

# Evaluating Length of Stay in Assisted Housing Programs: A Methodological Note

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*This article reflects the views of the author and does not necessarily reflect the views of the U.S. Department of Housing and Urban Development.*

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## Abstract

*This study uses new methods and approaches that augment findings from previously completed research on length of stay in assisted housing programs. This study differs from previous research in six areas. First, most previous research used mean and median calculations for a single program year; the present study, however, evaluates data from an 8-year period of time—1995 to 2002. Second, due largely to data limitations, the prior research has generally focused on currently assisted households that continue to receive housing assistance. This new research includes data for households that have exited the programs (former households) to gain a broader perspective on housing tenure. Third, this study identifies multiple program participants, or mixed households, that moved between public housing and housing voucher programs across the eight-year study period. Using an 8-year data file allows for this type of identification. Fourth, this study separately identifies the length of stay for participants with very short durations (less than six months). The existence of this group might reflect an administrative data collection problem, or it may suggest some other phenomenon among assisted housing recipients worthy of further investigation. Fifth, this study systematically identifies data gaps, logical inconsistencies, and out-of-range data in the file using a data quality process that goes beyond what has been done in past work. Last, and perhaps most importantly, this study presents tenure estimates for assisted households based on median survival time that may be more realistic than calculations that rely solely on mean and median summary statistics. Estimates based on the life-table method produces statistics, including the median survival time, that account for the current cases in making predictions about housing tenure.*

## Introduction

Accurate and reliable length-of-stay estimates are necessary to inform budget and policy debate about the appropriate use and duration of time limits for households in the U.S. Department of Housing and Urban Development's (HUD's) subsidized housing programs. Such debate is already under way. Recent legislation introduced in the U.S. House of Representatives, H.R. 1999, the State and Local Housing Flexibility Act of 2005, proposed that, beginning in 2008, public housing agencies (PHAs) be allowed the discretion to establish term limits of no less than 5 years for households assisted by the Housing Choice Voucher (HCV) Program.<sup>1</sup> According to the bill, which has not been enacted, elderly and disabled households would not be subject to this provision of the bill until January 1, 2009.

Valid tenure estimates are also relevant for addressing perceptions about the extent to which housing assistance patterns reflect a way of life for some recipients. Discussing the HCV Program before a congressional committee in 2005, Secretary of HUD Alphonso Jackson noted that its "current program design has made housing assistance a permanent support for some families (Jackson, 2005). At a 2006 congressional subcommittee hearing on the future of public housing, HUD Deputy Secretary Roy Bernardi noted in a written statement that "[i]n the interest of making the most of a limited asset and in transforming public housing from a lifetime entitlement to a temporary resource," PHAs participating in the Moving to Work program were already testing term limits, rent reform, and employment incentives (Bernardi, 2006).

This study presents new results on length of stay in assisted housing that rely on some modifications to traditional methods and on an entirely new approach. Previous research by Lubell, Shroder, and Steffen (2003) on tenure in public housing and tenant-based assistance are based on mean (average) and median (the middle of a sorted distribution) calculations. The present study, although informed by those methods, amends the methods in several important ways. First, the present research evaluates data from an 8-year period of time, from 1995 to 2002. The prior study analyzed household records submitted to HUD's Multifamily Tenant Characteristics System (MTCS) as of September 30, 2000 (a 9-month period). We have created a longitudinal file that crosses the 8-year period and matches records on individual households. This process permits a more comprehensive and accurate assessment of length of stay.

Furthermore, the prior study focused on current households only, while the present one adds former participants.<sup>2</sup> Current households have not yet left assisted housing. For each of these households, the departure date, and, therefore, the ultimate length of stay, is still an unknown. Instead of an exit date, which current recipients lack, the latest effective date in the housing record is used to project the household's tenure. We believe it is worthwhile to include households that have actually exited (former households) in order to gain a broader perspective on housing tenure. Our research also identifies households that are likely unrecorded exits, which further augments the number of former participants for study.

Along with public housing and tenant-based assisted households, this study also includes a new group that the Lubell, Shroder, and Steffen (2003) work could not address. This group consists of the mixed program participants, or mixed program households, identified as those that moved between public housing and tenant-based assisted programs across the 8-year study period. These

households may reflect a unique tenure dynamic compared with those that are solely public housing or tenant-based assisted recipients, which makes their separate analysis useful.

In another departure, this research distinguishes between households that have received housing assistance at least 6 months or longer and all program participants (including those staying less than 6 months). Participants with very short durations (less than 6 months) might reflect an administrative data collection problem, or these characteristics may suggest some other phenomenon among assisted housing recipients that is worthy of further investigation. In any event, the resulting tenure calculations—with and without tenants of less than 6 months—could be very different and are worth comparing. Moreover, every family that exits assisted housing, even those with the shortest stays (assuming reliable data), means another vacant unit that can house a family that has likely been on a long waiting list.

Also, we have systematically identified data gaps, logical inconsistencies, and out-of-range data in the file by using a data quality process that goes beyond what has been done in past work. The data quality work includes checking for missing or invalid unique identifiers, missing admission dates, conflicting (multiple) admission dates, participation in more than one program, and invalid End of Participation (EOP) reports.

## Findings

Using data from a specially created longitudinal file, we have drawn a 5-percent sample for all cases reported by PHAs to the MTCS over the 1995-to-2002 period. Households reported in this file include, among other variables, households that were receiving assistance at the time of reporting (current participants) and households that had left the program, an event that is reported to HUD as an end-of-participation event, or EOP (former participants).

Exhibit 1 provides general summary statistics on mean and median length of stay for nonelderly, nondisabled households (with and without children) and for all households. In contrast to the subsequent exhibits, these data do not distinguish among participants who have resided in assisted housing for more than 6 months or current and former enrollees. Households living in public housing stay the longest, followed by the mixed program households; tenant-based assisted households stay the least amount of time. Nonelderly, nondisabled households (regardless of the presence of children) have shorter stays than do tenants in assisted housing overall. These tenure trends are true across all selected program types (public housing, tenant-based assistance, or a multiple program mix). Nevertheless, estimates can vary widely between mean and median calculations. Median estimates, less sensitive to extreme scores, are shorter than mean statistics.

Not all results of the Lubell, Shroder, and Steffen (2003) study and the present one are comparable; however, the broad findings in exhibit 1 on mean and median housing tenure in public housing and tenant-based assisted programs compare favorably with some statistics in the Lubell, Shroder, and Steffen (2003) report. According to mean estimates, both studies indicate that all public housing tenants stay nearly twice as long as tenant-based assisted recipients. In contrast, our estimates are slightly shorter because we also included exiting households, which stay for shorter terms than do current participants. For example, Lubell, Shroder, and Steffen (2003) calculated a

mean length of stay for public housing at 8.50 years versus 7.46 in the present study. Their mean tenure for tenant-based assisted recipients was 4.75 years compared with our 4.24 years. In both the Lubell, Shroder, and Steffen (2003) study and the present study, median tenure between the public housing and tenant-based assisted programs was not as divergent, but public housing participants still stayed longer than their tenant-based assisted counterparts. The earlier work estimated a median length of stay in public housing at 4.69 years versus 3.97 years. According to Lubell, Shroder, and Steffen (2003), tenant-based assisted households stayed 3.08 years, while findings from the present study indicate slightly less time at 2.75 years.

Nonelderly, nondisabled households (with and without children) were highlighted in the present study (Lubell, Shroder, and Steffen [2003] also provided tenure for elderly and disabled households). Both Lubell, Shroder, and Steffen (2003) and this study found that such households, regardless of the presence of children, spend less time in assisted housing (public housing or the tenant-based assistance program) than do all recipients. Lubell, Shroder, and Steffen (2003), however, reported shorter mean and median stays for these households with children than those without children. These tenure trends applied to both the public housing and tenant-based assistance programs. In the present research, the trends were not as clear. Median length of stay was actually slightly longer for households with children than for those without them (2.12 years versus 1.95 years for public housing and 2.07 years versus 1.03 years for the voucher program; the same trend held true for mixed program participants). Meanwhile, mean tenure calculations reflected a similar pattern for tenant-based assisted households, but not so for the other programs. The findings for public housing and mixed program households reflected the trends of the prior study. Households with children that participated in either public housing (3.86 versus 6.12 years) or mixed programs (5.40 years compared with 6.23 years) had shorter tenures than their family counterparts without children, which compares favorably with patterns found in the Lubell, Shroder, and Steffen (2003) research. Furthermore, the present study reports lower tenure estimates across all categories compared with the earlier work. For example, public housing households with children spend a mean length of stay of 3.86 years versus 5.59 years (Lubell,

**Exhibit 1**

**Mean and Median Length of Stay Among Selected Household Types, by Program (in reporting period)**

Program	Measure	Reporting Years 1995–2002		
		Households: Nonelderly/Nondisabled		Households: All Types
		Without Children	With Children	
Public housing	Mean	6.12	3.86	7.46
	Median	1.95	2.12	3.97
Tenant-based	Mean	2.99	3.41	4.24
	Median	1.03	2.07	2.75
Mixed	Mean	6.23	5.40	6.33
	Median	4.18	4.79	5.25

*Notes: Tenant-based includes the Section 8 tenant-based certificate and voucher programs and the subsequent tenant-based Housing Choice Voucher Program (a merger of the certificate and voucher programs). These statistics are based on 5-percent samples of public housing, tenant-based, and mixed program households.*

*Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002*

Shroder, and Steffen, 2003), and the median is 2.12 years compared with 3.17 years (Lubell, Shroder, and Steffen, 2003). Tenure for tenant-based assisted households with children reflects similar findings: 3.41 mean years versus 3.95 mean years (Lubell, Shroder, and Steffen, 2003) and 2.07 median years compared with 2.63 median years (Lubell, Shroder, and Steffen, 2003).

## Average Mean Length of Stay in Public Housing

In exhibits 2 through 7, results (based on mean and median length of stay) are examined in much greater detail for all households reported to the system by program type, including those that are currently participating in any given year and those that have left in any given year. The results are examined for all households and for nonelderly, nondisabled households (with and without children) by program type. Exhibit 8 reports a new statistic—estimated median survival time (a new approach)—for these same households and program types, which will be discussed in more detail later.

In exhibit 2 we display results for the 5-percent sample file by reporting year. For example, the 1999 cases presented in this exhibit are households whose status as a current or former participant was reported to HUD in calendar year 1999. As mentioned before, for all household types enrolled in public housing, the mean length of stay during the 1995-to-2002 period was 7.46 years (see exhibit 2).<sup>3</sup> Average tenure is reported for two subsets of all participants: nonelderly, nondisabled households without children and nonelderly, nondisabled households with children. Each subset is further divided into current participants and former participants. Current participants include households reported to HUD to be receiving assistance as of a particular year, say 1999. In that year, the average length of stay for current nonelderly, nondisabled households without children

### Exhibit 2

#### Mean Length of Stay Among Selected Household Types: Public Housing Program Only\* (in reporting years)

Reporting Year(s)	Households: Nonelderly/Nondisabled				Households: All Types				All
	Without Children		With Children		Current		Former		
	Current	Former	Current	Former	6+ Months	All	6+ Months	All	
1999	10.72	3.23	4.74	2.83	10.64	9.43	6.51	5.32	8.15
2000	9.29	3.03	4.53	2.94	10.06	8.82	6.33	5.32	7.73
2001	9.70	3.22	4.80	3.09	10.61	9.45	6.46	5.51	8.55
2002	8.62	3.71	4.82	3.62	10.60	9.51	6.59	6.18	8.81
1995–2002	7.85	3.49	4.21	3.19	9.85	8.44	6.08	5.44	7.46

\* Nonelderly households are those in which the household head and/or spouse is age 62 or less. In nondisabled households, neither the household head nor his or her spouse is disabled. Households with children include household members age 17 and less (their disability status is not relevant in this study). Before extracting the 5-percent sample, the larger file of more than 2 million public housing records was examined for data quality. Suspect admission dates (for example, selected ones prior to 1960) and effective dates were treated as missing data. For household records in which a transaction type 5 (portability move-out) was reported, the corresponding admission and effective dates for those years were set to missing values. Household records in public housing, tenant-based, and mixed programs were dropped in cases in which the age of the household head was implausible and no admission dates were reported across all years from 1995 to 2002. (See Technical Appendix A.)

Note: These statistics are based on a 5-percent sample of public housing households (n = 102,495).

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

was 10.72 years and 3.23 years for those households that left the program, which are widely divergent results. The comparable statistics for nonelderly, nondisabled households with children were 4.74 years for current participants and 2.83 years for former participants (surprisingly low numbers).

For 1999 and the other years reported in exhibit 2, households with children do not stay long in public housing compared with all public housing participants. Households with children (distinguishing between both current and former participants) consistently have shorter lengths of stay than the nonelderly, nondisabled households without children. This trend is clearer than the trend for tenure in exhibit 1 that included both current and former participants in the equation. According to those mean statistics, households with children residing in public housing or in mixed program households stayed in assisted housing for less time than their childless counterparts did; but households with children in the voucher program stayed longer.

Another pattern that holds up consistently is that tenure for public housing households that leave the program is shorter than the average stay for current participants. In other words, there are households with rather lengthy stays, but many other households stay for a brief time only.

Moreover, the differences between mean tenure for current and former participants can be considerable and may be heightened by the sensitivity of the mean (unlike the median) to extreme scores. Obviously, these results measuring average tenure for either current or former participants do not by themselves accurately capture length of stay.

Once again, when results are examined for all households reported to the system, both currently participating households and those that have left, including all household types regardless of age, disability, or presence of children, the average length of stay during the 1995-to-2002 period was 7.46 years. This estimate understates the actual length of stay, however, for the following reasons:

- The estimate includes households that had resided in public housing for less than 6 months, including many newly admitted households. It is reasonable to exclude such households, and doing so increases the length of stay by approximately 1.25 years. It is not clear why people move into assisted housing and then leave within 6 months.
- The estimate measures participation only through the actual effective date in the report, not the end date of the year of reporting, which understates the length of stay by approximately 0.5 years.
- For the portion of the estimate measuring length of stay for currently assisted households, the estimate describes the length of stay that has occurred through the as-of date, not the ultimate length of stay. Let's use the 2001 statistic as an example. For current participants staying 6 or more months, the average length of stay was 10.61 years and counting. We do not yet know the average length of stay for these households, but we do know that many households (seniors and people with disabilities) are unlikely to move and are aging in place.

## Median Length of Stay in Public Housing

Exhibit 3 presents a distribution of length of stay in the public housing program by number of years receiving assistance, as well as median statistics, for some major categories that focus on households with children. These data suggest some general findings. Confirming trends from exhibit 2, households that actually leave public housing tend to have relatively short stays. About half of the households that leave have stays of 2 years or less, and this frees up public housing for use by others. It seems particularly noteworthy that some of the shortest observed stays are among households with children. So, on the one hand, the findings show that there really are people who stay in public housing for long periods of time, but, on the other hand, the average stays are quite short for many households, resulting in an overall average that is perhaps lower than expected.

Tenure estimates based on median calculations are typically shorter (often significantly) than those for mean length of stay because, as previously mentioned, the median is not as sensitive to outlier values, unlike the mean. Data are presented separately for households with children, including both current participants and former participants (that is, households that had left the program). When we look at the distribution of length of stay by number of years in public housing, we find that the median length of stay is only 3.97 years (compared with a mean tenure of 7.46 years). This observation means that half the households stayed less than 3.97 years, while the other half stayed longer. Approximately one-third of households enrolled in the program for at least 6 months have received assistance for up to 3 years compared with closer to 40 percent for all households. For

### Exhibit 3

Distribution/Median Stay Among Selected Household Types: Public Housing Program Only (in interval of years)

Interval of Years (1995–2002)	Households With Children: Nonelderly/Nondisabled Household Heads								Households: All Types (Current and Former)			
	Current				Former				6+ Months (%)		All (%)	
	6+ Months (%)	All (%)	6+ Months (%)	All (%)	6+ Months (%)	All (%)	6+ Months (%)	All (%)	6+ Months (%)	All (%)		
0–1	<b>10.2</b>	<i>10.2</i>	<b>30.4</b>	<i>30.4</i>	<b>17.5</b>	<i>17.5</i>	<b>28.1</b>	<i>28.1</i>	<b>8.3</b>	<i>8.3</i>	<b>20.5</b>	<i>20.5</i>
1–2	<b>27.7</b>	<i>37.9</i>	<b>14.8</b>	<i>45.2</i>	<b>24.5</b>	<i>41.9</i>	<b>21.3</b>	<i>49.4</i>	<b>17.6</b>	<i>25.9</i>	<b>12.1</b>	<i>32.6</i>
2–3	<b>12.4</b>	<i>50.3</i>	<b>11.0</b>	<i>56.2</i>	<b>15.5</b>	<i>57.4</i>	<b>13.5</b>	<i>62.9</i>	<b>10.0</b>	<i>36.0</i>	<b>9.1</b>	<i>41.7</i>
3–4	<b>9.2</b>	<i>59.6</i>	<b>8.2</b>	<i>64.3</i>	<b>11.0</b>	<i>68.4</i>	<b>9.6</b>	<i>72.5</i>	<b>8.0</b>	<i>44.0</i>	<b>7.3</b>	<i>49.0</i>
4–5	<b>7.6</b>	<i>7.2</i>	<b>6.7</b>	<i>71.0</i>	<b>7.3</b>	<i>75.8</i>	<b>6.4</b>	<i>78.9</i>	<b>6.8</b>	<i>50.7</i>	<b>6.2</b>	<i>55.1</i>
5–6	<b>5.7</b>	<i>72.9</i>	<b>5.0</b>	<i>76.1</i>	<b>6.3</b>	<i>82.1</i>	<b>5.5</b>	<i>84.4</i>	<b>5.7</b>	<i>56.4</i>	<b>5.2</b>	<i>60.4</i>
6–7	<b>4.4</b>	<i>77.3</i>	<b>3.9</b>	<i>80.0</i>	<b>4.1</b>	<i>86.3</i>	<b>3.6</b>	<i>88.1</i>	<b>4.7</b>	<i>61.2</i>	<b>4.3</b>	<i>64.7</i>
7–10	<b>9.0</b>	<i>86.3</i>	<b>8.0</b>	<i>88.0</i>	<b>7.5</b>	<i>93.8</i>	<b>6.5</b>	<i>94.6</i>	<b>10.7</b>	<i>71.9</i>	<b>9.7</b>	<i>74.4</i>
10–15	<b>7.4</b>	<i>93.8</i>	<b>6.6</b>	<i>94.5</i>	<b>4.2</b>	<i>98.0</i>	<b>3.7</b>	<i>98.3</i>	<b>10.5</b>	<i>82.4</i>	<b>9.5</b>	<i>83.9</i>
15–20	<b>3.2</b>	<i>97.0</i>	<b>2.8</b>	<i>97.3</i>	<b>1.2</b>	<i>99.3</i>	<b>1.1</b>	<i>99.3</i>	<b>6.1</b>	<i>88.4</i>	<b>5.5</b>	<i>89.5</i>
20+	<b>3.0</b>	<i>100.0</i>	<b>2.7</b>	<i>100.0</i>	<b>0.7</b>	<i>100.0</i>	<b>0.7</b>	<i>100.0</i>	<b>11.6</b>	<i>100.0</i>	<b>10.5</b>	<i>100.0</i>
Median	3.35		2.25		2.39		1.99		5.00		3.97	

**Boldface** data = interval.

*Italicized data* = cumulative.

Notes: These statistics are based on a 5-percent sample of public housing households (n = 102,495). Each variable displays both interval and cumulative percentages.

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

both groups (all households and those in the program for 6 months or more), about one-third have had stays of between 3 years and 10 years. About 25 percent of all participants stay more than 10 years. For those in the program for 6 months or more, the percentage is slightly higher.

Once again, we see that all current households with children have a shorter median length of stay (2.25 years) than all households (3.97 years). For such households that have participated 6 months or more, the median length of stay is 3.35 years and 5.0 years for all households in the program longer than 6 months. Exhibit 3 also confirms that nonelderly, nondisabled households that actually leave public housing have much shorter lengths of stay (1.99 years) than currently participating households (2.25 years). For such households participating at least 6 months, those numbers are 2.39 years and 3.35 years for former and current households, respectively. Although the differences for median tenure between current and former participants are not as divergent as the comparable mean statistics are in exhibit 2, they deviate nonetheless. As with calculating mean tenure, calculating median tenure for either current or former participants, although providing some insight, may not adequately capture the true length of stay.

### **Average Mean Length of Stay in the Tenant-Based Program**

Turning to the tenant-based program, exhibit 4 displays results for the 5-percent sample by reporting year. As in exhibit 2, the mean length of stay is reported for the same household types: nonelderly, nondisabled households without children and nonelderly, nondisabled households with children. Each household type is grouped into current and former participants.

As with public housing recipients, tenant-based households that left the program generally had shorter average stays than did current participants. Sometimes the differences are significant. For example, in reporting year 1999, the average length of stay for current nonelderly, nondisabled households without children was 5.29 years. Their counterparts that left the program stayed only about half that time (2.46 years). Among nonelderly, nondisabled households with children, the comparable numbers for current and former participants were 3.72 and 2.88 years, respectively.

Although tenure among current and former tenant-based participants was not as divergent as in public housing, it was noticeable nonetheless. For example, in 2000, current tenant-based participants (nonelderly, nondisabled households without children) stayed 5.10 years on average, while former participants stayed 2.83 years. In the public housing program, the comparable family type received assistance for 9.29 years, while those formerly in the program averaged 3.03 years, a much wider range of difference.

Results are also reported for current and former participants, regardless of family type. Current and former participants are grouped according to whether the household participated in tenant-based assistance for 6 months or longer. In 1999, current participants who had been in the program at least 6 months averaged 5.54 years, while the entire population of current tenant-based households stayed, on average, 4.72 years. In 1999, the mean length of stay for all households was even less, at 4.31 years.

Tenant-based households with children—both current and former participants—reported relatively brief average lengths of stay. In fact, among current participants, they generally indicated some of

the shortest tenures. Households without children that left the program, however, spent the least amount of time in public housing. Between 1999 and 2002, their stays ranged from 2.46 to 2.83 years.

Exhibit 4 invites some other comparisons to the findings for the public housing program (exhibit 2). Examining all households reporting to the system, including current and former participants, regardless of household type, the average length of stay over the 1995-to-2002 period was 4.24 years (in contrast to 7.46 years in public housing). The duration for households in the tenant-based program was usually less across all years and categories than for households in the public housing program. Nonelderly, nondisabled households with children that have left the program, however, are the exception; they had a shorter stay in public housing than those in the tenant-based program (3.19 years versus 3.34 years, respectively).

#### Exhibit 4

Mean Length of Stay Among Selected Household Types: Tenant-Based Program Only\* (in reporting years)

Reporting Year(s)	Households: Nonelderly/Nondisabled				Households: All Types				All
	Without Children		With Children		Current		Former		
	Current	Former	Current	Former	6+ Months	All	6+ Months	All	
1999	5.29	2.46	3.72	2.88	5.54	4.72	4.16	3.39	4.31
2000	5.10	2.83	3.85	3.13	5.74	4.87	4.44	3.75	4.53
2001	4.57	2.83	3.74	3.34	5.88	4.83	4.72	4.05	4.65
2002	3.76	2.79	3.79	3.84	5.89	4.84	4.84	4.59	4.79
1995–2002	3.46	2.10	3.44	3.34	5.56	4.43	4.06	3.74	4.24

\* Before taking the 5-percent sample, the larger file of more than 3 million tenant-based records was reviewed for data quality. Erroneous admission dates (for example, those prior to 1975) and effective dates were treated as missing data. For household records in which a transaction type 5 (portability move-out) or transaction type 9 (voucher or certificate search) was reported, the corresponding admission and effective dates for those years were set to missing values. (See Technical Appendix A.)

Notes: Tenant-based includes the Section 8 tenant-based certificate and voucher programs and the subsequent tenant-based Housing Choice Voucher Program (a merger of the certificate and voucher programs). These statistics are based on a 5-percent sample of tenant-based households (n = 120,805).

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

#### Median Length of Stay in the Tenant-Based Program

Similar to the distribution/median stay statistics for public housing participants shown in exhibit 3, exhibit 5 displays a distribution for length of stay in the tenant-based program, as well as median statistics, according to the duration for which assistance was received. Patterns are similar to those found in exhibit 3 for public housing. According to exhibit 5, households with children (current and former) have a lower median length of stay (2.03 years and 2.30 years, respectively) than all households combined (2.75 years.) Unlike the comparable statistics for public housing, however, the contrast between these medians for current and former participants is not particularly striking.

In the tenant-based program the length of stay is relatively low for households with children but also relatively low for all households. Among all households, about 40 percent received assistance for 2 years or less. Of all households participating in the tenant-based program for 6 months or

more, about 40 percent report stays of 3 years or less. Compared with the data in exhibit 3, the pattern for median length of stay among current and former participants is less clear. Former participants, at least among households with children, stayed slightly longer in the program than did their currently participating counterparts (2.30 years versus 2.03 years, respectively). Among those in the program for at least 6 months, the pattern is reversed; current households with children stayed 3.09 years, while tenure was 2.59 years for former households with children.

In general, median length of stay is shorter for participants in the tenant-based program than for those in public housing. Nonelderly, nondisabled households that left public housing, however, were the exception; their stay was slightly less (2.39 years for those who stayed 6 months or more and 1.99 for all lengths of stay) than that for their tenant-based counterparts (2.59 years for those who stayed 6 months or more and 2.30 for all lengths of stay).

### Exhibit 5

#### Distribution/Median Stay Among Selected Household Types: Tenant-Based Program Only (in interval of years)

Interval of Years (1995–2002)	Households With Children: Nonelderly/Nondisabled Household Heads								Households: All Types (Current and Former)			
	Current				Former				6+ Months (%)		All (%)	
	6+ Months (%)		All (%)		6+ Months (%)		All (%)					
0–1	<b>8.7</b>	8.7	<b>30.5</b>	30.5	<b>15.7</b>	15.7	<b>22.6</b>	22.6	<b>9.2</b>	9.2	<b>24.8</b>	24.8
1–2	<b>22.1</b>	30.8	<b>16.8</b>	47.3	<b>23.7</b>	39.4	<b>21.7</b>	44.4	<b>19.5</b>	28.7	<b>16.2</b>	40.9
2–3	<b>15.0</b>	45.8	<b>11.4</b>	58.7	<b>16.2</b>	55.6	<b>14.9</b>	59.2	<b>13.7</b>	42.4	<b>11.4</b>	52.3
3–4	<b>11.4</b>	57.2	<b>8.7</b>	67.4	<b>12.1</b>	67.7	<b>11.1</b>	70.3	<b>11.0</b>	53.4	<b>9.1</b>	61.4
4–5	<b>8.7</b>	65.8	<b>6.6</b>	74.0	<b>8.4</b>	76.1	<b>7.7</b>	78.0	<b>8.5</b>	61.9	<b>7.0</b>	68.4
5–6	<b>6.7</b>	72.6	<b>5.1</b>	79.1	<b>6.4</b>	82.5	<b>5.9</b>	83.9	<b>6.8</b>	68.6	<b>5.6</b>	74.0
6–7	<b>5.8</b>	78.4	<b>4.4</b>	83.5	<b>4.7</b>	87.2	<b>4.3</b>	88.2	<b>5.6</b>	74.2	<b>4.6</b>	78.7
7–10	<b>11.6</b>	89.9	<b>8.8</b>	92.3	<b>7.5</b>	94.6	<b>6.8</b>	95.1	<b>11.6</b>	85.8	<b>9.6</b>	88.3
10–15	<b>7.6</b>	97.6	<b>5.8</b>	98.2	<b>4.3</b>	98.9	<b>3.9</b>	99.0	<b>9.3</b>	95.1	<b>7.7</b>	96.0
15–20	<b>1.9</b>	99.5	<b>1.4</b>	99.6	<b>1.0</b>	99.8	<b>0.9</b>	99.9	<b>3.4</b>	98.5	<b>2.8</b>	98.7
20+	<b>0.5</b>	100.0	<b>0.4</b>	100.0	<b>0.2</b>	100.0	<b>0.1</b>	100.0	<b>1.5</b>	100.0	<b>1.3</b>	100.0
Median	3.09		2.03		2.59		2.30		3.56		2.75	

**Boldface** data = interval.

*Italicized* data = cumulative.

Notes: Tenant-based includes the Section 8 tenant-based certificate and voucher programs and the subsequent tenant-based Housing Choice Voucher Program (a merger of the certificate and voucher programs). These statistics are based on a 5-percent sample of tenant-based households (n = 120,805).

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

### Average Mean Length of Stay in a Mixed Program

Households in this sample participated in more than one housing assistance program (public housing, tenant-based, and/or moderate rehabilitation) across the 1995-to-2002 period. Mixed program participants constitute a very small share of all assisted housing recipients, relative to other housing program participants. Generally, their length of stay across all years and categories was shorter than that of households participating only in public housing but was longer compared with tenant-

based households' length of stay (see exhibit 6). In an exception to that pattern, former nonelderly, nondisabled households (with and without children) participating in mixed programs tended toward longer tenures than did former public housing tenants. Among mixed program participants (across both reporting years and household types), former recipients of assisted housing had shorter tenures than did current participants, but the differences were not striking. In a familiar pattern, during the 1995-to-2002 period, households with children (current and former) had a shorter average tenure (5.75 and 4.98 years, respectively) than did all households combined (6.33 years). The latter statistic is lower than for public housing (at 7.46 years) but higher than the overall tenure in the tenant-based program (4.24 years). Median length of stay varied widely between former and current participants, meaning that neither measure adequately captured length of stay.

## Exhibit 6

Mean Length of Stay Among Selected Household Types: Mixed Program Only\*  
(in reporting years)

Reporting Year(s)	Households: Nonelderly/Nondisabled				Households: All Types				
	Without Children		With Children		Current		Former		All
	Current	Former	Current	Former	6+ Months	All	6+ Months	All	
1999	5.86	3.02	3.86	3.11	5.81	5.19	4.31	3.79	4.48
2000	6.36	4.35	4.89	3.85	6.28	5.79	4.95	4.57	5.17
2001	6.91	4.80	5.15	4.47	6.84	6.50	5.60	5.26	5.92
2002	7.93	5.42	6.34	5.57	7.77	7.61	6.53	6.34	7.02
1995–2002	7.24	5.13	5.75	4.98	7.29	7.06	5.85	5.62	6.33

\*Data quality was evaluated in the 100-percent file of more than 300,000 records before the 5-percent sample was drawn. Suspect admission and effective dates, depending on the program, were set to missing values.

Notes: These statistics are based on a 5-percent sample of mixed program households (n=15,174). Households in this sample participated in more than one housing assistance program (public housing, tenant-based, and/or moderate rehabilitation) in the 1995-to-2002 period.

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

## Median Length of Stay in a Mixed Program

Exhibit 7 displays a distribution for length of stay among mixed program participants. Similar to findings for public housing and tenant-based households, mixed program households with children (current and former) have a slightly shorter median length of stay (5.07 years and 4.43 years, respectively) than all households combined (5.25 years). As with the comparable statistics for the tenant-based program, the contrast between these medians is not particularly striking. Of the households participating in more than one assisted housing program, about one-third stay 4 years or less. Compared with exhibits 3 and 5, overall median stays for mixed program participants are longer than those for public housing or tenant-based households.

## Median Survival Time (Life-Table Analysis)

Traditional research methods have relied on mean and median summary statistics. Such calculations may not capture true length of stay because many of these households have not yet exited assisted housing programs. Exhibit 8 introduces a new approach. It displays a measure for length of stay based on survival analysis, known as the estimated median survival time.

**Exhibit 7****Distribution/Median Stay Among Selected Household Types: Mixed Program Only  
(in interval of years)**

Interval of Years (1995–2002)	Households With Children: Nonelderly/Nondisabled Household Heads								Households: All Types (Current and Former)			
	Current				Former				6+ Months (%)		All (%)	
	6+ Months (%)		All (%)		6+ Months (%)		All (%)		6+ Months (%)		All (%)	
0–1	<b>2.2</b>	<i>2.2</i>	<b>6.0</b>	<i>6.0</i>	<b>3.2</b>	<i>3.2</i>	<b>6.9</b>	<i>6.9</i>	<b>2.6</b>	<i>2.6</i>	<b>6.2</b>	<i>6.2</i>
1–2	<b>8.6</b>	<i>10.8</i>	<b>8.3</b>	<i>14.2</i>	<b>9.2</b>	<i>12.4</i>	<b>8.9</b>	<i>15.8</i>	<b>8.3</b>	<i>11.0</i>	<b>8.0</b>	<i>14.2</i>
2–3	<b>11.6</b>	<i>22.4</i>	<b>11.1</b>	<i>25.4</i>	<b>14.6</b>	<i>27.0</i>	<b>14.0</b>	<i>29.8</i>	<b>10.5</b>	<i>21.4</i>	<b>10.1</b>	<i>24.3</i>
3–4	<b>12.1</b>	<i>34.5</i>	<b>11.6</b>	<i>37.0</i>	<b>15.0</b>	<i>42.0</i>	<b>14.4</b>	<i>44.2</i>	<b>11.9</b>	<i>33.4</i>	<b>11.5</b>	<i>35.8</i>
4–5	<b>12.5</b>	<i>47.0</i>	<b>12.0</b>	<i>49.0</i>	<b>13.0</b>	<i>55.0</i>	<b>12.5</b>	<i>56.7</i>	<b>11.6</b>	<i>45.0</i>	<b>11.2</b>	<i>47.0</i>
5–6	<b>10.6</b>	<i>57.6</i>	<b>10.2</b>	<i>59.2</i>	<b>13.5</b>	<i>68.5</i>	<b>13.0</b>	<i>69.7</i>	<b>10.7</b>	<i>55.6</i>	<b>10.3</b>	<i>57.3</i>
6–7	<b>9.8</b>	<i>67.4</i>	<b>9.5</b>	<i>68.7</i>	<b>10.0</b>	<i>78.5</i>	<b>9.6</b>	<i>79.3</i>	<b>9.1</b>	<i>64.7</i>	<b>8.7</b>	<i>66.0</i>
7–10	<b>20.0</b>	<i>87.4</i>	<b>19.3</b>	<i>87.9</i>	<b>14.3</b>	<i>92.8</i>	<b>13.8</b>	<i>93.1</i>	<b>19.2</b>	<i>83.9</i>	<b>18.5</b>	<i>84.5</i>
10–15	<b>9.4</b>	<i>96.9</i>	<b>9.1</b>	<i>97.0</i>	<b>5.4</b>	<i>98.3</i>	<b>5.2</b>	<i>98.3</i>	<b>10.2</b>	<i>94.1</i>	<b>9.8</b>	<i>94.4</i>
15–20	<b>2.4</b>	<i>99.2</i>	<b>2.3</b>	<i>99.3</i>	<b>1.2</b>	<i>99.5</i>	<b>1.2</b>	<i>99.5</i>	<b>3.3</b>	<i>97.5</i>	<b>3.2</b>	<i>97.5</i>
20+	<b>0.8</b>	<i>100.0</i>	<b>0.7</b>	<i>100.0</i>	<b>0.5</b>	<i>100.0</i>	<b>0.5</b>	<i>100.0</i>	<b>2.5</b>	<i>100.0</i>	<b>2.5</b>	<i>100.0</i>
Median	5.24		5.07		4.59		4.43		5.43		5.25	

**Boldface** data = interval.

*Italicized* data = cumulative.

Note: These statistics are based on a 5-percent sample of mixed program households (n = 15,174).

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

**Exhibit 8****Estimated Median Survival Time Among Selected Household Types by Program  
(in reporting period years)**

Program	Method	Reporting Years 1995–2002		
		Households: Nonelderly/Nondisabled		Households: All Types
		Without Children	With Children	
Public housing	Mean	6.12	3.86	7.46
	Median	1.95	2.12	3.97
	Survival	4.09	3.91	8.30
Tenant-based	Mean	2.99	3.41	4.24
	Median	1.03	2.07	2.75
	Survival	3.32	5.93	7.82
Mixed	Mean	6.23	5.40	6.33
	Median	4.18	4.79	5.25
	Survival	6.87	6.77	7.24

Notes: Tenant-based includes the Section 8 tenant-based certificate and voucher programs and the subsequent tenant-based Housing Choice Voucher Program (a merger of the certificate and voucher programs). These statistics are based on 5-percent samples of public housing, tenant-based, and mixed program households.

Source: Multifamily Tenant Characteristics System merged data file for reporting years 1995 to 2002

Computations that include current participants are inherently biased because they underestimate the actual overall length of stay for assisted households. Excluding these households from the analysis is not a viable option, however, because it introduces still more bias. Dropping current participants means that households with some of the longest tenures in assisted housing would be underrepresented among the remaining cases, while those with the shortest stays would be overrepresented. Still another strategy to address these problems is also flawed: it is impractical to wait until all of a group of recipients have left assisted housing before tallying the recipients' lengths of stay. To overcome these problems, a statistical methodology is needed that offers some estimates about housing tenures and also accounts for both current and former participants.

Survival analysis is a set of statistical tools that answers questions about probabilities relating to survival time. Primarily developed in the biological and medical sciences, survival analysis has been widely adapted for use in many areas, such as actuarial, demographic, and economic research. One of the most basic tools in survival analysis is the life table. Constructing a life table is one of the simplest ways to describe survival times within a population sample.

A life table is a kind of enhanced frequency table: it is a distribution of survival times (the length of time intervals between one event and another, such as births and deaths). Often the data for the life table includes some cases for which the second (or terminal) event (such as death) has not yet occurred, which are known as censored cases. In a life table, the array of survival times is divided into smaller intervals. Cases are then allocated among those smaller survival time intervals. Cases that are observed for at least a certain time period are used to predict the likelihood of an event occurring at that particular time. In turn, the probabilities estimated at each interval are invoked to assess the overall chances of an event happening at different points in time.

For many years, actuaries and demographers have constructed life tables to describe aspects of human mortality, such as the expectation of life (at birth). This term is defined as the mean number of years a person would live, given the age-specific death rates used to construct the table.

The analysis of survival times, however, can refer to many other types of events—not just mortality. For example, life tables can also address survival issues related to housing assistance tenures—such as the likelihood that a household will stay in assisted housing until a certain time and the timing of housing exits. The method derives its estimates from households that have actually left assisted housing and also those that have not yet exited. Distributions produced in a life-table analysis can complement (or even replace) conventional length-of-stay calculations for assisted housing.

A life-table analysis in Statistical Packages for the Social Sciences (SPSS) was conducted on a 5-percent sample of public housing, tenant-based, and mixed program recipients for the reporting years 1995 to 2002. The three data sets included households that had already left assisted housing and those that had not yet exited (censored cases). The life-table method produced various statistics, which are explained in greater detail in Technical Appendix B.

One of those estimates is especially useful in summarizing housing tenure: the median survival time. It is the estimated tenure at which exactly half the households would still be expected to survive as housing recipients while the other half would have exited.<sup>4</sup> Exhibit 8 compares median survival time with previously displayed statistics for mean and median length of stay. According to the table in this exhibit, all public housing households stay longer in assisted housing (8.30 years)

based on median survival time than do tenant-based (7.82 years) or mixed program recipients (7.24 years). The estimate of 8.30 years for public housing is similar to the mean statistics calculated by Lubell, Shroder, and Steffen (2003) (8.50 years) and the present study (7.46 years). The median survival time for tenant-based households (7.82), however, is much longer (by two to three times) than mean and median findings under Lubell, Shroder, and Steffen (2003) or this research. Under survival analysis, mixed program households, not voucher holders, have the shortest tenures (7.24 years). The differences between these estimates, however, are fairly narrow. Tenant-based households with children still stay longer (5.93 years) than their childless tenant-based counterparts (3.32). This finding is in contrast to Lubell, Shroder, and Steffen (2003) but is consistent with some of the trends found in the present research. Similar to the findings of the two studies, these households (with and without children) also have a shorter tenure when compared with all tenant-based households (7.82 years). Furthermore, the survival estimates often exceed most of the comparable mean and median length-of-stay estimates in both studies (especially median tenure). These lengthier survival time estimates contradict some trends from the previous two studies. For example, survival analysis indicates, in contrast to mean and median tenure calculations, that nonelderly, nondisabled tenant-based households with children stay longer by 2 years than do their counterparts in public housing (5.93 years for tenant-based participants versus only 3.91 years for public housing). According to mean and median estimates in the present study, households with children in public housing actually stayed slightly longer (3.86 and 2.12 years) than did their tenant-based counterparts (3.41 and 2.07 years). The Lubell, Shroder, and Steffen (2003) study also estimated a longer tenure for households with children in public housing 5.59 (mean) years and 3.17 (median) years, in contrast to their counterparts in the tenant-based program: 3.95 (mean) years and 2.63 (median) years.

## Conclusion

Tenure estimates for assisted households based on median survival time may be more realistic than calculations that rely on mean and median summary statistics. Estimates based on mean and median length of stay make no assumptions about how long current participants will stay in assisted housing. The latter methods are more likely to underestimate tenure because current recipients have not yet left the program. On the other hand, the life-table method produces statistics, including the median survival time, that account for the current cases in making predictions about housing tenure. It is a relatively simple calculation that only requires a few variables. In addition to a variable indicating the number of years a household has received assistance (from which mean and median statistics are also derived), the only other variable needed to estimate median survival time is one that flags households that have exited assisted housing. The life table (and its associated median survival time statistic) should be seriously considered as a viable alternative method for more accurately and realistically measuring tenure in assisted housing programs.

## Technical Appendix A: Data Quality and Scope

This study is based on samples drawn from merged Multifamily Tenant Characteristics System data for the years spanning 1995 to 2002. Before analyzing length of stay in the 5-percent sample files, an extensive data quality review was performed on the longitudinal data file (the 100-percent count). Suspect or unreliable household records were deleted, and some cell entries were either recoded or set to missing values. Some of the most important items addressed during the data quality check are admission dates, effective dates, age of the household head, mixed program participation, transaction types (portability move-out and voucher search), and unrecorded exits, all of which are discussed in the following sections.

### **Admission Dates**

Unique identifiers for each household head in the 100-percent file were reviewed to determine whether each household had at least one admission date. About 16.8 percent of all household records lacked an admission date across all 8 years (from 1995 to 2002). These records were dropped because, without an admission date, calculations for length of stay would be impossible for these households.

Such records were also examined to assess the extent to which more than one unique admission date per household existed across the 1995-to-2002 period. Although most household records (68.6 percent) contained only one unique admission date for each household head, more than one unique admission date existed for some households. In those cases, the earliest admission date was used when calculating tenure for these households.

Admission dates were also checked for validity. Public housing admission dates before January 1, 1960, were especially scrutinized. Dates before January 1, 1938, were considered invalid and the values were set to missing values in the file. Likewise, erroneous admission dates for households that exited before January 1, 1975, for records in the voucher program were considered invalid and the values were set to missing.

### **Effective Dates**

Suspect effective dates—those recorded after December 31<sup>st</sup> of a particular reporting year—were recoded as missing values. For example, for reporting year 1995, any effective date for the year 1996 was identified as a questionable cell entry and was set to missing value.

### **Household Head Age**

Household records were dropped in cases in which the age of the household head was implausible. These were records in which the difference between the minimum and maximum household head age across the 1995-to-2002 period was 10 years or more.

### **Mixed Program Participation**

Households in the longitudinal file were reviewed for the extent to which they were assisted by the same program (either public housing or vouchers) or by a mixed program across 1995 to 2002.

About 52.8 percent of all households resided in only public housing during these years, while 41.6 percent participated only in the voucher program. A mere 5.6 percent of households in this file participated in more than one of these programs (including moderate rehabilitation) over the 8-year period.

### **Transaction Types: Portability Move-Out and Voucher Search**

In the public housing program, household records that included a transaction type 5 (portability move-out) for certain years were identified. The corresponding admission and effective dates for those years were set to missing values.

In the voucher program, household records in which a transaction type 5 (portability move-out) or transaction type 9 (voucher search) occurred in certain years were flagged. The corresponding admission and effective dates for those years were recoded as missing values.

### **Unrecorded Exits**

Because some households may have left assisted housing without the public housing agency having generated an exit record, all household records in the public housing and tenant-based programs were evaluated for unrecorded exits. Households were recoded as exits (and added to the pool of former participants that already had an exit record) if an End of Participation (EOP) record was absent and reporting had lapsed for the past 2 or more consecutive years. For example, households that last reported in 2000, but failed to do so in either 2001 or 2002, fell into that category. If an EOP flag was also lacking, these households also qualified as unrecorded exits.

## **Technical Appendix B: Survival Analysis (Life Tables)**

### **Interpreting the Life-Table Output**

To illustrate the Statistical Packages for the Social Sciences (SPSS) life-table output, 1996 cohort data from the public housing program (based on the 5-percent sample file) were analyzed. A 1996 cohort in public housing is one that enters the program (for the first time) in 1996. This cohort has a 1996 admission date and either a new admission or an End of Participation code (a transaction type of either 1 or 6). SPSS produced both a table and graphs, as shown in exhibits B-1, B-2, and B-3, which require some detailed explanation.

### **Interval Start Time**

The distribution of survival times is divided into a certain number of intervals. In the table in exhibit B-1, it represents length of stay in assisted housing according to 1-year time frames (0 to 1, 1 to 2, 2 to 3, etc.). For the 1996 cohorts, lengths of stay among individual households ranged from 0 to 6.86 years. Seven intervals capture that distribution.

### **Number Entering This Interval**

This output is the number of households that were receiving assistance at least at the beginning of the interval. For example, 1,920 households received assistance for at least 1 year.

**Exhibit B-1**

Life-table Analysis of 1996 Cohorts: Public Housing Only (5-Percent Sample)

Interval Start Time	Number Entering This Interval	Number Withdrawn During Interval	Number Exposed to Risk	Number of Terminal Events	Proportion Terminating	Proportion Surviving	Cumulative Proportion Surviving at End	Probability Density	Hazard Rate
0	2,647	417	2,438.5	310	0.1271	0.8729	0.8729	0.1271	0.1358
1	1,920	141	1,849.5	237	0.1281	0.8719	0.7610	0.1119	0.1369
2	1,542	82	1,501	167	0.1113	0.8887	0.6763	0.0847	0.1178
3	1,293	76	1,255	141	0.1124	0.8876	0.6004	0.0760	0.1190
4	1,076	204	974	113	0.1160	0.8840	0.5307	0.0697	0.1232
5	759	306	606	115	0.1898	0.8102	0.4300	0.1007	0.2097
6	338	262	207	76	0.3671	0.6329	0.2721	0.1579	0.4497

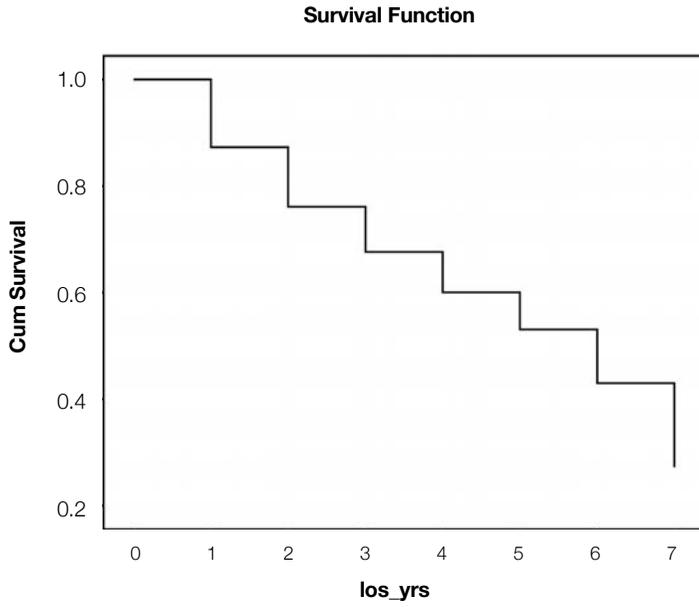
The median survival time for these data is 5.3 years

Interval Start Time	Standard Error of Cumulative Proportion Surviving at End	Standard Error of Probability Density	Standard Error of Hazard Rate
0	0.0067	0.0067	0.0077
1	0.0090	0.0068	0.0089
2	0.0101	0.0063	0.0091
3	0.0108	0.0061	0.0100
4	0.0114	0.0063	0.0116
5	0.0125	0.0087	0.0194
6	0.0164	0.0151	0.0503

**Exhibit B-2**

Survival Function for 1996 Cohorts (5-Percent Sample)

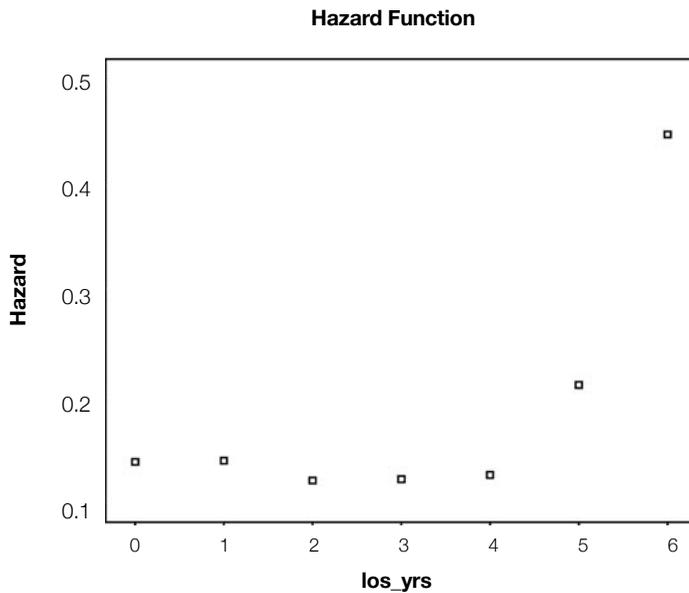
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**Exhibit B-3**

Hazard Function for 1996 Cohorts (5-Percent Sample)

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### **Number Withdrawn During Interval**

This output is the number of current participants. As recipients for certain time periods, they have not yet left assisted housing. Known as censored cases because the terminal event (a housing exit) has not occurred, they are also termed withdrawn because they do not appear in later intervals (these cases are lost to observation). For instance, 141 cohorts are current recipients with tenures of at least 1 year but less than 2.

### **Number Exposed to Risk**

This output is the estimated number of households entering an interval that are potentially at risk for exiting assisted housing. At the start of year 1, a projected 1,849.5 households are exposed to the risk of terminating housing assistance. The number exposed to risk is derived by subtracting half the withdrawn (censored) cases from the number entering the interval [ $1,920 - (141 / 2) = 1,849.5$ ]. This estimate is notable because the last five columns in the life table are based either directly or indirectly on the risk set

### **Number of Terminal Events**

This output is the number of former participants—the number of households that left assistance during a certain time interval. In exhibit B-1, 237 households left housing assistance after a stay of at least 1 year but less than 2 years.

### **Proportion Terminating**

This output is the share of households that ended their stay during a certain year. Accordingly, 12.81 percent of households left after receiving assistance for at least 1 year but less than 2 years. The proportion terminating is calculated by dividing the number of terminal events (housing exits) by the number of cases at risk in the interval ( $237 / 1,849.5 = 0.1281$ ).

### **Proportion Surviving**

This output is the proportion of households that were current participants through a given year. Thus, 87.19 percent of households were still recipients with a length of stay of at least 1 year but less than 2 years. The proportion surviving is calculated by subtracting the proportion terminating from 1 ( $1 - 0.1281 = 0.8719$ ).

### **Cumulative Proportion Surviving at End**

Also known as the survival function, this output indicates the likelihood that a household will continue to receive housing assistance up to and through the end of a given year. For example, there is a 67.63-percent chance that a household will receive assistance at least through the end of year 2. The cumulative share of surviving households is computed by multiplying the prior cumulative proportion surviving at end value by the current proportion surviving ( $0.7610 * 0.8887 = 0.6763$ ). So an estimated 67.63 percent of households remained on assistance (or survived) up to the end of year 2.

The graph in exhibit B-2 plots the survival function associated with this column. It shows that the estimated survivor rate declines a little more in the first few years than in years 3 and 4 and that a marked drop occurs by the end of year 6 (27.21 percent).

### **Probability Density**

This output is the estimated probability of exiting assisted housing during a particular year. In year 2, a household had an 8.47-percent chance of ending its housing tenure. The probability density is derived by subtracting successive values in the column labeled “Cumulative Proportion Surviving at End” ( $0.7610 - 0.6763 = 0.0847$ ).

### **Hazard Rate**

This output is also known as the hazard function, or the estimated rate at which households exit assistance in a certain year. Stated another way, it is the likelihood that a household receiving assistance up to the beginning of a certain year will leave at the end of the year. For instance, households with a length of stay of up to 1 year have a 13.69-percent chance of terminating before year’s end. (Because hazard rates can take on values greater than 1, they are not true probabilities.) The hazard rate is calculated by dividing values in the Probability Density column by averages of successive entries in the Cumulative Proportion Surviving at End column, as demonstrated for year 2 [ $2 * 0.0847 / (0.7610 + 0.6763) = 0.1178$ ].

The graph in exhibit B-3 plots the hazard function (or exit rate) associated with this column. Among the 1996 cohorts, the graph shows that the estimated exit rates for public housing recipients were slightly higher in the first 2 years than for years 3 and 4, but they rose more sharply for years 5 and, especially, for year 6, in which the predicted exit rate rose to almost 45 percent.

### **Median Survival Time**

This output is the point at which the survival function (the column for Cumulative Proportion Surviving at End) is equal to 50 percent (also known as the 50<sup>th</sup> percentile). It is the estimated tenure at which exactly half the households would still be expected to survive as housing recipients while the other half would have exited. According to the table in exhibit B-1, the estimated median survival time is 5.3 years.

Median survival time is constructed directly from the output column for Cumulative Proportion Surviving at End. The table indicates that the 50<sup>th</sup> percentile lies somewhere around years 4 and 5 (between 0.5307 and 0.4300). The following equation yields the median survival time for this life table:  $5 + (0.5307 - 0.5) / (0.5307 - 0.4300) = 5.3$  years.

Also, the median survival time can be visualized using the survivor function plot (see the figure in exhibit B-2). The vertical (or y axis) indicates the survival values. A horizontal line can be drawn at the 50<sup>th</sup> percentile and followed until it meets the curve: the point of intersection (as noted by the values on the x axis) is the median survival time. (The 50<sup>th</sup> percentile for the cumulative survival function is usually not the same as the point in time up to which 50 percent of the sample survived—this would be the case only if there were no censored observations before this time; that is, if those sample records had known outcomes.) Median survival time is commonly used to summarize the survivor function.

## **Standard Error of Cumulative Proportion Surviving at End**

This output is the error associated with the cumulative proportion estimate. For year 2 (where the cumulative proportion surviving at end is 0.6763), the standard error is  $\pm 0.0101$ . At one standard deviation, there is a 68.26-percent chance that the cumulative proportion falls between 0.6662 ( $0.6763 - 0.0101$ ) and 0.6864 ( $0.6763 + 0.0101$ ).

## **Standard Error of Probability Density**

This output is the estimated error surrounding the probability density. For example, in year 2, the probability density of 0.0847 has a standard error of  $\pm 0.0063$ . The resulting 68.26-percent confidence interval ranges from 0.0784 ( $0.0847 - 0.0063$ ) to 0.091 ( $0.0847 + 0.0063$ ).

## **Standard Error of Hazard Rate**

For year 2, the error associated with a hazard rate of 0.1178 is  $\pm 0.0091$ . This means that at one standard deviation (68.26 percent), the estimated hazard rate lies between 0.1087 ( $0.1178 - 0.0091$ ) and 0.1269 ( $0.1178 + 0.0091$ ).

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## **Notes**

1. State and Local Housing Flexibility Act of 2005, H.R. 1999, 106<sup>th</sup> Congress, 1<sup>st</sup> Session (2005). The text of H.R.1999 is posted at [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109\\_cong\\_bills&docid=f:h1999ih.txt.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h1999ih.txt.pdf). An identical bill, S. 771, was introduced in the U.S. Senate at about the same time (April 2005). State and Local Housing Flexibility Act of 2005, S. 771, 109<sup>th</sup> Congress, 1<sup>st</sup> Session (2005). The text can be accessed at [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109\\_cong\\_bills&docid=f:s771is.txt.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:s771is.txt.pdf).
2. To support their case for using only current participants, Lubell, Shroder, and Steffen (2003) included in their appendix a few length-of-stay calculations comparing current recipients with those who had ended their participation.

3. All tenure calculations were informed by the difference between the latest effective date (for the last housing transaction in the file) and the earliest admission date for every household record across all years from 1995 to 2002.
4. In this context, *median survival time* does not relate to mortality; that is, it does not estimate a recipient's remaining life span. In this study, it merely estimates the time it will take for half of the recipients to leave assisted housing. (See Technical Appendix B for an expanded explanation of median survival time.)

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Jackson, Alphonso. 2005. Testimony. *H.R. 1999—The State and Local Housing Flexibility Act of 2005*. Hearing Before the Committee on Financial Services, U.S. House of Representatives, 109<sup>th</sup> Congress, 1<sup>st</sup> Session. Washington, DC: U.S. Congress. Secretary Jackson's remarks are published at <http://financialservices.house.gov/media/pdf/109-28.pdf>.

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## Additional Reading

Ambrose, Brent W. 2005. "A Hazard Rate Analysis of Leavers and Stayers in Assisted Housing Programs," *Cityscape: A Journal of Policy Development and Research* 8 (2): 69–94.

Freeman, Lance. 2005. "Does Housing Assistance Lead to Dependency? Evidence From HUD Administrative Data," *Cityscape: A Journal of Policy Development and Research* 8 (2): 115–134.

Olsen, Edgar O., Scott E. Davis, and Paul E. Carrillo. 2005. "Explaining Attrition in the Housing Voucher Program," *Cityscape: A Journal of Policy Development and Research* 8 (2): 95–114.