-1} a_x$, noting that $\sum_{t=M}^{\infty} P(T>t-1) = \sum_{x=M}^{\infty}(x-M+1)P(T=x)$, and that $(x-M+1)P(T=x) = 0$ for $x = (M-1)$, $E[y_\lambda(t)]$ may be expressed as:

$$E[y_\lambda(t)] = E[y(t)] + E(N)\left\{\sum_{x=t}^{M-2}(x-t)P(T=x) + \sum_{x=M-1}^{\infty}(M-t-1)P(T=x) + \sum_{x=M-1}^{\infty}(x-M+1)P(T=x)\right\}$$

$$= E[y(t)] + E(N)\sum_{x=t}^{\infty}(x-t)P(T=x)$$

$$= E[y(t)] - E(N)tS(t-1) + E(N)\sum_{x=t}^{\infty} xP(T=x)$$

$$= E[y(t)] - E(N)tS(t-1) + E(N)S(t-1)E(T|T>t-1).$$

Since $\hat{h}(t)/\hat{h}_\lambda(t) = y_\lambda(t)/y(t)$, it follows that

$$\frac{E[\hat{h}(t)]}{E[\hat{h}_\lambda(t)]} = \frac{NS(t-1)[(M-t-1)-t+E(T|T>t-1)]}{NS(t-1)(M-t-1)}.$$

Thus
$$E[\hat{h}(t)] = \left[\frac{M-2t-1+E(T|T>t-1)}{M-t-1}\right]E[\hat{h}_\lambda(t)]. \tag{4.11}$$

Equation (4.11) gives the relationship between the expected value of the biased estimate of the hazard function that incorporates both spells existing at the start of the panel and spells starting during the life of the panel, and the expected value of the standard estimate of the hazard function based only on spells starting during the life of the panel. The term in brackets thus represents a correction factor that can be applied to $\hat{h}_\lambda(t)$ to give a valid estimator of the hazard function at duration $t$. Thus the proposed estimator of $h(t)$ is

$$\hat{h}_c(t) = \left[\frac{M-2t-1+\hat{\mu}_t}{M-t-1}\right]\hat{h}_\lambda(t)$$

$$= \left[1+\frac{\hat{\mu}_t-t}{M-t-1}\right]\hat{h}_\lambda(t) \tag{4.12}$$

where $\hat{\mu}_t$ is an estimate of $E(T|T>t-1) = E(T|T\geq t)$.

In order to apply the estimate of the hazard function in (4.12), it is necessary to estimate the value of $E(T|T>t-1)$ by $\hat{\mu}_t$. The procedure employed here is first to estimate $E(T) = E(T|T>0)$, and then to estimate $E(T|T>t-1)$ for $t>1$ successively based on the relationship:

$$E(T|T>t-1) = \frac{E(T)-\sum_{x=1}^{t-1} xP(T=x)}{S(t-1)}. \tag{4.13}$$

An estimate of $E(T)$ is obtained from the following argument. Let $P$ be the monthly prevalence for the spells, that is the number of persons on spells in each month, and let $I$ be the monthly incidence for the spells, that is the number of spells starting each month. Under the strict stationarity assumptions employed, both incidence and prevalence are constant across months. Moreover, the number of spells ending each month is constant and equal to $I$. Under these assumptions, $E(T) = P/I$. The prevalence may be estimated by summing the spells active in each month across all months of the panel, and dividing by $M = 28$. This estimate is equivalent to the sum of all spell lengths (initial censored, doubly censored, right censored and uncensored spells) divided by 28. The incidence may be estimated by the sum of all starts over the 27 months of the panel for which starts can be identified divided by 27, or equally by the sum of all stops over the 27 months of the panel for which stops can be identified divided by 27. We have used the average of these two estimates, in other words (total starts + total stops)/54, to estimate $I$. The estimates of $P$ and $I$ employed are both weighted estimates, using the panel weights. Let $\hat{\mu}_1 = \hat{P}/\hat{I}$ denote this estimate of $E(T)$.

The estimation of $h(t)$ then proceeds as follows. Let $t = 1$, and compute $\hat{h}_\lambda(1)$ from equation (4.3). Compute $\hat{h}_c(1)$ from equation (4.12), and hence compute $\hat{S}_c(1)$ on substituting $\hat{h}_c(1)$ for $h(1)$ in equation (4.1). Finally, compute $\hat{f}_c(1)$, the estimated PDF, from

$$\hat{f}_c(t) = \hat{S}_c(t-1) - \hat{S}_c(t)$$

with $t = 1$ and $\hat{S}_c(0) = 1$.

Next, let $t = 2$, and compute $\hat{h}_\lambda(2)$ from equation (4.3). Compute $\hat{\mu}_2$, based on equation (4.13), as

$$\hat{\mu}_2 = \frac{\hat{\mu}_1 - \hat{f}_c(1)}{\hat{S}_c(1)}.$$

Hence compute $\hat{h}_c(2)$ from equation (4.12), $\hat{S}_c(2)$ on substituting $\hat{h}_c(1)$ and $\hat{h}_c(2)$ for $h(1)$ and $h(2)$ in equation (4.1), and $\hat{f}_c(2) = \hat{S}_c(1) - \hat{S}_c(2)$. The procedure can then be applied successively to estimate the survival functions for all $t$.

The above discussion has described an unweighted analysis. The estimators are, however, readily adapted to take account of the panel weights by treating each spell for person $i$ with a weight of $w_i$ as equivalent to $w_i$ spells. This is the approach adopted in the next section for the analysis of spells in the 1987 SIPP panel. Stars are added to the symbols for the estimators to indicate that weights have been used (e.g., $\hat{h}_c^*(t)$, $\hat{S}_c^*(t)$ and $\hat{f}_c^*(t)$).

## 4.3 Analyses of All Spells Observed in the 1987 SIPP Panel

This section applies the methodology described in the previous section to estimate survival functions for spells of program participation in the 1987 SIPP panel. Panel weights are used in the analyses, with the weights being modified as described in Section 3.3 to adjust for the seam effect. The standard errors reported have been computed using balanced repeated replications (BRR) to take into account the complex sample design employed for SIPP. For comparative purposes, estimates of the survival functions based on all spells starting in the life of the panel and using the standard Kaplan-Meier estimator are presented alongside the estimates from the new methodology. The estimates based only on all spells starting in the life of the panel are also weighted estimates, with the same adjusted weights as used with the new methodology. The standard errors of these estimates are also obtained by BRR.

Tables 4.1 through 4.10 present the survival functions and their standard errors for the ten programs examined in this report, computed with the new methodology and with the standard Kaplan-Meier approach using only spells starting during the panel. Tables of the estimated hazard functions and PDFs, with associated standard errors, are given in Appendix C. Also given in the tables in Appendix C are the values of the estimated mean lengths of spells that are of length

**Table 4.1**

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: AFDC (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 89.45 | 1.46 | 88.35 | 1.53 |
| 2 | 83.56 | 1.65 | 81.78 | 1.76 |
| 3 | 77.21 | 1.81 | 74.53 | 2.06 |
| 4 | 67.98 | 2.24 | 64.05 | 2.63 |
| 5 | 62.85 | 2.24 | 58.11 | 2.75 |
| 6 | 58.76 | 2.47 | 53.49 | 3.05 |
| 7 | 54.44 | 2.53 | 48.79 | 3.14 |
| 8 | 51.34 | 2.55 | 45.21 | 3.16 |
| 9 | 48.77 | 2.52 | 42.90 | 3.13 |
| 10 | 45.82 | 2.71 | 39.94 | 3.18 |
| 11 | 43.77 | 2.70 | 37.92 | 3.21 |
| 12 | 40.91 | 2.83 | 35.12 | 3.27 |
| 13 | 40.37 | 2.88 | 34.59 | 3.29 |
| 14 | 38.86 | 3.02 | 33.03 | 3.38 |
| 15 | 38.10 | 3.15 | 32.24 | 3.46 |
| 16 | 35.48 | 4.21 | 29.49 | 4.12 |
| 17 | 34.65 | 4.41 | 28.68 | 4.26 |
| 18 | 34.36 | 4.41 | 28.38 | 4.25 |
| 19 | 33.95 | 4.44 | 27.95 | 4.26 |
| 20 | 33.66 | 4.46 | 27.64 | 4.35 |
| 21 | 33.37 | 4.49 | 27.34 | 4.44 |
| 22 | 31.04 | 4.81 | 25.18 | 4.78 |
| 23 | 30.90 | 4.84 | 25.05 | 4.87 |
| 24 | 30.90 | 4.84 | 25.05 | 4.87 |
| 25 | 30.90 | 4.84 | 25.05 | 4.87 |
| 26 | 30.90 | 4.84 | 25.05 | 4.87 |

## Table 4.2

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: General Assistance (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 87.81 | 2.63 | 86.29 | 2.94 |
| 2 | 78.56 | 3.91 | 75.87 | 4.36 |
| 3 | 71.62 | 4.33 | 67.93 | 4.81 |
| **4** | **61.50** | **4.41** | **56.42** | **4.80** |
| 5 | 53.97 | 4.77 | 48.11 | 4.92 |
| 6 | 46.74 | 4.83 | 40.33 | 4.86 |
| 7 | 42.78 | 5.03 | 36.11 | 5.06 |
| **8** | **40.03** | **5.10** | **33.31** | **5.12** |
| 9 | 37.83 | 5.20 | 31.17 | 5.21 |
| 10 | 36.04 | 5.16 | 29.51 | 5.17 |
| 11 | 34.08 | 5.21 | 27.64 | 5.11 |
| **12** | **31.02** | **5.07** | **24.74** | **4.91** |
| 13 | 30.40 | 4.95 | 24.15 | 4.81 |
| 14 | 29.87 | 4.88 | 23.63 | 4.74 |
| 15 | 29.70 | 4.89 | 23.47 | 4.76 |
| **16** | **29.70** | **4.89** | **23.47** | **4.76** |
| 17 | 29.43 | 4.85 | 23.15 | 4.69 |
| 18 | 29.00 | 4.80 | 22.61 | 4.59 |
| 19 | 27.90 | 4.71 | 20.80 | 4.26 |
| **20** | **26.27** | **4.76** | **16.88** | **4.49** |
| 21 | 24.82 | 4.94 | 13.43 | 5.08 |
| 22 | 23.08 | 5.30 | 9.18 | 5.94 |
| 23 | 22.47 | 5.51 | 7.32 | 6.27 |
| **24** | **22.47** | **5.51** | **7.32** | **6.27** |
| 25 | 22.47 | 5.51 | 7.32 | 6.27 |
| 26 | 22.47 | 5.51 | 7.32 | 6.27 |

## Table 4.3

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: AFDC or General Assistance (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 89.36 | 1.45 | 88.13 | 1.51 |
| 2 | 83.06 | 1.82 | 81.01 | 1.92 |
| 3 | 76.55 | 1.98 | 73.47 | 2.13 |
| **4** | **67.29** | **2.27** | **62.80** | **2.45** |
| 5 | 61.81 | 2.25 | 56.43 | 2.46 |
| 6 | 57.16 | 2.48 | 51.14 | 2.76 |
| 7 | 52.91 | 2.56 | 46.47 | 2.83 |
| **8** | **49.64** | **2.56** | **43.01** | **2.86** |
| 9 | 47.40 | 2.55 | 40.72 | 2.84 |
| 10 | 44.63 | 2.67 | 37.91 | 2.85 |
| 11 | 42.64 | 2.62 | 35.90 | 2.80 |
| **12** | **39.50** | **2.72** | **32.74** | **2.75** |
| 13 | 38.93 | 2.74 | 32.15 | 2.73 |
| 14 | 37.55 | 2.81 | 30.68 | 2.74 |
| 15 | 36.90 | 2.90 | 29.98 | 2.79 |
| **16** | **34.64** | **3.70** | **27.48** | **3.34** |
| 17 | 33.93 | 3.86 | 26.73 | 3.45 |
| 18 | 33.60 | 3.87 | 26.36 | 3.42 |
| 19 | 33.09 | 3.91 | 25.76 | 3.41 |
| **20** | **32.45** | **3.92** | **24.98** | **3.41** |
| 21 | 31.89 | 3.96 | 24.33 | 3.45 |
| 22 | 29.49 | 4.24 | 21.67 | 3.81 |
| 23 | 29.16 | 4.27 | 21.34 | 3.89 |
| **24** | **29.16** | **4.27** | **21.34** | **3.89** |
| 25 | 29.16 | 4.27 | 21.34 | 3.89 |
| 26 | 29.16 | 4.27 | 21.34 | 3.89 |

**Table 4.4**

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: Food Stamps (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 89.31 | 1.32 | 88.50 | 1.40 |
| 2 | 81.48 | 1.85 | 79.99 | 1.98 |
| 3 | 73.36 | 2.02 | 71.18 | 2.17 |
| 4 | 64.39 | 2.37 | 61.41 | 2.53 |
| 5 | 57.25 | 2.41 | 53.60 | 2.65 |
| 6 | 53.02 | 2.39 | 49.06 | 2.61 |
| 7 | 49.45 | 2.40 | 45.35 | 2.57 |
| 8 | 46.27 | 2.03 | 42.10 | 2.15 |
| 9 | 43.34 | 2.07 | 39.13 | 2.12 |
| 10 | 40.26 | 2.03 | 36.13 | 2.08 |
| 11 | 38.27 | 1.97 | 34.19 | 2.04 |
| 12 | 36.01 | 1.96 | 31.98 | 2.06 |
| 13 | 34.86 | 1.97 | 30.88 | 2.07 |
| 14 | 33.35 | 2.01 | 29.45 | 2.13 |
| 15 | 32.86 | 2.03 | 28.97 | 2.13 |
| 16 | 32.48 | 2.03 | 28.61 | 2.12 |
| 17 | 32.04 | 2.03 | 28.17 | 2.10 |
| 18 | 31.80 | 2.02 | 27.94 | 2.09 |
| 19 | 31.56 | 2.01 | 27.69 | 2.10 |
| 20 | 31.37 | 2.01 | 27.48 | 2.11 |
| 21 | 31.29 | 2.01 | 27.39 | 2.13 |
| 22 | 31.21 | 2.02 | 27.30 | 2.14 |
| 23 | 30.45 | 2.09 | 26.43 | 2.31 |
| 24 | 29.40 | 2.38 | 25.07 | 2.70 |
| 25 | 28.73 | 2.61 | 24.10 | 3.27 |
| 26 | 27.64 | 3.12 | 22.54 | 5.64 |

## Table 4.5

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: Federal SSI (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 89.79 | 2.23 | 90.20 | 2.17 |
| 2 | 84.29 | 2.94 | 84.93 | 2.89 |
| 3 | 79.78 | 3.21 | 80.60 | 3.09 |
| 4 | 76.16 | 3.54 | 77.15 | 3.43 |
| 5 | 72.92 | 3.82 | 74.06 | 3.74 |
| 6 | 69.59 | 4.12 | 70.92 | 4.07 |
| 7 | 66.66 | 4.40 | 68.17 | 4.36 |
| 8 | 64.41 | 4.55 | 66.09 | 4.51 |
| 9 | 62.30 | 4.79 | 64.15 | 4.74 |
| 10 | 61.22 | 4.88 | 63.17 | 4.81 |
| 11 | 59.94 | 5.03 | 62.04 | 4.92 |
| 12 | 58.11 | 5.03 | 60.43 | 4.92 |
| 13 | 57.37 | 5.10 | 59.78 | 4.94 |
| 14 | 56.81 | 5.13 | 59.28 | 4.95 |
| 15 | 54.49 | 5.35 | 57.26 | 4.98 |
| 16 | 52.19 | 5.71 | 55.33 | 5.14 |
| 17 | 48.58 | 6.00 | 52.48 | 5.26 |
| 18 | 45.76 | 6.75 | 50.37 | 5.67 |
| 19 | 39.95 | 7.58 | 46.10 | 6.25 |
| 20 | 39.26 | 7.67 | 45.62 | 6.30 |
| 21 | 39.26 | 7.67 | 45.62 | 6.30 |
| 22 | 39.26 | 7.67 | 45.62 | 6.30 |
| 23 | 39.26 | 7.67 | 45.62 | 6.30 |
| 24 | 39.26 | 7.67 | 45.62 | 6.30 |
| 25 | 39.26 | 7.67 | 45.62 | 6.30 |
| 26 | 39.26 | 7.67 | 45.62 | 6.30 |

## Table 4.6

**Comparisons of Estimates of Survival Functions based on all spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: Social Security (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 94.48 | 0.75 | 95.55 | 0.62 |
| 2 | 91.85 | 0.88 | 93.41 | 0.72 |
| 3 | 87.90 | 1.17 | 90.46 | 0.96 |
| **4** | **82.24** | **1.60** | **85.79** | **1.39** |
| 5 | 77.64 | 1.96 | 81.92 | 1.75 |
| 6 | 73.78 | 2.29 | 78.66 | 2.08 |
| 7 | 70.12 | 2.48 | 75.86 | 2.31 |
| **8** | **67.07** | **2.52** | **73.48** | **2.41** |
| 9 | 64.15 | 2.66 | 71.21 | 2.52 |
| 10 | 61.99 | 2.71 | 69.57 | 2.59 |
| 11 | 59.90 | 2.74 | 67.94 | 2.64 |
| **12** | **58.29** | **2.74** | **66.77** | **2.64** |
| 13 | 56.74 | 2.73 | 65.49 | 2.66 |
| 14 | 55.41 | 2.76 | 64.39 | 2.70 |
| 15 | 54.12 | 2.78 | 63.34 | 2.76 |
| **16** | **52.93** | **2.83** | **62.48** | **2.84** |
| 17 | 52.03 | 2.92 | 61.75 | 2.93 |
| 18 | 51.32 | 2.99 | 61.17 | 3.00 |
| 19 | 50.17 | 3.05 | 60.26 | 3.03 |
| **20** | **49.88** | **3.04** | **60.05** | **3.03** |
| 21 | 49.56 | 3.05 | 59.82 | 3.04 |
| 22 | 49.19 | 3.09 | 59.52 | 3.06 |
| 23 | 48.86 | 3.10 | 59.25 | 3.07 |
| **24** | **47.35** | **3.34** | **57.91** | **3.30** |
| 25 | 46.90 | 3.42 | 57.52 | 3.36 |
| 26 | 45.95 | 3.78 | 56.69 | 3.69 |

## Table 4.7

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: State Unemployment Compensation (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 70.29 | 1.21 | 69.16 | 1.23 |
| 2 | 54.66 | 1.22 | 52.88 | 1.23 |
| 3 | 40.75 | 1.20 | 38.38 | 1.20 |
| **4** | **28.42** | **1.23** | **25.88** | **1.22** |
| 5 | 19.62 | 1.10 | 17.27 | 1.15 |
| 6 | 12.62 | 0.95 | 10.68 | 1.00 |
| 7 | 6.31 | 0.65 | 5.02 | 0.64 |
| **8** | **3.93** | **0.53** | **3.01** | **0.51** |
| 9 | 2.40 | 0.45 | 1.76 | 0.39 |
| 10 | 1.54 | 0.37 | 1.12 | 0.30 |
| 11 | 1.02 | 0.34 | 0.74 | 0.26 |
| **12** | **0.86** | **0.34** | **0.63** | **0.25** |
| 13 | 0.35 | 0.26 | 0.26 | 0.18 |
| 14 | 0.18 | 0.19 | 0.14 | 0.14 |
| 15 | 0.18 | 0.19 | 0.14 | 0.14 |
| **16** | **0.18** | **0.19** | **0.14** | **0.14** |
| 17 | 0.07 | 0.14 | 0.05 | 0.05 |
| 18 | 0.05 | 0.14 | 0.03 | 0.03 |
| 19 | 0.03 | 0.16 | 0.01 | 0.01 |
| **20** | **0.03** | **0.24** | **0.00** | **0.00** |
| 21 | 0.03 | 0.24 | 0.00 | 0.00 |
| 22 | 0.03 | 0.24 | 0.00 | 0.00 |
| 23 | 0.03 | 0.24 | 0.00 | 0.00 |
| **24** | **0.03** | **0.24** | **0.00** | **0.00** |
| 25 | 0.03 | 0.24 | 0.00 | 0.00 |
| 26 | 0.03 | 0.24 | 0.00 | 0.00 |

**Table 4.8**

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: Veterans Compensation (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 93.49 | 0.98 | 93.82 | 0.94 |
| 2 | 88.49 | 1.25 | 88.92 | 1.18 |
| 3 | 80.80 | 1.85 | 81.12 | 1.77 |
| 4 | 70.58 | 2.72 | 70.65 | 2.72 |
| 5 | 62.33 | 3.35 | 62.04 | 3.49 |
| 6 | 54.63 | 3.83 | 54.06 | 4.05 |
| 7 | 49.04 | 4.00 | 48.39 | 4.30 |
| 8 | 45.33 | 4.04 | 44.78 | 4.37 |
| 9 | 42.02 | 4.21 | 41.50 | 4.54 |
| 10 | 39.50 | 4.34 | 39.02 | 4.66 |
| 11 | 37.56 | 4.40 | 37.15 | 4.70 |
| 12 | 36.18 | 4.42 | 35.86 | 4.70 |
| 13 | 35.08 | 4.54 | 34.84 | 4.79 |
| 14 | 33.85 | 4.66 | 33.70 | 4.88 |
| 15 | 33.07 | 4.75 | 32.98 | 4.95 |
| 16 | 32.67 | 4.74 | 32.61 | 4.94 |
| 17 | 32.23 | 4.76 | 32.22 | 4.94 |
| 18 | 32.23 | 4.76 | 32.22 | 4.94 |
| 19 | 32.23 | 4.76 | 32.22 | 4.94 |
| 20 | 32.23 | 4.76 | 32.22 | 4.94 |
| 21 | 32.23 | 4.76 | 32.22 | 4.94 |
| 22 | 32.23 | 4.76 | 32.22 | 4.94 |
| 23 | 32.23 | 4.76 | 32.22 | 4.94 |
| 24 | 32.23 | 4.76 | 32.22 | 4.94 |
| 25 | 32.23 | 4.76 | 32.22 | 4.94 |
| 26 | 32.23 | 4.76 | 32.22 | 4.94 |

## Table 4.9

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: WIC (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 92.27 | 1.48 | 92.46 | 1.49 |
| 2 | 85.83 | 1.92 | 85.75 | 1.98 |
| 3 | 79.19 | 2.10 | 78.69 | 2.19 |
| 4 | 69.70 | 2.43 | 68.63 | 2.58 |
| 5 | 60.32 | 2.76 | 59.07 | 2.87 |
| 6 | 50.62 | 3.19 | 48.91 | 3.26 |
| 7 | 43.18 | 3.11 | 41.28 | 3.16 |
| 8 | 38.28 | 2.98 | 36.27 | 3.01 |
| 9 | 33.57 | 2.85 | 31.66 | 2.86 |
| 10 | 29.79 | 2.80 | 28.04 | 2.80 |
| 11 | 25.55 | 2.65 | 24.09 | 2.80 |
| 12 | 22.67 | 2.58 | 21.41 | 2.80 |
| 13 | 19.68 | 2.50 | 18.67 | 2.78 |
| 14 | 16.97 | 2.55 | 16.23 | 2.80 |
| 15 | 14.97 | 2.57 | 14.45 | 2.74 |
| 16 | 12.92 | 2.61 | 12.69 | 2.69 |
| 17 | 11.03 | 2.66 | 11.11 | 2.70 |
| 18 | 9.59 | 2.68 | 10.00 | 2.72 |
| 19 | 8.23 | 2.72 | 9.05 | 2.75 |
| 20 | 7.17 | 2.78 | 8.34 | 2.76 |
| 21 | 5.92 | 2.98 | 7.42 | 2.92 |
| 22 | 5.11 | 3.11 | 6.91 | 2.99 |
| 23 | 3.97 | 3.34 | 6.26 | 3.13 |
| 24 | 3.97 | 3.34 | 6.26 | 3.13 |
| 25 | 3.97 | 3.34 | 6.26 | 3.13 |
| 26 | 3.97 | 3.34 | 6.26 | 3.13 |

**Table 4.10**

**Comparisons of Estimates of Survival Functions based on all Spells, $\hat{S}_c^*(t)$, with those based on only Spells starting during the Panel, $\hat{S}^*(t)$: No Health Insurance (Percentages)**

| Month $t$ | All spells | | Starting spells | |
|---|---|---|---|---|
| | $\hat{S}_c^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. |
| 1 | 90.12 | 0.49 | 89.39 | 0.53 |
| 2 | 82.97 | 0.60 | 81.69 | 0.63 |
| 3 | 75.04 | 0.69 | 72.86 | 0.72 |
| **4** | **66.18** | **0.78** | **63.05** | **0.82** |
| 5 | 59.13 | 0.86 | 55.26 | 0.92 |
| 6 | 53.15 | 0.94 | 48.80 | 1.01 |
| 7 | 48.62 | 0.95 | 43.91 | 1.01 |
| **8** | **45.71** | **0.97** | **40.79** | **1.02** |
| 9 | 42.99 | 1.01 | 37.83 | 1.06 |
| 10 | 40.66 | 1.05 | 35.30 | 1.09 |
| 11 | 38.80 | 1.06 | 33.27 | 1.10 |
| **12** | **37.09** | **1.09** | **31.40** | **1.12** |
| 13 | 35.57 | 1.11 | 29.72 | 1.14 |
| 14 | 34.18 | 1.12 | 28.17 | 1.15 |
| 15 | 32.80 | 1.11 | 26.62 | 1.08 |
| **16** | **31.83** | **1.09** | **25.51** | **1.05** |
| 17 | 30.83 | 1.10 | 24.38 | 1.04 |
| 18 | 30.02 | 1.07 | 23.37 | 1.05 |
| 19 | 29.29 | 1.09 | 22.41 | 1.09 |
| **20** | **28.78** | **1.11** | **21.68** | **1.16** |
| 21 | 28.39 | 1.14 | 21.03 | 1.23 |
| 22 | 28.07 | 1.18 | 20.44 | 1.30 |
| 23 | 27.91 | 1.19 | 19.98 | 1.35 |
| **24** | **27.70** | **1.21** | **18.68** | **1.64** |
| 25 | 27.39 | 1.29 | 15.74 | 3.64 |
| 26 | 27.39 | 1.29 | 15.74 | 3.64 |

$t$ or greater, $\hat{\mu}_t$, used in computing the survival function estimates based on all spells (see equation 4.12).

Comparisons of the survival functions in Tables 4.1 through 4.10 show that in the cases of State unemployment compensation, Veterans compensation, and the WIC program, the survival functions computed from all spells are similar to those computed from only spells starting during the panel. For other programs, the two versions of the survival function diverge as the length of spell increases.

In the cases of AFDC, general assistance, AFDC or general assistance, food stamps, and no health insurance, the analyses based on all spells produce longer spell lengths than those based on spells starting during the panel. For instance, the percentage of AFDC spells lasting more than 18 months is 34.4% based on all spells compared with 28.4% based on starting spells. The corresponding percentages for the other programs are: 29.0% and 22.6% for general assistance; 33.6% and 26.4% for AFDC or general assistance; 31.8% and 27.9% for food stamps; and 30.0% and 23.4% for no health insurance.

For the remaining two programs - Federal SSI and Social Security - it is the analyses based on starting spells that yield the longer estimates of spell durations. Based on all spells, 45.8% of Federal SSI spells and 51.3% of Social Security spells are estimated to last for more than 18 months, compared with estimates of 50.4% and 61.2%, respectively, based on starting spells. Since these two programs have the highest percentages of initial censored and doubly censored spells (see Table 1.3), they are the ones most likely to be influenced by a change from using only starting spells to using all spells in the survival analysis. Indeed, 80% of Social Security spells and 70% of SSI spells reported in the 1987 SIPP panel were initial censored or doubly censored. (In contrast, only 14% of spells of State unemployment compensation were initial censored and none were doubly censored. It is therefore not surprising that the two forms of analysis yield similar results for this program.)

No straightforward explanation can be given as to why the two forms of analysis produce differing patterns of results across the various programs. In part,

the differences between the two forms of analysis relate to the different populations of inference. For starting spells, the population of inference is all spells starting during the time period of the panel, whereas for all spells the population of inference also includes spells that predate the panel. In part the differences may relate to the strong stationarity assumptions adopted for the analyses based on all spells.

A hoped-for advantage of using all spells for the survival analysis was that, by including more spells, it would yield estimates of greater precision. This would be particularly advantageous for situations where the analysis based on starting spells had too few spells to produce survival function estimates of adequate precision. In such situations, the greater precision attained by using all spells would in some circumstances justify the use of a less clear population of inference and of strong model assumptions. However, a review of the standard errors presented in Tables 4.1 through 4.10 shows that the gains in precision, if any, from basing the survival analyses on all spells rather than starting spells are very modest. It is therefore questionable whether the limited gains in precision obtained with the methodology developed here for incorporating multiple spells are worth the costs in terms of the stringent assumptions needed and the extended, vague, population of inference.

There are a number of other estimators of $h(t)$ that can be constructed using the general approach employed here for including initial censored and doubly censored spells in estimating survival functions for program spells from a SIPP panel. For instance, an alternative to $\hat{h}_\lambda(t)$ given by (4.3) is

$$h_{\lambda'}(t) = \frac{d_t + a_t}{\sum_{x=1}^{M-2} d_x + \sum_{x=t+1}^{M-1} (c_x + a_x) + b}.$$

The difference between this formulation and that in (4.3) is that here the number of initial censored spells of length $t$ is added to the numerator. Correcting for the bias in this version of $h_{\lambda'}(t)$ yields the following alternative estimator of the hazard function:

$$\hat{h}_{c'}(t) = \frac{(M-2t-1+\hat{\mu}_t)\hat{h}_{\lambda'}(t)-1}{M-t-1}.$$

It is possible that some other version of an estimated hazard function, such as $\hat{h}_{c'}(t)$, performs better than $\hat{h}_c(t)$. However, it may be that the instability of this class of estimators results from the need to estimate $E(T|T>t-1)$, in which case all the estimators will be similarly affected.

## 4.4 Concluding Remarks

Program spells observed in a SIPP panel are comprised of two types: incident spells that start during the life of the panel, and prevalent spells that are present at the beginning of the panel. The estimation of the distribution of spell durations from incident spells is in principle straightforward, although - as noted in Chapters 1 through 3 - there are a number of issues to be resolved. These issues include: how to deal with the seam effect; whether to use all new spells starting in the panel or only first new spells; what length of gap of nonparticipation, if any, to permit within a spell; and how to deal with program participants who leave the survey universe.

The use of prevalent spells for estimating spell durations is less straightforward since they constitute a length-biased sample. The longer a spell lasts, the greater the chance that it will exist at a given point of time. Hence, the sample of spells extant at the beginning of a panel overrepresents long spells. One way to analyze such spells is to work backwards in time from spell stops, as discussed in Chapter 3. However, that form of analysis is restricted to spells stopping during the panel, and hence excludes right censored and doubly censored spells.

For many purposes the application of standard survival analysis procedures to spells starting in a SIPP panel will yield satisfactory estimates. Such estimates have the attractions of being straightforward to produce and of relating to a clearly defined population of inference. Sometimes the reverse time methodology applied to spells stopping during the life of the panel may also be of interest.

There are occasions, however, when the above procedures are inadequate because the spell sample sizes are too small to produce estimates of the survival functions of adequate precision. It is then natural to seek a method that employs data from all spells observed during the panel in order to produce more precise estimates. It will be necessary to adopt stronger model assumptions for such a method, but this may be acceptable in the circumstances.

The methodology developed in this chapter provides one way to incorporate all observed spells in estimating the survival functions. This methodology has the attraction of being simple to apply. Unfortunately, however, in its current form it fails to increase the precision of the survival function estimates to an appreciable extent. However, some variant of the methodology may perform better.

Alternative approaches should also be considered. It may be that approaches being developed to estimate the distribution of the length of time between infection with the human immunodeficiency virus (HIV) and the onset of AIDS (see, for example, Bacchetti and Jewell, 1991; De Gruttola and Lagakos, 1989) may be adaptable for estimating distributions of spell durations from SIPP. Kalbfleisch and Lawless (1989) provide another approach to the analysis of panel data, using a Markov life process model to examine transitions onto and off programs, that may also be usefully applied to SIPP data.

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# APPENDIX A

A series of logistic regression analyses was conducted to investigate characteristics of persons and their spells that serve as predictors that a spell would start or stop on the seam. The predictor variables considered were sex, race, age and the length of the spell. The logistic regression analyses were run using PC-SUDAAN PROC LOGISTIC. The panel weights were incorporated in the analyses, and the tests of significance took the complex SIPP sample design into account. All uncensored spells and right censored spells were used to examine spell starts, and all uncensored and initial censored spells were used to examine spell stops.

The results of eight logistic regression analyses, relating to starts and stops on four programs, are presented in Table A.1. The table contains the regression coefficients for the categories of the predictor variables included in the model (one category being excluded for each variable). The statistical significance of each variable taken as a whole in the regression is indicated in parentheses underneath the regression coefficient for the last category of the variable. Although there are some significant effects in these analyses, no consistent pattern emerges.

- Sex is an insignificant predictor in all analyses.

- Race is a significant predictor only for starts of food stamp spells and stops of spells of no health insurance, with Blacks being more likely to report starts/stops on the seam in both cases.

- Age is a significant predictor for five of the eight analyses, with persons over 65 (the excluded group) being more likely to report changes at the seam for stops of food stamps spells and for starts and stops of spells of no

health insurance, but less likely to report changes at the seam for starts and stops of Social Security spells.

- Length of spell is a significant predictor for starts of food stamp spells and spells of no health insurance, with the excluded group of censored spells being more likely to be associated with reports of starts at the seam.

**Table A.1**

**Logistic Regression Analysis Predicting Starts or Stops on the Seam for Four Programs**

| | AFDC or General Assistance | | Food Stamps | | Social Security | | No Health Insurance | |
|---|---|---|---|---|---|---|---|---|
| | Starts | Stops | Starts | Stops | Starts | Stops | Starts | Stops |
| Intercept | 2.45 | 1.20 | 0.14 | 0.55 | -0.33 | 0.06 | 2.95 | 2.66 |
| Female | -0.62 ($P<0.01$) | -0.18 (NS) | -0.13 (NS) | -0.05 (NS) | -0.01 (NS) | 0.35 (NS) | 0.00 (NS) | -0.03 (NS) |
| Black | -0.18 (NS) | 0.41 (NS) | 0.78 ($P<0.01$) | 0.32 (NS) | 0.14 (NS) | 0.42 (NS) | 0.16 (NS) | 0.66 ($P<0.01$) |
| Age | | | | | | | | |
| Under 15 | -2.13 | -0.86 | -0.39 | -0.67 | 1.94 | 2.62 | -1.72 | -1.59 |
| 15-24 | -1.82 | -0.69 | -0.07 | -0.11 | 1.33 | 0.99 | -1.50 | -1.86 |
| 25-44 | -2.05 | -0.90 | -0.32 | -0.75 | 1.39 | 1.02 | -1.84 | -1.81 |
| 45-64 | -1.64 (NS) | -0.47 (NS) | -0.06 (NS) | -0.31 ($P<0.01$) | 0.03 ($P<0.01$) | 0.70 ($P<0.01$) | -1.46 ($P<0.01$) | -1.20 ($P<0.01$) |
| Length of spell | | | | | | | | |
| 1-4 months | -0.40 | -0.04 | -0.37 | 0.24 | 0.60 | -0.14 | -0.16 | -0.25 |
| 5-12 months | 0.19 | -0.31 | -0.71 | -0.06 | 0.10 | -0.13 | -0.31 | -0.14 |
| Over 12 months | -1.52 (NS) | -0.57 (NS) | -0.22 ($P<0.05$) | 0.04 (NS) | -0.21 (NS) | -0.73 (NS) | -0.70 ($P<0.05$) | -0.42 (NS) |

# APPENDIX B

Section 3.4 discusses the effects of alternative definitions of a spell on estimates of survival functions for the food stamp program. The alternatives considered permit gaps of up to a specified number of months of nonparticipation during a spell. This appendix presents detailed results for the hazard functions, survival functions, and probability density functions (PDFs) for allowable gaps in a spell of 1, 2, 3, 4, 5 or 6 months. The results are presented in Tables B.1 through B.6. See Section 3.4 for additional information.

## Table B.1

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, all Spells starting during the Panel, and with the Modified Seam Adjustment: A Gap of 1 Month permitted during a Spell**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0793 | 0.0108 | 0.9207 | 0.0108 | 0.0793 | 0.0108 |
| 2 | 0.0793 | 0.0110 | 0.8477 | 0.0150 | 0.0730 | 0.0100 |
| 3 | 0.1097 | 0.0114 | 0.7547 | 0.0188 | 0.0930 | 0.0093 |
| **4** | **0.1250** | **0.0123** | **0.6603** | **0.0235** | **0.0944** | **0.0079** |
| 5 | 0.1166 | 0.0171 | 0.5833 | 0.0252 | 0.0770 | 0.0111 |
| 6 | 0.0771 | 0.0090 | 0.5384 | 0.0253 | 0.0450 | 0.0050 |
| 7 | 0.0620 | 0.0082 | 0.5050 | 0.0247 | 0.0334 | 0.0045 |
| **8** | **0.0699** | **0.0213** | **0.4697** | **0.0210** | **0.0353** | **0.0115** |
| 9 | 0.0684 | 0.0130 | 0.4375 | 0.0213 | 0.0321 | 0.0060 |
| 10 | 0.0469 | 0.0109 | 0.4170 | 0.0226 | 0.0205 | 0.0045 |
| 11 | 0.0403 | 0.0074 | 0.4002 | 0.0229 | 0.0168 | 0.0029 |
| **12** | **0.0474** | **0.0131** | **0.3812** | **0.0237** | **0.0190** | **0.0051** |
| 13 | 0.0276 | 0.0068 | 0.3707 | 0.0239 | 0.0105 | 0.0025 |
| 14 | 0.0420 | 0.0126 | 0.3551 | 0.0239 | 0.0156 | 0.0046 |
| 15 | 0.0309 | 0.0122 | 0.3442 | 0.0234 | 0.0110 | 0.0044 |
| **16** | **0.0187** | **0.0074** | **0.3377** | **0.0237** | **0.0064** | **0.0024** |
| 17 | 0.0156 | 0.0068 | 0.3325 | 0.0241 | 0.0053 | 0.0022 |
| 18 | 0.0057 | 0.0027 | 0.3306 | 0.0241 | 0.0019 | 0.0009 |
| 19 | 0.0033 | 0.0019 | 0.3295 | 0.0242 | 0.0011 | 0.0006 |
| **20** | **0.0015** | **0.0016** | **0.3290** | **0.0242** | **0.0005** | **0.0005** |
| 21 | 0.0012 | 0.0013 | 0.3286 | 0.0243 | 0.0004 | 0.0004 |
| 22 | 0.0010 | 0.0011 | 0.3282 | 0.0243 | 0.0003 | 0.0004 |
| 23 | 0.0007 | 0.0008 | 0.3280 | 0.0243 | 0.0002 | 0.0002 |
| **24** | **0.0000** | **0.0000** | **0.3280** | **0.0243** | **0.0000** | **0.0000** |

**Table B.2**

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, all Spells starting during the Panel, and with the Modified Seam Adjustment: A Gap of up to 2 Months permitted during a Spell**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0678 | 0.0110 | 0.9322 | 0.0110 | 0.0678 | 0.0110 |
| 2 | 0.0709 | 0.0099 | 0.8661 | 0.0145 | 0.0661 | 0.0092 |
| 3 | 0.1001 | 0.0115 | 0.7794 | 0.0189 | 0.0867 | 0.0096 |
| **4** | **0.1164** | **0.0122** | **0.6887** | **0.0242** | **0.0907** | **0.0081** |
| 5 | 0.0978 | 0.0155 | 0.6213 | 0.0269 | 0.0673 | 0.0102 |
| 6 | 0.0664 | 0.0082 | 0.5801 | 0.0272 | 0.0413 | 0.0048 |
| 7 | 0.0532 | 0.0072 | 0.5492 | 0.0275 | 0.0308 | 0.0039 |
| **8** | **0.0659** | **0.0193** | **0.5130** | **0.0233** | **0.0362** | **0.0115** |
| 9 | 0.0582 | 0.0123 | 0.4832 | 0.0238 | 0.0299 | 0.0062 |
| 10 | 0.0391 | 0.0081 | 0.4643 | 0.0249 | 0.0189 | 0.0036 |
| 11 | 0.0308 | 0.0065 | 0.4500 | 0.0254 | 0.0143 | 0.0028 |
| **12** | **0.0355** | **0.0109** | **0.4340** | **0.0263** | **0.0160** | **0.0047** |
| 13 | 0.0194 | 0.0055 | 0.4256 | 0.0268 | 0.0084 | 0.0022 |
| 14 | 0.0266 | 0.0092 | 0.4143 | 0.0268 | 0.0113 | 0.0039 |
| 15 | 0.0172 | 0.0065 | 0.4072 | 0.0270 | 0.0071 | 0.0026 |
| **16** | **0.0154** | **0.0063** | **0.4009** | **0.0273** | **0.0063** | **0.0025** |
| 17 | 0.0242 | 0.0116 | 0.3912 | 0.0278 | 0.0097 | 0.0045 |
| 18 | 0.0234 | 0.0172 | 0.3820 | 0.0285 | 0.0091 | 0.0066 |
| 19 | 0.0046 | 0.0023 | 0.3803 | 0.0287 | 0.0017 | 0.0008 |
| **20** | **0.0024** | **0.0018** | **0.3794** | **0.0288** | **0.0009** | **0.0007** |
| 21 | 0.0011 | 0.0012 | 0.3789 | 0.0288 | 0.0004 | 0.0005 |
| 22 | 0.0009 | 0.0011 | 0.3786 | 0.0288 | 0.0004 | 0.0004 |

## Table B.3

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, all Spells starting during the Panel, and with the Modified Seam Adjustment: A Gap of up to 3 Months permitted during a Spell**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0663 | 0.0110 | 0.9337 | 0.0110 | 0.0663 | 0.0110 |
| 2 | 0.0702 | 0.0095 | 0.8681 | 0.0142 | 0.0656 | 0.0089 |
| 3 | 0.0865 | 0.0102 | 0.7930 | 0.0183 | 0.0751 | 0.0084 |
| 4 | 0.1131 | 0.0111 | 0.7033 | 0.0227 | 0.0897 | 0.0077 |
| 5 | 0.0951 | 0.0148 | 0.6364 | 0.0258 | 0.0669 | 0.0099 |
| 6 | 0.0709 | 0.0098 | 0.5913 | 0.0265 | 0.0451 | 0.0060 |
| 7 | 0.0512 | 0.0067 | 0.5610 | 0.0262 | 0.0303 | 0.0039 |
| 8 | 0.0368 | 0.0062 | 0.5403 | 0.0258 | 0.0207 | 0.0035 |
| 9 | 0.0558 | 0.0129 | 0.5102 | 0.0263 | 0.0302 | 0.0069 |
| 10 | 0.0347 | 0.0065 | 0.4925 | 0.0267 | 0.0177 | 0.0032 |
| 11 | 0.0320 | 0.0069 | 0.4767 | 0.0273 | 0.0158 | 0.0032 |
| 12 | 0.0404 | 0.0121 | 0.4575 | 0.0283 | 0.0193 | 0.0055 |
| 13 | 0.0224 | 0.0062 | 0.4472 | 0.0288 | 0.0103 | 0.0026 |
| 14 | 0.0298 | 0.0085 | 0.4339 | 0.0291 | 0.0133 | 0.0036 |
| 15 | 0.0251 | 0.0104 | 0.4230 | 0.0296 | 0.0109 | 0.0044 |
| 16 | 0.0176 | 0.0078 | 0.4155 | 0.0299 | 0.0075 | 0.0032 |
| 17 | 0.0344 | 0.0161 | 0.4012 | 0.0311 | 0.0143 | 0.0065 |
| 18 | 0.0127 | 0.0061 | 0.3961 | 0.0317 | 0.0051 | 0.0023 |
| 19 | 0.0083 | 0.0048 | 0.3928 | 0.0322 | 0.0033 | 0.0018 |
| 20 | 0.0065 | 0.0052 | 0.3903 | 0.0328 | 0.0025 | 0.0019 |

## Table B.4

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, all Spells starting during the Panel, and with the Modified Seam Adjustment: A Gap of up to 4 Months permitted during a Spell**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0572 | 0.0120 | 0.9428 | 0.0120 | 0.0572 | 0.0120 |
| 2 | 0.0509 | 0.0088 | 0.8948 | 0.0146 | 0.0479 | 0.0083 |
| 3 | 0.0620 | 0.0093 | 0.8394 | 0.0187 | 0.0555 | 0.0080 |
| **4** | **0.0788** | **0.0090** | **0.7732** | **0.0221** | **0.0661** | **0.0069** |
| 5 | 0.0654 | 0.0137 | 0.7227 | 0.0256 | 0.0505 | 0.0103 |
| 6 | 0.0387 | 0.0073 | 0.6947 | 0.0265 | 0.0280 | 0.0051 |
| 7 | 0.0236 | 0.0045 | 0.6783 | 0.0267 | 0.0164 | 0.0030 |
| **8** | **0.0190** | **0.0042** | **0.6654** | **0.0266** | **0.0129** | **0.0029** |
| 9 | 0.0324 | 0.0099 | 0.6438 | 0.0273 | 0.0216 | 0.0066 |
| 10 | 0.0183 | 0.0050 | 0.6321 | 0.0277 | 0.0118 | 0.0032 |
| 11 | 0.0236 | 0.0063 | 0.6172 | 0.0284 | 0.0149 | 0.0038 |
| **12** | **0.0284** | **0.0100** | **0.5997** | **0.0299** | **0.0175** | **0.0060** |
| 13 | 0.0122 | 0.0042 | 0.5923 | 0.0304 | 0.0073 | 0.0024 |
| 14 | 0.0160 | 0.0057 | 0.5829 | 0.0309 | 0.0095 | 0.0033 |
| 15 | 0.0123 | 0.0078 | 0.5757 | 0.0314 | 0.0072 | 0.0045 |
| **16** | **0.0041** | **0.0042** | **0.5733** | **0.0317** | **0.0024** | **0.0024** |
| 17 | 0.0131 | 0.0100 | 0.5658 | 0.0319 | 0.0075 | 0.0057 |
| 18 | 0.0000 | 0.0000 | 0.5658 | 0.0319 | 0.0000 | 0.0000 |

## Table B.5

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel, all Spells starting during the Panel, and with the Modified Seam Adjustment: A Gap of up to 5 Months permitted during a Spell**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0527 | 0.0120 | 0.9473 | 0.0120 | 0.0527 | 0.0120 |
| 2 | 0.0490 | 0.0087 | 0.9009 | 0.0146 | 0.0464 | 0.0082 |
| 3 | 0.0507 | 0.0071 | 0.8553 | 0.0180 | 0.0456 | 0.0061 |
| **4** | **0.0699** | **0.0093** | **0.7955** | **0.0215** | **0.0598** | **0.0074** |
| 5 | 0.0614 | 0.0134 | 0.7466 | 0.0248 | 0.0489 | 0.0105 |
| 6 | 0.0305 | 0.0052 | 0.7239 | 0.0251 | 0.0228 | 0.0038 |
| 7 | 0.0215 | 0.0043 | 0.7083 | 0.0254 | 0.0156 | 0.0031 |
| **8** | **0.0159** | **0.0040** | **0.6970** | **0.0254** | **0.0113** | **0.0028** |
| 9 | 0.0306 | 0.0097 | 0.6757 | 0.0258 | 0.0213 | 0.0068 |
| 10 | 0.0167 | 0.0051 | 0.6644 | 0.0264 | 0.0113 | 0.0034 |
| 11 | 0.0204 | 0.0059 | 0.6509 | 0.0271 | 0.0135 | 0.0038 |
| **12** | **0.0390** | **0.0127** | **0.6255** | **0.0288** | **0.0254** | **0.0081** |
| 13 | 0.0102 | 0.0038 | 0.6191 | 0.0294 | 0.0064 | 0.0023 |
| 14 | 0.0175 | 0.0064 | 0.6083 | 0.0299 | 0.0108 | 0.0039 |
| 15 | 0.0073 | 0.0052 | 0.6038 | 0.0303 | 0.0044 | 0.0032 |
| **16** | **0.0041** | **0.0042** | **0.6013** | **0.0308** | **0.0025** | **0.0025** |

## Table B.6

**Survival Functions for Spells on the Food Stamp Program, based on all Panel Members of the 1987 SIPP Panel; all Spells starting during the Panel, and with the Modified Seam Adjustment: A Gap of up to 6 Months permitted during a Spell**

| Month $t$ | Hazard function | | Survival function | | PDF | |
|---|---|---|---|---|---|---|
| | $\hat{h}^*(t)$ | s.e. | $\hat{S}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 0.0480 | 0.0115 | 0.9520 | 0.0115 | 0.0480 | 0.0115 |
| 2 | 0.0393 | 0.0071 | 0.9146 | 0.0135 | 0.0374 | 0.0067 |
| 3 | 0.0466 | 0.0067 | 0.8720 | 0.0168 | 0.0426 | 0.0059 |
| 4 | 0.0643 | 0.0084 | 0.8160 | 0.0199 | 0.0560 | 0.0070 |
| 5 | 0.0570 | 0.0133 | 0.7695 | 0.0233 | 0.0465 | 0.0107 |
| 6 | 0.0282 | 0.0047 | 0.7478 | 0.0243 | 0.0217 | 0.0034 |
| 7 | 0.0193 | 0.0036 | 0.7334 | 0.0251 | 0.0144 | 0.0025 |
| 8 | 0.0125 | 0.0031 | 0.7242 | 0.0254 | 0.0092 | 0.0022 |
| 9 | 0.0288 | 0.0098 | 0.7033 | 0.0261 | 0.0209 | 0.0071 |
| 10 | 0.0161 | 0.0048 | 0.6920 | 0.0269 | 0.0114 | 0.0033 |
| 11 | 0.0184 | 0.0056 | 0.6793 | 0.0281 | 0.0127 | 0.0037 |
| 12 | 0.0293 | 0.0105 | 0.6594 | 0.0302 | 0.0199 | 0.0069 |
| 13 | 0.0117 | 0.0047 | 0.6516 | 0.0311 | 0.0077 | 0.0087 |
| 14 | 0.0133 | 0.0063 | 0.6430 | 0.0320 | 0.0030 | 0.0040 |

# APPENDIX C

Section 4.2 develops a methodology for incorporating all spells observed during the life of a SIPP panel in the estimation of the survival functions. Section 4.3 presents the survival function estimates obtained with this methodology for the ten programs studied in this report, and compares those estimates with estimates based on new spells starting during the life of the panel (see Tables 4.1 through 4.10). Tables C.1 through C.10 provided in this appendix correspond to Tables 4.1 through 4.10. They compare the estimated hazard functions and PDFs obtained with the new methodology, based on all observed spells, with those obtained with the standard methodology, based on only new spells. The tables also contain the estimates $\hat{\mu}_t$ that are employed in estimating the hazard functions with the new methodology (see equation 4.12).

**Table C.1**

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: AFDC (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 10.55 | 1.46 | 10.55 | 1.46 | 27.89 | 2.00 | 11.65 | 1.53 | 11.65 | 1.53 |
| 2 | 6.59 | 0.93 | 5.89 | 0.83 | 31.06 | 2.22 | 7.44 | 1.09 | 6.57 | 0.97 |
| 3 | 7.59 | 1.08 | 6.34 | 0.91 | 33.11 | 2.41 | 8.87 | 1.38 | 7.25 | 1.12 |
| 4 | 11.95 | 1.78 | 9.23 | 1.37 | 35.59 | 2.59 | 14.07 | 2.16 | 10.49 | 1.58 |
| 5 | 7.56 | 0.97 | 5.14 | 0.66 | 39.88 | 3.06 | 9.27 | 1.32 | 5.94 | 0.81 |
| 6 | 6.51 | 1.11 | 4.09 | 0.65 | 42.73 | 3.28 | 7.94 | 1.45 | 4.62 | 0.75 |
| 7 | 7.34 | 1.22 | 4.32 | 0.70 | 45.28 | 3.52 | 8.80 | 1.54 | 4.71 | 0.78 |
| 8 | 6.25 | 1.51 | 3.40 | 0.83 | 48.32 | 3.82 | 7.32 | 1.83 | 3.57 | 0.89 |
| 9 | 4.44 | 0.91 | 2.27 | 0.47 | 51.00 | 3.99 | 5.11 | 1.09 | 2.31 | 0.49 |
| 10 | 6.05 | 1.70 | 2.95 | 0.80 | 52.96 | 4.13 | 6.90 | 1.87 | 2.96 | 0.78 |
| 11 | 4.47 | 1.18 | 2.05 | 0.54 | 55.72 | 4.38 | 5.06 | 1.41 | 2.02 | 0.54 |
| 12 | 6.55 | 3.02 | 2.87 | 1.33 | 57.82 | 4.49 | 7.38 | 3.45 | 2.80 | 1.32 |
| 13 | 1.31 | 0.61 | 0.54 | 0.24 | 61.03 | 4.78 | 1.51 | 0.71 | 0.53 | 0.24 |
| 14 | 3.73 | 1.85 | 1.51 | 0.73 | 61.66 | 4.85 | 4.52 | 2.14 | 1.56 | 0.72 |
| 15 | 1.95 | 1.13 | 0.76 | 0.42 | 63.51 | 5.19 | 2.38 | 1.31 | 0.79 | 0.41 |
| 16 | 6.89 | 5.65 | 2.62 | 2.08 | 64.48 | 5.45 | 8.53 | 6.74 | 2.75 | 2.12 |
| 17 | 2.34 | 1.68 | 0.83 | 0.56 | 68.06 | 6.61 | 2.77 | 1.94 | 0.82 | 0.53 |
| 18 | 0.83 | 0.56 | 0.29 | 0.19 | 69.29 | 7.21 | 1.02 | 0.72 | 0.29 | 0.20 |

**Table C.2**

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: General Assistance (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 12.19 | 2.63 | 12.19 | 2.63 | 16.51 | 1.76 | 13.71 | 2.94 | 13.71 | 2.94 |
| 2 | 10.54 | 2.94 | 9.26 | 2.53 | 18.67 | 1.87 | 12.08 | 3.37 | 10.42 | 2.84 |
| 3 | 8.83 | 1.46 | 6.93 | 0.99 | 20.63 | 2.00 | 10.46 | 1.71 | 7.94 | 1.08 |
| 4 | 14.14 | 2.19 | 10.13 | 1.52 | 22.34 | 2.13 | 16.95 | 2.53 | 11.51 | 1.65 |
| 5 | 12.23 | 2.73 | 7.52 | 1.55 | 25.36 | 2.45 | 14.74 | 3.01 | 8.31 | 1.59 |
| 6 | 13.41 | 3.97 | 7.24 | 2.17 | 28.19 | 2.84 | 16.17 | 4.67 | 7.78 | 2.31 |
| 7 | 8.47 | 1.91 | 3.96 | 0.70 | 31.63 | 3.15 | 10.46 | 2.43 | 4.22 | 0.71 |
| 8 | 6.43 | 1.86 | 2.75 | 0.71 | 33.91 | 3.52 | 7.77 | 2.35 | 2.81 | 0.72 |
| 9 | 5.49 | 1.95 | 2.20 | 0.70 | 35.69 | 3.87 | 6.41 | 2.38 | 2.13 | 0.67 |
| 10 | 4.72 | 2.13 | 1.79 | 0.79 | 37.24 | 4.19 | 5.32 | 2.55 | 1.66 | 0.74 |
| 11 | 5.46 | 2.81 | 1.97 | 0.97 | 38.59 | 4.51 | 6.34 | 3.44 | 1.87 | 0.97 |
| 12 | 8.96 | 4.96 | 3.05 | 1.71 | 40.18 | 5.09 | 10.49 | 5.92 | 2.90 | 1.65 |
| 13 | 2.00 | 1.36 | 0.62 | 0.43 | 42.96 | 6.11 | 2.41 | 1.72 | 0.60 | 0.43 |
| 14 | 1.76 | 1.22 | 0.54 | 0.37 | 43.57 | 6.32 | 2.14 | 1.55 | 0.52 | 0.37 |
| 15 | 0.56 | 0.57 | 0.17 | 0.16 | 44.10 | 6.53 | 0.68 | 0.76 | 0.16 | 0.17 |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 44.26 | 6.63 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | 0.92 | 0.65 | 0.27 | 0.19 | 44.26 | 6.63 | 1.34 | 0.99 | 0.31 | 0.24 |
| 18 | 1.46 | 1.03 | 0.43 | 0.30 | 44.52 | 6.68 | 2.34 | 1.63 | 0.54 | 0.39 |

## Table C.3

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: AFDC or General Assistance (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 10.64 | 1.45 | 10.64 | 1.45 | 26.88 | 1.83 | 11.87 | 1.51 | 11.87 | 1.51 |
| 2 | 7.05 | 1.12 | 6.30 | 0.98 | 29.96 | 2.00 | 8.08 | 1.29 | 7.12 | 1.12 |
| 3 | 7.84 | 1.03 | 6.51 | 0.85 | 32.08 | 2.17 | 9.31 | 1.27 | 7.54 | 1.03 |
| 4 | 12.09 | 1.57 | 9.26 | 1.18 | 34.55 | 2.34 | 14.52 | 1.85 | 10.67 | 1.34 |
| 5 | 8.14 | 0.95 | 5.47 | 0.65 | 38.76 | 2.75 | 10.14 | 1.21 | 6.37 | 0.76 |
| 6 | 7.53 | 1.27 | 4.65 | 0.74 | 41.75 | 2.93 | 9.37 | 1.65 | 5.29 | 0.85 |
| 7 | 7.44 | 1.16 | 4.26 | 0.63 | 44.66 | 3.16 | 9.13 | 1.45 | 4.67 | 0.70 |
| 8 | 6.18 | 1.27 | 3.27 | 0.67 | 47.69 | 3.44 | 7.44 | 1.59 | 3.46 | 0.73 |
| 9 | 4.50 | 0.75 | 2.23 | 0.36 | 50.30 | 3.59 | 5.33 | 0.93 | 2.29 | 0.38 |
| 10 | 5.85 | 1.49 | 2.77 | 0.69 | 52.24 | 3.76 | 6.90 | 1.69 | 2.81 | 0.68 |
| 11 | 4.47 | 1.07 | 1.99 | 0.48 | 54.87 | 4.01 | 5.30 | 1.27 | 2.01 | 0.49 |
| 12 | 7.36 | 3.13 | 3.14 | 1.35 | 56.92 | 4.17 | 8.81 | 3.70 | 3.16 | 1.37 |
| 13 | 1.45 | 0.58 | 0.57 | 0.23 | 60.49 | 4.50 | 1.79 | 0.71 | 0.59 | 0.23 |
| 14 | 3.53 | 1.60 | 1.38 | 0.61 | 61.19 | 4.58 | 4.58 | 1.95 | 1.47 | 0.62 |
| 15 | 1.73 | 0.94 | 0.65 | 0.34 | 62.91 | 4.88 | 2.28 | 1.16 | 0.70 | 0.34 |
| 16 | 6.12 | 4.91 | 2.26 | 1.76 | 63.76 | 5.10 | 8.34 | 6.36 | 2.50 | 1.89 |
| 17 | 2.05 | 1.38 | 0.71 | 0.45 | 66.87 | 6.04 | 2.73 | 1.75 | 0.75 | 0.45 |
| 18 | 0.97 | 0.52 | 0.33 | 0.17 | 67.92 | 6.50 | 1.36 | 0.71 | 0.36 | 0.19 |

## Table C.4

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: Food Stamps (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 10.69 | 1.32 | 10.69 | 1.32 | 22.78 | 1.18 | 11.50 | 1.40 | 11.50 | 1.40 |
| 2 | 8.77 | 1.20 | 7.84 | 1.04 | 25.38 | 1.26 | 9.61 | 1.33 | 8.51 | 1.14 |
| 3 | 9.96 | 0.96 | 8.12 | 0.75 | 27.63 | 1.34 | 11.01 | 1.08 | 8.81 | 0.83 |
| 4 | 12.22 | 1.12 | 8.97 | 0.69 | 30.36 | 1.47 | 13.72 | 1.24 | 9.77 | 0.73 |
| 5 | 11.10 | 1.41 | 7.15 | 0.90 | 34.03 | 1.69 | 12.73 | 1.71 | 7.82 | 1.03 |
| 6 | 7.38 | 0.91 | 4.22 | 0.52 | 37.65 | 1.95 | 8.46 | 1.03 | 4.53 | 0.55 |
| 7 | 6.73 | 0.99 | 3.57 | 0.51 | 40.18 | 2.10 | 7.58 | 1.07 | 3.72 | 0.52 |
| 8 | 6.44 | 1.81 | 3.18 | 0.97 | 42.57 | 2.35 | 7.17 | 2.03 | 3.25 | 1.01 |
| 9 | 6.33 | 1.16 | 2.93 | 0.53 | 44.95 | 2.25 | 7.04 | 1.26 | 2.96 | 0.53 |
| 10 | 7.10 | 1.45 | 3.08 | 0.64 | 47.38 | 2.50 | 7.67 | 1.58 | 3.00 | 0.63 |
| 11 | 4.94 | 0.91 | 1.99 | 0.38 | 50.24 | 2.92 | 5.38 | 1.01 | 1.95 | 0.37 |
| 12 | 5.90 | 1.41 | 2.26 | 0.55 | 52.28 | 3.12 | 6.44 | 1.57 | 2.20 | 0.53 |
| 13 | 3.21 | 0.78 | 1.16 | 0.27 | 54.80 | 3.27 | 3.44 | 0.85 | 1.10 | 0.26 |
| 14 | 4.31 | 1.35 | 1.50 | 0.47 | 56.19 | 3.42 | 4.64 | 1.52 | 1.43 | 0.46 |
| 15 | 1.49 | 0.53 | 0.50 | 0.17 | 58.09 | 3.60 | 1.63 | 0.56 | 0.48 | 0.16 |
| 16 | 1.14 | 0.49 | 0.38 | 0.16 | 58.74 | 3.69 | 1.24 | 0.53 | 0.36 | 0.15 |
| 17 | 1.37 | 0.59 | 0.45 | 0.19 | 59.24 | 3.75 | 1.52 | 0.63 | 0.43 | 0.18 |
| 18 | 0.72 | 0.36 | 0.23 | 0.11 | 59.82 | 3.81 | 0.81 | 0.39 | 0.23 | 0.11 |

## Table C.5

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: Federal SSI (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 10.21 | 2.23 | 10.21 | 2.23 | 66.97 | 5.72 | 9.80 | 2.17 | 9.80 | 2.17 |
| 2 | 6.12 | 1.54 | 5.49 | 1.33 | 74.48 | 6.30 | 5.85 | 1.50 | 5.27 | 1.30 |
| 3 | 5.35 | 1.40 | 4.51 | 1.16 | 79.20 | 6.76 | 5.10 | 1.28 | 4.33 | 1.08 |
| 4 | 4.54 | 1.12 | 3.62 | 0.84 | 83.51 | 7.07 | 4.28 | 1.10 | 3.45 | 0.84 |
| 5 | 4.25 | 1.00 | 3.24 | 0.70 | 87.29 | 7.47 | 4.00 | 0.99 | 3.08 | 0.70 |
| 6 | 4.57 | 1.09 | 3.34 | 0.72 | 90.94 | 7.89 | 4.25 | 1.06 | 3.14 | 0.71 |
| 7 | 4.21 | 0.97 | 2.93 | 0.58 | 95.02 | 8.34 | 3.87 | 0.93 | 2.75 | 0.57 |
| 8 | 3.38 | 1.13 | 2.25 | 0.72 | 98.88 | 8.82 | 3.05 | 1.06 | 2.08 | 0.69 |
| 9 | 3.28 | 1.11 | 2.11 | 0.65 | 102.06 | 9.21 | 2.93 | 1.01 | 1.94 | 0.61 |
| 10 | 1.73 | 0.62 | 1.08 | 0.35 | 105.21 | 9.70 | 1.53 | 0.53 | 0.98 | 0.32 |
| 11 | 2.08 | 0.75 | 1.28 | 0.42 | 106.89 | 9.98 | 1.79 | 0.63 | 1.13 | 0.36 |
| 12 | 3.07 | 1.82 | 1.84 | 1.10 | 108.93 | 10.39 | 2.60 | 1.57 | 1.61 | 0.97 |
| 13 | 1.27 | 0.63 | 0.74 | 0.35 | 111.99 | 10.51 | 1.08 | 0.50 | 0.65 | 0.29 |
| 14 | 0.98 | 0.53 | 0.56 | 0.30 | 113.26 | 10.72 | 0.83 | 0.44 | 0.50 | 0.26 |
| 15 | 4.08 | 2.32 | 2.32 | 1.28 | 114.25 | 10.89 | 3.40 | 1.85 | 2.02 | 1.10 |
| 16 | 4.21 | 2.27 | 2.29 | 1.16 | 118.47 | 11.47 | 3.37 | 1.75 | 1.93 | 0.98 |
| 17 | 6.91 | 3.34 | 3.61 | 1.69 | 122.98 | 12.62 | 5.16 | 2.50 | 2.86 | 1.37 |
| 18 | 5.81 | 3.27 | 2.82 | 1.37 | 130.85 | 14.84 | 4.02 | 2.10 | 2.11 | 1.01 |

**Table C.6**

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: Social Security (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 5.52 | 0.75 | 5.52 | 0.75 | 129.95 | 7.51 | 4.45 | 0.62 | 4.45 | 0.62 |
| 2 | 2.79 | 0.32 | 2.63 | 0.29 | 137.48 | 8.10 | 2.24 | 0.26 | 2.14 | 0.24 |
| 3 | 4.30 | 0.57 | 3.95 | 0.51 | 141.37 | 8.34 | 3.16 | 0.41 | 2.95 | 0.37 |
| 4 | 6.44 | 0.83 | 5.66 | 0.69 | 147.58 | 8.70 | 5.17 | 0.71 | 4.67 | 0.62 |
| 5 | 5.58 | 0.73 | 4.59 | 0.55 | 157.47 | 9.17 | 4.50 | 0.60 | 3.86 | 0.47 |
| 6 | 4.98 | 0.74 | 3.86 | 0.51 | 166.49 | 9.59 | 3.99 | 0.61 | 3.27 | 0.45 |
| 7 | 4.96 | 0.69 | 3.66 | 0.46 | 174.89 | 9.80 | 3.55 | 0.53 | 2.79 | 0.37 |
| 8 | 4.35 | 0.82 | 3.05 | 0.57 | 183.65 | 9.97 | 3.14 | 0.62 | 2.38 | 0.46 |
| 9 | 4.36 | 0.91 | 2.93 | 0.59 | 191.64 | 9.95 | 3.10 | 0.63 | 2.27 | 0.44 |
| 10 | 3.36 | 0.57 | 2.15 | 0.34 | 199.97 | 10.50 | 2.30 | 0.42 | 1.64 | 0.28 |
| 11 | 3.38 | 0.55 | 2.10 | 0.33 | 206.57 | 10.75 | 2.34 | 0.40 | 1.63 | 0.27 |
| 12 | 2.67 | 0.73 | 1.60 | 0.44 | 213.42 | 10.99 | 1.72 | 0.46 | 1.17 | 0.31 |
| 13 | 2.66 | 0.75 | 1.55 | 0.44 | 218.94 | 11.50 | 1.92 | 0.52 | 1.28 | 0.34 |
| 14 | 2.35 | 0.57 | 1.33 | 0.32 | 224.58 | 11.77 | 1.68 | 0.39 | 1.10 | 0.25 |
| 15 | 2.34 | 0.60 | 1.29 | 0.33 | 229.64 | 12.05 | 1.63 | 0.43 | 1.05 | 0.27 |
| 16 | 2.19 | 0.74 | 1.19 | 0.39 | 234.77 | 12.27 | 1.36 | 0.50 | 0.86 | 0.31 |
| 17 | 1.70 | 0.63 | 0.90 | 0.32 | 239.67 | 12.43 | 1.17 | 0.43 | 0.73 | 0.26 |
| 18 | 1.36 | 0.54 | 0.71 | 0.27 | 243.53 | 12.69 | 0.94 | 0.37 | 0.58 | 0.22 |

## Table C.7

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: State Unemployment Compensation (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 29.71 | 1.21 | 29.71 | 1.21 | 3.43 | 0.07 | 30.84 | 1.23 | 30.84 | 1.23 |
| 2 | 22.24 | 1.06 | 15.63 | 0.78 | 4.46 | 0.08 | 23.54 | 1.10 | 16.28 | 0.80 |
| 3 | 25.45 | 1.19 | 13.91 | 0.67 | 5.16 | 0.08 | 27.41 | 1.28 | 14.50 | 0.70 |
| 4 | 30.26 | 1.73 | 12.33 | 0.70 | 5.90 | 0.08 | 32.57 | 1.87 | 12.50 | 0.71 |
| 5 | 30.94 | 2.15 | 8.79 | 0.68 | 6.73 | 0.09 | 33.25 | 2.50 | 8.60 | 0.68 |
| 6 | 35.71 | 2.56 | 7.01 | 0.56 | 7.50 | 0.12 | 38.19 | 2.91 | 6.60 | 0.54 |
| 7 | 49.98 | 3.82 | 6.31 | 0.70 | 8.34 | 0.15 | 52.98 | 3.83 | 5.66 | 0.64 |
| 8 | 37.67 | 4.93 | 2.38 | 0.37 | 9.68 | 0.26 | 40.04 | 5.50 | 2.01 | 0.34 |
| 9 | 39.08 | 6.44 | 1.54 | 0.29 | 10.69 | 0.39 | 41.59 | 7.06 | 1.25 | 0.26 |
| 10 | 35.94 | 8.53 | 0.86 | 0.23 | 11.77 | 0.63 | 36.27 | 8.41 | 0.64 | 0.18 |
| 11 | 33.67 | 11.63 | 0.52 | 0.17 | 12.77 | 1.41 | 34.35 | 11.37 | 0.39 | 0.13 |
| 12 | 15.33 | 11.27 | 0.16 | 0.05 | 13.67 | 2.54 | 14.89 | 9.44 | 0.11 | 0.04 |
| 13 | 59.74 | 33.40 | 0.51 | 0.23 | 13.97 | 3.92 | 58.79 | 24.13 | 0.37 | 0.18 |
| 14 | 49.57 | 56.23 | 0.17 | 0.16 | 15.40 | 9.69 | 46.02 | 38.83 | 0.12 | 0.12 |
| 15 | 0.00 | 0.00 | 0.00 | 0.00 | 16.78 | 9.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | 0.00 | 0.00 | 0.00 | 0.00 | 16.78 | 9.89 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | 59.56 | 39.95 | 0.10 | 0.10 | 16.78 | 9.89 | 60.85 | 30.51 | 0.08 | 0.08 |
| 18 | 36.05 | 121.57 | 0.03 | 0.02 | 16.47 | 26.47 | 43.40 | 21.85 | 0.02 | 0.02 |

**Table C.8**

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: Veterans Compensation (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 6.51 | 0.98 | 6.51 | 0.98 | 38.15 | 2.33 | 6.18 | 0.94 | 6.18 | 0.94 |
| 2 | 5.36 | 0.54 | 5.01 | 0.48 | 40.73 | 2.57 | 5.23 | 0.52 | 4.91 | 0.47 |
| 3 | 8.69 | 1.01 | 7.69 | 0.83 | 42.92 | 2.75 | 8.76 | 1.01 | 7.79 | 0.84 |
| 4 | 12.65 | 1.53 | 10.22 | 1.05 | 46.72 | 3.12 | 12.91 | 1.62 | 10.47 | 1.13 |
| 5 | 11.69 | 1.48 | 8.25 | 0.77 | 52.91 | 3.89 | 12.19 | 1.65 | 8.61 | 0.87 |
| 6 | 12.35 | 1.65 | 7.70 | 0.71 | 59.25 | 4.85 | 12.87 | 1.85 | 7.98 | 0.79 |
| 7 | 10.23 | 1.54 | 5.59 | 0.67 | 66.76 | 6.13 | 10.49 | 1.74 | 5.67 | 0.71 |
| 8 | 7.56 | 2.08 | 3.71 | 0.98 | 73.57 | 7.33 | 7.46 | 2.13 | 3.61 | 0.97 |
| 9 | 7.30 | 2.01 | 3.31 | 0.81 | 78.93 | 8.27 | 7.32 | 2.04 | 3.28 | 0.79 |
| 10 | 6.01 | 1.73 | 2.53 | 0.63 | 84.44 | 9.52 | 5.96 | 1.71 | 2.47 | 0.60 |
| 11 | 4.91 | 1.65 | 1.94 | 0.60 | 89.20 | 10.76 | 4.79 | 1.59 | 1.87 | 0.56 |
| 12 | 3.67 | 2.15 | 1.38 | 0.78 | 93.23 | 11.73 | 3.49 | 2.02 | 1.30 | 0.73 |
| 13 | 3.05 | 1.86 | 1.10 | 0.63 | 96.33 | 12.37 | 2.84 | 1.72 | 1.02 | 0.57 |
| 14 | 3.51 | 1.71 | 1.23 | 0.54 | 98.94 | 13.25 | 3.28 | 1.61 | 1.14 | 0.50 |
| 15 | 2.29 | 1.11 | 0.78 | 0.33 | 102.04 | 14.33 | 2.13 | 1.06 | 0.72 | 0.31 |
| 16 | 1.21 | 0.88 | 0.40 | 0.28 | 104.08 | 15.11 | 1.11 | 0.84 | 0.37 | 0.26 |
| 17 | 1.35 | 1.00 | 0.44 | 0.31 | 105.16 | 15.31 | 1.21 | 0.94 | 0.40 | 0.28 |
| 18 | 0.00 | 0.00 | 0.00 | 0.00 | 106.36 | 15.62 | 0.00 | 0.00 | 0.00 | 0.00 |

**Table C.9**

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: WIC (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard function | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 7.73 | 1.48 | 7.73 | 1.48 | 11.52 | 0.64 | 7.54 | 1.49 | 7.54 | 1.49 |
| 2 | 6.99 | 0.92 | 6.45 | 0.81 | 12.40 | 0.67 | 7.25 | 0.97 | 6.71 | 0.85 |
| 3 | 7.73 | 0.74 | 6.64 | 0.59 | 13.19 | 0.70 | 8.23 | 0.81 | 7.06 | 0.64 |
| 4 | 11.99 | 1.30 | 9.49 | 0.96 | 14.04 | 0.75 | 12.79 | 1.42 | 10.06 | 1.03 |
| 5 | 13.46 | 1.58 | 9.38 | 1.01 | 15.41 | 0.84 | 13.93 | 1.57 | 9.56 | 0.96 |
| 6 | 16.07 | 2.43 | 9.69 | 1.35 | 17.03 | 1.00 | 17.19 | 2.54 | 10.16 | 1.38 |
| 7 | 14.70 | 1.68 | 7.44 | 0.82 | 19.14 | 1.15 | 15.61 | 1.79 | 7.63 | 0.84 |
| 8 | 11.34 | 1.54 | 4.90 | 0.68 | 21.23 | 1.32 | 12.13 | 1.66 | 5.01 | 0.70 |
| 9 | 12.33 | 1.91 | 4.72 | 0.75 | 22.92 | 1.45 | 12.71 | 2.02 | 4.61 | 0.76 |
| 10 | 11.25 | 1.74 | 3.78 | 0.55 | 24.88 | 1.59 | 11.44 | 1.83 | 3.62 | 0.54 |
| 11 | 14.22 | 2.25 | 4.24 | 0.68 | 26.76 | 1.83 | 14.09 | 2.66 | 3.95 | 0.67 |
| 12 | 11.30 | 2.20 | 2.89 | 0.54 | 29.38 | 2.13 | 11.14 | 2.46 | 2.68 | 0.51 |
| 13 | 13.18 | 3.68 | 2.99 | 0.85 | 31.59 | 2.49 | 12.80 | 3.81 | 2.74 | 0.78 |
| 14 | 13.77 | 3.34 | 2.71 | 0.56 | 34.42 | 2.94 | 13.07 | 3.32 | 2.44 | 0.50 |
| 15 | 11.75 | 2.82 | 1.99 | 0.37 | 37.68 | 3.80 | 10.92 | 2.47 | 1.77 | 0.31 |
| 16 | 13.72 | 4.27 | 2.05 | 0.51 | 40.69 | 4.79 | 12.18 | 3.55 | 1.76 | 0.43 |
| 17 | 14.66 | 5.15 | 1.89 | 0.50 | 44.62 | 6.41 | 12.44 | 4.45 | 1.58 | 0.43 |
| 18 | 13.06 | 5.52 | 1.44 | 0.45 | 49.37 | 9.01 | 10.01 | 4.03 | 1.11 | 0.32 |

## Table C.10

**Estimates of Hazard Functions and Probability Distribution Functions (PDFs) based on all Spells and on only Spells starting during the Panel: No Health Insurance (Percentages)**

| Month $t$ | All spells | | | | | | Starting spells | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hazard function | | PDF | | Mean length for spells of length $t$ or greater | | Hazard fun tion | | PDF | |
| | $\hat{h}_c^*(t)$ | s.e. | $\hat{f}_c^*(t)$ | s.e. | $\hat{\mu}_t$ | s.e. | $\hat{h}^*(t)$ | s.e. | $\hat{f}^*(t)$ | s.e. |
| 1 | 9.88 | 0.49 | 9.88 | 0.49 | 23.57 | 0.62 | 10.61 | 0.53 | 10.61 | 0.53 |
| 2 | 7.94 | 0.37 | 7.15 | 0.33 | 26.05 | 0.70 | 8.61 | 0.37 | 7.70 | 0.33 |
| 3 | 9.55 | 0.30 | 7.93 | 0.23 | 28.12 | 0.75 | 10.81 | 0.33 | 8.83 | 0.25 |
| **4** | **11.81** | **0.37** | **8.87** | **0.25** | **30.77** | **0.83** | **13.46** | **0.42** | **9.81** | **0.27** |
| 5 | 10.65 | 0.36 | 7.05 | 0.20 | 34.36 | 0.94 | 12.35 | 0.43 | 7.79 | 0.22 |
| 6 | 10.11 | 0.41 | 5.98 | 0.20 | 37.86 | 1.05 | 11.70 | 0.48 | 6.47 | 0.21 |
| 7 | 8.53 | 0.43 | 4.53 | 0.22 | 41.44 | 1.16 | 10.02 | 0.48 | 4.89 | 0.23 |
| **8** | **5.98** | **0.42** | **2.91** | **0.19** | **44.65** | **1.26** | **7.09** | **0.49** | **3.11** | **0.20** |
| 9 | 5.96 | 0.43 | 2.72 | 0.18 | 46.98 | 1.34 | 7.27 | 0.51 | 2.97 | 0.19 |
| 10 | 5.41 | 0.49 | 2.32 | 0.20 | 49.39 | 1.43 | 6.67 | 0.57 | 2.52 | 0.20 |
| 11 | 4.57 | 0.43 | 1.86 | 0.17 | 51.64 | 1.52 | 5.75 | 0.54 | 2.03 | 0.18 |
| **12** | **4.42** | **0.58** | **1.72** | **0.22** | **53.59** | **1.60** | **5.63** | **0.75** | **1.87** | **0.24** |
| 13 | 4.10 | 0.53 | 1.52 | 0.19 | 55.51 | 1.69 | 5.34 | 0.69 | 1.68 | 0.21 |
| 14 | 3.91 | 0.47 | 1.39 | 0.16 | 57.33 | 1.79 | 5.22 | 0.62 | 1.55 | 0.18 |
| 15 | 4.03 | 0.69 | 1.38 | 0.24 | 59.10 | 1.89 | 5.50 | 0.86 | 1.55 | 0.26 |
| **16** | **2.96** | **0.39** | **0.97** | **0.13** | **60.95** | **1.97** | **4.17** | **0.54** | **1.11** | **0.15** |
| 17 | 3.14 | 0.46 | 1.00 | 0.14 | 62.32 | 2.05 | 4.43 | 0.60 | 1.13 | 0.15 |
| 18 | 2.64 | 0.39 | 0.81 | 0.12 | 63.79 | 2.17 | 4.14 | 0.68 | 1.01 | 0.16 |