Gender Differences in Nursing Home Durations Among the Elderly: A Backward Recurrence Time Approach

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Abstract

This paper proposes two parametric regression models for the current nursing home duration data. It studies the effects of marital status and health conditions on nursing home stays among elderly men and women. More precisely, it focuses on whether the differences in marital and health statuses between the two genders cause different patterns in nursing home stay lengths. Results from this analysis indicate that marriage reduces elderly males’ nursing home stays by 30% when compared to females of the same age and status. In addition, health status also plays an important role in explaining why elderly males have shorter nursing home stays than elderly females.

Keywords: nursing home, duration models, survival analysis, backward recurrence time, accelerate failure time model, weibull distribution, generalized weibull distribution.
1. Introduction

Based on the National Center of Health Statistics in 2007, over 1.4 million people were living in nursing homes in the United States, and the national average price of a semiprivate room was $189 per day. The statistics have also shown that this price has steadily increased over the years. Also, data from the 1999 National Nursing Home Survey (NNHS) of the National Center for Health Statistics shows that the overall average length of a nursing home stay was 761 days. That is, an elderly individual may need to spend approximately $143,829 (761 days × $189) on average for their nursing home costs. Or, if an individual enrolls in a governmental insurance policy (i.e. Medicaid\(^1\)), the government has to cover the costs fully for the individual; this expenses then will be a heavy burden for the government. Therefore, the length of a nursing home stay plays an important role in managing the costs of nursing home care for both policymakers and individuals.

Additionally, the above NNHS data shows that the length of a nursing home stay for elderly men and elderly women admitted after the age of 65 was different (Charts 1 (a) and 1 (b)). Compared to elderly females, elderly males consistently stayed for shorter durations. 50% of elderly males stayed less than one year compared with 43% of elderly females, and only 8% of them stayed over 5 years in the nursing home compared with 11% of elderly females.

\(^1\) Medicaid is a health insurance program for lower income class individuals regardless of their ages. Once being eligible for Medicaid (i.e., the individual passes both the income and asset test), the individual’s nursing home expenses are 100% covered if he did not have other insurance plan to cover the expenses for him.
This phenomenon is caused by differences in individuals’ characteristics such as marital and health statuses. For example, the 1999 America’s Family and Living Arrangements statistics reported from the U.S. Census Bureau shows that more elderly men are married than elderly women (Table I) because women tend to outlive their husbands. In addition, a study from 2003 Family Caregiver Alliance at the National Center on Caregiving indicates that 59% to 75% of informal caregivers are females, and female caregivers may spend as much as 50% more time on providing care than male caregivers. Thus, elderly men have a higher chance of receiving informal care at home and, therefore, delaying their entrance into a nursing home.

The 2002 and 2006 Health, United States show that men tend to have a higher risk of cancer or incurring an occupational injury than women, both of which correspond to a short-term stay in a nursing home, while women have a higher risk of becoming disabled (Tables II and III) and having joint problem, both of which correspond to a long-term stay in a nursing home. These differences in health status may result from different health behaviors between women and men.
The *Senior Journal*[^1], within its “Women Face Much Different Challenges than Men in Aging Process,” states that (2007) elderly men are more likely to smoke and drink. For example,

between 1965 and 2004/2005, the percentage of noninstitutionalized women aged 65 years and over (age adjusted) who were current cigarette smokers rose from 8 percent in 1965 to 13 percent in the mid-1980s, and then decreased back to 8 percent in 2004/2005. The percentage of older men who smoked decreased from 25 percent in 1965 to 9 percent in 2004/2005. ([http://seniorjournal.com/NEWS/Aging/2007/7-04-17-WomenFace.htm](http://seniorjournal.com/NEWS/Aging/2007/7-04-17-WomenFace.htm))

The journal also states that “[i]n 2005, 7 percent of noninstitutionalized men aged 65 years and over reported having had five or more drinks in 1 day at least once in the past year compared with 1 percent of women.” These statistics show that elderly men have lived their lives in such a way as to provide themselves with higher health risks in their later lives than elderly women. Thus, by the time an elderly man enters a nursing home, his health has already deteriorated in such a way as to increase his probability of dying.

The main goal of this study is to obtain a better understanding of what causes the different durations of nursing home stay lengths for elderly men and women. To that end, this paper uses data from the 1999 NNHS current resident file. Two important properties of this data set are that only a random sample of individuals who were in a nursing home at the time of the survey were observed and nursing home stays in which the individual was discharged or died were not observed. Thus, this paper studies the nursing home stays that occurred between the survey date and the date of nursing home admission. Therefore, the paper is able to estimate

nursing home stay durations from the time of interview back to the time when each individual was admitted to the facility, which is referred to as a backward recurrence time approach.

The study is constructed as follows. Section 2 contains the literature review. Section 3 contains the data description and statistics, while Section 4 contains the model. Finally, the results and conclusions are presented in Sections 5 and 6.

2. Literature Review

Nursing home utilization or the risk of entering a nursing home has been studied in many different ways. Most of these studies have discussed the relationship between an individual’s characteristics and the risk of entering a nursing home, and have, therefore, discussed how informal care or public insurance policies have affected nursing home use and the length of an individual’s nursing home stay. For example, it has been shown that being female, unmarried, white, living alone or not having any living children, being eligible for Medicaid or having dementia or a high impairment level are associated with a higher probability of nursing home use and a longer stay duration in a nursing home (Liu, ScD, & Manton, 1983; Liu, ScD, Coughlin, & McBride, 1991; Keeler, Kane, & Solomon, 1981; Murtaugh, Kemper, Spillman, & Carlson, 1997; Garber & MaCurdy, 1990; Laditka, 1996; Kemper, Komisar, & Alexihi, 2005).

Headen (1993) claims that an individual’s rising wealth level would reduce that individual’s risk of entering a nursing home. That is, his results show that the nursing home service is an inferior good and that wealthier individuals would accept alternatives, such as home health care instead of entering a nursing home. Tinetti and Williams (1997) indicate that falls and fractures are strong predictors of the demand for skilled nursing home services.
Previous research on the effect of informal care on the length of a nursing home stay has shown that informal care is a substitute for formal care. Females are more likely than males to provide informal care, and more likely than males to care for longer hours (Bolin et al., 2007; Dwyer, 2007; Houtven and Norton, 2004; and Carmichael and Charles, 2003). For example, according to Dwyer (2007), approximately 60% of informal caregivers are females. Also, Freedman (1993) states that informal care reduces the length of a nursing home stay. He uses a backward recurrence time approach to show that living with a spouse will decrease the length of nursing home stays by four months for men and three months for women. On the other hand, living with a child can decrease the average length of stay by three months for women, but has no effects on men. Pezzin, Pollak, and Schone (2006) then point out that compared to biological children, step children would be less likely to take care of their parents or co-reside with parents.

Charles and Sevak (2005) use two-stage least square estimates to examine the nursing home utilization and use children’s characteristics as the instruments for informal care. They find that, first, nursing home admission and informal care are negatively related, and, therefore, substitutes, after controlling for endogeneity from the receipt of informal care. However, informal care is only a substitute for a long-term care resident not for a short-term care resident. Second, if a daughter or son lives close to the parents, then the parents have a 3% or 4% higher probability of receiving informal care. Third, receiving informal care reduces individual’s risk of entering a nursing home by 39-49%.

In their study, Bruni and Ugolini (2006) state “[T]he severity of disability of elderly people or eligibility for Medicaid pays a major role in the decision of choosing an institutional care (ex: nursing home facilities) or an informal care (care at home)” (p. 87). In addition, they find that family size, income and attitude (e.g., intergeneration relationships and willingness to
provide home care) are good predictors of the choice between formal and informal care. If younger family members are willing to provide care to their seniors, the seniors would choose to receive informal care at home instead of entering a nursing home.

Studies on the affects of Medicare\(^3\) and Medicaid on nursing home utilization state that the primary payment for long-term stays at nursing homes are almost never covered by Medicare. In contrast, Medicaid support is an important contribution to long-term stay patients and is associated with a higher probability of nursing home use (Keeler, Kane, & Solomon, 1981; Garber & MaCurdy, 1990; Gulley & Santerre, 2003). Therefore, a higher Medicaid reimbursement rate would increase utilization of nursing home services.

However, Grabowski and Gruber (2005; 2007) have different findings on the effects of the Medicaid policies. They concentrate on how changes in State policies (i.e., eligibility for Medicaid coverage, Medicaid reimbursement and nursing home capacity restriction) affect nursing home use and suggest that the demand for nursing home care services is quite inelastic with regard to state policies. Changing Medicaid policy (i.e. decreasing Medicaid reimbursement) will not affect much of an individual’s nursing home use rate.

Although these studies acknowledge the importance of an individual’s demographic information, informal care and the importance of an individual’s insurance status on nursing home use and length of stay, the extent to how marital status and health conditions affect and cause nursing home experiences to differ for men and women has not been demonstrated. The 1999 NNHS current resident file reveals that more elderly men were married and stayed fewer days than elderly women (see Tables IV and V). For example, Table V shows that, compared to

\(^3\) Medicare is a health insurance program for individuals over 65. It only pays for nursing home services for the first 100 days under the hospital insurance plan or part A plan. Under this plan, the insurance will cover the full expenses for the first 20 days and then, according to data from 2007, will cover $124 per day until day 100. After 100 days, the residents are required to pay the full nursing home service expense amount. Medicare is more likely to be associated with short-term stays.
approximately 10% of elderly female residents, approximately 40% of elderly male residents were married. In addition, elderly female residents spent approximately three more months than elderly male residents (794.46 days vs. 666.33 days (Tables V)) in the nursing home. One possibility to explain this circumstance is that, because women have longer life expectancies and, therefore, tend to outlive their husbands. Also, on average, husbands are older than their wives (Lakdawalla and Schoeni, 2003) and, therefore, have a higher chance of dying, leaving women more likely to be widowed.

Additionally, as mentioned before, elderly men are more likely to receive informal care from their spouses because the majority of informal caregivers are females. This fact can be another reason to explain why male nursing home residents tend to be short-term residents. A third possibility is the differences between women and men’s health statuses. For example, the statistics from the 2002 Health, United States shows that elderly women were more likely to need help undertaking daily activities than elderly men (Table III) in 1999. This need implies that elderly women are more likely than elderly men to need long-term care, and may ultimately lead elderly females to have a longer stay in a nursing home.

The data from the 1999 NNHS current resident file indicates that elderly men were more likely to receive occupational therapy or physical therapy. These therapy services are associated with the skilled care. (Table V). On the other hand, women tended to need the assistance to do the activities of daily living, which is associated with long term personal care.

After compiling the data, this paper applies two parametric regression models, Weibull and generalized Weibull, to the current nursing home durations. The results of these models find that married individuals or individuals who receive physical or occupational therapy have shorter nursing home stays than unmarried or individual who receive personal care. Additionally, the
results show that, compared to married female residents, married male residents stay approximately 30% fewer days during each nursing home stay. Also, male patients who need therapy services tend to stay approximately 40% fewer days during each nursing home stay than female residents with the same needs. These results provide evidence that explains why male nursing home residents stay fewer days than female residents.

3. Data

The data used in this paper is collected from the 1999 NNHS current resident file. The NNHS survey was conducted between July and December, 1999. The file contains nursing home resident demographical characteristics, health conditions and payment sources.

Sample selections for the NNHS study are based on a two-stage design. The first stage is to select nursing home facilities. The second stage is to select current nursing home residents, up to six current residents for each facility. The 1999 current resident file included 8,215 current nursing home residents (7,157 residents over the age of 65) from 1,423 nursing homes.

Graph 1. Nursing Home Durations.

This type of cross-section survey data has some particular features. First, the entire current resident population consists of individuals already in a nursing home. Therefore, rather

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than observe a random sample of individuals who enter a nursing home during an interval time (flow sampling: duration x1 in Graph 1), a random sample of residents that are in a nursing home at the time of the interview are observed (stock sampling: durations x2 and x3 in Graph 1).

Second, some individuals may leave the nursing home due to death, hospitalization or moving back into the community by this interview time (complete spells: x3 in Graph 1), but others may stay in the nursing home (incomplete spells: x2 in Graph 1) until some time after 1999. Therefore, all of the observations are right-censored.

Finally, the 1999 NNHS current resident file asked interviewees the following question: “What was the date of (his/her) most recent admission with this facility, that is, the date on which (he/she) was admitted for the current episode of care?” One should treat this data with a backward recurrence time approach (see Graph 2), which states that the length of the nursing home duration is measured backward from the survey time to the date of last admission either at or before the survey time.

![Graph 2. Recurrence Times. U: Backward Recurrence Time. V: Forward Recurrence Time. S: Complete Spell.](image)

This paper focuses on the behavior of the elderly population. Therefore, individuals under the age of 65 are omitted. After eliminating these individuals and any individuals with missing
data for any of the independent variables, 5,470 residents remained in the data set. Of the remaining individuals, 4,040 are women and 1,430 are men.

The dependent variable for this study is an individual’s nursing home stay length. The average and median censored length of stay in the sample are approximately 2.17 and 1.33 years for elderly women and 1.82 and 1.01 years for elderly men, respectively. The differences in nursing home length of stay between genders may be affected by an individual’s demographic characteristics and nursing home facility supply factors, such as facility type (i.e. for-profit or non-profit).

The explanatory variables used in this study include: (1) the individual’s characteristics such as gender, age at admission, marital status, residence status before entering a nursing home and health status; (2) the individual’s insurance status, including the resident’s primary method of payment since admission and (3) the facility’s status, such as the facility type (for-profit/non-profit) and supply of beds, which is intended to address the “supply-induced-demand” problem. More details about these explanatory variables are provided below.

First, in regard to the health status of the elderly individuals, the 1999 NNHS current resident file indicates which types of services the individuals had received within the last month or since admission.\textsuperscript{5} From this information, two additional indicator variables could be generated: THERAPY, which equals one if the resident received either occupational or physical therapy, and ADL, which equals one if the resident had at least three daily living activity limitations. In order to answer why elderly male nursing home residents spend fewer days in a nursing home than elderly female residents, I hypothesize that THERAPY would be negatively

\textsuperscript{5} Using the term “last month” means that the residents were admitted to the nursing home in the month before the interview month or earlier. Additionally, the term “since admission” means that the residents were admitted to the nursing home in the month an agent was interviewed.
and statistically significantly related to nursing home durations and that the coefficient of ADL would be a significant positive number.

Second, several demand factors are associated with an individual’s nursing home stay length. For example, marital status can be treated as a potential informal care variable. If an elderly person is married and his/her spouse is still alive and healthy, then his/her spouse may be able to provide some informal care at home. Such care would delay the individual’s entrance into a nursing home or reduce the length of the nursing home stay. As males are more likely to receive informal care from their family members (Dwyer, 2007), men would be expected to spend less time in a nursing home.

Racial/ethnic differences may also have an effect on nursing home utilization. Some researchers report that Caucasian individuals use significantly more nursing home services and are more likely to die in a nursing home than all other races (Laditka, 1996; Liu, Wissoker, & Swett, 2007). Also, Cagney and Agree (2005) state that African-Americans are more likely than Caucasians to get married at a young age, and, thus, become parents at an early age and, therefore, are more likely to have a larger family size than non-African-Americans. Such life experiences would increase an African-American individual’s probability of receiving informal or home health care. Moreover, the 1999 NNHS current resident file shows that approximately 90% of nursing home residents were Caucasian (Chart 2). Therefore, in regard to the race variable, those individuals who are Caucasians may be more likely to have a long-term nursing home stay.

In addition, the older an individual is, the higher the negative relationship is that the individual has with the length of his/her stay at a nursing home. This negative relationship occurs because the older an individual is, the higher the risk of dying or being discharged to death from
a nursing home the individual has. This evidence can be showed by using the 1999 NNHS discharged resident file. For example, Chart 3 shows that forty-three out of one hundred individuals whose ages were over the age of 85 died while in a nursing home, compared with twenty-four out of one hundred elders who were at the ages of 65 – 74.

Where a patient resides directly before entering a nursing home facility may also be a predictor of how long the individual’s nursing home stay will be. For instance, individuals who stayed in a hospital immediately prior to entering a nursing home facility probably have an acute disease or need skilled therapy care. Therefore, the patients who come from a hospital may tend to be short-stay residents. An individual’s insurance status may influence his nursing home stay length as well. The individuals whose payments were paid from their own income or Medicare consistently may stay fewer days in a nursing home than those residents whose payments were covered by Medicaid.

Third, the effect of the “supply-induced-demand” problem on nursing home durations is examined within this study. The 1999 NNHS current resident file contains information about the supply of nursing home beds and nursing home facility types. The number of nursing home beds per old population can be an indicator of supply conditions in the nursing home market. A
facility containing a large number of beds indicates that the facility has a large capacity, which may, in turn, delay an individual’s discharge from the nursing home.

A nursing home’s facility type, either for-profit or non-profit, may have an effect on the length of an individual’s stay in a nursing home. For example, for-profit facilities may shorten a nursing home resident’s stay to attract more patients to the facility in order to earn more profits. Basic summary statistics are displayed in Table V.

Finally, this article carefully examines the interactions between gender and marital status, gender and health status and the interaction between gender, health and marital statuses in order to examine how marriage and health conditions impact both male and female nursing home stay durations. For example, these considerations can show that, compared to married female residents, whether married male residents would have a shorter duration, and how much shorter this duration would be. In addition, among all patients who need therapy services, the treatments of gender and health and the treatments of gender, health and marital status can examine whether male patients or married male residents would have a shorter length of stay than female residents or married female patients, respectively.

4. Model

Three main methods have been applied to measure an individual’s expected nursing home stay length in the previous literatures. One method is to use the life table model (Liu, ScD, & Manton, 1983; Liu & Manton, 1991), which estimates an individual’s movement from one state (i.e., living in a nursing home) to another in order to measure the average expected length of a stay in a nursing home. A second method is to apply a Markov model and micro-simulations (Manheim & Hughes, 1986; Garber & MaCurdy, 1990; Laditka, 1996; Xie, Chaussalet, &
Millard, 2005), both of which compute the probability of a transition from one state to another (i.e., from a nursing home to death, from a nursing home to the individual’s community, from the individual’s community to a nursing home or from an individual’s community to death). These models generate transition probabilities between different states in order to estimate the lifetime use of nursing homes for individuals who were, at the time of the data survey, in a nursing home. The third approach then focuses on the hazard model (Liu, ScD, Coughlin, & McBride, 1991; Dick, Garber, & MaCurdy, 1992; Williams & Mehr, 1993), which estimates the probability of leaving a state (i.e., the probability of being discharged from a nursing home).

Diverging from the paths chosen by previous authors, this study applies two parametric regression models, Weibull and generalized Weibull, for a backward recurrence time approach to the current nursing home durations in order to evaluate demand and supply factor effects.

The reason to use a backward recurrence time approach is that, according to the studies conducted by Allison (1985) and Ali et al. (2001), a cross-section survey usually only includes information on the duration for a specific group (i.e., nursing home residents in this study) that can be observed at the time of the survey. Researchers often cannot follow up on the true survival time after the survey ends. That is, a cross-section data set often refers to the backward recurrence time data (study individuals’ behaviors from the interview date back to the starting time of an event) and often contains incomplete durations.

This approach has been explored in many research areas. For example, the backward recurrence time model has been used to estimate the length of the use of contraceptive pills (Ali et al., 2001), the distribution of time from conception to pregnancy (Weinberg, 1986; Keiding et al., 2002; Scheike & Keiding, 2006) and the duration of current residence (Allison, 1985; Baydar
& White, 1988). This study then applies this approach to analyze two genders’ differences in their nursing home stay lengths.

4.1. Assumptions

In this analysis, a backward recurrence time approach will refer to the time from the beginning of the survey back to the individual’s most recent admittance into a nursing home. Hence, one important assumption when estimating a duration model with a backward recurrence time approach is that the nursing home entry has to be produced by a renewal process. Cox (1962) and Lancaster (1990) point out that this process states that the components in a population are replaced immediately upon failure (ex: electric light bulb), and the process is primarily applied in response to the failure and replacement subjects. They define a renewal process as a series of positive, independent and identically distributed random variables \( \{ T_i \} \). One could treat these \( T_i \)s as the lifetimes and the start of each new life, and name them renewals or events. In this study, the \( T_i \)s can be thought of as nursing home stay durations and the beginning of a new nursing home stay. For example, when a patient leaves a nursing home, failure time occurs. Then, the empty bed is filled with a new patient, which is realistic as nursing home facilities often have waiting lists for entrance. Graph 3(a) provides an example of this process. For instance, suppose that a patient enters a nursing home at time \( t_0 \) and leaves a nursing home at time \( t_1 \) (duration \( T_1 \)). After he leaves, he will be replaced immediately by a new patient with a duration \( T_2 \). Let this process be continued and the second patient will be replaced immediately by a new patient. Therefore, the duration (ex: \( T_1, T_2, ..., T_5 \)) in Graph 3(a) is the nursing home stay and the start of each new nursing home spell.
In addition, notice that only a random sample of individuals who were in a nursing home at the time of the survey could be observed. Also, the NNHS survey asked the interviewees the date of the most recent admission to the facility. This question corresponds with \( U_1, U_2, U_3, \) and \( U_4 \) in Graph 3(b), which are the renewals or all of the durations that are not aggregated from previous stays/admissions. Therefore, the NNHS survey satisfies the renewal process assumption. All of the residents’ nursing home durations in the data are renewals.

(a)

![Graph 3](image-url)

(b)

**Graph 3. Renewal process**

The other assumption needed is that the survey time, (i.e., when the sample was created) is independent from the start of the nursing home entry. This means that any spell that is generated in the sample is independent from any other spell. According to Freedman (1993), the NNHS dataset was designed as a serial evaluation of nursing home facilities and did not occur in any particular nursing home development enterprise. Thus, the date of the survey is not related to
the institutionalization process. Given these two assumptions, a backward recurrence time approach model can be applied.

4.2. Theoretical Analysis

Suppose that \( U \) is the observed incomplete duration of a nursing home stay and \( T \) is the unobserved complete duration of a nursing home stay. As the distribution of \( U \) must be derived from the distribution of \( T \), choosing an appropriate parametric regression model is important. In this case, this study chooses to utilize a model from the Weibull family, which is often used to analyze lifetime data for survival studies. These models allow researchers to acquire more flexible monotone hazard rates than other commonly used models, such as exponential, log-logistic, or log-normal distributions.

For this article, it is assumed that the complete nursing home stay duration is Weibull distributed. Then, the duration presents an alternative distribution, the generalized Weibull distribution, for the complete nursing home stay durations. The generalized Weibull distribution offers a more flexible shape in regard to the hazard rates by adding one more shape parameter.

4.2.1. Weibull Distribution

When the complete spell \( T \) is assumed to be Weibull distributed, its probability function can be written as

\[
f(t) = \gamma \alpha t^{\alpha-1} \exp\{-(\gamma t)^\alpha\}
\]

and the survival function is

\[
S(t) = \exp\{-(\gamma t)^\alpha\}.
\]

Therefore, the hazard function is

\[
\lambda(t) = \frac{f(t)}{S(t)} = \gamma \alpha t^{\alpha-1},
\]

which is the probability of leaving a nursing home conditional on having survived to time \( t \). In this model \( \gamma > 0 \) is the proportion parameter, and \( \alpha > 0 \) is the shape parameter. Also, notice that \( \alpha > 1 \) states that the Weibull hazard function is monotone increasing over time, and that the hazard
function is monotone decreasing over time when \( \alpha < 1 \). This distribution has a mean of \( E(T) = \gamma^{-1} \Gamma(\alpha^{-1} + 1) \) and a variance of \( V(T) = \gamma^{-2} \left[ \Gamma(2\alpha^{-1} + 1) - [\Gamma(\alpha^{-1} + 1)]^2 \right] \), where \( \Gamma(.) \) is the gamma function.

Following the renewal theory and lifetime data theorem (see Appendix A), it can be shown that the probability of a nursing home entry will be proportional to its complete duration \( T \). The probability density function and the cumulative distribution function for the incomplete duration \( U \) are then given by the following equations, which are different from the distribution of the complete spell \( T \) (see Appendix B):

\[
g(u) = \frac{1 - F(u)}{E(T)} = \frac{S(u)}{E(T)} \tag{1}
\]

\[
G(u) = \frac{1}{E(t)} \int_0^u [1 - F(u)] \, dx = \int_0^u \frac{S(x)}{E(T)} \, dx . \tag{2}
\]

After transforming the model for the complete duration (\( F(.) \)) into the incomplete duration (\( G(.) \)), Equations (1) and (2) can be rewritten as Equations (3) and (4):

\[
g(u) = \gamma e^{x \left[ -\left( \gamma u \right)^{\alpha} \right]} \tag{3}
\]

\[
G(u) = I(\alpha^{-1}, \gamma u^{\alpha}) \tag{4}
\]

where \( I(\alpha^{-1}, \gamma u^{\alpha}) \) is the incomplete gamma function. Unlike the cumulative distribution function of complete spells \( T \), \( G(.) \) becomes a member of the generalized gamma distribution function (Allison, 1985).

### 4.2.2. Generalized Weibull Distribution

The generalized Weibull distribution model has two shape parameters, \( \alpha \) and \( \rho \). This distribution relaxes the restriction on the shape of the hazard function. The probability density function

\[
l(a,x) = \frac{1}{\Gamma(a)} \int_0^x e^{-t} t^{a-1} \, dt , \quad 0 < l(a,x) < 1.
\]
function of this distribution is \( f(t) = \gamma^\alpha at^{\alpha-1}\{1 - \rho(yt)^\alpha\}^{\frac{1}{\rho}} \) and the survival function is 
\[ S(t) = \{1 - \rho(yt)^\alpha\}^{\frac{1}{\rho}}. \]
Therefore, the hazard function becomes 
\[ \lambda(t) = \frac{f(t)}{S(t)} = \gamma^\alpha at^{\alpha-1}\{1 - \rho(yt)^\alpha\}^{-\frac{1}{\rho}}. \]
Following Mudholkar, Srivastava and Kollia (1999, p.1576) Theorem 1, the shape of the hazard function in this case is U-shaped if \( \alpha < 1 \) and \( \rho > 0 \), monotone decreasing if 
\( \alpha \leq 1 \) and \( \rho \leq 0 \), unimodal if \( \alpha > 1 \) and \( \rho < 0 \), monotone increasing if \( \alpha \geq 1 \) and \( \rho \geq 0 \) and constant if \( \alpha = 1 \) and \( \rho = 0 \). The mean of the distribution is 
\[ E(T) = \alpha^{-1}(\gamma p)^{-\frac{1}{\alpha}} B(\alpha^{-1}, 1 + \rho^{-1}), \]
where \( B(\cdot) \) is the beta function. After applying the renewal theory and lifetime data theorem, the probability density and cumulative distribution functions for the incomplete duration \( U \) can be written as Equations (5) and (6):

\[ g(u) = \frac{a(\gamma p)^{\frac{1}{\alpha}}(1-\rho)(yu)^{\alpha}}{B(\alpha^{-1}, 1+\rho^{-1})} \]  
(5)

\[ G(u) = I_x(\alpha^{-1}, 1 + \rho^{-1}, (yu)^\alpha) \]  
(6)

where \( I_x(\alpha^{-1}, 1 + \rho^{-1}, (yu)^\alpha) \) is the incomplete beta function.\(^7\)

4.3. Estimation

Obtaining the probability density and the cumulative distribution functions for the incomplete spells (Equations (3), (4), (5) and (6)) facilitates the derivation of the likelihood and log-likelihood functions used to analyze the influences of the covariates on the mean durations.

Consider a right censoring model where one observes the incomplete durations \( u_i \) if a resident enters a nursing home at some point before the start of the survey and remains in the nursing home until the end of the survey. That is, \( u_i = \min(U_i, C_i) \); \( u_i \) will take the values that are less than \( C_i \), which is the censoring time in the model and a fixed constant (survey year 1999).

\(^7\) \( I_x(a, b, x) = \frac{1}{B(a, b)} \int_0^x t^{a-1}(1-t)^{b-1} dt, a, b > 0 \)
for all residents, and $i = 1, 2, ..., n$ presents individuals. $d_i = 1[U_i \leq C_i]$ is denoted as the indicator function and is equal to one if the duration $U_i$ is less than or equal to the survey time.

$$\Pr(u_i = C_i, d_i = 0) = \Pr(U_i > C_i) = S(u_i)$$

$$\Pr(u_i, d_i = 1) = g(u_i) \quad u_i \leq C_i$$

Therefore, the joint probability density function is

$$g(u_i)^d_i \Pr(U_i > C_i)^{1-d_i}$$

Next, suppose that the nursing home durations $U_1, U_2, ..., U_n$ are statistically independent. Then, the likelihood function for the case that the complete spell $T$ is Weibull distributed can be obtained via Equation (7):

$$L = \prod_{i=1}^{n} g(u_i)^{d_i} S(u_i)^{1-d_i} = \prod_{i=1}^{n} \left( \frac{\gamma e^{-(\gamma u_i)^{\alpha}}}{\Gamma(\alpha^{-1}+1)} \right)^{d_i} [1 - I(\alpha^{-1}, (\gamma u_i)^{\alpha})]^{1-d_i} \quad (7)$$

and its log-likelihood function as Equation (8):

$$l = \sum_{i=1}^{n} \left\{ d_i \log \left( \frac{\gamma e^{-(\gamma u_i)^{\alpha}}}{\Gamma(\alpha^{-1}+1)} \right) + (1 - d_i) \log[1 - I(\alpha^{-1}, (\gamma u_i)^{\alpha})] \right\}.$$  \quad (8)

Also, the likelihood function for the case that $T$ is a generalized Weibull distribution can be obtained as Equation (9):

$$L = \prod_{i=1}^{n} g(u_i)^{d_i} S(u_i)^{1-d_i}$$

$$= \prod_{i=1}^{n} \left( \frac{\alpha (\gamma \rho)^{\frac{1}{\rho}} (1-\rho (\gamma u_i)^{\alpha})^{\frac{1}{\rho}}}{B(\alpha^{-1}, 1+\rho^{-1})} \right)^{d_i} [1 - I_x(\alpha^{-1}, 1 + \rho^{-1}, (\gamma u_i)^{\alpha})]^{1-d_i} \quad (9)$$

and its log-likelihood function as Equation (10):

$$l = \sum_{i=1}^{n} \left\{ d_i \log \left( \frac{\alpha (\gamma \rho)^{\frac{1}{\rho}} (1-\rho (\gamma u_i)^{\alpha})^{\frac{1}{\rho}}}{B(\alpha^{-1}, 1+\rho^{-1})} \right) + (1 - d_i) \log[1 - I_x(\alpha^{-1}, 1 + \rho^{-1}, (\gamma u_i)^{\alpha})] \right\}.$$  \quad (10)
After expanding the log-likelihood function, it can be shown that the model can be rewritten for both the Weibull and generalized Weibull distributions:

$$\log(U) = \theta(\alpha) - \log(\gamma) = \beta_\alpha + \beta x + \nu$$

where $\gamma = \exp(x'\beta)$, $x$ is the set of covariates and $\theta(\alpha)$ is an expression that is not associated with the covariates. This model is well-known as the Accelerated Failure Time (AFT) model or ln(times) model. It is commonly used in the analysis of backward recurrence times and current duration data. Instead of learning how the actual risk process changes with the different values of the covariates (the Proportional Hazard model), this study decides to utilize an AFT model in order to examine how the different values of $x_i$ would affect the expected values of $\log(u_i)$. The estimators of parameters can be obtained by the maximum likelihood estimation (MLE).

4.4. The choice of the distribution

(to be continued).

5. Results

Two parametric regression models, Weibull and generalized Weibull, are applied to the backward recurrence time data from the NNHS current nursing home data file on nursing home stay durations in order to analyze how marital and health statuses of elderly individuals cause differences between nursing home stay lengths for elderly men and women. The results of these models are shown in Table VI. Method (1) in Table VI shows the results without any interaction

---

8 An AFT model is an alternative parametric model to the proportional hazards model used in survival analysis. An AFT model assumes that the effects of the covariates are to multiply the predicted event time by some constant ($t_i = \exp(-x_i'\beta)t_i$), and, therefore, can be formed as a linear model for the logarithm of the survival time ($\ln(t_i) = x_i\beta_s + \epsilon_i$). Unlike proportional hazards models, the estimates from AFT models are more robust and less affected by the choice of which probability distributions to use (Lambert, Collett, Kimber, & Johnson, 2004). Also, more probability distributions can be used in AFT models, including distributions that have unimodal hazard functions. Finally, the results of the AFT model are easily interpreted (Kay & Kinnersley, 2002).
between the terms. Methods (2) to (5) show the results with treatments for gender and marital status, gender and health conditions, and gender, marital status and health status.

Most of the coefficients in method (1) have expected signs. The coefficients of the individual characteristic effects, such as gender, age at admission, marital status, race, payment sources and residence before entering a nursing home, strongly influence nursing home stay durations. These influences exist for several reasons. First, as females are the often the providers of informal care (Evason, 2007; Center on an Aging Society, 2005), men are more likely to receive care from their wives or daughters at home. Therefore, men are expected to have a shorter nursing home stay. The results of this study coincide with this reasoning as a resident who is male has an expected log nursing home stay value of 0.1339 points less than a female resident. Thus, on average, compared to the predicted length of stay for female residents (817 days), the predicted nursing home stay will decrease to 670 days for male residents.

Results from this study suggest that individuals admitted to a nursing home at older ages are associated with short-term nursing home stays. This result occurs because an older individual is more likely to be in poor health and, consequently, has a higher chance of dying. In addition, like most studies on the effects of race on nursing home stay lengths, being Caucasian has a positive effect on the length of a nursing home stay.

Marriage can also be an indicator of potential informal care, and it is assumed that married individuals are more likely to receive informal care at home from their spouses. Model (1) provides evidence that marriage is, in fact, negatively and significantly associated with nursing home stay lengths.

The results also show that paying nursing home expenses on one’s own or with Medicaid has a weak correlation to the individual’s nursing home stay length. Conversely, the effect of

\[ \ln(\mu_{\text{male}} = 1) - \ln(\mu_{\text{male}} = 0) = \beta_1 = -0.1339 \]
Medicare has a significant negative relationship to an individual’s nursing home stay length. Moreover, residents who live at home or a hospital right before entering the nursing home facility also play an important role in this study.

Health status variables such as THERAPY and ADL have a negative and positive effect on nursing home stay durations, respectively. The coefficient of THERAPY in method (1) is negatively and statistically significantly associated with a nursing home stay duration. An individual who receives occupational therapy or physical therapy while in a nursing home will decrease his/her expected logarithm value by 0.4844 points. That is, compared to non-therapy residents’ predicted stay length (approximate 906 days), individuals who received therapy services tended to spend approximate 505 days in a nursing home.

Additionally, daily living activity limitations are positively and significantly related to nursing home stay durations. Residents who needed help with daily living activities are expected to spend 15% more time in a nursing home than those residents who do not need help doing daily living activities.

On the supply side, the nursing home facility type is an important prediction of the nursing home stay duration. The type is statistically and negatively significant. A for-profit nursing home facility may shorten a resident’s stay length in order to admit new patients, who might bring in more money. Bed size, in contrast, has a positive effect on a resident’s stay length, but is not statistically significant.

Methods (2) to (5) in Table VI show the interaction between marriage and gender, marriage and health, and marriage, health and gender. These variables do not have an effect on the basic conclusions of this study.
Results from the interactions between these variables indicate that, compared to married females, married males are expected to reduce their nursing home stays to $0.70 \times (\exp(-0.35))^{10}$ (see coefficients of “Married Male” in methods (2) to (5)). That is, married men are expected to spend 30% less time in a nursing home than married females.

In addition, compared to female (methods (3) to (5)) or unmarried (methods (2) to (4)) patients who need therapy, male (variable “Male_Thy” =1) or married (“Mar_Thy” =1) patients who need therapy tend to spend less time in a nursing home. However, a married male who needs therapy services (variable “Mar_M_Thy” in methods (2) to (5)) will spend more time in a nursing home than a married female who also needs therapy services.

Finally, all of the estimates for $\alpha$ were less than one, which implies that the underlying Weibull hazard function is monotone decreasing. That is, the risk of leaving a nursing home decreases with time since the most recent admission. This result may occur due to the fact that only the residents in nursing homes in 1999 could be observed. Thus, the longer that a patient stayed in a nursing home, the higher the individual’s chance that he/she would be sampled in the data. Therefore, the 1999 NNHS current resident file might have contained individuals who had been in the nursing home for an extended period of time, thus decreasing the rate of discharge from the nursing homes.

The results from the generalized Weibull distribution (to be continued)

6. Conclusion and Discussion

This study analyzes the pattern found within the length of stay of male and female nursing home residents utilizing marital and health statuses as variables. In order to discover this

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10 The time ratio for nursing home stay lengths for married male residents ($u_{im}^m = \exp(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k) v_i$) and for married female residents ($u_{in}^m = \exp(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k) v_i$) is $\exp(\beta_3)$, where $x_3 = 1$ if mar male = 1.
pattern, the paper applies two parametric regression models for the current data that allows it to conduct a backward recurrence time approach analyses on the data within the 1999 NNHS current resident file. The findings show that marriage has a negative effect on nursing home stay durations as more elderly male residents are married than female residents. Also, male residents have a higher chance of receiving informal care from their spouses and, therefore, spend less time in a nursing home than a married female patient.

Several limitations exist in this study. The first stems from the limitations in the data, including missing values. After eliminating the missing marriage, insurance, residence and health indicated variable, the resident pool is reduced from 7,157 to 5,470 individuals. The results could have potentially caused a sample selection bias problem. This study chooses to deal with this problem by generating indicator variables that indicate the missing values for each independent variable, which sets the value of the missing variable to one, and includes these indicator variables in the regressions. After generating the indicator variables, the paper is able to use all 7,157 observations. The results are shown in Table VII. The magnitudes are the same as the results from using only 5,470 observations. For example, being males, being placed in a nursing home at an older age, being married or being covered by Medicare program is significantly negatively associated with the length of nursing home stays.

After including the indicator variables, the missing information on marriage and insurance do not have a significant influence on the accuracy of the effects of the marriage and insurance statuses on the length of a nursing home stay. However, the missing information as to where residents lived before entering the nursing home and a resident’s limitations in undertaking daily living activities has an important effect on the robustness of the effects of these
two variables. This non-robustness means that the estimates of these two variables may not be correct.

Second, a resident’s health and insurance statuses may not have been treated as exogenous variables. For instance, an individual who has a poor health condition needs more professional care, and, therefore, chooses to enter a nursing home facility, while an individual who has a better health condition would tend to use informal care (Norton, et. al., 2007). In addition, one’s nursing home stay may affect his/her decision of buying private LTC insurance, and insurance status can have an effect on one’s length of stay. Therefore, it is necessary for the study to consider carefully these endogeneity problems.

Third, whether an individual lived in a city or a suburban area and what type of job they had before entering the nursing home may also have influenced the individual’s heterogeneity in regard to his/her health condition, and, ultimately, affects his/her nursing home stay lengths. In addition, the affect of the state in which the resident lived could not be controlled for as no information was provided on in which state the residents lived or in which state the nursing home facility was located. This information is important because different states may have different Medicaid policies. For instance, some States may impose high asset limits, while others may set low asset limits for individuals to be eligible for the Medicaid program.

Fourth, the 1999 NNHS current resident file did not contain enough information on whether the individual had received informal care before entering the nursing home for this to be a useful variable. This information would be useful to have as it could help determine the length of an individual’s nursing home stay based on whether a family member would be able to care for them and provide the individual support necessary once he/she left the nursing home, but was not completely rehabilitated.
Another limitation in this paper is the length of stay bias. This bias occurs because the data set focuses on individuals who were staying in a nursing home in 1999. The longer the individual was in the nursing home, the higher the probability that the individual would end up in the survey and random survey sample. Therefore, the survival time studied in this paper may not be the same as the true survival time.

This bias must be solved in future studies in order to avoid this problem. One way to avoid this problem would be to obtain more robust results and apply a quantile regression to the survival analysis in order to avoid the affects of the long-term nursing home stay lengths that may lead the researcher to overestimate the analysis.

Reference


Tong Lancaster (1990), The Econometric Analysis of Transition Data. Cambridge University Press.


Appendix

Appendix A: Renewal theory and related theorem

* Renewal Theory (Cameron and Trivedi (2005), page 626-7 and Lancaster (1990), page 89):

Suppose that \( N(t) \) is the number of renewals in the interval \((0, c]\); \( H(t) = E[N(t)] \) is the expected number of nursing home renewals in this interval and called renewal function, then the renewal density function at \( t \) can be obtained by differentiating the renewal function \( H(t) \) with respect to \( t \):

\[
h(t) = \lim_{dt \to 0} \frac{E(N(t + dt))}{dt} = H'(t)
\]

* Theorem that is related to \( N(t), H(t), \) and \( h(t) \) (Lancaster (1990), page 90):

Suppose that the lifetimes \( \{T_j\} \) have a mean \( \mu \) and a finite variance \( \sigma^2 \), then the random variable \( Z = \frac{N(t) - t/\mu}{\sigma/\sqrt{t/\mu}} \) will be asymptotically normally distributed as \( t \to \infty \). Also, the renewal and renewal density functions will have the following properties as \( t \to \infty \):

\[
H(t) = E[N(t)] = \frac{t}{\mu} + O(1) \text{ as } t \to \infty
\]

\[
h(t) = H'(t) = \frac{1}{\mu} + o(1) \text{ as } t \to \infty
\]

Appendix B

Based on Lancaster (1990, page 91-92)’s steps, one can think of the incomplete duration \( U \) is the length of time since the sampled residents admitted to a nursing home. When the patient who entered a nursing home at initial time \( t_0 \) and lasted up to time \( C \) (the survey time/censoring time), then one has \( U = C \) with a probability \( S(c) \). On the other hand, the length of spell \( U \) is less than \( C \) (that is, patients were admitted to nursing homes at some point in time after time \( t_0 \)) will lie in a short interval from \( u \) to \( du \) only when there was a renewal in the short interval
between \((c - u - du)\) and \((c - u)\), which has probability \(h(c - u)du\), and the nursing home
duration that began and then lasted at least for \(u\) has a probability \(S(u)\). Subsequently, the
probability density function of \(U\) will be

\[
(1) \quad g(u = c) = S(c)
\]

\[
(2) \quad g(u) = h(c - u)S(u), \quad t_0 < u < c
\]

When \(c \to \infty\), the first probability density function form will vanish because \(S(c)\) will go to zero.

Also, by the second equation of theorem in Appendix A, this term \(h(c - u) \to \frac{1}{\mu}\) for every fixed
\(u\), then equation (2) because \(g(u) = \frac{S(u)}{\mu}\). Apply it to the model, I then have \(g(u) = \frac{S(u)}{E(T)}\), where
\(E(t)\) is the expected values of complete spell \(T\).
### Table I. 1999 marital status by sex and age

<table>
<thead>
<tr>
<th>All Races</th>
<th>Married Spouse Total</th>
<th>Married Spouse Present</th>
<th>Married Spouse Absent</th>
<th>Widowed</th>
<th>Divorced</th>
<th>Separated</th>
<th>Never Married</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-69 years</td>
<td>100.0</td>
<td>78.3</td>
<td>1.0</td>
<td>7.1</td>
<td>8.7</td>
<td>1.0</td>
<td>3.9</td>
</tr>
<tr>
<td>70-74 years</td>
<td>100.0</td>
<td>76.1</td>
<td>1.2</td>
<td>10.8</td>
<td>7.5</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>75+ years</td>
<td>100.0</td>
<td>68.5</td>
<td>1.7</td>
<td>21.4</td>
<td>4.2</td>
<td>0.6</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-69 years</td>
<td>100.0</td>
<td>57.1</td>
<td>1.9</td>
<td>26.0</td>
<td>9.7</td>
<td>1.5</td>
<td>3.8</td>
</tr>
<tr>
<td>70-74 years</td>
<td>100.0</td>
<td>49.2</td>
<td>1.4</td>
<td>36.9</td>
<td>7.7</td>
<td>0.8</td>
<td>4.0</td>
</tr>
<tr>
<td>75+ years</td>
<td>100.0</td>
<td>29.1</td>
<td>1.6</td>
<td>60.0</td>
<td>4.6</td>
<td>0.6</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Note. The “Families and Living Arrangements” report from U.S. Census Bureau, 1999 -- Table A1: Marital Status of People 15 Years and Over, by Age, Sex, Personal Earnings, Race, and Hispanic Origin, March 1999 of reports:

### Table II. Health status of nursing home residents 65+ years of age

<table>
<thead>
<tr>
<th>Dependent mobility*</th>
<th>Incontinent**</th>
<th>Dependent eating*</th>
<th>Dependent mobility, eating, and incontinent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Male</td>
<td>Female</td>
<td>Male Male</td>
<td>Female</td>
</tr>
<tr>
<td>65-74</td>
<td>70.5%</td>
<td>76.4%</td>
<td>63.4%</td>
</tr>
<tr>
<td>75-84</td>
<td>76.9%</td>
<td>78.2%</td>
<td>64.6%</td>
</tr>
<tr>
<td>85+</td>
<td>78.1%</td>
<td>85.2%</td>
<td>63.4%</td>
</tr>
</tbody>
</table>

Note. Health, United States, 2006 --Table 102: Nursing home residents 65 years of age and over.

* Nursing home residents who are dependent in mobility and eating require the assistance of a person or special equipment. ** Nursing home residents who have difficulty in controlling bowels, bladder, or have an ostomy or indwelling catheter.
Table III. Health status of the noninstitutionalized population 65+ years of age

<table>
<thead>
<tr>
<th></th>
<th>ADL limitation</th>
<th>IADL limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>65+</td>
<td>4.9%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

Data resource: Health, United States, 2002 --Table 58: Limitation of activity caused by chronic conditions. (Data are based on household interviews of a sample of the civilian non-institutionalized population)

Table IV. Marital status by age group and sex from 1999 NNHS current resident file

<table>
<thead>
<tr>
<th>Married</th>
<th>All elderly population in the nursing home</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>65~74</td>
<td>37.02%</td>
</tr>
<tr>
<td>75~84</td>
<td>45.60%</td>
</tr>
<tr>
<td>85+</td>
<td>33.26%</td>
</tr>
</tbody>
</table>
Table V. Statistics summary of residents

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Descriptions</th>
<th>Women (%)</th>
<th>Men (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ageadm</td>
<td>Age at admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65~74</td>
<td></td>
<td>59.33</td>
<td>40.67</td>
</tr>
<tr>
<td>75~84</td>
<td></td>
<td>72.58</td>
<td>27.42</td>
</tr>
<tr>
<td>85+</td>
<td></td>
<td>80.61</td>
<td>19.39</td>
</tr>
<tr>
<td>Male</td>
<td>=1 if male</td>
<td>73.86</td>
<td>26.14</td>
</tr>
<tr>
<td>Marriage</td>
<td>=1 if married</td>
<td>9.93</td>
<td>39.51</td>
</tr>
<tr>
<td>Mar_Male</td>
<td>=1 if residents are married male</td>
<td>10.33%</td>
<td></td>
</tr>
<tr>
<td>Mar_Female</td>
<td>=1 if residents are married female</td>
<td>7.33%</td>
<td></td>
</tr>
<tr>
<td>Whites</td>
<td>=1, if resident is white</td>
<td>90.32</td>
<td>87.20</td>
</tr>
<tr>
<td>Primary payment</td>
<td>NH expenditures covered by Medicaid since admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td></td>
<td>55.45</td>
<td>53.50</td>
</tr>
<tr>
<td>Medicare</td>
<td></td>
<td>15.35</td>
<td>16.15</td>
</tr>
<tr>
<td>Ownpay</td>
<td>NH expenditures covered by own/family income or private insurance since admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary payment</td>
<td>NH expenditures covered by Medicare since admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where live before</td>
<td>=1 if stay home immediately before entering this facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td>32.95</td>
<td>31.54</td>
</tr>
<tr>
<td>Hospital</td>
<td>=1 if stay in hospital immediately before entering this facility</td>
<td>44.63</td>
<td>46.99</td>
</tr>
<tr>
<td>Nurhom</td>
<td>=1 if stay in a NH immediately before entering this facility</td>
<td>10.40</td>
<td>12.66</td>
</tr>
<tr>
<td>Health status</td>
<td>=1 if at least three limitations of activities of daily living</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL</td>
<td></td>
<td>85.69</td>
<td>81.61</td>
</tr>
<tr>
<td>Therapy</td>
<td>=1 if received occupational or physical therapy</td>
<td>30.84</td>
<td>33.71</td>
</tr>
<tr>
<td>Mar_Thy</td>
<td>=1 if married patients received therapy services</td>
<td>6.23%</td>
<td></td>
</tr>
<tr>
<td>Male_Thy</td>
<td>=1 if male patients received therapy services</td>
<td>8.81%</td>
<td></td>
</tr>
<tr>
<td>Mar_M_Thy</td>
<td>=1 if married male patients received therapy services</td>
<td>3.97%</td>
<td></td>
</tr>
<tr>
<td>Bedsize</td>
<td>1=3<del>49; 2=50</del>99; 3=100~199; 4=200+ beds</td>
<td>Mode: 3 (46.12%)</td>
<td>63.56%</td>
</tr>
<tr>
<td>Profit</td>
<td>=1 if ownership is for profit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOS</td>
<td>Length of a nursing home stay (in days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>794.46</td>
<td>666.33</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>485.5</td>
<td>367.5</td>
</tr>
<tr>
<td>N</td>
<td>Sample size (Total: 5470)</td>
<td>4040</td>
<td>1430</td>
</tr>
</tbody>
</table>
Table VI. Nursing home durations of residents

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-0.1339*** (0.0397)</td>
<td>-0.1308** (0.0457)</td>
<td>-0.0996 (0.0544)</td>
<td>0.0029 (0.0529)</td>
<td>0.0247 (0.5296)</td>
</tr>
<tr>
<td>Ageadm</td>
<td>-0.0229*** (0.0023)</td>
<td>-0.0219** (0.0023)</td>
<td>-0.0219** (0.0023)</td>
<td>-0.0219*** (0.0022)</td>
<td>-0.0204*** (0.0022)</td>
</tr>
<tr>
<td>Marriage</td>
<td>-0.3677*** (0.0457)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married Male</td>
<td>-0.3334*** (0.0769)</td>
<td>-0.3591*** (0.0808)</td>
<td>-0.3544*** (0.0802)</td>
<td>-0.3523*** (0.0804)</td>
<td></td>
</tr>
<tr>
<td>Whites</td>
<td>0.1173** (0.0536)</td>
<td>0.1121** (0.0538)</td>
<td>0.1116** (0.0538)</td>
<td>0.1082** (0.0534)</td>
<td>0.1034* (0.0536)</td>
</tr>
<tr>
<td>Ownerpay</td>
<td>-0.1449 (0.1255)</td>
<td>-0.1428 (0.1261)</td>
<td>-0.1509 (0.1263)</td>
<td>-0.1859 (0.1254)</td>
<td>-0.2047 (0.1258)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0.1457 (0.1236)</td>
<td>0.1526 (0.1241)</td>
<td>0.1454 (0.1243)</td>
<td>0.1107 (0.1235)</td>
<td>0.1040 (0.1239)</td>
</tr>
<tr>
<td>Medicare</td>
<td>-0.5944*** (0.1288)</td>
<td>-0.5957*** (0.1294)</td>
<td>-0.6027*** (0.1296)</td>
<td>-0.6438*** (0.1290)</td>
<td>-0.6751*** (0.1290)</td>
</tr>
<tr>
<td>Home</td>
<td>0.2046** (0.0563)</td>
<td>0.1950*** (0.0565)</td>
<td>0.1947*** (0.0565)</td>
<td>0.2106*** (0.0560)</td>
<td>0.2083*** (0.0562)</td>
</tr>
<tr>
<td>Hospital</td>
<td>-0.0976*** (0.0548)</td>
<td>-0.1047* (0.0550)</td>
<td>-0.1056* (0.5501)</td>
<td>-0.0956* (0.0546)</td>
<td>-0.092* (0.0548)</td>
</tr>
<tr>
<td>Nurhom</td>
<td>-0.0368 (0.0689)</td>
<td>-0.0401 (0.0692)</td>
<td>-0.0417 (0.0692)</td>
<td>-0.0324 (0.0687)</td>
<td>-0.0406 (0.0689)</td>
</tr>
<tr>
<td>ADL</td>
<td>0.1387*** (0.0455)</td>
<td>0.1311*** (0.0457)</td>
<td>0.1330*** (0.0457)</td>
<td>0.1035** (0.0452)</td>
<td>0.0971** (0.0454)</td>
</tr>
<tr>
<td>Therapy</td>
<td>-0.4844*** (0.0368)</td>
<td>-0.4559*** (0.0400)</td>
<td>-0.4367*** (0.0400)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male_Thy</td>
<td></td>
<td>-0.1054 (0.0368)</td>
<td></td>
<td>-0.5179*** (0.0400)</td>
<td>-0.5145*** (0.0400)</td>
</tr>
<tr>
<td>Mar_Thy</td>
<td></td>
<td>-0.5139*** (0.1130)</td>
<td></td>
<td>-0.5277*** (0.1137)</td>
<td>-0.8316*** (0.1094)</td>
</tr>
<tr>
<td>Mar_M_Thy</td>
<td>0.5391*** (0.1511)</td>
<td>0.6387*** (0.1772)</td>
<td>0.9363*** (0.1738)</td>
<td>0.1048 (0.1355)</td>
<td></td>
</tr>
<tr>
<td>Bedsize</td>
<td>0.0033 (0.0202)</td>
<td>0.0055 (0.0202)</td>
<td>0.0051 (0.0202)</td>
<td>-0.0097 (0.0200)</td>
<td>-0.0111 (0.0201)</td>
</tr>
<tr>
<td>Profit</td>
<td>-0.1916*** (0.0343)</td>
<td>-0.1913*** (0.0344)</td>
<td>-0.1914*** (0.0344)</td>
<td>-0.1887*** (0.0342)</td>
<td>-0.1899*** (0.0343)</td>
</tr>
<tr>
<td>alpha</td>
<td>0.8805*** (0.0411)</td>
<td>0.8722*** (0.0410)</td>
<td>0.8721*** (0.0410)</td>
<td>0.9313*** (0.0412)</td>
<td>0.9349*** (0.0411)</td>
</tr>
<tr>
<td>N</td>
<td>5470</td>
<td>5470</td>
<td>5470</td>
<td>5470</td>
<td>5470</td>
</tr>
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</table>

*** significant at the 1% level, ** significant at the 5% level, and * significant at the 10% level.
Table VII. Nursing home durations of all 7157 residents

<table>
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<tr>
<th></th>
<th>Nursing home durations</th>
<th>Coefficients (stdev.)</th>
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</thead>
<tbody>
<tr>
<td>Male</td>
<td>-0.1832***</td>
<td>(0.0344)</td>
</tr>
<tr>
<td>Ageadm</td>
<td>-0.0254***</td>
<td>(0.0019)</td>
</tr>
<tr>
<td>Marriage</td>
<td>-0.3475***</td>
<td>(0.0393)</td>
</tr>
<tr>
<td>Marriage_missing</td>
<td>0.02376</td>
<td>(0.1172)</td>
</tr>
<tr>
<td>Whites</td>
<td>0.1479***</td>
<td>(0.0427)</td>
</tr>
<tr>
<td>Ownpay</td>
<td>-0.0992</td>
<td>(0.1113)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>0.1955*</td>
<td>(0.1095)</td>
</tr>
<tr>
<td>Medicare</td>
<td>-0.5034***</td>
<td>(0.1138)</td>
</tr>
<tr>
<td>Insurance_missing</td>
<td>-0.2202</td>
<td>(0.1986)</td>
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<td>Home</td>
<td>0.1725***</td>
<td>(0.0507)</td>
</tr>
<tr>
<td>Hospital</td>
<td>-0.1496***</td>
<td>(0.0491)</td>
</tr>
<tr>
<td>Nurhom</td>
<td>-0.0480</td>
<td>(0.0609)</td>
</tr>
<tr>
<td>Where live_missing</td>
<td>0.4189***</td>
<td>(0.1053)</td>
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<tr>
<td>Therapy</td>
<td>-0.4371***</td>
<td>(0.0320)</td>
</tr>
<tr>
<td>Personcr</td>
<td>0.0363</td>
<td>(0.0503)</td>
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<td>ADL</td>
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<td>(0.0108)</td>
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<td>(0.0303)</td>
</tr>
<tr>
<td>Profit</td>
<td>-0.2002***</td>
<td>(0.0298)</td>
</tr>
<tr>
<td>alpha</td>
<td>0.9635***</td>
<td>(0.0374)</td>
</tr>
<tr>
<td>N</td>
<td>7157</td>
<td></td>
</tr>
</tbody>
</table>

*** significant at the 1% level, ** significant at the 5% level, and * significant at the 10% level.