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A Long-Term Care Simulation Model

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Abstract

This project examines the efficacy of a Long- Term Care (LTC) simulation model in aiding people on quantitative basis to make purchasing decisions. Working from literature, interviews, and surveys we will describe how the Model is built, its use in purchasing LTC insurance and its impact on consumers' decision-making. We will assess: 1) how LTC simulation model affects purchasing decision-making, and 2) the utility of the LTC model in helping consumers make educated decisions to minimize possible future LTC cost.

Table of Contents

Chapter I Introduction

"If we look at the demographics, the graying of America is about to generate an unprecedented need for long term care services that will impact nearly every family in the nation. Many experts agree, elder care will be to the 21st Century what child care has been to the past few decades."

Joyce Ruddock, Vice President, MetLife. May 8, 2000[1]

Long-Term Care (LTC) is a phenomenon that affects and will continue to affect the society as a whole. However, when the growing likelihood of the need of LTC services is combined with the expected dramatic increase in LTC cost then one can realize that paying for LTC services could easily deplete lifetime savings and jeopardize income, retirement savings, estates, and most importantly family standards of living. In fact, Joyce Ruddock indicates that: *"Long-term care is the greatest uninsured risk Americans face.*[1]*"*

Nonetheless, there is a general misconception that Medicaid or health insurance will pay for LTC services. However, Medicaid pays only if federal poverty level is met, and health insurance does not cover expenses on long term care services. For that reason, LTC insurance is an alternative that everyone should consider.

Yet, shopping for LTC insurance is anything but easy. There are many insurance companies that offer conflicting and hard to compare policies, and also, each policy comes with many optional benefits that make a decision to purchase very difficult. Premiums can range over thousands of dollars depending on the type and duration of coverage as well as the many optional benefits and riders. Insurance companies promote

[1] The U.S. Department of Labor, Advisory Council on Employee Welfare and Pension Benefit Plans Report, Findings, and Recommendations of the Working Group on Long-Term Care, November 14, 2000. May 2003. <http://www.efast.dol.gov/ebsa/publications/report2.htm>

the fact that the younger one buys LTC insurance then the lower the premium will be, but the question is: what is the best age to procure insurance? [2] A further point to consider is that purchasing LTC insurance is almost a life-time commitment, since policy benefits are lost if there is default in one's premium payments.

Since LTC insurance can significantly impact one's financial planning the question becomes if you decide to buy at what age is best and what coverage (i.e. deduction period, riders, optional benefits) you should chose in order to optimize your investment and to insure that you are not under or over insuring. Furthermore, if you have (or expected to have) adequate resources, is LTC something to self-insure against.

Currently there is no tool to help the consumer make these decisions on a quantitative basis and one has to rely on the advice of his or her insurance agent. However, different insurance agents give conflicting advice and one might be left on his/her own to make an important financial decision.[3]

Therefore, we would attempt to build a probabilistic simulation model that will aid subjects in making a decision on whether they should buy LTC insurance at a given age, sex, and risk tolerance.

The objective of our IQP project is to explore the utility of such a model in aiding and evaluating the decision to purchase Long-Term Care insurance. The usefulness of the model was tested on twelve subjects who expressed interest in purchasing LTCI.

The model will have a user interface where the user enters his age, sex, and belief on LTC inflation. The model will be comprised of two modules: financial and transition probability module. The transition probability module will be a Markov Chain transition

[2] Green, Kelly "Buying a Security Blanket" The Wall Street Journal 24 March 2003. R1.
[3] Green, Kelly "Buying a Security Blanket" The Wall Street Journal 24 March 2003. R3.

probability model with four possible states: healthy (W), undergoing institutional LTC (NH), undergoing home care (HC), and expired (E). Transitional probabilities for going from one state to the other will be used.

The financial module will have a built in actuarial data using cost per day for nursing home and home health care. A schedule of premiums will be obtained and used from UnumProvident Insurance Company.

Both modules will interact to construct a cash flow simulation with inflows of investments and outflows of expenses and insurance premiums. The primary performance evaluation measure will be the total expected LTC cost.

@ RISK simulation software will be used to simulate Monte Carlo simulations. Statistical evaluation measures provided in the @RISK software will be employed to aid decision making.

When the simulation model is built, twelve subjects (who currently consider purchasing LTC) will be surveyed to explore the utility of the model. First, they will be asked to make an unaided decision on purchasing LTC insurance by filling out a questionnaire sent through e-mail. The first questionnaire will be followed by a second one along with quantitative data generated by the model. The results of the survey will be analyzed to conclude how the LTC model has affected subjects' purchasing decision-making.

The project will proceed in the following order:

Chapter II discusses the background and analysis of LTC, what it is, how it is measured, and how many people it impacts, as well as common misunderstandings concerning LTC. The chapter elaborates on the need of LTC insurance as a measure to finance long term care expenditures and protect standard of living. **Chapter III** describes the project process starting from the goals of the IQP to the sequence of tasks that led to the achievement of the project's goals; also described are the methods and procedures used to achieve the project's objective. **Chapter IV** is a brief overview of the model and its components.

Chapter V elaborates on how the transition probabilities for each cohort and gender were obtained. **Chapter VI** explains in detail the model assumptions and the model logic. The chapter also gives a comprehensive analysis on the simulation model development. **Chapter VII** presents the results of running the simulation model for different options. Further, the results of running the simulation are analyzed. The second part of the chapter concentrates on a thorough analysis of the findings on the utility of the model from the performed survey. **Chapter VIII** derives from the results, findings and analysis of the preceding two chapters and combines the analysis with the goals to make conclusions about the utility of the simulation model.

Chapter II Background

"The [number of] individuals who will need different types of in-home or institutional care assistance, is going to climb dramatically as a result of each and every life extension success from medical research"

Dallas L. Salisbury, President & CEO Employee Benefits Research Institute

The advance of medical technology combined with improvement in nutrition has led to an increase of life expectancies. Americans are living longer than ever before. "In 1900, life expectancy at birth was about 49 years. By 1960, life expectancy had increased to 68 years, and in 1997, life expectancy at birth was 79 years for women and 74 years for men."[4] These trends will continue to increase. However, the longer one lives the greater the likelihood that he or she will experience cognitive impairment or become physically unable to carry out every day activities.

In 1995 from the total 13.1 million Americans with disabilities, about 3.8 million had disabilities that required some level of custodial care. This number is expected to skyrocket over the next 50 years. As Dallas Salisbury states, because of continual medical advances resulting in the prolonging of life, the chances of having to deal with a disabled family member are much higher now than at any other time in history. Conservative estimates are that as the baby boomers retire in the next 30 years the elderly population requiring LTC services will double to more than 70 million. In fact, LTC may become an issue that individuals are going to have to deal with as part of the normal course of life. [5]

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[4] Federal Interagency Forum on Aging-Related Statistics Older Americans 2000: Key Indicators of Well-Being June 2003. <http://www.agingstats.gov/chartbook2000/healthstatus.html#Indicator%2012>
[5] The U.S. Department of Labor, Advisory Council on Employee Welfare and Pension Benefit Plans Report, Findings, and Recommendations of the Working Group on Long-Term Care, November 14, 2000. May 2003. <http://www.efast.dol.gov/ebsa/publications/report2.htm>

Long-term care refers to a broad range of supportive and health services for persons of all ages who have lost the capacity to care for themselves because of physical or mental illness or impairments. LTC can be delivered in nursing home care, assisted living facilities, home care, adult day health care, respite care, and personal care services.

According to the 1999 report from the Health Insurance Association of America approximately three in five people over age 65 need assistance with day-to-day activities, and two out of five may spend some time in a nursing home.[6] Nonetheless, not only elderly need long term care. Studies have shown that 45 % of people receiving LTC services are under age 65.[7] Thus at a younger age, LTC may be needed because of chronic disease or while recuperating from an accident or serious illness. In conclusion, LTC is a phenomenon that affects half of the people in our society at one point of life.

Paying for long-term care can be very expensive. On a national average, a year in a nursing home cost $ 55,000, and in the next thirty years is expected to rise to $190,000 annually.[8] Home health care is generally less expensive, but when needed around the clock can be close to nursing home cost. As a result, paying out of pocket for extended LTC services could easily deplete lifetime savings and jeopardize income, retirement savings, estates, and most importantly a family's standard of living.

There is a general misconception about where LTC financing comes from. Many people think that Medicare, Medicaid, group and individual medical insurance or disability insurance will fund their LTC needs. Nonetheless, medical plans provide only

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[6] Health Insurance Association of America (HIAA). Guide to Long-Term Care Insurance. 1999. May 2003. <http://membership.hiaa.org/pdfs/1999LTCIGuide.pdg>

[7] The U.S. Department of Labor, Advisory Council on Employee Welfare and Pension Benefit Plans Report, Findings, and Recommendations of the Working Group on Long-Term Care, November 14, 2000. May 2003. <http://www.efast.dol.gov/ebsa/publications/report2.htm>

[8] U.S. General Accounting Office "Long-Term Care Insurance: Better Information Critical to Prospective Purchasers, 2000" TIAA-CREF May 2003. <http://www.tiaa-cref.org/ltc/ltcosts.html>

very limited coverage for LTC services. Medicare only provides for up to 120 days per illness of institutional LTC benefits and is only available after discharge from an acute care hospital. Further, the federal Medicaid program does provide extensive coverage for LTC services, but is only available to those who meet federal poverty level. However, many American workers who have worked all of their lives to financially secure retirement end up spending themselves into poverty in order to qualify for Medicaid.[9]

Thus, in order to protect against financial misfortune brought about by extended LTC services, LTC insurance should be in everyone's overall financial planning.

LTC Insurance overview

Insurance companies offer a variety of LTC insurance plans all of which are disability based. There are different indicators that can be used to monitor disability: including limitations in Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), and measures of physical, cognitive, and social functioning. While IADLs include preparing meals, shopping, managing money, using the telephone, doing housework, and taking medication, ADLs are those activities necessary to carry out basic functions, including bathing, dressing, eating, toileting, transferring from a bed to a chair, and continence.[10] Insurance companies pay benefits after care advisor or physician certifies that the insured suffers severe cognitive impairment and need substantial supervision or care to protect him/her, or that the insured is unable to perform two or

[9] The U.S. Department of Labor, Advisory Council on Employee Welfare and Pension Benefit Plans Report, Findings, and Recommendations of the Working Group on Long-Term Care, November 14, 2000. May 2003. <http://www.efast.dol.gov/ebsa/publications/report2.htm>

[10] Administration on Aging. A Profile of Older Americans: 2000 "Health, Health Care, and Disability" June 2003. < http://www.aoa.gov/aoa/stats/profile/default.html>

more ADLs without substantial assistance for a specified period (called deductible or elimination period and usually is between 30 to 90 days).[11]

There are two ways to pay benefits under LTC insurance: claim based and indemnity based. With the claim-based, payment model, also called expense-based, the insured must submit claims in order to be reimbursed. However, since a number of LTC related expenses are excluded under all policies, some claims may be denied. Further, the expense reimbursement method only pays up to expenses actually incurred, it may not pay the maximum allowable benefit. On the other hand, under the indemnity-based method, once the insured qualifies for benefits, he or she does not have to submit claims. The insurance company will send the insured or their representative a check once a month for the maximum allowable monthly benefit in the policy even if the expenses incurred by the insured are less than the specified policy benefit. With an indemnity plan the insured is more likely to receive the full benefit in the policy before recovery or death. Furthermore, under both plans, the insured is only reimbursed for the actual number of days when care is being received. Additionally, both plans require periodic proof that the insured still qualifies for benefits.[12]

<u>The Issue</u>

Nevertheless, the problem consumers are facing is that shopping for LTC insurance is anything, but easy. Comparison shopping is all but impossible since policies from different carriers are packaged with different bells and whistles.[13] Even considering purchasing under the same insurance's company plan is a formidable task. Premiums can range with thousands of dollars depending on the type and duration of coverage as well

[11] UnumProvident May, 2003 < http://www.unum.com/enroll/opers/solution.htm >
[12] Dr Kumar, Nanda. May 2003.
[13] Green, Kelly "Buying a Security Blanket" <u>The Wall Street Journal</u> 24 March 2003. R1.

as the many optional benefits and riders. Many insurance companies post calculators on their web sites to facilitate consumer's decision by calculating premiums, but with the many different options and riders the calculations could result in hundreds and even thousands of different combinations under the same plan.[14]

Even under the more "simple" employee offered group plans there are many different combinations possible. All of that combined with the fact that LTC is not inexpensive, and further, purchasing LTC insurance is almost a life-time commitment, since policy benefits are lost if there is default in one's premium payment, makes purchasing LTC insurance a very important and difficult decision.

Furthermore, not only different insurance companies give conflicting advice on best combination of coverage duration and riders, but most all insurance companies advised that the younger one buys the lower his or her premium will be. Nevertheless, the question is: is that the best decision at one's given age? [15]

Thus, since LTC insurance can significantly impact one's financial planning the question becomes if one decides to buy at what age is best and what coverage, deduction period, riders, optional benefits, he or she should choose in order to optimize one's investment and to insure that he or she is not under or over insuring. Furthermore, if one has (or expected to has) adequate resources, is LTC something to self-insure against.

To the best of our knowledge currently there is no tool that can aid consumers to make these decisions on a quantitative basis. We came across a LTC status transition model[16] developed by Jim Robinson which at first looked very promising. Robinson had

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[14] Dr. Kumar, Nanda. May 2003.
[15] Green, Kelly "Buying a Security Blanket" The Wall Street Journal 24 March 2003. R3.
[16] Robinson, Jim. "A Long-Term Care Status Transition Model" May 2003.
<http://www.soa.org/library/monographs/Retirement_Systems/m-rs99-1/M-RS99-1_I.pdf>

employed many of the concepts we were considering but the model did not have as a goal to address the financial decisions we were attempting to tackle. Nevertheless, when the model was tested the only results that could be considered correct were those he had used as an example in his paper. When the model was run as a function of age for females and males, some of the generated probabilities were either a negative number, did not add up to one or exceeded one dramatically (probability must be a positive number, and the sum of all probabilities for a given event to occur must add up to one).

Long Term Care Financing Model[17] developed by Brookings Institution under a contract between the U.S. Department of Health and Human Services (HHS), Office of Disability, Aging and Long-Term Care Policy (DALTCP) and the Lewin Group was also examined. The financing model simulates the utilization and financing of LTC services. The overall objective of the model is to simulate the effects of various financing and organizational reform options on future public and private expenditures for nursing home and home care. Information on institutional and non-institutional length of stay and recovery rates obtained from the Brookings LTC Financing Model were employed in the derivation of probabilities utilized in our simulation model.

Since there is no tool to aid purchasing decision-making we set as an objective of our IQP project to build a probabilistic simulation model that will aid subjects in making a decision on whether they should buy LTC insurance at a given age, sex, and risk tolerance, and further to explore the utility of such a model in aiding and evaluating the decision to purchase LTC insurance.

[17] Brookings Institution "Long Term Care Financing Model" February 1992. U.S. Department of Health and Human Services. May 2003 <http://aspe.hhs.gov/daltcp/reports/modampes.htm>

Chapter III Methodology

3.1 *Process*

3.1.1 Project formulation

Since purchasing LTC insurance is a very difficult decision that could significantly impact one's financial planning, we proceeded to build a Long-Term Care probabilistic simulation model that attempts to address this decision on quantitative basis. More precisely, we set up as a goal of our IQP project to develop a LTC simulation model that can aid consumers in making a decision on whether one should purchase LTC insurance at a given age, sex, and risk tolerance.

After having familiarized ourselves with the Long-Term Care insurance industry by researching a variety of electronic journals through WPI library, sources on the internet, information obtained from UnumProvident, articles provided by ABT Associates, as well as conducting an interview with Dr. Nanda Kumar[18] we proceeded to formulate the project.

The first step in the project formulation was to decide on the scope of the project. We were faced by the dilemma of whether our simulation model is going to be generic and capable of simulating for the entire LTC insurance industry, or will it be customized to a given insurance company.

As explained in the Chapter II there are two main types of insurance benefits models offered by different insurance companies: indemnity-based and claim-based. With the claimed based model, after being qualified, the insured has to file a claim to the insurance agency as expenses are incurred in order to collect benefits. Since a number of

[18] Consultant at ABT Associates, interviewed May 2003,

LTC related expenses are excluded under all policies, some claims may be denied, or some expenses may not be reimbursed fully.[19] On the other hand, those whose insurance is based on the indemnity model, once qualified, will receive the monthly benefit selected even if the benefit payment exceeds the actual monthly charge incurred. The insured does not have to submit a record of expenses, and there is no hassle over the amount of the benefit paid[20].

However, because the two models are very different in their cash flow structure, it would be difficult to build a single simulation model that would work for both cases. Therefore, in order to make the IQP project feasible, we had to select one of the two models to build the LTC simulation model. At the same time, analyzing policies offered by different insurance companies, we learned that the policies greatly differ and are packaged with different options. Thus, we had to decide on a model plan and an insurance company.

In view of the fact that WPI is offering an indemnity group plan with UnumProvident, we decided to build the simulation model based on UnumProvident group plan options and premiums. Therefore, Unum's options provided in their group plan became the first constraint in our model building.

Moreover, conducting a survey with the WPI faculty and staff to test how the LTC model affects decision-making could be performed.

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[19] Dr. Kumar, Nanda. May 2003,
[20] UnumProvident May, 2003 < http://www.unum.com/enroll/opers/solution.htm >

Furthermore, since WPI is in Worcester, information on nursing home/ home care cost was obtained for the state of Massachusetts as most of the subjects participating in the planned survey are likely to, if needed, use LTC services in this state.

After having determined the goal and the scope of the project we proceeded to determine the procedures and methods needed to develop the LTC simulation Model.

Next, we had to determine how the project exactly will work, what questions to address, as well as what performance evaluation measures will be used. The next major step in completing the project was to obtain the necessary data, which in the most part, was conducted in parallel with the building of the LTC model.

3.1.2 Obtaining Data

The information required for the simulation modeling is statistical data on transition probabilities from different health states, and financial data including premium, benefit amount and duration for different options, institutional and non-institutional LTC cost for the state of Massachusetts, historical average on LTC inflation and return on investments.

The financial data was obtained first since calculating the transition probabilities turned out to be a formidable and time-consuming task. From the brochure provided to WPI by UnumProvident, the needed information on premium prices for different facility benefit amount and benefit duration with and without inflation protection was obtained. Next, the daily nursing home care cost was obtained form 2002 MetLife survey[21] and then annualized since we are modeling on an annual basis. The U.S. Consumer Price

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[21] MetLife Ins. Market Survey on Nursing Home and Home Care Costs 2002. May, 2003 < http://www.metlife.com/WPSAssets/17157088621027365380V1FPDF1.pdf >

Index for Nursing Home Cost[22] for the past ten years was the basis for the calculation of the historical average on LTC cost used in the simulation.

The statistical data necessary to build the probabilistic simulation model are the incidence rates from different health states. Incidence rates are not readily available with respect to age, and therefore, exponential and polynomial functions had to be formulated[23] to interpolate and extrapolate the needed probabilities.[24]

Mortality transition probabilities for females/males were obtained from ABT Associates[25] and then the needed mortality rates from healthy status calculated for each sex. Transitioning incidence rates for healthy subjects to nursing home and home care were also obtained from ABT Associates. A variety of sources [26] was employed for the generation of the nursing home and home care mortality rates since many adjustments were necessary. Exponential functions were used for all mortality rates to interpolate data as a function of age.

Recovery rates were based on data obtained from the National Center for Health Statistics[27] and Brookings Institution[28]. Lagrange interpolation was used to define polynomial functions for all recovery rates data generation as a function of age based on the data obtained from the sources above.

Finally, all financial and statistical[29] data was critically scrutinized and validated.

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[22] Arizona Department of Health Services. " U.S. Consumer Price Index for Nursing Home Cost." July 2003 <http://www.hs.state.az.us/plan/hosp/cpinci.pdf >

[23] Please refer to Subchapter 3.2 Project Methods

[24] For detailed information on how transition probabilities were obtained please refer to Chapter V-Transition Probabilities

[25] Dr. Kumar, Nanda. May, 2003.

[26] Society of Actuaries, National Center for Health Statistics, ABT Associates, Brookings Institution

[27] National Center for Health Statistics. May 2002. <http://www.cdc.gov/nchs/>

[28] Wiener, Joshua M. & Hanley, Raymond. "Brookings/ICF Long-Term Care Financing Model" 1992. Brookings Institution. May 2003. <http://aspe.hhs.gov/daltcp/reports/modampes.htm>

[29] Transition probabilities were validated against tables obtained from Society of Actuaries. May 2003, <http://www.soa.org/tablemgr/tablemgr.asp>

3.1.3 Model Validation and Generating Results

As all needed financial and statistical information was being obtained, the data was being incorporated in the simulation model. Using @RISK simulation software and its Monte Carlo recalculation technique, statistical output was generated for all simulated cohorts (male and female for age (years) groups : 40-44,45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-100).

The statistical output consisted of mean values and standard deviations for the future value of total expected LTC cost, including expected premiums paid and benefit received, as well as expected LTC cost. We also had a measure of risk, the probability of the future value of the LTC cost exceeding some user specified threshold. All performance evaluation measures were generated for male and female for the options[30] offered by UnumProvident's group plan to WPI.

With a preliminary model, we advanced to critically analyze it. An important validation phase was then completed in an interview with Jeannine Kwatowski[31]. At the interview we abandon the unlimited option and base plan because of difficulties calculating expected benefits paid. Once we had concluded that there was no conflict in the generated data and we felt confident in the simulation results, we proceeded to the final phase of the completion of the IQP project: the testing of the LTC simulation model to explore effects on purchasing decision-making.

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[30] Exceptions for the unlimited benefit duration, and Base Plan because of difficulties calculating accurate financial data

[31] Insurance agent of UnumProvident; interviewed July, 2003

3.1.4 Model Deployment

The final stage of the IQP project completion was to conduct a survey to explore the utility of the developed LTC simulation model in helping customers make guided decisions. We conducted a confidential e-mail survey in two phases by sampling twelve WPI faculty and staff members who were considering purchasing Long-Term care insurance offered by Unum.

The first stage of the survey included a memorandum explaining the background of the project, the purpose of the survey, statement of assurance of confidentiality, as well as an attached questionnaire.[32] Questionnaire 1 asked which policy, if any, subjects will select without the benefit of any formal quantitative actuarial analysis. Due to time restraint the surveyed WPI employees were asked to reply within one week in order to have their questionnaire addressed. A LTC simulation was performed based on how the subjects filled out the questions in the Questionnaire 1. Then a second questionnaire was sent along with: generated statistical results for each individual; explanation of how to make use of the results; recommendations on the best option to minimize possible future cost given subjects age, sex, and risk tolerance; and a glossary of terms. The goal of Questionnaire 2 was to determine if the results of the simulation affected the subjects' decision-making.

The data from the survey was then analyzed and conclusions from conducting the project derived.

[32] Please find the above mentioned documents enclosed in Appendix 11 and Appendix 12

3.2 Project Methods

3.2.1 @RISK and Monte Carlo Simulation

We have decided that the LTC simulation model once developed on a Microsoft Excel Spreadsheet will make use of a simulation software called @RISK. Without the aid of simulation, a spreadsheet model will only reveal a single outcome, generally the most likely or average scenario. When we use the word simulation, we refer to any analytical method meant to imitate a real-life system, especially when other analyses are too mathematically complex or too difficult to reproduce.[33] @RISK Spreadsheet risk analysis uses both a spreadsheet model and simulation (Monte Carlo) to automatically analyze the effect of varying inputs on outputs of the modeled system.

@RISK is an add-in software to Microsoft Excel. @RISK provides statistics outcomes which users are familiar with such as means value, standard deviation, variance, etc.

Moreover, @RISK uses a recalculation technique known as Monte Carlo simulation. Monte Carlo simulation is a numerical method, which randomly generates values for uncertain variables (variables that have a known range of values but an uncertain value for any particular time or event) by utilizing sequences of random numbers (transition probabilities in our case) to perform the simulation. Every time a Monte Carlo simulation is performed @RISK records the output and then recalculates the spreadsheet for the next simulation. @RISK defines all possible outcomes with a probability distribution. Accordingly, @RISK Monte Carlo simulation calculates

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[33] Goldman, Lawrence. "Risk Analysis and Monte Carlo Simulation" Decisioneering, Inc June 2003 < http://www.pmboulevard.com/expert_column/archives/reg/risk_analysis_and_monte_carlo_goldman.pdf html>

multiple scenarios of a model by repeatedly sampling values from the probability distributions for the uncertain variables.[34]

@RISK recalculates spreadsheet hundreds or even thousands of times, each time selecting random numbers from the @RISK functions entered. Thus, with @RISK the user specifies how many simulation runs to generate. Since the LTC simulation problem that we are modeling has a long planning horizon with many degrees of freedom, we need to run 10, 000 iterations (i.e. the equivalent of 10,000 people's lives) to insure confidence in the statistical significance of the outcome and decrease the statistical error-deviation due to insufficient sample size. Further, the multiple simulations not only indicate what could happen in a given situation, but how likely it is that it will happen. With @RISK, you can determine the probability of output measure being above or below any threshold.

3.2.2 Markov Chain and Transition Probabilities

Since our task is to model the evolution of an individual's health over time we require an understanding of the migration of individual health states. Underlying process in the envisioned LTC simulation model can be adequately approximated by a Markov Chain status transition process which combined with a financial cash flow model can generate a powerful actuarial simulation tool that can accurately depict LTC utilization and cost.

A Markov chain is a sequence of random values whose probabilities at a time interval depend only upon the value of the number at the previous time interval.[35] In our

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[34] "Overview of @RISK" Palisade July 2003 < http://palisade.com/html/risk/overview.html >

context Markov Chain can be used to describe the transition of individual health status over uniform increments in time, for example on annual basis.

The (discrete-time) Markov property says that the conditional distribution of the "future" $X_{n+1}, X_{n+2}, X_{n+3}, \ldots$, given the "past", $X_1,\ldots,X_n$, depends on the past only through X_n. In other words, knowledge of the most recent past state of the system renders knowledge of less recent history irrelevant.[36]

The controlling factor in a Markov chain is the transition probability. It is a conditional probability for the system to go to a particular new state, given the current state of the system. Each particular Markov chain may be identified with its matrix of transition probabilities, often called simply its transition matrix. The entries in the transition matrix are given by

$$p_{ij} = P(X_{n+1} = j \mid X_n = i)$$

= the probability that the system will be in state j "next year" given that it is in state i "this year".

3.2.3 Extrapolations and Interpolations

Because of gaps in the data obtained, we had to use the interpolation and extrapolation techniques to compute the needed transition probabilities. The methods used were exponential functions and Lagrange polynomials.

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[35] Math World. June 2003 <http://mathworld.wolfram.com/MarkovChain.html>
[36] Math World. June 2003 <http://mathworld.wolfram.com/MarkovSequence.html>

Fitting an exponential function to data points was used to generate most of the data. The following formula shows the process used.

Given points (x_1, y_1); (x_2, y_2)

$$y_1 = a * b^{x_1}$$
$$y_2 = a * b^{x_2}$$

Then,

$$a = y_1 / b^{x_1}$$
$$y_2 = (y_1 / b^{x_1}) * b^{x_2}$$
$$y_2 / y_1 = b^{(x_2 - x_1)}$$

$$b = (y_2 / y_1) * [1/ (x_2 - x_1)]$$

$$a = y_1 / [(y_2 / y_1) * (1/ (x_2 - x_1))]^{x_1}$$

Next,

$$y_n = a * b^n$$

or,

$$y_n = [y_1 / [(y_2 / y_1) * (1/ (x_2 - x_1))]^{x_1}] * [(y_2 / y_1) * [1/ (x_2 - x_1)]]^n$$

The preceding function was used to extrapolate and interpolated incidence mortality rates from healthy status, mortality transition probabilities from a nursing home care and mortality transition probabilities from home care.

For recovery rates we used binomial function generated using Lagrange method.

The method of Lagrange Interpolation can be used to approximate a function everywhere even if values of the function are only known at a finite set of points. The following shows the process used:

Let the function f be tabulated at (n + 1), not necessarily equidistant points x_j, j = 1, 2,…., n and be approximated by the polynomial

$$P_n(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_i x + a_0$$

of degree at most n, such that

$$f_j = f(x_i) = P_n(x_j) \text{ for } j = 0, 1, 2, \ldots, n$$

Since for $k = 0, 1, 2, \ldots, n$

$$L_k(x) = \frac{(x - x_0)(x - x_1)\ldots(x - x_{k-1})(x - x_{k+1})\ldots(x - x_n)}{(x_k - x_0)(x_k - x_1)\ldots(x_k - x_{k-1})(x_k - x_{k+1})\ldots(x_k - x_n)}$$

is a polynomial of degree n which satisfies

$$L_k(x_j) = 0,\ j \neq k, j = 0, 1, 2, \ldots, n, \text{ and } L_k(x_k) = 1$$

then:

$$P_n(x) = \sum_{k=0}^{n} L_k(x) f_k$$

is a polynomial of degree n which satisfies

$$L_k(x_j) = 0,\ j \neq k, j = 0, 1, 2, \ldots, n, \text{ and } L_k(x_k) = 1$$

Hence,

$$P_n(x) = \sum_{k=0}^{n} L_k(x) f_k$$

is a polynomial of degree (at most) n such that

$$P_n(x_j) = f_j,\ j = 1, 2, \ldots, n$$

i.e., the (unique) interpolating polynomial. [37]

[37] Knowledge Representation Laboratory May 2003 <http://kr.cs.ait.ac.th/~radok/math/mat7/step23.htm>

Chapter IV Model Overview

After defining the concepts, processes and methods we can proceed to the model development. We decided that the model we are going to build will consist of two modules: a Health Status Transition Model and a Financial Module. Both modules will interact to construct a cash flow simulation of LTC expenses and insurance benefits. The sum total of life-time long term care cash inflows and outflows will gives us the Total Expected Cost. Therefore, the primary performance evaluation measure will be the Total Expected Cost accumulated at the time of death or 100 years, which ever comes first.

4.1 State Transition Module

By employing the Markov Chain concept the model portrays an individual's health status over a specified planning horizon: the subject's current age (no lesser then 40) to age 100 or to the time of death whichever comes first. An Individual's health status is modeled as being in one of four possible states: Well (W), in a nursing home (N), in home care (H) or expired (E). Health status can change only from one year to the next. Utilizing sets of transition matrices as a function of gender, age and current health status the individual transitions to one of the above specified four health states. We assume that expired (E) is an absorption state, that is once in it there is no transitioning back.

By using @RISK, the model performs Monte Carlo simulation which means that the user can specify a sample size of future state transitions and the model will generate the sample of health status histories where each history defines the subject's health status year by year over the planning horizon. The financial module, described below, explains how each history is utilized to produce a financial result.

4.2 Financial Module

The model is targeted to assist middle class consumers who are trying to determine whether it is best to self-insure or purchase LTC insurance. Further if consumers decide to buy then at what age, how much coverage and should inflation protection be included or not.

The model starts the client off with a "fund" which is set to zero. This way when simulation is performed the output will be total expected cost. From it LTC insurance premiums that are due or LTC expenses, for that year, which are not covered by insurance are deducted. Either of the mentioned expenses is assumed to occur at the beginning of each year. The insurance premiums are assumed to be the values from the Unum Tables for the base plan with and without inflation protection. The premiums are set according to the subject's age when they initiate procurement. The LTC expenses for the nursing home are set for the Worcester average values for nursing home care for 2003 and they are inflated at a rate that the user must specify. The LTC expenses for the home care status are set at 50% of the expenses for the nursing home status, since Unum pays for home care 50% of the facility monthly benefit amount for nursing home.

Our primary evaluation measure for evaluating decisions will be total expected cost when simulation terminates, that is, at time of death or at age 100 (whichever comes first). Further, total expected cost can be broken to its components: total expected life-time premium, total expected benefit received, and life – time nursing home/ home care cost, which can also be employed as evaluation measures.

Chapter V Transition Probabilities

5.1 Overview

As described in the previous chapter, our model is comprised of two modules: a system state transition probability module and a financial module. The first step in our project is to build the state transition module.

The status transition probability model, as already indicated, is based on a Markov chain which in our case is used to describe the progression of an individual's health status over time. We are going to use four possible states: Well (W), undergoing institutional LTC (N), undergoing home care (H), and expired (E). As specified, we will be using discrete increments of time – one year - to model the transition from one health status to another. Thus, transitions will be on annual bases and will be expressed as a transition probability (i.e., the probability of going from, for example, a state W to a state N, H, E or to remain in W for each year). The term incidence rate (a term used in the insurance industry) will also be used through out the paper to refer to transition probabilities. In order to model realistically, the transition probabilities that we have to use have to be age and sex dependant.

Obtaining the transition probabilities, thus, becomes one of the major steps in our model-building. However, incidence rates are not readily available, and the insurance companies are reluctant to release information on them. Therefore, to compute the transition probabilities we proceeded by using data obtained from the Society of

Actuaries (SOA)[38], statistics released by National Center for Health Statistics(NCHS)[39], data obtained from ABT Associates[40], and data from Brookings Institution.[41]

Figure 1

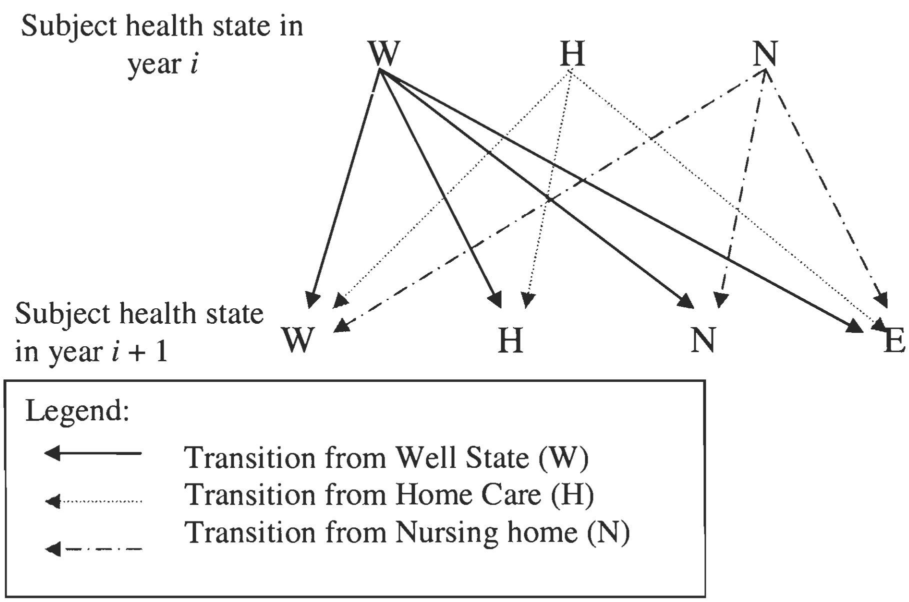

Figure 1 graphically represents the transition schema from a given state in year *i*, to a state in year *i* + 1. There are number of assumptions that will be made:

- Transitions will be on annual bases
- A subject can make only one transition within a year.
- At the start of year *i* an individual will be in one of the three possible health states (W, H, N)
- At the end of the year *i* the subject will transition from his/ her current state to one of the four possible states (W, H, N, E)
- There will be no transitioning out from an expired state(E)

[38] Society of Actuaries. May 2003, <http://www.soa.org/TABLEmgr/TABLEmgr.asp>
[39] National Center for Health Statistics. May 2002. <http://www.cdc.gov/nchs/>
[40] Dr. Kumar, Nanda. - consultant at ABT Associates, May 2003.
[41] Brookings Institution "Long Term Care Financing Model" February 1992. U.S. Department of Health and Human Services. May 2003 <http://aspe.hhs.gov/daltcp/reports/modampes.htm>

- The probability of moving from one state in year i to a state in year $i + 1$, depends only on the current status.
- A subject that has been in a disable state and recovers has the same transition probability of becoming disabled as a healthy subject.
- Recovery from a Nursing Home Status (N) and from Home Care Status (H) is to a Well status (W) only. (There is no data available on transition probabilities from N to H or H to N)

Since a subject can be in one of three states at the start of the year, for the purpose of not confusing the reader, we shall proceed in the following order in obtaining the transition probabilities.

- First, we will calculate the transition probabilities from a Healthy State in 5.2.
- Next, we will compute the transition probabilities from Nursing Home Care state in 5.3.
- Lastly, we will work out the transition probabilities from Home Care state in 5.4.
- After all transitions probabilities are calculated, transition matrices for each sex and cohort will be presented in 5.5.

5.2 Transition Probabilities from a Healthy State (W).

Figure 1 indicates that there are four possible transitions from Healthy State (W): remaining in W, and transitions to H, N, E.

5.2.1 Transition Probabilities from a Healthy State (W) to Death (E).

First we proceeded to calculate the transition probabilities from a healthy state (W) to death (E). Statistics on mortality rates are available at the website of Society of Actuaries and the National Center for Health Statistics, but those include the mortality of the total population (including mortalities of people with disabilities), or mortality rates on people with disability (including people with IADLs and 1ADLs who are not covered by LTC insurance). However, for building our status transition probability model, we needed to first calculate the annual mortality rates for the healthy population.

From ABT Associates[42] we obtained recent (2000) data on incidence rates for nursing home and home care, male/ female mortality, healthy and disable lives dying, intra-year length of stay statistics, mortality rates on people with disabilities ; all formula driven and as a function of age, calculated for a population of 100,000 people and based on data from the NCHS.

In order to calculate mortality rates of healthy people, however, we need to have data on the Healthy Lives Dying, and the Healthy Population as a function of age. The data provided by ABT Associates already contained the Healthy Lives Dying as a function of age. The Healthy Population at a given year was calculated by subtracting

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[42] Data provided by Dr. Kumar, Nanda. May 2003.

from the Total Population at year i the number of people in a nursing home and the numbers of people receiving home care at year i.

$$\text{Healthy Population}_i = \text{Total Population}_i - (\text{People in N} + \text{People H})_i$$

The number of people in a nursing home and the number of people receiving home care as a function of age was in the data obtained from ABT Associates.

Thus, if:

x = Healthy Lives Dying in year i
y = Healthy Population in year i - 1

Then,

$$\text{Group Transition Probabilities of Healthy Population in year } i = x_i / y_{i-1}$$

Because the health characteristics of an individual that is, for example, 60 years old are nearly the same as for the average 61 years old, to simplify the project, we use the cohort effect - widely used in the insurance industry. The cohort effect states that within a given cohort (group of subjects) analyzed characteristics do not vary significantly, and therefore, for the purpose of simplicity, are assumed to be the same. Therefore, since the transition probabilities do not vary greatly from year to year by using the average function the following cohorts were formed.

40-44, 45- 49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-100

Within each cohort the transition probabilities are assumed to be the equal.

Table1: Group Mortality Transition Probabilities from a Healthy State (W)

COHORT *j*	Group Mortality ***G*** for the Healthy Population
50-54	0.0045
55-59	0.0071
60-64	0.0121
65-69	0.0208
70-74	0.0329
75-79	0.0511
80-84	0.0783
85-100	0.2020

Since our simulation model requires transition probabilities for MALE and FEMALE using the group mortality transition probabilities (TABLE 1) from a W state we proceeded to generate data for each gender. Based on analysis of SOA mortality data[43] of the total population (i.e. healthy and disabled) we assumed that the group mortality for the healthy population for each cohort *j* is equal to the average of the female and male mortality for the cohort *j*.

that is,

$$G_j = (F_j + M_j) / 2$$

where,

j is a cohort : 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85 -100

M_j = Male Mortality Transition Probabilities of Healthy Population for cohort j

F_j = Female Mortality Transition Probabilities of Healthy Population for cohort j

G_j = Group Mortality Transition Probabilities of Healthy Population for cohort j

[43] Lumsden, R. S., TABLE No 587 – US 1991, Male Mortality Rates ; TABLE No 588 – US 1991, Female Mortality Rates. TABLE No 589 – US 1991, Population Mortality Rates. Society of Actuaries., May 2003, <http://www.soa.org/TABLEmgr/TABLEmgr.asp>

Furthermore, using a SOA male to female mortality rates for the total population we calculated a ratio R of male to female mortality rates for each cohort ***j*** (Table 2). We further assumed that the ratio R is the same for total population and for the healthy population.

Table 2 Ratio of Male to Female Incidence rates	
	$R_j = M_j / F_j$ Ratio of Male to Female Transition Probabilities
40-64	2.3484
65-69	2.2579
70-74	1.8217
75-79	1.5576
80-84	1.3835
85-100	1.0761

That is, we assume:

R_j for total population = R_j for healthy population

Where R_j – ratio of Male_j to Female_j for cohort j

Therefore since,

$$R_j = M_j / F_j$$

by substituting first $M_j = F_j * R_j$, and then $F_j = M_j / R_j$ in the equation

$$G_j = (F_j + M_j) / 2$$

and solving for each sex we obtained the equations:

$$F_j = G_j * [2 / (R_j + 1)] \quad \text{and,} \quad M_j = G_j * [2 * R_j / (R_j + 1)]$$

where,

$2 / (R_j + 1) = \text{ADJ } F_j$ is the female adjustment factor for cohort j

and,

$2 * R_j / (R_j + 1) = \text{ADJ } M_j$ is the male adjustment factor for cohort j

Table 3 below displays the calculated adjustment factors for each cohort

Table 3: FEMALE and MALE adjustment factors based on total population mortality

	ADJ F_j Adjustment factor for FEMALE	ADJ M_j Adjustment factor for MALE
40-64	1.6742	0.7129
65-69	1.6289	0.7214
70-74	1.4109	0.7745
75-79	1.2788	0.8210
80-84	1.1917	0.8614
85-100	1.0380	0.9647

Next, multiplying the group mortality from a W state for each cohort by the corresponding adjustment factor we calculated the transition probabilities from a W state for each gender.

$$F_j = \text{ADJ } F_j * G_j \qquad \text{and,} \qquad M_j = \text{ADJ } M_j * G_j$$

Table 4: Transition Probabilities from a Healthy State (W) for each gender

	MALE	FEMALE
40-44	0.0031	0.0009
45-49	0.0053	0.0016
50-54	0.0064	0.0026
55-59	0.0099	0.0044
60-64	0.0165	0.0077
65-69	0.0289	0.0128
70-74	0.0423	0.0236
75-79	0.0620	0.0401
80-84	0.0910	0.0657
85-100	0.2336	0.1704

The data for cohorts 40-44, 45-49 was extrapolated using the exponential functions:

MALE $f(x) = 1.9\text{E-}04 * 1.0685^{x}$

FEMALE $f(x) = 1.1\text{E-}05 * 1.1107^{x}$

The obtained mortality transition probabilities of the Healthy Population for each gender were verified with 2000 statistics released by the Society of Actuaries[44] on mortality rates of healthy annuitants. We did not use the SOA's data since we found out[45] that the general population has a higher incidence rate than the insured population. Thus, as expected the calculated transition probabilities of the Healthy Population were slightly higher than the SOA's transition probabilities of Healthy Annuitants data.

5.2.2 Transition Probabilities from Healthy State (W) to Nursing Home Care and Home Care States

To find the transition probabilities for Nursing Home Care and Home Care we used the incidence rates provided by ABT Associates which were already divided into cohorts and gender. We had to extrapolate to find the incidence rate for cohorts (40-49, 50-54, 55-59) for males and females by fitting an exponential function to data points. The following exponential equations were fitted and used:

Males	N	$f(x) = 1.09\text{E-}06 * 1.1416^{x}$
	H	$f(x) = 9.49\text{E-}05 * 1.0868^{x}$
Females	N	$f(x) = 1.71\text{E-}06 * 1.1362^{x}$
	H	$f(x) = 2.80\text{E-}04 * 1.0731^{x}$

[44] Strommen, Stephen. "TABLE No 986 – RP 2000 Male Healthy Annuitant" & "TABLE No 990 – RP 2000 Female Healthy Annuitant" Society of Actuaries. May 2003, <http://www.soa.org/TABLEmgr/TABLEmgr.asp>

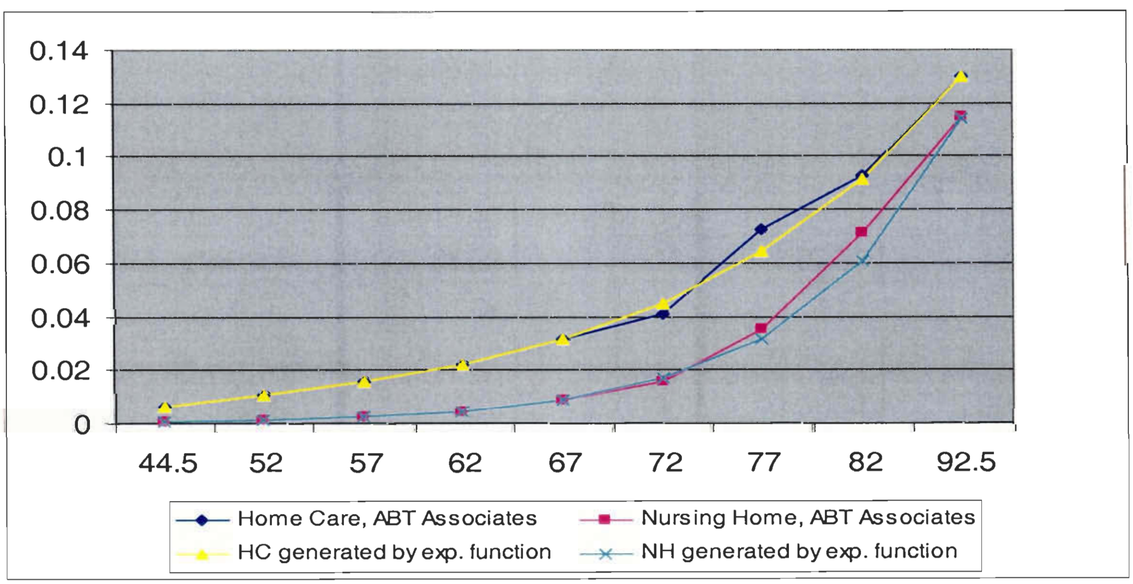
[45] Interview with Dr. Kumar, Nanda. May 2003

Table 5 Transition Probabilities form W to N and H states

A=		9.49E-05	1.09E-06	2.80E-04	1.71E-06
B=		1.0868	1.1416	1.0731	1.1362
		MALE		FEMALE	
		H	N	H	N
42	40-44	0.0031	0.0003	0.0054	0.0004
47	45-49	0.0047	0.0006	0.0077	0.0007
52	50-54	0.0072	0.0011	0.0110	0.0013
57	55-59	0.0109	0.0021	0.0156	0.0025
62	60-64	0.0165	0.0041	0.0222	0.0047
67	65-69	0.0250	0.0078	0.0316	0.0089
72	70-74	0.0327	0.0163	0.0412	0.0157
77	75-79	0.0606	0.0314	0.0726	0.0351
82	80-84	0.0909	0.0570	0.0929	0.0713
92.5	85-100	0.1321	0.0962	0.1296	0.1145

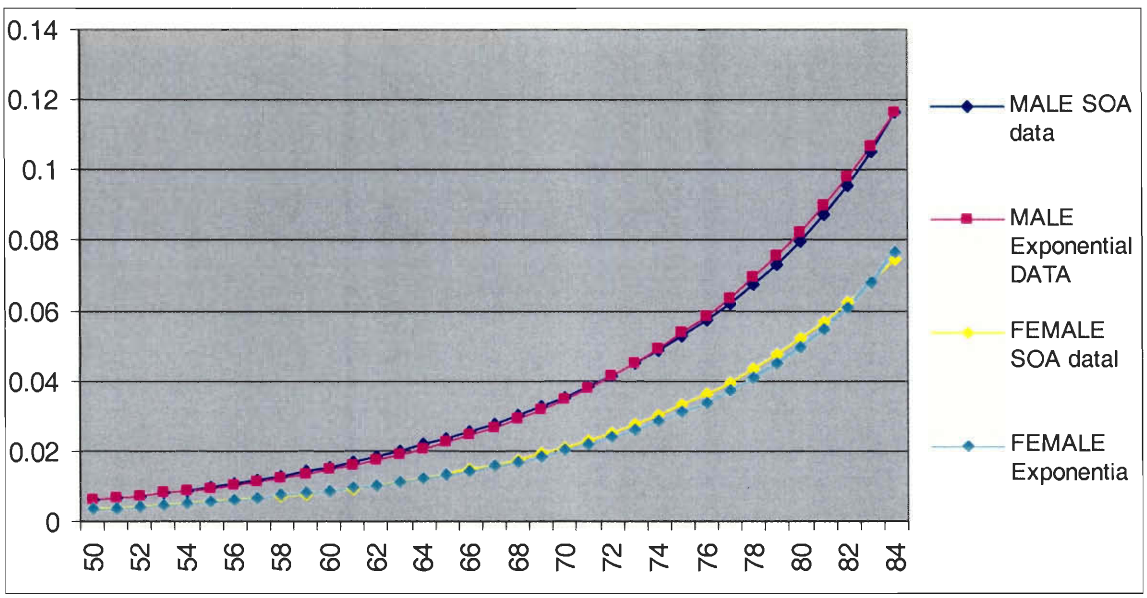
Figure 2 shows a graphical representation of how the results generated through the exponential functions fits with the original data obtained form ABT Associates.

Figure 2 Transition Probabilities for FEMALE from Healthy State (W) to Nursing Home Care and Home Care States



Exponential functions were used through out this paper to extrapolate and interpolate mortality rates and nursing/home care incidence rates to obtain data as a function of age. We observed that the numerous mortality rates data for different years obtained from the Society of Actuaries could be almost flawlessly mapped by exponential functions. The following example of Roger Scott Lumsden[46] mortality rates data indicates that the actuary has used an exponential function to make his calculations. The same phenomenon was observed for Stephen Strommen's Mortality rates of Healthy Annuitants[47].

Figure 3 Roger Scott Lumsden, Population mortality US 1991, Male, Female



[46] Lumsden, R. S., TABLE No 587 – US 1991, Male Mortality Rates & TABLE No 588 – US 1991, Female Mortality Rates. Society of Actuaries., May 2003, <http://www.soa.org/TABLEmgr/TABLEmgr.asp>

[47] Strommen, Stephen. TABLE No 986 – RP 2000 Male Healthy Annuitant & TABLE No 990 – RP 2000 Female Healthy Annuitant" Society of Actuaries. May 2003, <http://www.soa.org/TABLEmgr/TABLEmgr.asp>

5.2.3 Transition Probabilities for Remaining in Healthy State (W)

Lastly, by subtracting the sum of the transition probabilities for E, H, N, from one, the transition probability for remaining healthy (W) was obtained for each cohort.

$$W_j = 1 - (E + N + H)_j$$

Table 6 Transition Probabilities from Healthy State (W) for Males and Females

		MALE				FEMALE			
		W	H	N	E	W	H	N	E
42	40-44	0.9934	0.0031	0.0003	0.0031	0.9933	0.0054	0.0004	0.0009
47	45-49	0.9894	0.0047	0.0006	0.0053	0.9900	0.0077	0.0007	0.0016
52	50-54	0.9853	0.0072	0.0011	0.0064	0.9851	0.0110	0.0013	0.0026
57	55-59	0.9771	0.0109	0.0021	0.0099	0.9775	0.0156	0.0025	0.0044
62	60-64	0.9630	0.0165	0.0040	0.0165	0.9654	0.0222	0.0047	0.0077
67	65-69	0.9383	0.0250	0.0078	0.0289	0.9467	0.0316	0.0089	0.0128
72	70-74	0.9087	0.0327	0.0163	0.0423	0.9195	0.0412	0.0157	0.0236
77	75-79	0.8460	0.0606	0.0314	0.0620	0.8522	0.0726	0.0351	0.0401
82	80-84	0.7611	0.0909	0.0570	0.0910	0.7701	0.0929	0.0713	0.0657
92.5	85-100	0.5382	0.1320	0.0962	0.2336	0.5855	0.1296	0.1145	0.1704

5.3 Transition probabilities from a Nursing Home Care status

From the National Center for Health Statistics (NCHS)[48] we obtained the discharges from a nursing home for three cohorts: 65 -74, 75-84, 85+. The data was grouped into recovery, other discharges (including transferring to another nursing home, or hospital), stabilized, and diseased. These data we grouped into three transition states: Recover to W, remain in N(includes transferring to another nursing home or hospital, and

[48] National Center for Health Statistics. "Characteristics of Elderly Nursing Home Current Residents and Discharges: Data from the 1997 National Nursing Home Survey." Advance Data 312. June, 2003. <http://www.cdc.gov/nchs/data/ad/ad312.pdf>

stabilized), and diseased (E). Next we extrapolated and interpolated to find the data points for the ten age cohorts using the equation:

$$f(x) = 0.9586 * 1.0422^{x}$$

Table 7* Recovery and Mortality rates, National Center for Health Statistics[49] (data used to generate the data in Table 8)

	Recovery rates	Mortality rates
65-74	13 %	17 %
75-84	11.1	23.4
85+	8	35.8

* Probabilities expressed as percentages

Table 8 Group Mortality Transition Probability from a N status

	A=	0.9586
	B=	1.0422
42	40-44	0.0545
47	45-49	0.0670
52	50-54	0.0824
57	55-59	0.1014
62	60-64	0.1246
67	65-69	0.1533
72	70-74	0.1885
77	75-79	0.2319
82	80-84	0.2851
92.5	85-100	0.3580

Next using the sex adjustment factors for each cohort (Table 3), transition probabilities were calculated for females and males (see Table 10)

$$F_j = ADJ\ F_j * G_j \qquad \text{and,} \qquad M_j = ADJ\ M_j * G_j$$

Where:

G_j – Group Transition Probability from a N to death (E) for cohort j (Table 7)
ADJ F_j and ADJ M_j – adjustment factors for each sex for cohort j (Table 2)

[49] Same as above

Obtaining the annual probabilities to recover-- to transition from a N status to a Healthy state (W) -- proved to be a more difficult task. First, the same method as for obtaining the mortality rates was used, nevertheless, the generated results were much higher then expected. The results contradicted with earlier information obtained through interviews[50] where we were advised to ignore the likelihood of recovery from a nursing home since the probabilities are very low. Nevertheless, we decided that if we could obtain accurate data, the error from the calculations will justify the much greater error from not including the recovery into the simulation model since the 1997 National Center for Health Statistics data indicated that the probability to recover for a subject, for example, in the 65-74 cohort is 13 percent. Thirteen percent seemed to us too big a number to ignore.

In a search for more detailed data on which we could base our doubts, we came across the 1982-84, and 1985 NCHS statistics. Advance data 142 NCHS[51] , gave a very detailed break down on the recovery data. The recovery data was broken down to different Length of Stay periods. Since we are modeling on annual bases, and since insurance companies (based on UnumProvident LTC insurance policy) do not pay benefits for annuitants who do not satisfied the 90 days elimination period, we decided that we have to subtract from the recovery rate data the probabilities of recovery for subjects with length of stay less then 90 days. In Advance Data 142, we found the Intra-Year nursing home recovery rates available for three cohorts (65 -74, 75-84, 85+). Thus, we first extrapolated and interpolated to find the recovery data for each cohort and then

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[50] Kwatowski, Jeannine. UnumProvident. Interviewed June 2003, and Dr. Kumar, ABT Associates interviewed May 2003

[51] Sekscenski, E.S. "Discharges From Nursing Homes: Preliminary Data From the 1985 National Nursing Home Survey" Division of Health Care Statistics (NCHS) <http://www.cdc.gov/nchs/data/ad/ad142.pdf>

we adjusted our transition probabilities by subtracting the probabilities for people with length of stay less then ninety days from the annual nursing home incidence rates.

In a more in depth reading of the 1982-84, 1985, statistics we also found that most people discharged with a length of stay less then 90 days were subjects recovering from prior hospitalization and were subject to disability which will not satisfy the insurance companies requirement for 2+ ADLs or cognitive impairment in order to qualify for LTC benefits. We questioned that if people with 1ADL or IADLs were included in the nursing home recovery data of the NCHS, then what percentage of these subjects were in the remaining recovery transition probabilities for subjects with length of stay greater then 90 days. A study based on the 1985 National Nursing Home Survey Discharge File conducted by Brookings Institution and Lewin-ICF[52], presented the prevalence rates of people by length of stay in the three groups: subjects with IADLs, 1ADL and 2+ ADLs. The Table below shows the percentages of each group.

Table 9

Nursing Home Discharges		
	Length of Stay	
	Less than 3 Months	**More Than 3 Months**
IADL Only[a]	52.20%	40.10%
1 ADL	25.8	26.1
2+ ADLs	21.9	33.8
Total	100.00%	100.00%

a. IADL only are those who report no deficiencies in either mobility or continence.

SOURCE: Brookings Institution and Lewin-ICF calculations using data from 1985 National Nursing Home Survey Discharge File.

Looking at Table 9 we concluded that since 33.8 percent of subjects who stay more then three months are subjects with 2+ ADLs, and satisfy the insurance companies

[52] Brookings Institution "Long Term Care Financing Model" February 1992. U.S. Department of Health and Human Services. May 2003 <http://aspe.hhs.gov/daltcp/reports/modampes.htm>

requirements, then it is a fare assumption to use an adjustment factor of 0.338 to multiply the transition probabilities for recovery to adjust and discard subjects with less then 2 ADLs.

Finally, the recovery rates were adjusted for females and males. The adjustment factors were obtained by dividing the recovery rates in nursing home (length of stay - under a year) for male and female for each cohort.[53] Since the results for all cohorts were approximately the same we used a factor of 1.05 for female and 0.9545 for male.

The Status N, or remain it the same health state, was obtained by subtracting recovery and death transition probabilities for each cohort *j,* from one.

$$N_j = 1 - (E + R)_j$$

Table 10 Transition Probabilities from a Nursing Home status

NURSING HOME						
	MALE			FEMALE		
	R(W)	N	E	R(W)	N	E
40-44	0.1472	0.7763	0.0764	0.1338	0.8336	0.0325
45-49	0.1143	0.7917	0.0940	0.1039	0.8560	0.0400
50-54	0.0888	0.7956	0.1156	0.0807	0.8701	0.0492
55-59	0.0689	0.7889	0.1422	0.0627	0.8768	0.0605
60-64	0.0535	0.7716	0.1748	0.0487	0.8769	0.0745
65-69	0.0416	0.7460	0.2125	0.0378	0.8681	0.0941
70-74	0.0323	0.7243	0.2434	0.0293	0.8370	0.1336
75-79	0.0251	0.6925	0.2824	0.0228	0.7959	0.1813
80-84	0.0195	0.6495	0.3310	0.0177	0.7431	0.2393
85+	0.0147	0.6142	0.3711	0.0134	0.6417	0.3449

[53] Dr. Kumar, Nanda. data May, 2003.

5.4 Transition Probabilities from a Home Care Status.

The mortality incidence rates from a home care status (H) were computed from Brookings Institution[54] estimates calculated based on the data from the 1982-84 NLTCS. Brookings data was on annual basis, age (65-100), and sex dependant. Moreover, the data was grouped into annual mortality probabilities for people with no disabilities, subjects with IADLs, with 1ADLs, and 2+ADLs. We took advantage of the available data and extrapolated to find the mortality rates for subjects from 65 years old to 40 years old. Since the data was from 1982-4, we adjusted it by using the 2000 population mortality of Dr. Kumar and divided each year by the 1982 population mortality data.[55] Next we multiplied each annual transition probability by the corresponding adjustment factor to update the data.

$$\text{2000 Male Mortality}_i \;/\; \text{1982-4 Male Mortality}_i = \text{ADJ}_i$$
$$\text{ADJ}_i * \text{MaleH}_i = \text{Updated MaleH}_i$$
$$\text{2000 Female Mortality}_i \;/\; \text{1982-4 Female Mortality}_i = \text{ADJ}_i$$
$$\text{ADJ}_i * \text{FemaleH}_i = \text{Updated FemaleH}_i$$

Where,

i is year in the range 40 – 100

MaleHP_i -- Male Home Care Mortality Incidence Rate in year i for 1982-4

Updated MaleH_i, FemaleH_i – estimate for year 2000

FemaleHP_i -- Female Home Care Mortality Incidence Rate in year i for 1982-4

Population mortality statistics were used since data for mortality on subjects with disabilities was not available for both years.

---

[54] Brookings Institution "Long Term Care Financing Model" February 1992. U.S. Department of Health and Human Services. May 2003 <http://aspe.hhs.gov/daltcp/reports/modampes.htm>
[55] SOA "TABLE No 386 – US 1982 Population Mortality." Society of Actuaries. May 2003, <http://www.soa.org/TABLEmgr/TABLEmgr.asp>

After the home care mortality incidence rates were adjusted for year 2000, the data was averaged to obtain the mortality transition probabilities for each cohort. (see Table 15)

The recovery data was also calculated based on Brookings Institution's statistics.

Table 11 Brookings Institution data

Annual Disability Transition Probability Matrices for the Noninstitutionalized Elderly				
	Non-Disabled	**IADL Only**	**1 ADL**	**2+ ADLs**
AGE 65-74				
Non-Disabled	0.9580	0.0226	0.0102	0.0092
IADL Only	0.0958	0.7190	0.1220	0.0632
1 ADL	0.0427	0.2515	0.4970	0.2088
2+ ADLs	0.0248	0.0887	0.1384	0.7480
AGE 75 - 84				
Non-Disabled	0.9080	0.0471	0.0267	0.0182
IADL Only	0.0591	0.6610	0.1616	0.1183
1 ADL	0.0313	0.1910	0.5960	0.1816
2+ ADLs	0.0053	0.0688	0.0899	0.8360
AGE 85 +				
Non-Disabled	0.2530	0.2851	0.2450	0.2169
IADL Only	0.0045	0.6910	0.1523	0.1523
1 ADL	0.0062	0.1113	0.5670	0.3155
2+ ADLs	0.0046	0.0277	0.0737	0.8940
SOURCE: Lewin-ICF and Brookings calculations using the 1982-84 National Long Term Care Survey				

As specified, in the begging of the project we were advised against using recovery rates in our simulation. Table 11 confirms that chances for full recovery, that is transition from 2+ADL's to a Non-Disable State are miniscule; for instance, such a transition for the 75 -84 cohort is only 0.5 %. Nevertheless, in our project we assume that recovery constitutes subjects' transition from disabled state, that is, subjects having 2+ ADLs, to any of the statuses not covered by LTC insurance (Well, IADLs and 1ADL). Such a recovery we mark as a recovery to a well status (W) in our simulation model. Thus, summing up the recovery transition probability for the 65-74 cohort adds up to a 16.4%. We believe this is percentage that should not be ignored.

Next, we proceeded by summing up the recovery rates from a 2 + ADL's status for the three cohorts displayed in Table 11 and presented it Table 12 below.

Table 12

Cohort	Transition. Prob. for Recovery
65-74	0.2519
75-85	0.164
85+	0.106

From the three data points, using Lagrange interpolation we obtain the quadratic function:

$$f(x) = 0.0000856 * x^2 - 0.022 * x + 1.3355$$

Using the above polynomial, we generated the transition probabilities for recovery (W) for all of the remaining cohorts (Table 14). Linear and Exponential functions were also used but the generated data was questionable; therefore, the more accurate Langrage polynomial was used.

Next, we had to adjust for length of stay. Since, as indicated earlier, subjects have to satisfy the insurance companies 90 days elimination period, Table 13 obtained from Brookings Institution was very useful in calculating the adjustment factors.

Table 13 Distribution of Home Care Length of Use for the Chronically Disabled (2+ ADLs)		
Duration	**Percentage Distribution**	**Assigned Number of Months of Use**
Less than 3 months	59.00%	2
3-6 months	14.2	4.5
6-12 months	9.6	9
12-36 months	7.1	24
36-60 months	7	48
More than 60 months	3.1	72
SOURCE: Brookings Institution and Lewin-ICF calculations using data from the 1982-84 NLTCS.		

Again, the purpose of this calculation was to adjust the transition probabilities only for the group of subjects with 2 + ADLs who use home care services for more then 90 days. From Table 13, percent distributions of those who stay 3-6 months were added up with the percentage of those who stay 6-12 months resulting in a 23.8 %. The total percentage of people who used services in one year was calculated to 82.8 % (Less then 3 months + '3-6' months + '6-12' months). From, there the adjustment factor was calculated.

$$\frac{\text{Subjects using services 3 to 12 months}}{\text{Subjects using services 1 year}} = 0.2874$$

Having the adjustment factor calculated we multiplied it by each of the previous computed transition probabilities.

Table 14

Cohort	Transition Prob. To Recover	Adjusted Tr. Prob. * (0.2874)
40-44	0.5819	0.1672
45-49	0.5122	0.1472
50-54	0.4469	0.1285
55-59	0.3858	0.1109
60-64	0.3291	0.0946
65-69	0.2765	0.0795
70-74	0.2283	0.0656
75-79	0.1844	0.0530
80-84	0.1447	0.0416
85-100	0.1060	0.0305

The adjustment for sex was conducted by the same method as for nursing home care. The recovery gender adjustment factors were computed by dividing the recovery rates in disabled in community (length of stay - under a year) for male and female for each cohort.[56] The results are 1.025 for female and 0.9762 for male. Table 16 displays the transition probabilities from a home care status for female and males.

Finally, as for Nursing Home, the status (Stay) for Home Care was obtained by subtracting recovery and death transition probabilities from one.

$$STAY_j = 1 - (E + R)_j$$

Table 15: TRANSITION PROBABILITES FROM HOME CARE STATUS

	MALE			FEMALE		
	R	STAY	E	R	STAY	E
40-44	0.1752	0.7891	0.0356	0.1593	0.8314	0.0094
45-49	0.1543	0.8021	0.0436	0.1402	0.8470	0.0128
50-54	0.1346	0.8120	0.0534	0.1223	0.8601	0.0176
55-59	0.1162	0.8184	0.0654	0.1056	0.8703	0.0240
60-64	0.0991	0.8201	0.0808	0.0901	0.8765	0.0334
65-69	0.0833	0.8187	0.0980	0.0757	0.8792	0.0451
70-74	0.0688	0.8113	0.1200	0.0625	0.8757	0.0618
75-79	0.0555	0.7976	0.1469	0.0505	0.8649	0.0847
80-84	0.0436	0.7766	0.1798	0.0396	0.8444	0.1160
85-100	0.0319	0.6896	0.2784	0.0290	0.7390	0.2320

[56] Dr Kumar, Nanda. May 2003.

5.5 Transition Probabilities Matrices for Each Cohort and Sex

Below are the transition matrices with the transition probabilities as a function of age from all health states for male and female. The health progression of an individual over time is based on these probabilities.

For example, a male who falls in the 55-59 cohort, and is in a well state (W) has a 97.71 % chance to begin next year in a healthy state, 1.09 % chance to begin next year in a Home care, 2.1 % chance to transfer to a Nursing home, and 0.99 % likelihood to die. The male will be subject to these transition probabilities until his age reaches age 60, then he will be subject to the probabilities in cohort 60-64 and so on.

MALE				
AGE : 55-59				
Current Health Status	**Probability that you begin next year as**			
	W	**HC**	**NH**	**E**
W	0.9771	0.0109	0.0021	0.0099
HC	0.1162	0.8184		0.0654
NH	0.0689		0.7889	0.1422

Table16 Male Transition Probabilities Matrices for each Cohort

MALE				
AGE : 40-44				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9934	0.0031	0.0003	0.0031
HC	0.1752	0.7891		0.0356
NH	0.1472		0.7763	0.0764

MALE				
AGE : 45-49				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9894	0.0047	0.0006	0.0053
HC	0.1543	0.8021		0.0436
NH	0.1143		0.7917	0.094

MALE				
AGE : 50-54				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9853	0.0072	0.0011	0.0064
HC	0.1346	0.812		0.0534
NH	0.0888		0.7956	0.1156

MALE				
AGE : 55-59				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9771	0.0109	0.0021	0.0099
HC	0.1162	0.8184		0.0654
NH	0.0689		0.7889	0.1422

MALE				
AGE : 60-64				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.963	0.0165	0.004	0.0165
HC	0.0991	0.8201		0.0808
NH	0.0535		0.7716	0.1748

MALE				
AGE : 65-69				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9383	0.025	0.0078	0.0289
HC	0.0833	0.8187		0.098
NH	0.0416		0.746	0.2125

MALE				
AGE : 70-74				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9087	0.0327	0.0163	0.0423
HC	0.0688	0.8113		0.12
NH	0.0323		0.7243	0.2434

MALE				
AGE : 75-79				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.846	0.0606	0.0314	0.062
HC	0.0555	0.7976		0.1469
NH	0.0251		0.6925	0.2824

MALE				
AGE : 80-84				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.7611	0.0909	0.057	0.091
HC	0.0436	0.7766		0.1798
NH	0.0195		0.6495	0.331

MALE				
AGE : 85-100				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.5382	0.132	0.0962	0.2336
HC	0.0319	0.6896		0.2784
NH	0.0147		0.6142	0.3711

Table 17 Female Transition Probabilities Matrices for each Cohort

FEMALE				
AGE : 40-44				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9933	0.0054	0.0004	0.0009
HC	0.1593	0.8314		0.0094
NH	0.1338		0.8336	0.0325

FEMALE				
AGE : 45-49				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.99	0.0077	0.0007	0.0016
HC	0.1402	0.847		0.0128
NH	0.1039		0.856	0.0400

FEMALE				
AGE : 50-54				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9851	0.011	0.0013	0.0026
HC	0.1223	0.8601		0.0176
NH	0.0807		0.8701	0.0492

FEMALE				
AGE : 55-59				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9775	0.0156	0.0025	0.0044
HC	0.1056	0.8703		0.024
NH	0.0627		0.8768	0.0605

FEMALE				
AGE : 60-64				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9654	0.0222	0.0047	0.0077
HC	0.0901	0.8765		0.0334
NH	0.0487		0.8769	0.0745

FEMALE				
AGE : 65-69				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9467	0.0316	0.0089	0.0128
HC	0.0757	0.8792		0.0451
NH	0.0378		0.8681	0.0941

FEMALE				
AGE : 70-74				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.9195	0.0412	0.0157	0.0236
HC	0.0625	0.8757		0.0618
NH	0.0293		0.837	0.1336

FEMALE				
AGE : 75-79				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.8522	0.0726	0.0351	0.0401
HC	0.0505	0.8649		0.0847
NH	0.0228		0.7959	0.1813

FEMALE				
AGE : 80-84				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.7701	0.0929	0.0713	0.0657
HC	0.0396	0.8444		0.116
NH	0.0177		0.7431	0.2393

FEMALE				
AGE : 85-100				
Current Health Status	Probability that you begin next year as			
	W	HC	NH	E
W	0.5855	0.1296	0.1145	0.1704
HC	0.029	0.739		0.232
NH	0.0134		0.6417	0.3449

Chapter VI Description of Long-Term Care Simulation Model

In order to build the effective simulation model, the software called @RISK has been used to develop the model. This software is run by the Microsoft Excel spreadsheet and Monte Carlo simulation methodology. Unlike other simulation programs, @RISK has many useful functions to assist the user in making decisions. For example, it lets users in one step to input different policy options for comparison and evaluation. @RISK also provides the statistical outcomes which users are familiar with such as mean value, standard deviation, and etc. @RISK can show users the risk probability of an output measure falling below a target threshold. The LTC simulation model allows user to determine an optimal alternative and how sensitive an outcome is to changes.[57] This chapter describes the LTC simulation model.

6.1 Transition Probabilities

The model shows a subject's health status over one's lifetime or at age 100, whichever comes first. Health status is formed as being one of four potential stages : healthy (W), undergoing home care (H), undergoing nursing home care (N), or expired(E). In order to build the simulation model, these health stages are indexed where W is 1, H is 2, N is 3, and E is 4. Health status is modeled year-by-year. The sets of transition probabilities of health status are established in order to perform the subject's

[57] Winston, Wayne L, Simulation Modeling using @RISK : Updated for Version 4, California : Duxbury,2001, Page 2

health status. Separate transition probabilities are provided for male and female and for each of these for the following ten age cohorts:

40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, 85-100

The following tables are examples of male health transition probabilities.[58]

Table18 : Examples of the transition probabilities

AGE : 40-44 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9934	0.0031	0.0003	0.0031
HC	0.1752	0.7891		0.0356
NH	0.1472		0.7763	0.0764

AGE : 45-49 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9894	0.0047	0.0006	0.0053
HC	0.1543	0.8021		0.0436
NH	0.1143		0.7917	0.0940

AGE : 50-54 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9853	0.0072	0.0011	0.0064
HC	0.1346	0.8120		0.0534
NH	0.0888		0.7956	0.1156

AGE : 55-59 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9771	0.0109	0.0021	0.0099
HC	0.1162	0.8184		0.0654
NH	0.0689		0.7889	0.1422

The model starts the subject's initial health status as being in healthy status. The model assumes that the probabilities of shifting health status in the next year depend only on the current status.

[58] Please refer to the completed transition probabilities tables in Table 16 and Table 17, Chapter V

6.2 Model Assumptions

- The model is set up to only analyze one LTC insurance supplier, UnumProvident.
- The model assumes that once a subject procures insurance, a subject will not falter in payments until he/she is expired. However, UnumProvident waives the premium requirement if the subject is in LTC status.[59]
- An elimination period is set to 90 days as specified by UnumProvident.[60] In other words, the subject has to pay the cost of using LTC services in the first 90 days of entering home care/nursing home care. The model assumes that the elimination period is satisfied every time that subject transitions from healthy stage to home care/nursing home stages.
- The $4,000, $5,000, and $6,000 facility monthly benefit amount of LTC insurance has been used in this simulation model. Also, three years and six years benefit durations have been applied to this model.
- An inflation protection is 5% compounded growth uncapped. The monthly benefit of the LTC insurance with inflation protection option will increase every year by 5% regardless of the subject's health status.[61]
- UnumProvident provides two plans: Base Plan option and Total Home Health care option. Because of uncertainties in the base plan benefits, we did not include the base plan option and decided to model only for Total Home Health Care option. Under Total Home Health Care option, the model

[59] UnumProvident May,2003 <https://w3.unumprovident.com/enroll/upitt/plan.htm>
[60] UnumProvident May,2003 <https://w3.unumprovident.com/enroll/upitt/plan.htm>
[61] UnumProvident May,2003 <https://w3.unumprovident.com/enroll/upitt/plan.htm>

assumes that UnumProvident pays 50 % of selected facility monthly benefit amount for Home Care Benefit.[62]

- The nursing home care cost is based on the average daily rate for the semiprivate room in Worcester, Massachusetts which is $219.6.[63]
- The home care cost is assumed to be 50% of the nursing home cost. We assumed that the home care cost includes both the professional care cost and incidental cost.
- The home care and nursing home care cost rises every year according to a user specified inflation rate. The model's default value is 5 %.[64]
- Since the transition probabilities of health status are on an annual basis, all the LTC costs that occurred during one's lifetime are assumed to be based on annual cost.
- All the LTC costs and benefits received from UnumProvident are taken place at the beginning of the year.

6.3 Modeling options

The LTC simulation models are constructed to align with UnumProvident's LTC insurance policy. The LTC simulation models are configured into 10 models to cover different subject types and insurance choices;

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[62] UnumProvident May,2003 <https://w3.unumprovident.com/enroll/upitt/plan.htm>
[63] MetLife Ins. Market Survey on Nursing Home and Home Care Costs 2002. May, 2003 < http://www.metlife.com/WPSAssets/17157088621027365380V1FPDF1.pdf >
[64]Arizona Department of Health Services. " U.S. Consumer Price Index for Nursing Home Costs" July 2003 <http://www.hs.state.az.us/plan/hosp/cpinci.pdf > Please refer to Ten-Year Average U.S. Consumer Price Index for Nursing Home Cost in Appendix 1

- Male Self-Insure Model
- Male 3 years Duration Insurance Model
- Male 6 years Duration Insurance Model
- Male 3 years Duration with Compounded Inflation Protection Option Insurance Model
- Male 6 years Duration with Compounded Inflation Protection Option Insurance Model
- Female Self-Insure Model
- Female 3 years Duration Insurance Model
- Female 6 years Duration Insurance Model
- Female 3 years Duration with Compounded Inflation Protection Option Insurance Model
- Female 6 years Duration with Compounded Inflation Protection Option Insurance Model

6.4 Financial Analysis

In order to calculate all the total expected costs during one's lifetime or at the age 100, whichever comes first, the simulation model starts the subject off with a zero fund. Total expected cost is the summation of future equivalent value of expected premium cost, expected home care/ nursing home cost, minus any expected paid benefits.

(Total expected costs = Expected Premium + Expected Home Care/Nursing Home Cost – Expected Benefit received)

The LTC insurance premiums are obtained from the UnumProvident Premium Tables for the Total Home Health Care option with and without inflation protection.[65] The premiums are set consistent with the subject's age when he/she first purchases LTC insurance under the chosen LTC insurance options. As indicated in the modeling assumptions, the premiums are waived when the subject is qualified for benefits. In other words, the subject undergoing home care or nursing home status does not have to pay a premium.

The annual home care and nursing home cost are increased every year by the percentage as designated by user or default value, 5%. The increase in these costs starts at the year after the current year.[66]

$$\text{Annual Home care cost}_{i+1} = \text{Annual Home care cost}_{i} * (1 + 0.05)$$

$$\text{Annual Nursing Home cost}_{i+1} = \text{Annual Nursing Home cost}_{i} * (1 + 0.05)$$

The subjects will receive the annual benefit when they are in home care or nursing home care status and after the 90-day elimination period has been fulfilled. The paid benefit is subject to the maximum lifetime benefit.[67] Once the subject entering home care or nursing home, the value of three months benefit is deducted from the annual benefit of that year. However, the cumulative of paid benefit over one's lifetime cannot go beyond maximum lifetime benefit. Below are examples of how to calculate the maximum lifetime benefit for the option of no inflation protection;

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[65] Please refer to a completed annual premium table in Appendix 2
[66] Please refer to a completed forecasting LTC cost in Appendix 3
[67] UnumProvident May,2003 <https://w3.unumprovident.com/enroll/upitt/plan.htm>

4,000 facility monthly benefit and 3 year duration

Maximum Lifetime Benefit = $4,000/month*12month*3years

= $144,0000

6,000 facility monthly benefit and 6 year duration

Maximum Lifetime Benefit = $6,000/month*12month*6years

= $432,000

Since there are recovery rates from both home care and nursing home in the simulation models, the elimination period has to be satisfied every time that the subject transitions from healthy status to home care or nursing home. The following formulas are used to calculate the annual benefit for home care and nursing home care.

- Annual facility benefit during the elimination period
  - Home care = Annual facility benefit * 50 %*75%
  - Nursing Home Care = Annual facility benefit *75%
- Annual facility benefit after realizing elimination period in previous year
  - Home care = Annual facility benefit * 50 %
  - Nursing Home Care = Annual facility benefit

In addition, under the inflation protection option, both annual facility benefit and maximum lifetime benefit are escalated by compounded inflation rate of 5%. The following formulas are employed to evaluate both the inflated annual benefit and inflated maximum lifetime benefit.

Annual facility benefit $_{i+1}$ = Annual facility benefit $_i$*(1+ 0.05)

Maximum lifetime benefit $_{i+1}$ = Maximum lifetime benefit $_i$*(1+ 0.05)

To sum costs over time, the model utilizes a user specified time value of money denoted as ROI (Return on Investment). Total Cost is for a future time either age 100 or the year of expiration, whichever comes first. The measurable outputs of each simulation model equal the future value of the expected total cost.

Ending of year $_i$ Fund Value = (Beginning of year $_i$ Fund Value - Annual Premium Cost - Annual Home care/ Nursing home Cost + Annual paid benefit)*(1+ ROI%)

6.5 Simulation Model Logic

Although there are ten different simulation models, these models are built in the same logic. This simulation explanation is referred to Figure 4, which is enclosed at the end of chapter. The simulation model allows users to input data as follows:

1. Subject's current age
2. Subject's gender
3. Desired age of procurement (i.e. the age that subject wants to purchase LTC insurance.)
4. Desired facility monthly benefit
5. Inflation rate of LTC cost (or set as default value 5%)
6. Annual ROI for equivalencing costs over time

After all users' input data are entered, the simulation model first tests whether to initiate or not. The simulation model starts at the subject's current age and terminates when the subject is expired or subject's age reaches the age 100, whichever comes first. At the first year of executing model, the beginning of the year (BOY) fund value is set as $0 and healthy status is assumed. In each following year, the health status is determined using transition probabilities and random sampling.

If health status is healthy, then the model checks whether the subject has LTC insurance. The subject initiates having insurance at the specified age of procurement. If the subject has LTC insurance, the constant premium cost of that chosen policy has to be paid.

If a subject's health status is either in home care or nursing home, the model computes the annual cost occurred in this stage. After computing the annual LTC cost, the model verifies whether or not the subject has LTC insurance. The annual facility benefit needs to be compensated by insurance company, if the subject has LTC insurance. As mentioned earlier in the financial module subchapter, the annual benefit is paid after the elimination period has been satisfied and the total amount of cumulative benefit does not surpass the maximum lifetime benefit.

Once all the calculation of costs and benefit are completed for a given year, the model calculates a future equivalent end of year (EOY) costs by compounding forward according to the specified ROI. The model keeps on running until the subject either expires or reaches the age of 100. Therefore, the final output of each simulation model is the future value of the last EOY fund value.[68]

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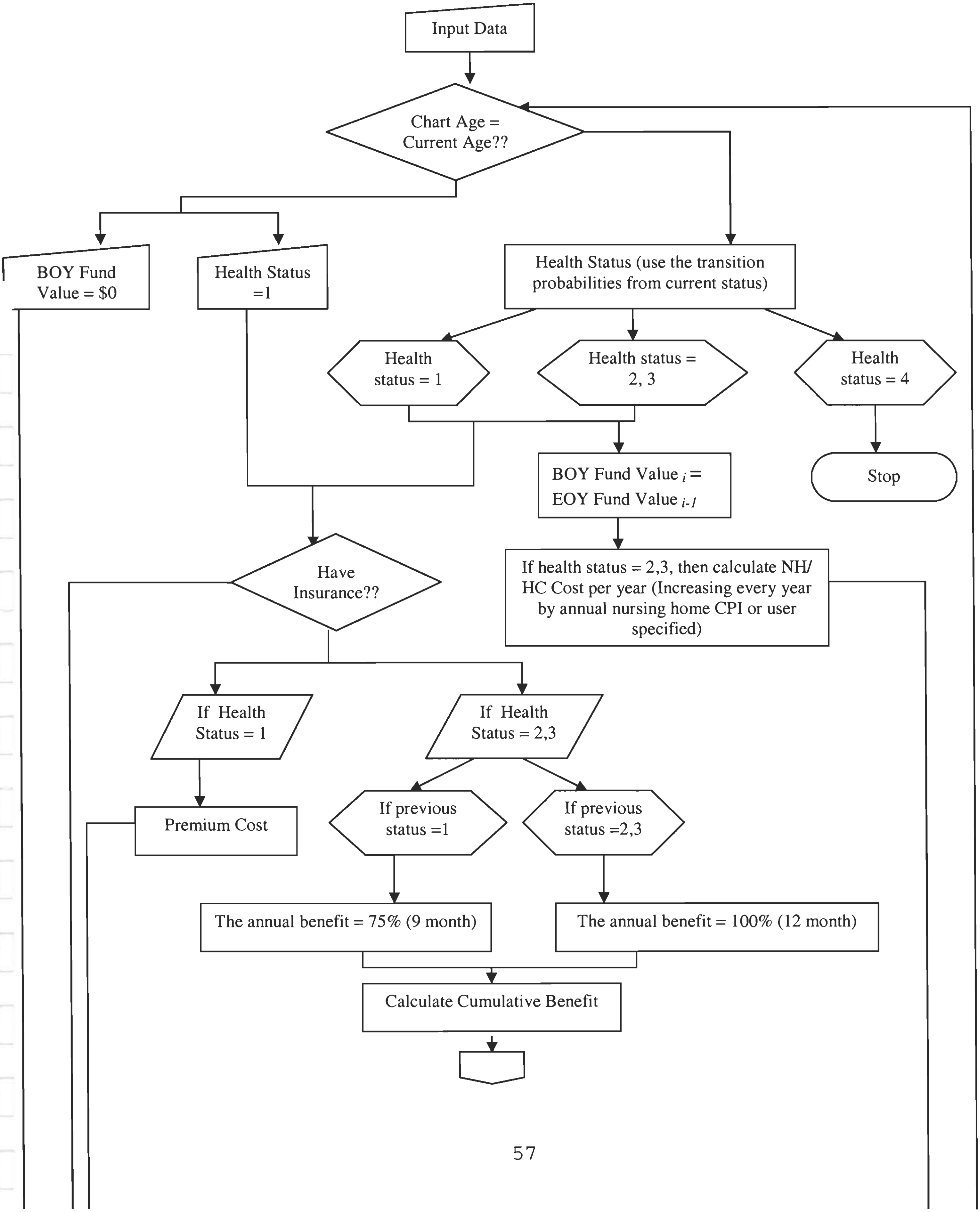
[68] Please refer to the attached CD-ROM to run the simulation model

Figure 4 : Simulation Model Logic



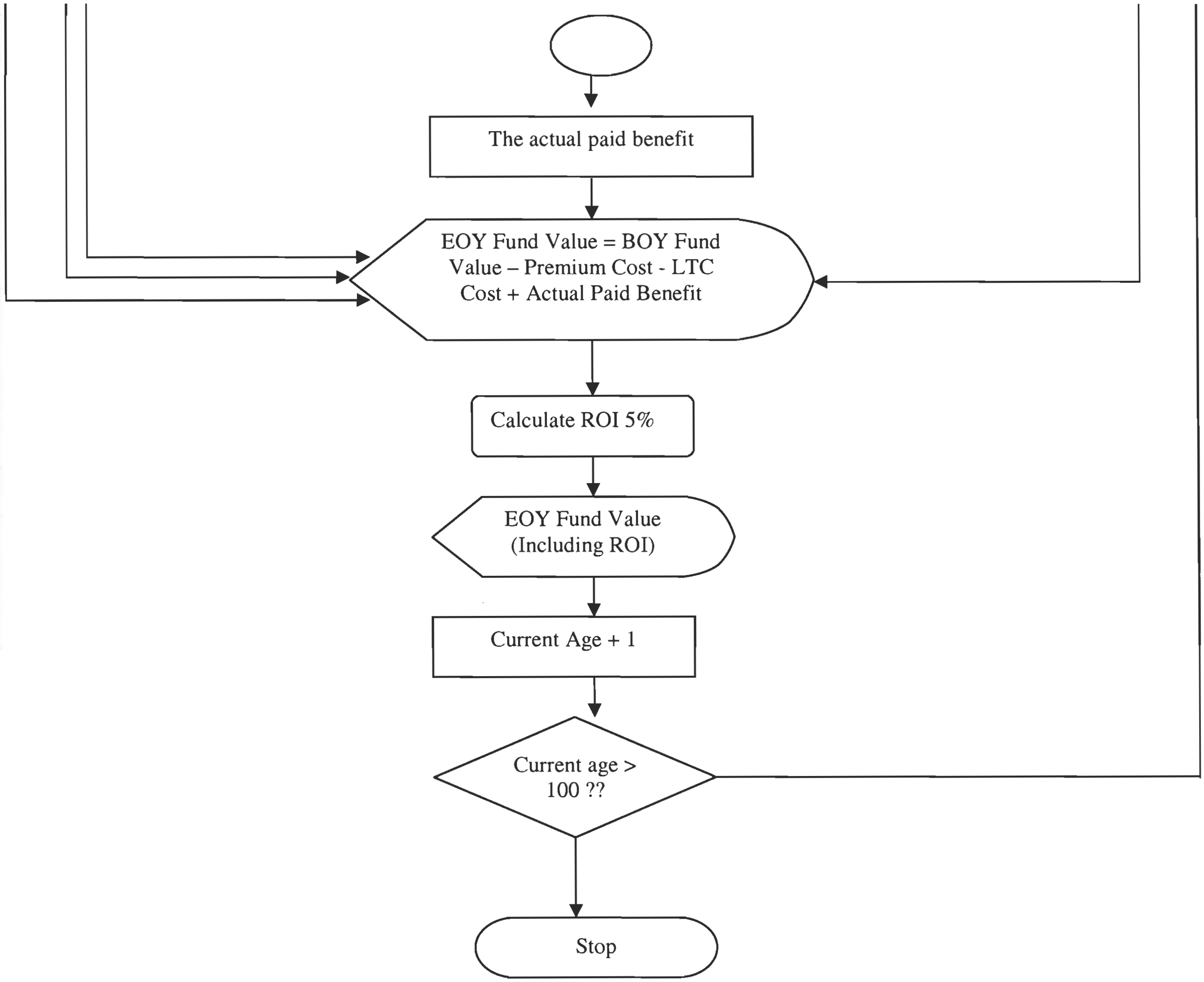


Figure 4 : Simulation Model Logic (Continued)

Chapter VII Results and Analysis of Results

7.1 Overview

The LTC simulation model guides a user on whether to obtain LTC insurance now, and if so, which option is the best option among twelve options for each age and gender. The model simulates the subject's health status on a year-by-year basis. In each year, the model estimates the prospective outflow monies, cost for undergoing home care/ nursing home and cost of premium, along with the inflow benefits received from the insurance company. Therefore, the ultimate output of the LTC simulation model is the subject's total expected cost, which is the future equivalent value of expected premium costs plus expected LTC cost minus expected received benefit, at the time he/she is expired or reaches the age 100. The LTC simulation model also calculates the risk that the total expected cost will exceed a target threshold and the risk results in this chapter use a threshold of $500,000. The results are provided for the following age cohorts[69]:

40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, and 80-over

The results for age over than 80 are not presented because the maximum age of purchasing LTC insurance is 80 years old.

[69] Please refer to the completed simulation result in Appendix 4

7.2 Summary of Simulations Results

In general, trying to minimize total expected cost and risk are conflicting objectives; when total expected cost is the lowest, the risk will not be the lowest for the same alternative. The subject has to trade off which goal he/she is concerned; whether to minimize cost or risk. However, in this project, these two objectives are consistent.

The objective of purchasing LTC insurance is that the total expected cost or the risk of having LTC insurance is less than that of paying out by one's own pocket. Figures 5 and 6 allow comparison between having insurance and self-insurance in terms of total expected cost for male and female, respectively. These two figures present the total expected costs of self-insure, the cheapest LTC insurance, and the most expensive LTC insurance. The cheapest LTC insurance is originated from the $4,000 facility monthly benefit with three years duration and without the inflation rider and the most high-priced is $6,000 facility monthly benefit with six years duration and the inflation option. Based on simulation results, even the most economical insurance plan outperforms self-insure for all age groups and both genders. Also, in the early age, there is a considerable difference between self-insure and insured; on the other hand, there is barely variation for those who are older. Moreover, the graphs show that the most expensive LTC insurance confers the lower total expected cost than the cheapest one. The details of LTC option will be discussed later in this chapter. These results show that in terms of total expected cost the subject receives more benefits than the premium he/she paid. Furthermore, these results show that the cost for female is higher than that of male. The reason why this circumstance arises will be discussed shortly.

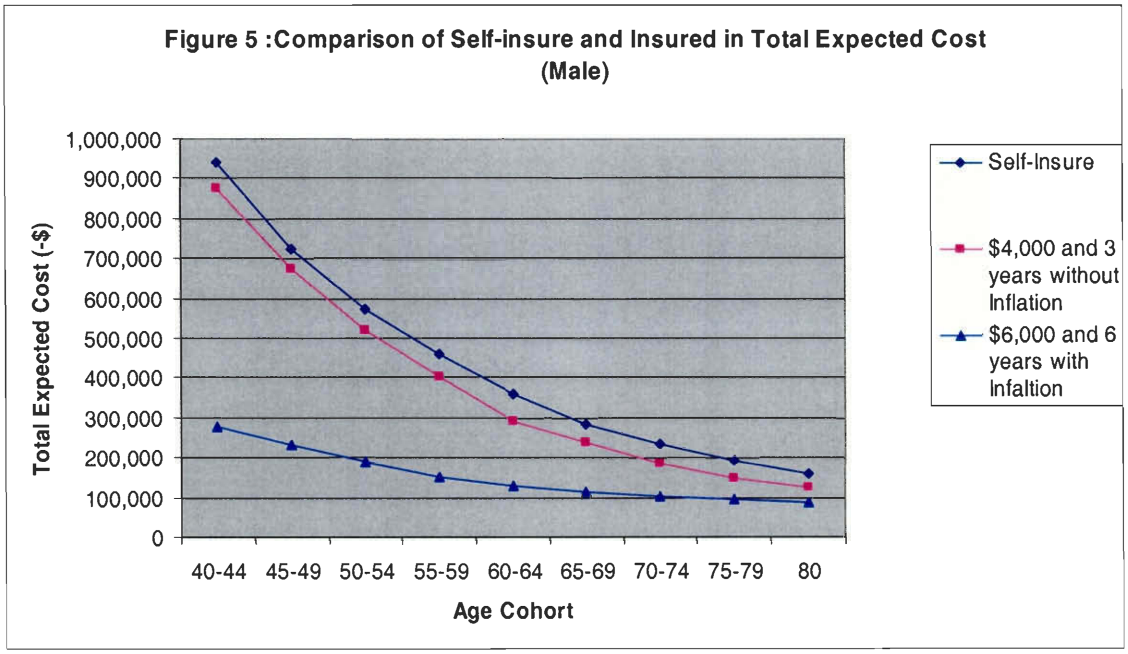


Figure 5 :Comparison of Self-insure and Insured in Total Expected Cost (Male)
Total Expected Cost (-$)
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80
Age Cohort
Self-Insure
$4,000 and 3 years without Inflation
$6,000 and 6 years with Infaltion

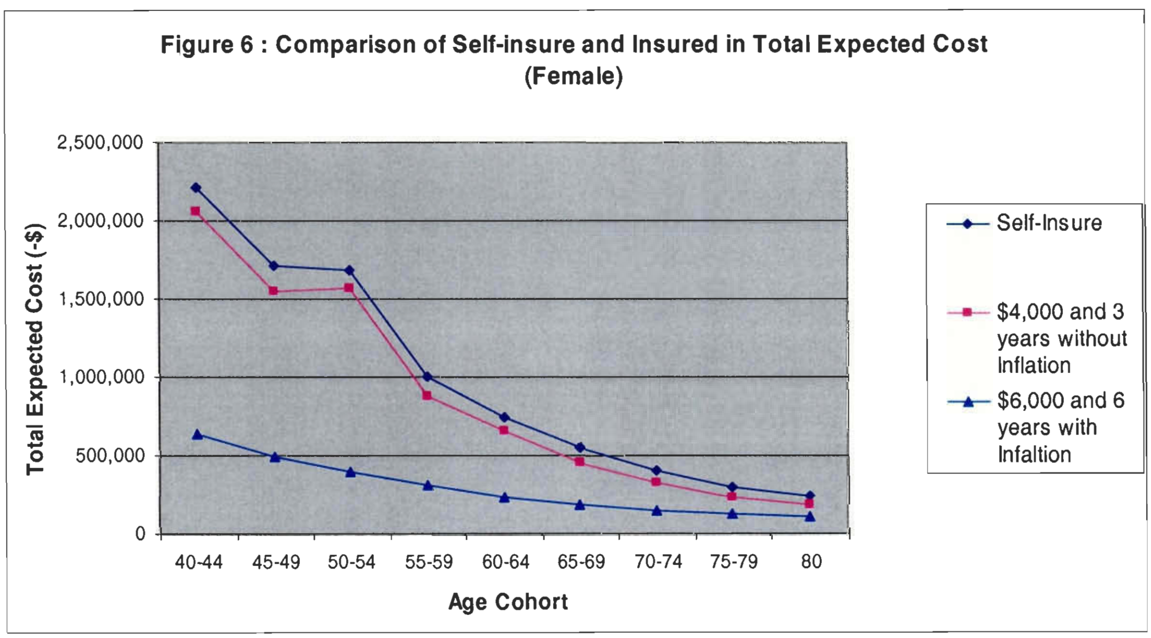
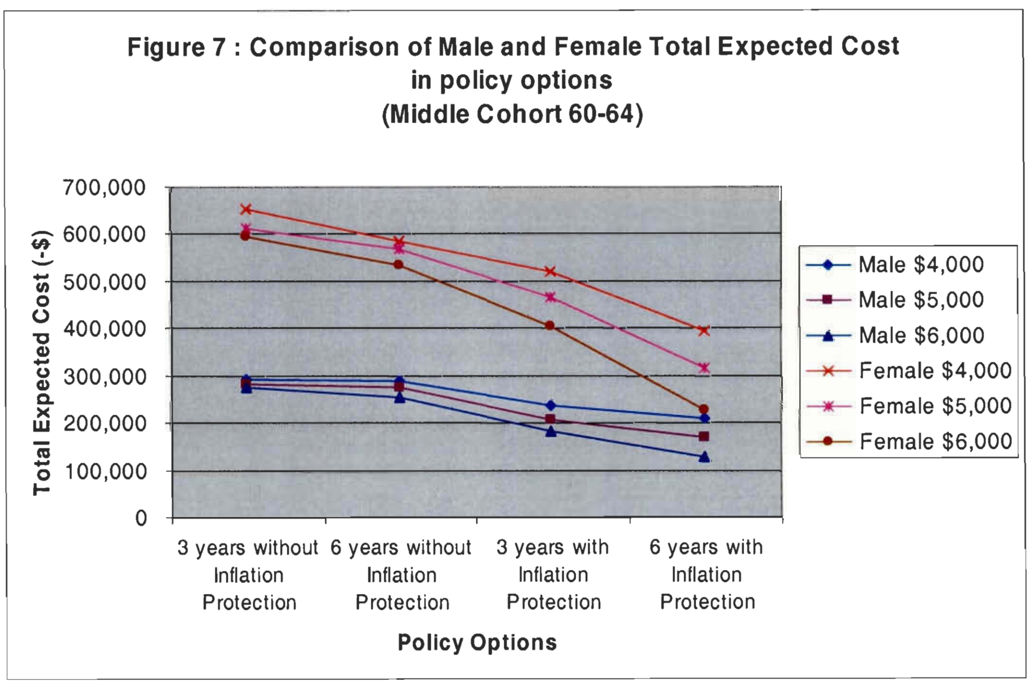


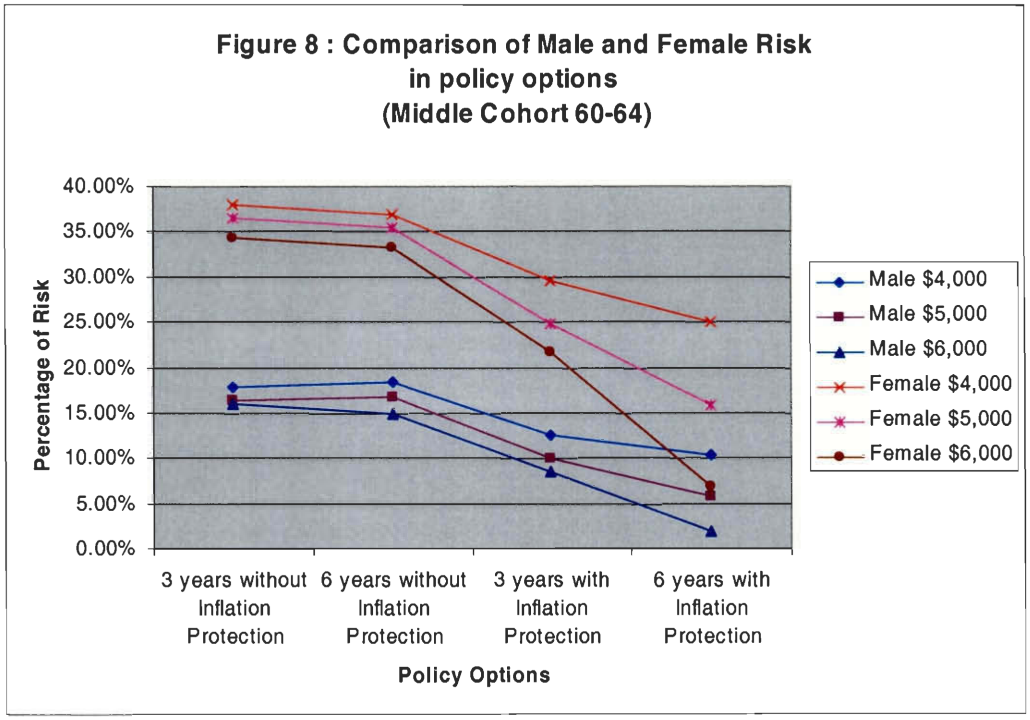
Figure 6 : Comparison of Self-insure and Insured in Total Expected Cost (Female)
Total Expected Cost (-$)
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
40-44
45-49
50-54
55-59
60-64
65-69
70-74
75-79
80
Age Cohort
Self-Insure
$4,000 and 3 years without Inflation
$6,000 and 6 years with Infaltion

After the question "whether to buy LTC insurance" has been solved, the following inquiry "which option is the best" is still in skepticism because there are various options offered by UnumProvident. The results derived from the simulation model show that the more the customers buy, the more they get; moreover, the results are consistent with every cohort and gender. Therefore, the sample results of one cohort can represent those of other cohorts.[70]

Figure 7 and figure 8 illustrate the comparison of total expected cost and the percentage of risk, respectively, in each policy options. The data of these two charts are obtained from the age cohort of 60-64, which is the middle cohort. Figure7 shows that the more coverage the subject buys, the less the subject pays. Figure8 shows that the same conclusion holds when one's performance measure is the risk of losing money more than $500,000.



[70] Please refer to the table of total expected cost and risk for each cohort in Appendix 5



Consequently, the maximum LTC insurance, which is the $6,000 facility monthly benefit and six year duration with inflation protection, is the optimum alternative for every cohort based on the obtained results.

Analysis of simulation results

7.3.1 Total Expected Cost Analysis

Since the transition probabilities of entering and staying in home care/nursing home care are higher for female than those of male[71], the expected LTC cost that occurs over a female's lifetime is greater than the male. The expected LTC cost is a majority

[71] Interview with Dr. Kumar, Nanda. May 2003.

portion of total expected cost; therefore, total expected cost of female is higher than that of male.

Furthermore, the reason why the probabilities of entering and staying in home care/nursing home care of females are larger is because the females have a longer life than males, outliving men by an average of seven years. With progressing age, for both male and female, the chance of losing the Activities of Daily Living (ADLs) is increasing; as a result, the need for LTC services is rising.[72]

Therefore, the total expected costs of female in the early ages are considerably higher than those of male, and such differences are decreasing with advancing age. The average ratio of female total expected cost to male total expected cost for the youngest age cohort is 2.4, and this ratio decreases to 1.5 for the age 80 cohort.[73]

Table19 presents the average ratios of female total expected cost to male total expected cost. **It can be concluded that the total expected cost of female is approximately twice that of male, based on simulation analysis.**

Table 19 : The Average Ratios of Female Total Expected Cost to Male Total Expected Cost

Coverage	Self-Insure	LTC insurance options			
		3 years without Inflation	6 years without Inflation	3 years with Inflation	6 years with Inflation
$4,000		2.1	2.1	2.1	1.9
$5,000	2.0	2.0	2.0	2.1	1.8
$6,000		2.0	2.0	2.1	1.8

[72]The U.S. Department of Labor, Advisory Council on Employee Welfare and Pension Benefit Plans Report, Findings, and Recommendations of the Working Group on Long-Term Care, November 14, 2000. May 2003. <http://www.efast.dol.gov/ebsa/publications/report2.htm>

[73] Please refer to a completed female total expected cost to male total expected cost ratio in Appendix 6

7.3.2 The Effect of Inflation Protection Options

Since the higher premium cost is required for obtaining the inflation protection option, one may question whether such option is adequate to meet future LTC costs. According to the AARP Public Policy Institute Issue Paper, a five percent compound inflation condition is likely sufficient to finance the future LTC costs of most policyholders. In general, more than 80 percent of total LTC costs will be covered by inflation option policy; however, people who enter the nursing homes may bear significant out-of-pocket costs.[74]

Nonetheless, the inflation protection is not a necessity for all ages. It can be argued that the older the procurer of long term care insurance, then inflation protection is less crucial. Younger buyers of LTC insurance, under age 60, should be particularly sensitive to inflation protection.[75] The reason why this situation occurs is the older people need LTC services sooner than younger people do.

Consequently, the results of LTC simulation model present the same effect as indicated above. The ratios of total expected cost of "without inflation" to that of "with inflation" are shown in Table 20. This ratios show how well the inflation protection trims down the total expect cost, based on $6,000 coverage and six year duration.[76] Clearly, in the early ages, the cost of **not** purchasing inflation protection is approximately three times over that of policies with inflation protection for both male and female.

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[74] AARP Public Policy Institute issue paper. "Inflation Protection and Long-Term Care Insurance: Finding the Gold Standard of Adequacy" August 2002. July 2003 <http://research.aarp.org/health/inb54_inflation. html>

[75] Driscoll, Marilee. "An Inflating Issue" Senior Market Advisor. March 2002. July 2003<http://www. seniormarketadvisor.com/Archives/mar02/feature4.cfm>

[76] Please refer a completed ratio of other coverage and options in Appendix 7

The ratio keeps shrinking as the age increases, and it reaches roughly at 1.3 in the age 80 for both gender. In other words, in an older age, the cost of both with and without insurance are likely the same. **It can be concluded that with increase in age the benefit of inflation decreases.**

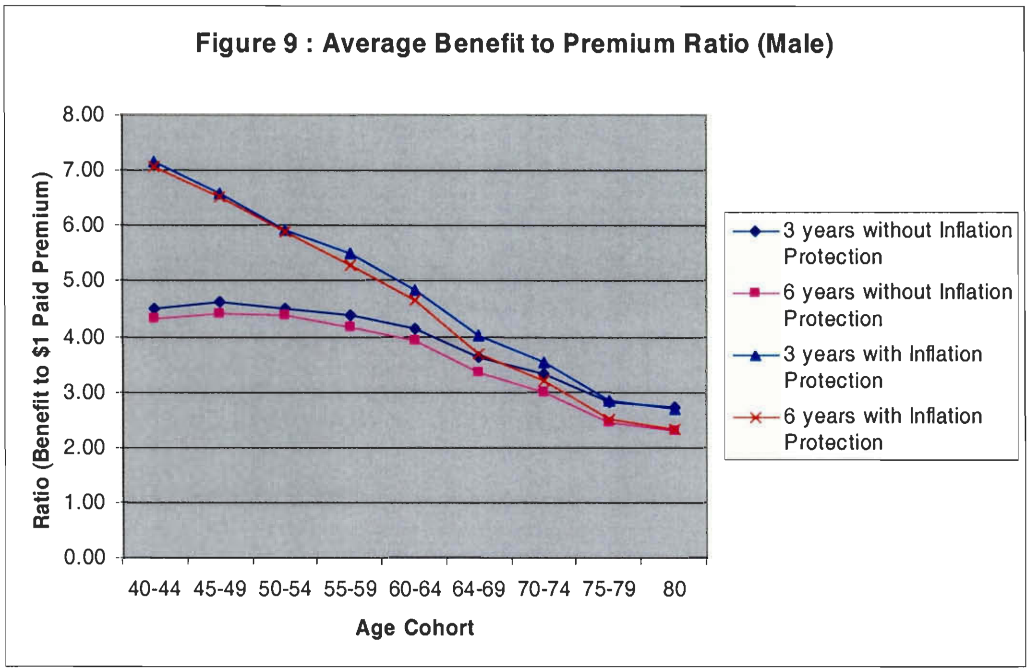
Table 20 : Ratio of Without Inflation to With Inflation Total Expected Cost (6years to 6 years Inflation and $6,000 coverage)		
Cohort	**Male**	**Female**
40-44	2.86	3.01
45-49	2.60	2.90
50-54	2.41	2.57
55-59	2.18	2.43
60-64	1.98	2.34
65-69	1.78	2.01
70-74	1.50	1.80
75-79	1.29	1.50
80	1.22	1.37

7.3.3 Benefit to Premium Ratio

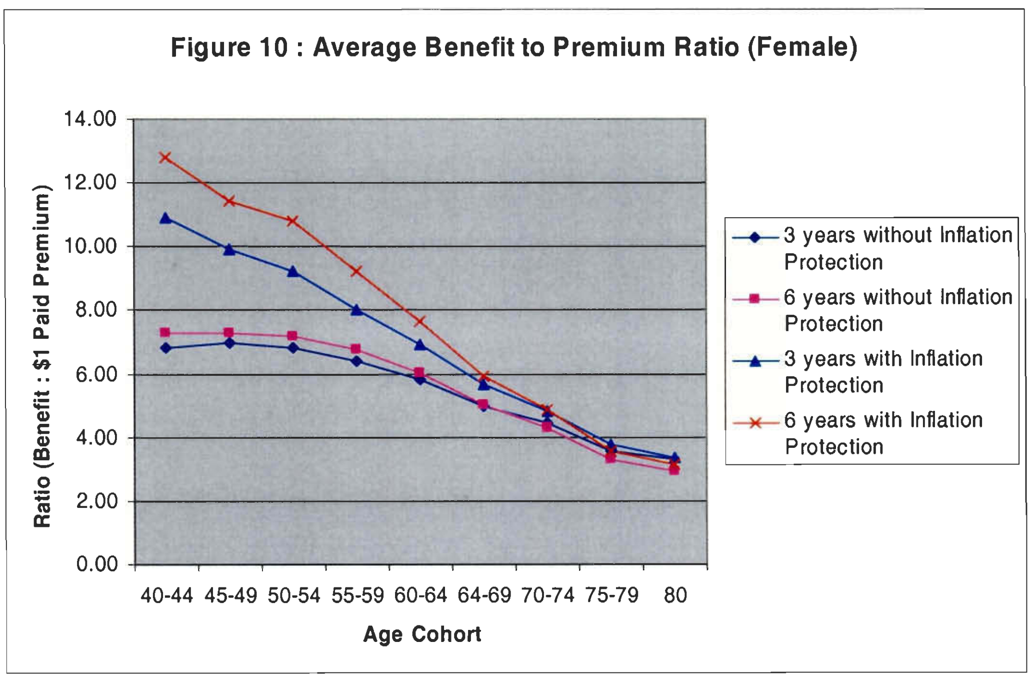
Although the more LTC insurance coverage a subject purchases the more advantages they obtain, the average benefit to premium ratio is not maximized under maximum coverage. Figure9 illustrates an average amount of dollars that a male subject gets back from each premium insurance dollar.[77] For example, in the male cohort of 40-44, the insured will get $7.14 for every dollar that he pays for providing three years with inflation protection options.

[77] Please refer to completed benefit to premium ratio in Appendix 8

From Figure9, the average benefit to premium ratio of three years with inflation protection for male, in every age cohort, is higher than that of the highest coverage option of six years with inflation protection. From the following chart, it can be concluded that the six years without inflation option is the less profitable option in terms of benefit to premium ratio.



From the next exhibit, Figure 10, the best option for early ages of female is 6 years with inflation protection; besides, the differences of benefit to premium ratio among these LTC insurance options are likely the same for older ages. Since women have an opportunity of living longer than men, the six years with inflation protection is still the best pay-off options for those people who are under 74. On the other hand, for those who are over 74, the three years with inflation protection is the best option if the users are concerned of benefit to premium ratio.



7.4 Summary of survey results

The final part of the IQP project was to conduct a confidential e-mail survey to explore the utility of the developed LTC simulation model. The experiment was conducted in two stages by sampling twelve WPI faculty and staff members who were considering purchasing Long-Term care insurance offered by Unum. The purpose of the survey was to investigate if and how the LTC model affects purchasing decisions.

The first stage of the survey included a memorandum explaining the background of the project, the purpose of the survey, statement of assurance of confidentiality, as well as an attached questionnaire.[78] Questionnaire 1 asked which policy, if any, subjects will select without the benefit of any formal quantitative actuarial analysis. A LTC simulation was performed based on how the subjects filled out the questions in the Questionnaire 1. Then a second questionnaire was sent along with: generated statistical results for each individual; explanation of how to make use of the results; recommendations on best option to minimize possible future cost given the subject's age, sex, and risk tolerance. The goal of Questionnaire 2 was to determine if the results of the simulation impacted the subjects' decision-making.

Table 21 displays the demographics of the surveyed individuals that began the survey and those who completed the simulation study.

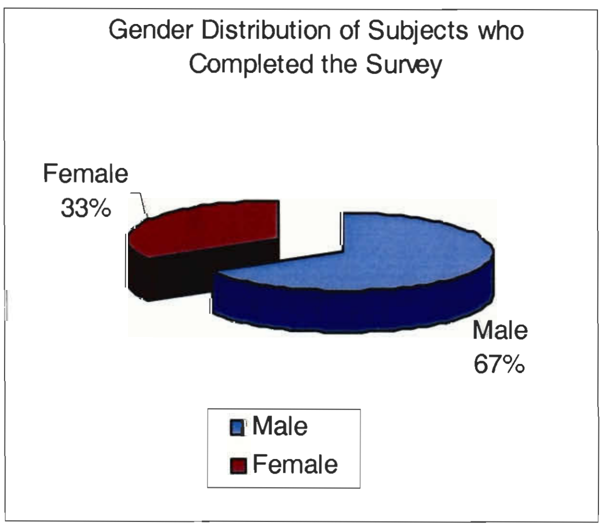
[78] Please find the above mentioned documents enclosed in Appendix 9 and Appendix 10

Table 21

	Questionnaire 1		Questionnaire 2	
Cohort	MALE	FEMALE	MALE	FEMALE
40-44	2			
45-49	1	1	1	1
50-54	1	1	1	
55-59	2	1	2	1
60-64	1	1	1	1
65-69	1		1	
TOTAL	8	4	6	3

Figure 11 shows a graphical representation of the participants who completed both questionnaires. One third of the subjects were women and two-thirds were men. Those who completed both surveys were between 45 and 69 years of age.

Figure 11 Graphical Representations of the Demographics of the Surveyed Subjects



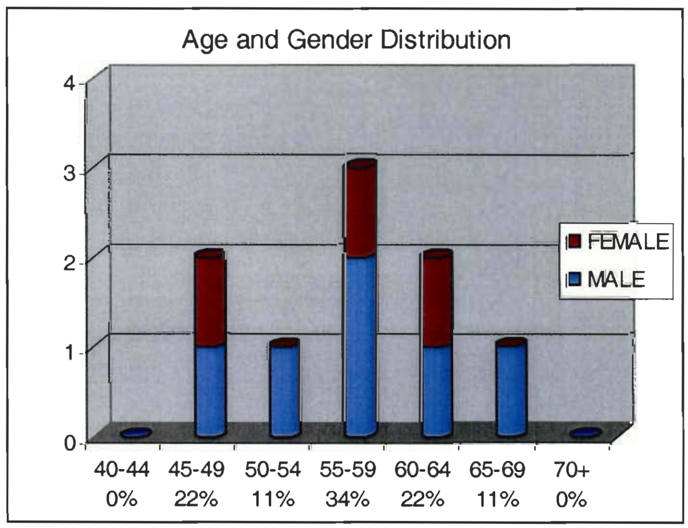
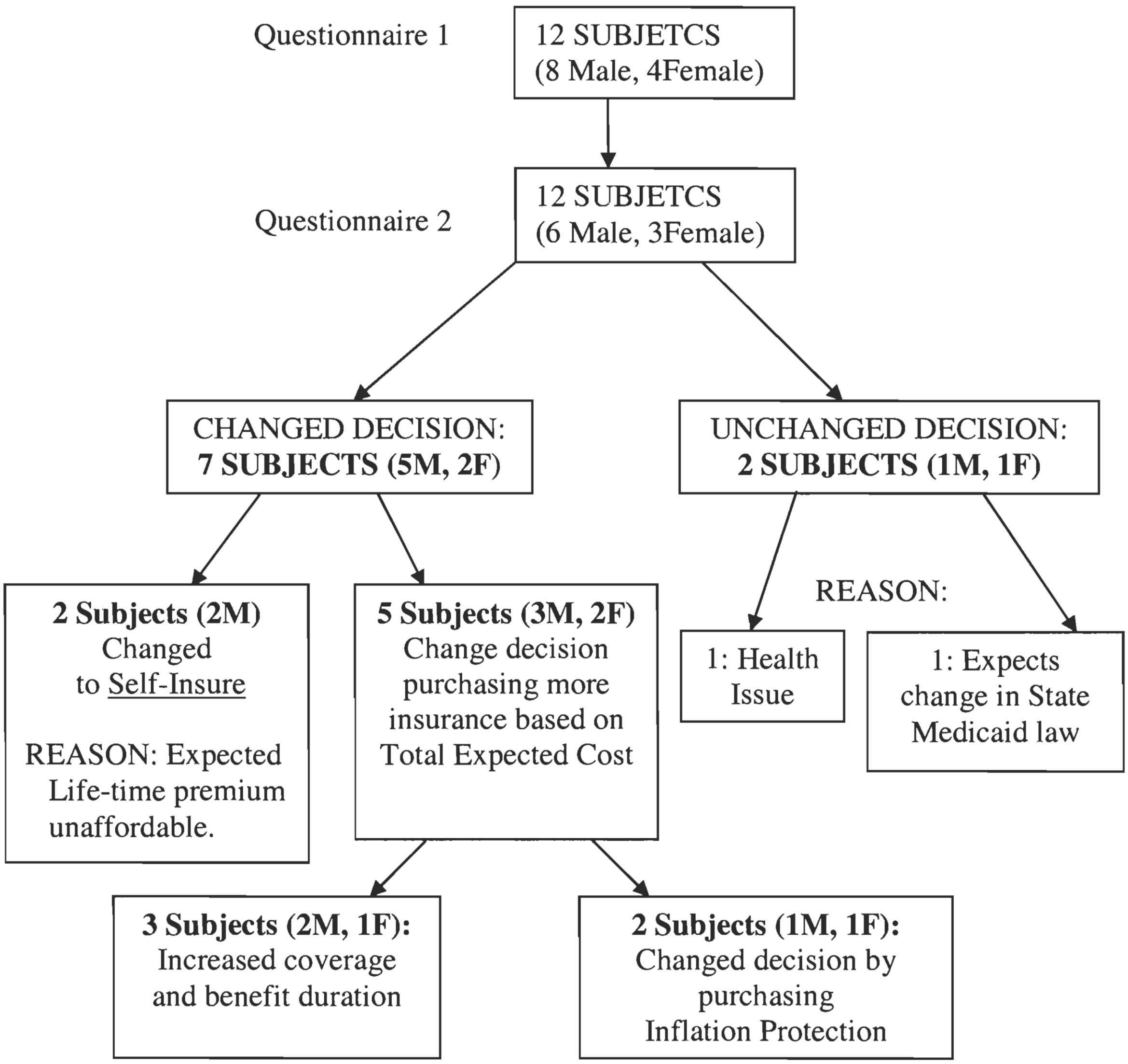


Figure 12 shows a graphical representation of the results of the survey. Nine out of the twelve subjects answered both questionnaires. From them, seven changed their decisions based on the quantitative data provided. Two kept their initial decisions. From the two that kept their decisions unchanged, one had health considerations and one believed that there will be a change in the Medicaid benefit system that will allow insured individuals to qualify for a better treatment and keep assets that might otherwise have to be forfeited.

From the seven who alter their decisions based on the provided quantitative data, two decided that they could not afford the expected life-time premium and decided to self-insure. The other five subjects purchased more insurance to minimize expected future cost and risk. One of the five subjects did not select any coverage in the first questionnaire and indicated being undecided about what to purchase, although the quantitative data helped her make a purchasing decision. Two of the five subjects recognized that purchasing inflation protection mitigate future expected cost and accordingly changed their decision by selecting inflation protection. One of those two decided to reduce benefit duration selected in favor of purchasing inflation protection. The other three subjects had chosen inflation protection in both surveys. From those three subjects, two changed their decision with one increasing the benefit amount and duration, and one increasing the benefit amount.

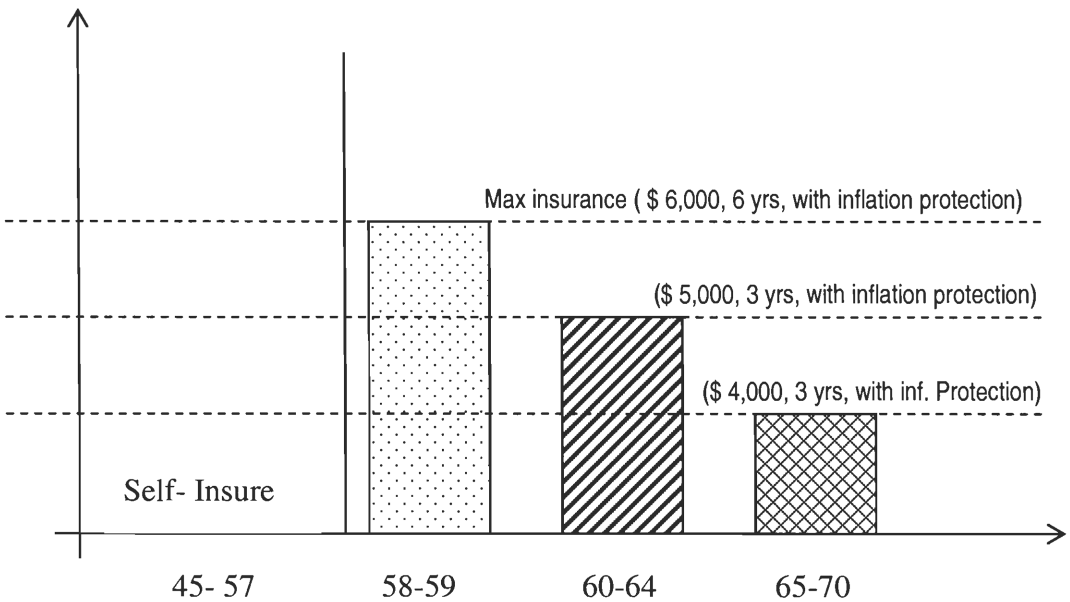
Overall the provided quantitative data affected nearly 80 percent of the subjects purchasing decision. The remaining 20 percent approached the questionnaire with concerns that are not captured in a quantitative analysis.

Figure 12: Summary of Survey Results



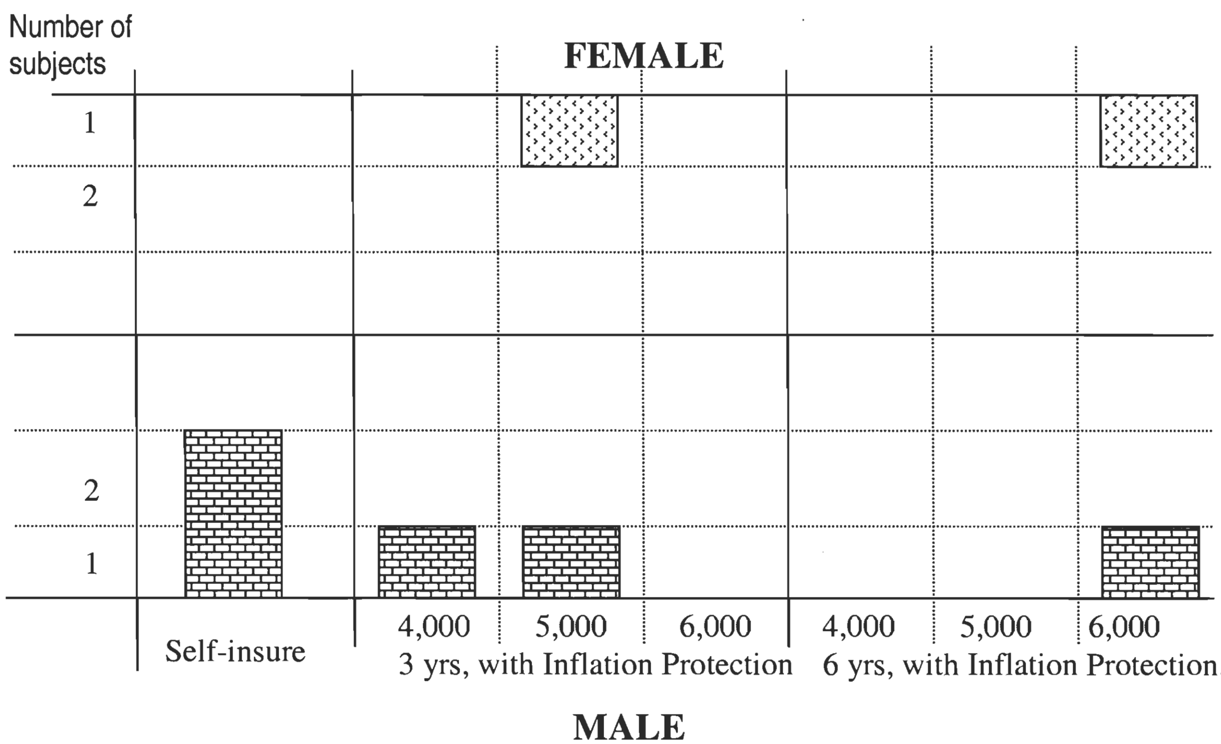
Analyzing the survey results (Figure13) of how age affects purchase decision-making, for those who changed their decisions, we concluded that as age increases subjects were considering purchasing less insurance. Also, the subjects who consider self-insuring are the youngest of those who changed their decisions.

Figure 13: Analysis of How Age Affects Purchasing Decision-Making.



The survey did not provide sufficient information of the effect of gender on purchasing decision-making. Figure 14 below displays the distribution of male and female by chosen policy plan. The results are inconclusive. Due to the number of options available, a larger sample size is necessary to draw meaningful conclusions. However, from the surveyed subjects who changed their decision, those who decided to self-insure were male.

Figure 14: Gender Distribution for Chosen Options



Chapter VIII Conclusions

Purchasing LTC insurance is a difficult decision that can significantly impact one's financial planning. The LTC simulation model we developed addresses this decision-problem on quantitative bases by providing statistical and actuarial data that facilitates decision-making. The generated data, based on average values, aids the consumer in making a decision on whether one should purchase LTC insurance - and if so, then what is the best combination of coverage duration, monthly benefit amount, and inflation protection to minimize future possible cost - or should one take the risk and self-insure.

The primary evaluation measures used in our simulation model were the total expected future cost and the risk of exceeding a specified threshold amount. The results generated by the simulation model showed that if one's goal is to minimize these evaluation measures, than, the solution is to maximize insurance coverage. On the other hand, those interested in optimizing the expected return on their insurance premium dollars should consider the benefit to premium ratio evaluation measure. This evaluation measure indicates that for women it is better to purchase longer benefit duration (6 yrs) with inflation protection and for men to purchase shorter benefit duration (3yrs) also with inflation protection.

A phenomenon further observed was that the expected future total cost for female significantly exceeds the total expected cost for males. These findings were validated with the statements released by the U.S. Department of Labor.

Moreover, purchasing inflation protection dramatically decreases total expected cost and risk for the younger age cohorts; however, with increase in age, the benefit of inflation protection decreases.

These quantitative results proved to be very helpful in aiding decision-making. The conducted survey showed that 78 percent of the participants in the survey changed their decisions based on the quantitative data that we provided. Those who did not alter their decisions had approached the survey with concerns that are not captured in a quantitative analysis.

Two trends were observed. First, younger males chose to self-insure based on the cumulative expected life-time premium data provided. Second, starting from age 58 subjects were selecting maximum insurance to protect against future expected total LTC cost. With increase in age fewer options were selected.

Overall, the performed survey proved that the quantitative data produced by the model has considerable influence on consumers' purchasing decision-making. Subjects who were unfamiliar with the cost, premiums and risk they were facing over their lifetime found the model very helpful. Overall comments received from the survey commended the usefulness of the data.

Still, we would like to assert that the accuracy of the LTC model is subject to the precision of the transition probabilities incorporated in the model. Since there are no extensive studies that provide incidence rates from all assumed health statuses, we had to make complicated calculations and make a number of assumptions in order to obtain necessary data. Thus, the model is limited to the accuracy of the employed transition probabilities and the assumption of the Markov chain model. A Markov chain assumes that the basis for transition depends only on the current state, thus the histories leading to it are disregarded. Given all that, it is our sense that <u>if there is a bias</u> in the model it is one of overstating the likelihood of staying in a nursing home/ home care, based on the concerns mentioned above. Nevertheless, we believe that the developed LTC model produces results with a reasonable accuracy.

For future references, we would recommend that by customizing the LTC model the accuracy of the output can be further improved. If transition probabilities can be calculated for marital status, income, and health condition--all of which influence subjects health progression over time—and the data incorporated in the model, the results of the LTC model will depict an even more realistic LTC simulation.

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Glossary of Long-Term Care terminology as presented by UnumProvident

Total Home Care (THC): Includes Professional Home Care services, as well as care received from any care provider of your choosing, including relatives and friends who provide care in your home. Professional Home Care services include visits to your home by a licensed Home Health Care Provider during which skilled nursing care; physical, respiratory, occupational, dietary or speech therapy; adult day care or hospice care, or homemaker services are provided.

Elimination Period (EP): The EP is a period of 90 consecutive days of continuous Disability (that occurs after the effective date of coverage) and during which you are receiving care. This 90-day period must be satisfied before benefits begin.

Facility Monthly Benefit Amount: This is the benefit amount Unum will pay monthly once you qualify for benefits and after the Elimination Period has been satisfied. The benefit paid is subject to the Lifetime Maximum Benefit Amount. Benefits are not paid during the Elimination Period.

Benefit Duration: This is the length of time benefits will be paid as long as you continue to be Disabled. You may move between facility and home care – depending on the need – and still receive benefits. You will continue to receive benefits as long as you qualify and until your Lifetime Maximum Benefit Amount has been completely used.

Lifetime Maximum Benefit Amount: This is the maximum benefit dollar amount Unum will pay over the life of your coverage. This dollar amount is based on the Long Term Care Facility Benefit Amount and the Benefit Duration (3 years or 6 years) you elect.

<u>For example:</u> If you choose a $3,000/month Facility Benefit Amount and a 3 year Benefit Duration, your Lifetime Maximum is as follows:

$3,000/month x 12 months x 3 years = $108,000

Inflation Protection: Compound Growth Uncapped. If you choose this benefit, your Monthly Benefit will increase each year by 5% of the Monthly Benefit in effect at the start . Your remaining Lifetime Maximum Benefit Amount will also increase. Increases will be automatic and will occur regardless of your health and whether or not you are Disabled. Your premium will not increase due to automatic increases in your Monthly Benefit.

Appendices

Appendix 1: Ten-Year Average of U.S. Consumer Price Index for Nursing Home Cost

Year	Percentage yearly Change
1992	8.20%
1993	7.50%
1994	5.70%
1995	4.40%
1996	4.40%
1997	3.90%
1998	4.30%
1999	4.60%
2000	4.90%
2001	4.50%
Average	**5.24%**

Source : Arizona Department of Health Services. " U.S. Consumer Price Index for Nursing Home Cost." July 2003 <http://www.hs.state.az.us/plan/hosp/cpinci.pdf >

Appendix 2: UnumProvident's Annual Premium Cost

Annual Premium for Total Home Health Care			
3 Year Duration			
Age of Procurement	Facility Monthly Benefit		
	$4,000	$5,000	$6,000
40	220.8	276.0	331.2
41	230.4	288.0	345.6
42	244.8	306.0	367.2
43	254.4	318.0	381.6
44	264.0	330.0	396.0
45	278.4	348.0	417.6
46	292.8	366.0	439.2
47	307.2	384.0	460.8
48	326.4	408.0	489.6
49	345.6	432.0	518.4
50	364.8	456.0	547.2
51	388.8	486.0	583.2
52	412.8	516.0	619.2
53	436.8	546.0	655.2
54	460.8	576.0	691.2
55	494.4	618.0	741.6
56	523.2	654.0	784.8
57	561.6	702.0	842.4
58	600.0	750.0	900.0
59	643.2	804.0	964.8
60	691.2	864.0	1036.8
61	748.8	936.0	1123.2
62	816.0	1020.0	1224.0
63	883.2	1104.0	1324.8
64	964.8	1206.0	1447.2
65	1075.2	1344.0	1612.8
66	1171.2	1464.0	1756.8
67	1281.6	1602.0	1922.4
68	1396.8	1746.0	2095.2
69	1526.4	1908.0	2289.6
70	1665.6	2082.0	2498.4
71	1824.0	2280.0	2736.0
72	1996.8	2496.0	2995.2
73	2193.6	2742.0	3290.4
74	2400.0	3000.0	3600.0
75	2860.8	3576.0	4291.2
76	3110.4	3888.0	4665.6
77	3379.2	4224.0	5068.8
78	3676.8	4596.0	5515.2
79	3998.4	4998.0	5997.6
80	4353.6	5442.0	6530.4

Annual Premium for Total Home Health Care with Inflation Protection			
3 Year Duration			
Age of Procurement	Facility Monthly Benefit		
	$4,000	$5,000	$6,000
40	624.0	780.0	936.0
41	643.2	804.0	964.8
42	662.4	828.0	993.6
43	681.6	852.0	1022.4
44	705.6	882.0	1058.4
45	724.8	906.0	1087.2
46	748.8	936.0	1123.2
47	772.8	966.0	1159.2
48	801.6	1002.0	1202.4
49	835.2	1044.0	1252.8
50	859.2	1074.0	1288.8
51	892.8	1116.0	1339.2
52	931.2	1164.0	1396.8
53	964.8	1206.0	1447.2
54	993.6	1242.0	1490.4
55	1032.0	1290.0	1548.0
56	1080.0	1350.0	1620.0
57	1132.8	1416.0	1699.2
58	1185.6	1482.0	1778.4
59	1238.4	1548.0	1857.6
60	1300.8	1626.0	1951.2
61	1387.2	1734.0	2080.8
62	1488.0	1860.0	2232.0
63	1574.4	1968.0	2361.6
64	1689.6	2112.0	2534.4
65	1852.8	2316.0	2779.2
66	1977.6	2472.0	2966.4
67	2136.0	2670.0	3204.0
68	2275.2	2844.0	3412.8
69	2448.0	3060.0	3672.0
70	2606.4	3258.0	3909.6
71	2822.4	3528.0	4233.6
72	3038.4	3798.0	4557.6
73	3273.6	4092.0	4910.4
74	3518.4	4398.0	5277.6
75	4123.2	5154.0	6184.8
76	4435.2	5544.0	6652.8
77	4737.6	5922.0	7106.4
78	5083.2	6354.0	7624.8
79	5433.6	6792.0	8150.4
80	5836.8	7296.0	8755.2

Appendix 2: UnumProvident's Annual Premium Cost (Continued)

Annual Premium for Total Home Health Care			
6 Year Duration			
Age of Procurement	Facility Monthly Benefit		
	$4,000	$5,000	$6,000
40	624.0	780.0	936.0
41	643.2	804.0	964.8
42	662.4	828.0	993.6
43	681.6	852.0	1022.4
44	705.6	882.0	1058.4
45	724.8	906.0	1087.2
46	748.8	936.0	1123.2
47	772.8	966.0	1159.2
48	801.6	1002.0	1202.4
49	835.2	1044.0	1252.8
50	859.2	1074.0	1288.8
51	892.8	1116.0	1339.2
52	931.2	1164.0	1396.8
53	964.8	1206.0	1447.2
54	993.6	1242.0	1490.4
55	1032.0	1290.0	1548.0
56	1080.0	1350.0	1620.0
57	1132.8	1416.0	1699.2
58	1185.6	1482.0	1778.4
59	1238.4	1548.0	1857.6
60	1300.8	1626.0	1951.2
61	1387.2	1734.0	2080.8
62	1488.0	1860.0	2232.0
63	1574.4	1968.0	2361.6
64	1689.6	2112.0	2534.4
65	1852.8	2316.0	2779.2
66	1977.6	2472.0	2966.4
67	2136.0	2670.0	3204.0
68	2275.2	2844.0	3412.8
69	2448.0	3060.0	3672.0
70	2606.4	3258.0	3909.6
71	2822.4	3528.0	4233.6
72	3038.4	3798.0	4557.6
73	3273.6	4092.0	4910.4
74	3518.4	4398.0	5277.6
75	4123.2	5154.0	6184.8
76	4435.2	5544.0	6652.8
77	4737.6	5922.0	7106.4
78	5083.2	6354.0	7624.8
79	5433.6	6792.0	8150.4
80	5836.8	7296.0	8755.2

Annual Premium for Total Home Health Care with Inflation Protection			
6 Year Duration			
Age of Procurement	Facility Monthly Benefit		
	$4,000	$5,000	$6,000
40	840.0	1050.0	1260.0
41	864.0	1080.0	1296.0
42	892.8	1116.0	1339.2
43	916.8	1146.0	1375.2
44	950.4	1188.0	1425.6
45	979.2	1224.0	1468.8
46	1012.8	1266.0	1519.2
47	1046.4	1308.0	1569.6
48	1084.8	1356.0	1627.2
49	1123.2	1404.0	1684.8
50	1156.8	1446.0	1735.2
51	1204.8	1506.0	1807.2
52	1252.8	1566.0	1879.2
53	1300.8	1626.0	1951.2
54	1348.8	1686.0	2023.2
55	1396.8	1746.0	2095.2
56	1454.4	1818.0	2181.6
57	1526.4	1908.0	2289.6
58	1603.2	2004.0	2404.8
59	1675.2	2094.0	2512.8
60	1761.6	2202.0	2642.4
61	1886.4	2358.0	2829.6
62	2020.8	2526.0	3031.2
63	2145.6	2682.0	3218.4
64	2299.2	2874.0	3448.8
65	2520.0	3150.0	3780.0
66	2702.4	3378.0	4053.6
67	2913.6	3642.0	4370.4
68	3105.6	3882.0	4658.4
69	3336.0	4170.0	5004.0
70	3566.4	4458.0	5349.6
71	3864.0	4830.0	5796.0
72	4161.6	5202.0	6242.4
73	4478.4	5598.0	6717.6
74	4814.4	6018.0	7221.6
75	5644.8	7056.0	8467.2
76	6076.8	7596.0	9115.2
77	6499.2	8124.0	9748.8
78	6969.6	8712.0	10454.4
79	7459.2	9324.0	11188.8
80	8016.0	10020.0	12024.0

Appendix 3 : Forecasting Home Care and Nursing Home Care Cost

Simulation Year	Home Care Cost	Nursing Home Cost
0	40,077	80,154
1	42,081	84,162
2	44,185	88,370
3	46,394	92,788
4	48,714	97,428
5	51,150	102,299
6	53,707	107,414
7	56,392	112,785
8	59,212	118,424
9	62,173	124,345
10	65,281	130,562
11	68,545	137,091
12	71,973	143,945
13	75,571	151,142
14	79,350	158,699
15	83,317	166,634
16	87,483	174,966
17	91,857	183,714
18	96,450	192,900
19	101,273	202,545
20	106,336	212,672
21	111,653	223,306
22	117,236	234,471
23	123,097	246,195
24	129,252	258,505
25	135,715	271,430
26	142,501	285,001
27	149,626	299,251
28	157,107	314,214
29	164,962	329,925
30	173,210	346,421

Source : MetLife Ins. Market Survey on Nursing Home and Home Care Costs 2002. May, 2003<http://www.metlife.com/WPSAssets/17157088621027365380V1FPDF1.pdf>

Appendix 3 : Forecasting Home Care and Nursing Home Care Cost (Continued)

Simulation Year	Home Care Cost	Nursing Home Cost
31	181,871	363,742
32	190,965	381,929
33	200,513	401,026
34	210,538	421,077
35	221,065	442,131
36	232,119	464,237
37	243,725	487,449
38	255,911	511,822
39	268,706	537,413
40	282,142	564,283
41	296,249	592,497
42	311,061	622,122
43	326,614	653,228
44	342,945	685,890
45	360,092	720,184
46	378,097	756,194
47	397,002	794,003
48	416,852	833,703
49	437,694	875,389
50	459,579	919,158
51	482,558	965,116
52	506,686	1,013,372
53	532,020	1,064,040
54	558,621	1,117,242
55	586,552	1,173,104
56	615,880	1,231,760
57	646,674	1,293,348
58	679,007	1,358,015
59	712,958	1,425,916
60	748,606	1,497,211

Source : MetLife Ins. Market Survey on Nursing Home and Home Care Costs 2002. May, 2003<http://www.metlife.com/WPSAssets/17157088621027365380V1FPDF1.pdf>

Appendix 4 : Simulation Results

Appendix 4.1 : Male Simulation Results

Cohort 40 -44	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(938,243)	1,700,534	40.26%	(929,131)	1,698,399	39.71%	(926,075)	1,633,228	40.07%
3 years									
Total Cost	(876,387)	1,608,747	38.85%	(861,497)	1,581,829	37.89%	(824,466)	1,532,246	36.75%
Premium	(19,099)	11,579		(23,867)	14,481		(28,654)	17,374	
LTC Cost	(943,367)	1,696,188		(944,991)	1,690,579		(923,611)	1,661,582	
Exp. Paid Benefit	86,079	121,906		107,362	150,214		127,799	179,916	
6 years									
Total Cost	(856,409)	1,542,285	38.62%	(836,033)	1,531,715	38.12%	(785,538)	1,433,932	37.00%
Premium	(25,959)	15,783		(32,523)	19,706		(38,735)	23,262	
LTC Cost	(943,409)	1,680,944		(944,281)	1,706,610		(912,393)	1,642,777	
Exp. Paid Benefit	112,959	175,777		140,771	224,201		165,590	265,214	
3 years with Inflation Protection									
Total Cost	(593,576)	1,214,864	28.49%	(535,604)	1,149,483	23.78%	(433,150)	1,003,259	16.47%
Premium	(51,492)	31,262		(64,572)	39,014		(77,372)	46,289	
LTC Cost	(901,869)	1,627,144		(940,219)	1,670,504		(910,548)	1,597,476	
Exp. Paid Benefit	359,785	511,882		469,187	655,868		554,771	768,264	
6 years with Inflation Protection									
Total Cost	(493,116)	854,259	29.81%	(387,499)	710,712	23.21%	(274,791)	533,148	12.78%
Premium	(69,838)	42,449		(86,703)	52,671		(104,581)	63,427	
LTC Cost	(922,129)	1,634,069		(911,271)	1,666,431		(899,225)	1,619,040	
Exp. Paid Benefit	498,850	845,049		610,475	1,050,354		729,016	1,246,769	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 45-49	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
elf-Insure									
Total Cost	(721,696)	1,279,649	36.31%	(729,794)	1,264,475	36.85%	(717,364)	1,288,301	36.02%
[illegible] years									
Total Cost	(674,199)	1,257,505	33.61%	(640,495)	1,189,555	32.91%	(635,851)	1,193,415	32.46%
Premium	(17,695)	11,037		(22,157)	13,799		(26,636)	16,483	
LTC Cost	(738,712)	1,339,618		(719,964)	1,291,719		(733,363)	1,317,310	
Exp. Paid Benefit	82,209	111,121		101,626	137,766		124,148	168,438	
6 years									
Total Cost	(639,444)	1,145,726	33.86%	(611,978)	1,091,036	32.62%	(598,762)	1,085,896	31.88%
Premium	(24,323)	15,195		(30,219)	18,633		(36,468)	22,494	
LTC Cost	(722,184)	1,284,125		(714,063)	1,256,488		(723,156)	1,286,535	
Exp. Paid Benefit	107,062	168,580		132,304	204,854		160,863	252,052	
[illegible] years with Inflation Protection									
Total Cost	(483,791)	965,714	24.36%	(424,826)	935,922	19.31%	(365,996)	857,297	14.45%
Premium	(44,329)	27,333		(55,749)	34,938		(66,353)	41,193	
LTC Cost	(730,431)	1,290,608		(735,791)	1,338,897		(737,275)	1,333,143	
Exp. Paid Benefit	290,969	404,387		366,714	513,968		437,632	613,945	
[illegible] years with Inflation Protection									
Total Cost	(399,964)	752,822	24.30%	(315,663)	544,678	17.65%	(230,424)	424,264	8.28%
Premium	(60,030)	36,925		(75,119)	47,094		(90,046)	55,763	
LTC Cost	(731,714)	1,353,447		(730,600)	1,298,159		(727,110)	1,316,943	
Exp. Paid Benefit	391,780	668,591		490,056	826,947		586,732	1,007,532	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 50-54	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(572,209)	992,255	32.33%	(583,861)	1,035,746	32.19%	(575,020)	1,014,325	32.71%
3 years									
Total Cost	(518,994)	926,623	29.15%	(484,882)	903,359	27.70%	(463,385)	857,581	26.16%
Premium	(17,233)	10,914		(21,570)	13,839		(25,622)	16,353	
LTC Cost	(580,752)	1,005,947		(559,532)	1,000,766		(552,324)	972,999	
Exp. Paid Benefit	78,992	102,230		96,220	127,074		114,560	150,356	
6 years									
Total Cost	(503,370)	914,819	28.79%	(474,414)	813,212	28.09%	(456,510)	810,785	26.96%
Premium	(23,625)	15,099		(29,352)	19,033		(35,297)	22,612	
LTC Cost	(582,633)	1,043,032		(573,133)	968,881		(576,073)	1,001,765	
Exp. Paid Benefit	102,889	157,096		128,071	190,678		154,860	233,741	
3 years with Inflation Protection									
Total Cost	(383,495)	779,145	20.08%	(336,768)	720,038	15.78%	(286,333)	662,852	11.62%
Premium	(38,950)	24,800		(48,660)	31,236		(58,144)	37,347	
LTC Cost	(575,822)	1,031,777		(576,542)	1,029,257		(572,349)	1,033,865	
Exp. Paid Benefit	231,278	316,757		288,434	395,027		344,160	480,041	
6 years with Inflation Protection									
Total Cost	(307,542)	499,486	19.29%	(253,113)	467,592	13.05%	(189,073)	328,272	5.29%
Premium	(52,387)	33,169		(65,228)	42,040		(78,207)	50,668	
LTC Cost	(557,244)	962,156		(569,975)	1,031,963		(579,495)	1,010,983	
Exp. Paid Benefit	302,088	499,174		382,090	640,306		468,630	775,620	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 55-59	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(459,319)	792,739	28.53%	(442,923)	738,907	28.16%	(457,218)	814,570	27.99%
3 years									
Total Cost	(401,537)	745,962	24.34%	(363,318)	661,661	22.02%	(359,544)	674,594	21.29%
Premium	(16,759)	11,409		(20,831)	14,043		(25,001)	16,861	
LTC Cost	(459,432)	818,227		(432,235)	754,397		(444,418)	783,057	
Exp. Paid Benefit	74,654	94,094		89,747	117,126		109,875	141,482	
6 years									
Total Cost	(368,306)	665,499	22.66%	(347,206)	577,824	22.26%	(331,791)	591,111	19.91%
Premium	(22,731)	15,402		(28,281)	18,973		(34,201)	22,811	
LTC Cost	(439,366)	783,172		(438,404)	727,514		(439,729)	769,290	
Exp. Paid Benefit	93,791	140,511		119,480	176,660		142,139	214,587	
3 years with Inflation Protection									
Total Cost	(306,665)	595,484	16.11%	(253,079)	508,477	12.14%	(227,840)	510,948	10.39%
Premium	(33,631)	22,562		(41,646)	27,982		(50,283)	33,720	
LTC Cost	(459,338)	799,364		(438,630)	761,667		(452,338)	800,651	
Exp. Paid Benefit	186,305	253,114		227,198	313,222		274,781	376,189	
6 years with Inflation Protection									
Total Cost	(251,451)	413,466	14.38%	(196,331)	310,479	8.16%	(152,360)	243,029	3.13%
Premium	(45,562)	30,436		(56,438)	37,590		(68,224)	45,910	
LTC Cost	(449,361)	788,409		(433,572)	745,986		(446,352)	779,817	
Exp. Paid Benefit	243,473	406,053		293,678	481,194		362,216	606,556	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 60-64	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(359,068)	626,019	23.73%	(364,967)	624,118	23.92%	(349,341)	610,790	22.88%
3 years									
Total Cost	(293,129)	531,823	17.88%	(282,433)	532,200	16.46%	(276,798)	517,319	16.04%
Premium	(16,698)	11,680		(21,064)	14,655		(25,328)	17,667	
LTC Cost	(345,506)	598,431		(347,665)	614,558		(356,338)	620,658	
Exp. Paid Benefit	69,074	86,263		86,296	108,812		104,869	132,343	
6 years									
Total Cost	(289,462)	492,040	18.47%	(273,577)	468,703	16.74%	(255,501)	443,174	14.93%
Premium	(23,181)	16,125		(29,072)	20,607		(34,550)	24,133	
LTC Cost	(357,189)	603,910		(358,001)	605,927		(356,868)	608,154	
Exp. Paid Benefit	90,908	131,390		113,497	164,453		135,918	198,313	
3 years with Inflation Protection									
Total Cost	(238,173)	443,230	12.60%	(208,462)	404,773	10.00%	(184,350)	385,831	8.54%
Premium	(30,612)	21,073		(38,572)	27,170		(46,300)	32,351	
LTC Cost	(355,493)	602,444		(356,145)	605,790		(362,128)	618,793	
Exp. Paid Benefit	147,932	196,742		186,255	251,433		224,078	301,204	
6 years with Inflation Protection									
Total Cost	(209,752)	338,645	10.40%	(169,389)	255,837	5.80%	(129,113)	185,767	2.03%
Premium	(41,984)	29,465		(52,965)	37,673		(62,826)	43,640	
LTC Cost	(364,024)	632,335		(364,354)	629,709		(357,326)	612,818	
Exp. Paid Benefit	196,257	322,488		247,931	411,559		291,039	481,782	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 65-69	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
elf-Insure									
Total Cost	(282,979)	476,702	18.93%	(285,680)	472,725	18.66%	(282,735)	467,731	19.17%
years									
Total Cost	(238,355)	423,870	14.26%	(215,205)	364,747	12.52%	(212,971)	400,163	11.88%
Premium	(18,287)	13,073		(22,824)	16,200		(27,305)	19,670	
LTC Cost	(286,486)	488,302		(274,226)	444,728		(285,199)	492,858	
Exp. Paid Benefit	66,417	81,802		81,844	100,472		99,533	122,596	
6 years									
Total Cost	(222,632)	364,402	12.44%	(209,991)	350,753	11.28%	(201,835)	336,577	10.04%
Premium	(25,284)	18,428		(31,329)	22,301		(37,805)	27,190	
LTC Cost	(280,193)	465,817		(283,640)	478,270		(293,766)	490,646	
Exp. Paid Benefit	82,845	118,672		104,978	150,536		129,737	184,423	
3 years with Inflation Protection									
Total Cost	(200,989)	373,989	9.90%	(171,611)	318,908	7.50%	(149,303)	286,884	6.37%
Premium	(30,452)	21,851		(38,011)	27,352		(45,504)	32,342	
LTC Cost	(293,374)	504,540		(284,174)	476,645		(287,759)	473,834	
Exp. Paid Benefit	122,837	163,515		150,574	199,032		183,960	241,908	
6 years with Inflation Protection									
Total Cost	(171,015)	249,260	6.40%	(142,033)	219,517	3.16%	(113,135)	147,256	1.22%
Premium	(41,455)	29,868		(51,158)	37,040		(62,178)	44,366	
LTC Cost	(284,003)	479,239		(279,876)	498,800		(278,524)	475,295	
Exp. Paid Benefit	154,443	250,693		189,001	314,318		227,567	375,069	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 70-74	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(236,462)	392,026	14.81%	(239,665)	399,252	15.51%	(237,164)	392,068	15.19%
3 years									
Total Cost	(186,713)	322,256	9.90%	(176,107)	302,709	8.80%	(164,357)	297,324	7.98%
Premium	(19,136)	13,974		(23,823)	17,123		(28,556)	20,676	
LTC Cost	(230,762)	381,932		(231,756)	376,656		(230,947)	383,028	
Exp. Paid Benefit	63,185	76,105		79,472	94,996		95,146	114,002	
6 years									
Total Cost	(180,510)	285,720	8.35%	(166,606)	258,872	6.82%	(153,487)	239,381	5.76%
Premium	(26,207)	18,772		(32,904)	23,677		(39,388)	28,639	
LTC Cost	(233,738)	380,382		(232,436)	377,667		(231,298)	377,562	
Exp. Paid Benefit	79,435	110,883		98,734	138,516		117,199	165,227	
3 years with Inflation Protection									
Total Cost	(160,433)	269,723	7.27%	(144,794)	261,176	5.67%	(126,554)	232,337	4.67%
Premium	(29,190)	21,197		(36,376)	26,650		(43,364)	31,502	
LTC Cost	(232,655)	375,990		(238,269)	391,428		(236,620)	385,872	
Exp. Paid Benefit	101,412	130,457		129,851	166,475		153,430	197,670	
6 years with Inflation Protection									
Total Cost	(148,680)	199,148	4.13%	(122,150)	151,335	1.82%	(102,039)	114,434	0.99%
Premium	(39,531)	28,558		(49,436)	36,270		(59,322)	42,883	
LTC Cost	(239,431)	390,058		(227,883)	370,975		(231,460)	377,049	
Exp. Paid Benefit	130,282	207,530		155,169	245,363		188,743	300,309	

Appendix 4.1 : Male Simulation Results(Continued)

Cohort 75-79	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(191,963)	309,540	10.73%	(189,143)	308,019	10.31%	(186,345)	301,128	10.07%
3 years									
Total Cost	(149,306)	246,663	6.28%	(139,211)	237,005	5.45%	(127,621)	210,860	4.68%
Premium	(21,157)	15,421		(26,355)	19,129		(31,545)	22,649	
LTC Cost	(187,516)	301,122		(187,409)	303,778		(184,658)	293,132	
Exp. Paid Benefit	59,368	70,242		74,553	88,090		88,582	106,058	
6 years									
Total Cost	(147,744)	226,418	5.06%	(136,278)	199,720	4.09%	(123,043)	176,185	3.05%
Premium	(29,208)	20,957		(36,821)	26,448		(43,690)	31,484	
LTC Cost	(190,333)	313,796		(188,546)	307,842		(185,592)	299,392	
Exp. Paid Benefit	71,798	101,309		89,089	126,262		106,239	148,735	
3 years with Inflation Protection									
Total Cost	(131,669)	221,601	4.54%	(118,261)	194,586	3.60%	(106,591)	181,466	3.17%
Premium	(29,473)	21,569		(36,904)	26,552		(44,433)	31,984	
LTC Cost	(184,906)	306,838		(187,659)	299,985		(188,858)	305,101	
Exp. Paid Benefit	82,710	107,378		106,303	135,333		126,700	162,135	
6 years with Inflation Protection									
Total Cost	(126,174)	156,384	2.40%	(110,728)	131,057	1.32%	(95,662)	95,726	0.66%
Premium	(40,332)	28,902		(50,508)	36,292		(60,758)	43,186	
LTC Cost	(187,605)	302,964		(186,226)	307,510		(187,384)	303,587	
Exp. Paid Benefit	101,763	160,934		126,006	201,565		152,480	242,084	

Appendix 4.1 : Male Simulation Results(Continued)

Age 80	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(158,963)	257,236	7.89%	(161,109)	259,653	8.10%	(160,897)	263,512	7.95%
3 years									
Total Cost	(124,975)	208,944	4.92%	(116,223)	190,346	4.06%	(110,259)	192,155	3.87%
Premium	(20,067)	14,594		(25,202)	18,384		(30,467)	22,452	
LTC Cost	(159,187)	261,738		(159,695)	255,632		(162,437)	266,896	
Exp. Paid Benefit	54,279	66,720		68,674	83,443		82,644	100,744	
6 years									
Total Cost	(121,214)	176,762	3.13%	(113,593)	157,800	2.68%	(105,834)	143,921	2.22%
Premium	(27,907)	20,243		(34,906)	25,305		(42,215)	31,115	
LTC Cost	(156,544)	257,275		(159,226)	257,993		(160,525)	262,589	
Exp. Paid Benefit	63,237	91,839		80,539	115,982		96,906	140,546	
3 years with Inflation Protection									
Total Cost	(114,766)	186,112	3.48%	(104,122)	174,259	3.04%	(94,405)	161,958	2.64%
Premium	(27,245)	19,747		(33,930)	24,773		(41,225)	30,628	
LTC Cost	(160,395)	264,005		(161,461)	269,047		(164,176)	270,458	
Exp. Paid Benefit	72,874	96,306		91,270	120,688		110,997	144,964	
6 years with Inflation Protection									
Total Cost	(112,182)	139,182	1.85%	(98,039)	100,229	0.94%	(86,652)	94,127	0.51%
Premium	(37,432)	27,796		(46,829)	34,328		(55,981)	40,865	
LTC Cost	(162,935)	268,840		(160,519)	260,804		(160,790)	273,086	
Exp. Paid Benefit	88,185	143,172		109,309	178,399		130,120	214,494	

Appendix 4.2 : Female Simulation Results

Cohort 40-44	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(2,210,782)	3,014,115	64.22%	(2,181,877)	2,936,074	64.00%	(2,204,298)	2,916,955	64.31%
3 years									
Total Cost	(2,062,059)	2,871,883	61.75%	(2,009,031)	2,849,874	61.61%	(1,964,582)	2,830,867	61.35%
Premium	(23,974)	12,575		(29,996)	15,812		(35,865)	18,837	
LTC Cost	(2,200,935)	3,001,751		(2,182,731)	3,006,539		(2,172,445)	3,014,438	
Exp. Paid Benefit	162,850	175,694		203,696	216,000		243,728	257,470	
years									
Total Cost	(2,013,742)	2,842,858	62.54%	(1,983,470)	2,811,099	62.44%	(1,915,588)	2,698,211	61.61%
Premium	(32,547)	17,064		(40,852)	21,565		(48,790)	25,453	
LTC Cost	(2,218,612)	3,064,993		(2,243,091)	3,091,958		(2,221,953)	3,032,117	
Exp. Paid Benefit	237,418	282,020		300,473	359,756		355,155	421,943	
years with Inflation Protection									
Total Cost	(1,545,241)	2,471,663	53.37%	(1,400,414)	2,370,769	47.76%	(1,245,054)	2,310,718	38.75%
Premium	(64,897)	33,842		(80,782)	42,695		(97,433)	51,030	
LTC Cost	(2,188,916)	2,993,820		(2,200,310)	3,007,377		(2,210,250)	3,050,026	
Exp. Paid Benefit	708,572	690,542		880,678	853,710		1,062,628	1,027,205	
years with Inflation Protection									
Total Cost	(1,173,677)	1,826,677	54.20%	(901,496)	1,518,096	47.55%	(636,560)	1,268,952	32.35%
Premium	(87,408)	45,550		(109,014)	56,852		(130,759)	68,201	
LTC Cost	(2,210,266)	3,023,099		(2,187,347)	2,956,333		(2,173,351)	2,989,780	
Exp. Paid Benefit	1,123,997	1,361,659		1,394,865	1,671,972		1,667,550	2,034,699	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 45-49	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**
Self-Insure									
Total Cost	(1,707,302)	2,360,764	60.32%	(1,676,280)	2,301,732	60.05%	(1,671,441)	2,268,050	59.99%
3 years									
Total Cost	(1,550,032)	2,207,332	56.71%	(1,532,322)	2,161,017	57.47%	(1,511,749)	2,175,442	56.31%
Premium	(21,966)	12,122		(27,537)	14,870		(32,978)	18,093	
LTC Cost	(1,679,587)	2,325,680		(1,697,883)	2,307,585		(1,709,083)	2,353,607	
Exp. Paid Benefit	151,520	155,542		193,098	195,213		230,311	235,473	
6 years									
Total Cost	(1,493,039)	2,087,492	57.00%	(1,470,942)	2,094,514	56.74%	(1,410,157)	2,017,951	56.12%
Premium	(30,338)	16,740		(38,064)	20,874		(45,423)	24,857	
LTC Cost	(1,682,460)	2,296,551		(1,711,636)	2,361,337		(1,696,777)	2,330,543	
Exp. Paid Benefit	219,758	255,584		278,758	326,259		332,043	384,769	
[illegible] years with Inflation Protection									
Total Cost	(1,169,054)	1,855,320	47.31%	(1,062,794)	1,758,959	41.90%	(973,502)	1,818,876	34.30%
Premium	(54,997)	29,978		(69,362)	38,236		(82,795)	45,341	
LTC Cost	(1,653,844)	2,258,402		(1,685,557)	2,262,652		(1,716,644)	2,404,178	
Exp. Paid Benefit	539,787	526,541		692,125	671,090		825,937	800,369	
6 years with Inflation Protection									
Total Cost	(891,845)	1,346,988	47.87%	(689,416)	1,146,878	38.86%	(485,620)	917,038	23.37%
Premium	(74,987)	41,043		(92,535)	51,063		(111,984)	60,921	
LTC Cost	(1,679,710)	2,294,075		(1,646,517)	2,269,405		(1,646,592)	2,237,051	
Exp. Paid Benefit	862,852	1,057,436		1,049,635	1,292,732		1,272,957	1,552,434	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 50-54	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(1,684,014)	2,291,950	59.92%	(1,308,652)	1,779,398	55.60%	(1,286,360)	1,771,166	54.96%
3 years									
Total Cost	(1,570,433)	2,211,890	57.25%	(1,153,635)	1,650,938	50.74%	(1,113,893)	1,679,762	50.08%
Premium	(21,969)	12,063		(26,562)	15,242		(31,572)	17,781	
LTC Cost	(1,701,489)	2,331,422		(1,303,952)	1,784,171		(1,295,626)	1,843,830	
Exp. Paid Benefit	153,026	156,387		176,879	172,866		213,306	211,302	
6 years									
Total Cost	(1,499,505)	2,075,515	57.31%	(1,076,734)	1,542,456	51.12%	(1,014,552)	1,463,487	48.91%
Premium	(30,326)	16,632		(35,998)	20,502		(43,217)	24,809	
LTC Cost	(1,690,157)	2,282,756		(1,298,921)	1,786,559		(1,275,333)	1,748,381	
Exp. Paid Benefit	220,978	255,063		258,185	291,764		303,999	345,041	
years with Inflation Protection									
Total Cost	(1,195,945)	1,923,302	47.20%	(819,515)	1,396,407	35.17%	(715,316)	1,311,029	29.64%
Premium	(55,084)	30,184		(59,593)	34,220		(71,923)	40,955	
LTC Cost	(1,683,546)	2,329,788		(1,288,028)	1,780,421		(1,285,940)	1,767,420	
Exp. Paid Benefit	542,684	532,442		528,106	513,708		642,547	621,953	
6 years with Inflation Protection									
Total Cost	(902,939)	1,340,758	48.10%	(538,291)	840,171	32.64%	(394,049)	748,727	16.75%
Premium	(74,840)	40,792		(81,103)	45,713		(96,113)	55,227	
LTC Cost	(1,701,238)	2,286,473		(1,291,863)	1,729,010		(1,304,053)	1,790,496	
Exp. Paid Benefit	873,139	1,053,574		834,675	1,010,473		1,006,117	1,233,279	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 55-59	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(996,505)	1,408,323	50.04%	(971,403)	1,325,066	49.72%	(968,831)	1,336,458	49.66%
3 years									
Total Cost	(870,956)	1,239,978	45.57%	(825,772)	1,200,110	43.92%	(827,189)	1,216,480	42.99%
Premium	(20,322)	12,176		(25,305)	15,295		(30,470)	18,202	
LTC Cost	(980,209)	1,338,329		(961,869)	1,320,298		(992,903)	1,362,177	
Exp. Paid Benefit	129,575	123,102		161,401	153,217		196,184	186,865	
6 years									
Total Cost	(813,938)	1,163,284	45.00%	(797,907)	1,137,295	44.95%	(735,103)	1,047,818	41.53%
Premium	(27,795)	16,823		(34,948)	20,813		(41,763)	25,003	
LTC Cost	(972,100)	1,340,155		(1,001,933)	1,362,280		(973,096)	1,305,896	
Exp. Paid Benefit	185,958	207,709		238,973	264,645		279,756	308,084	
3 years with Inflation Protection									
Total Cost	(691,088)	1,098,519	35.17%	(616,729)	1,034,912	29.76%	(563,101)	1,023,650	26.33%
Premium	(40,750)	24,363		(51,383)	30,775		(61,404)	37,024	
LTC Cost	(978,037)	1,339,169		(972,984)	1,339,604		(1,002,298)	1,382,082	
Exp. Paid Benefit	327,698	315,182		407,638	401,069		500,601	484,415	
6 years with Inflation Protection									
Total Cost	(509,698)	738,198	32.72%	(412,356)	650,905	23.60%	(302,927)	533,037	11.23%
Premium	(54,848)	33,009		(68,770)	41,157		(83,042)	49,358	
LTC Cost	(952,827)	1,289,977		(981,956)	1,356,233		(992,459)	1,339,667	
Exp. Paid Benefit	497,977	613,072		638,370	793,917		772,574	945,449	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 60-64	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(745,152)	1,014,547	44.49%	(736,324)	1,006,420	44.02%	(736,932)	1,005,094	43.66%
3 years									
Total Cost	(651,712)	936,537	37.97%	(611,190)	881,631	36.47%	(595,403)	902,147	34.39%
Premium	(20,425)	12,943		(25,513)	16,028		(30,601)	19,360	
LTC Cost	(750,749)	1,026,873		(733,607)	991,608		(742,981)	1,035,013	
Exp. Paid Benefit	119,462	111,527		147,930	137,452		178,179	167,134	
6 years									
Total Cost	(585,228)	821,795	36.87%	(567,178)	798,850	35.48%	(532,463)	780,499	33.29%
Premium	(27,734)	17,479		(35,170)	22,414		(42,002)	26,583	
LTC Cost	(724,387)	983,325		(744,741)	997,045		(745,250)	1,013,110	
Exp. Paid Benefit	166,893	185,878		212,732	232,595		254,788	277,639	
3 years with Inflation Protection									
Total Cost	(520,133)	805,813	29.56%	(466,959)	783,340	24.91%	(406,059)	728,670	21.69%
Premium	(37,235)	23,741		(46,445)	29,438		(55,476)	34,928	
LTC Cost	(741,206)	1,003,980		(742,571)	1,024,835		(735,060)	1,010,292	
Exp. Paid Benefit	258,307	253,381		322,057	315,649		384,477	375,718	
6 years with Inflation Protection									
Total Cost	(394,373)	556,774	24.95%	(316,050)	481,019	15.98%	(227,403)	383,168	6.95%
Premium	(50,391)	32,263		(62,518)	39,229		(75,165)	47,561	
LTC Cost	(729,701)	997,658		(734,790)	1,012,875		(721,709)	988,731	
Exp. Paid Benefit	385,719	486,723		481,259	604,771		569,471	710,061	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 65-69	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(552,477)	758,706	37.30%	(536,588)	729,482	36.20%	(546,947)	753,235	36.65%
3 years									
Total Cost	(454,747)	660,925	29.59%	(436,684)	634,878	28.19%	(426,922)	663,446	26.68%
Premium	(21,439)	14,003		(26,673)	17,573		(32,093)	21,209	
LTC Cost	(539,990)	739,243		(543,520)	731,082		(555,582)	783,478	
Exp. Paid Benefit	106,682	98,408		133,509	122,580		160,754	152,144	
6 years									
Total Cost	(439,397)	629,590	28.28%	(403,777)	597,628	25.37%	(371,429)	546,238	23.24%
Premium	(29,689)	19,757		(37,027)	24,925		(44,259)	29,476	
LTC Cost	(559,984)	773,747		(552,205)	774,019		(550,494)	755,477	
Exp. Paid Benefit	150,275	167,583		185,455	208,006		223,325	248,040	
3 years with Inflation Protection									
Total Cost	(388,660)	607,518	22.88%	(348,003)	579,216	19.42%	(299,049)	514,668	17.05%
Premium	(35,649)	23,719		(44,694)	29,852		(53,733)	35,613	
LTC Cost	(553,409)	761,910		(557,086)	770,489		(547,297)	737,521	
Exp. Paid Benefit	200,398	197,272		253,777	250,874		301,980	295,374	
6 years with Inflation Protection									
Total Cost	(298,474)	402,635	17.02%	(245,295)	347,705	9.58%	(185,227)	282,474	4.88%
Premium	(48,567)	32,215		(61,035)	40,579		(73,323)	49,213	
LTC Cost	(536,406)	741,348		(550,721)	762,512		(546,659)	751,814	
Exp. Paid Benefit	286,499	369,756		366,460	468,860		434,755	549,284	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 70-74	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(404,128)	547,113	28.74%	(409,537)	556,446	28.89%	(406,474)	565,783	28.44%
3 years									
Total Cost	(327,536)	494,066	20.66%	(312,508)	470,866	19.50%	(288,112)	436,279	17.48%
Premium	(21,640)	15,231		(27,019)	19,012		(32,160)	22,619	
LTC Cost	(400,778)	563,599		(406,026)	557,089		(399,343)	540,482	
Exp. Paid Benefit	94,882	89,504		120,538	111,644		143,391	134,079	
6 years									
Total Cost	(306,936)	427,488	18.59%	(282,669)	417,088	15.12%	(260,317)	394,557	12.88%
Premium	(29,952)	21,157		(37,363)	26,360		(44,789)	31,222	
LTC Cost	(406,261)	553,893		(405,620)	575,538		(410,959)	579,851	
Exp. Paid Benefit	129,277	145,384		160,314	184,874		195,431	221,739	
3 years with Inflation Protection									
Total Cost	(285,349)	450,035	16.15%	(244,513)	393,151	13.21%	(220,434)	380,544	11.13%
Premium	(32,881)	23,036		(40,666)	28,346		(49,267)	34,103	
LTC Cost	(411,609)	572,598		(399,917)	546,319		(407,980)	563,975	
Exp. Paid Benefit	159,140	158,336		196,070	197,279		236,813	240,732	
6 years with Inflation Protection									
Total Cost	(233,573)	305,885	10.09%	(190,431)	244,526	5.73%	(144,260)	194,269	2.66%
Premium	(44,760)	31,293		(55,983)	39,144		(67,365)	47,185	
LTC Cost	(408,467)	560,738		(409,659)	555,248		(400,976)	546,586	
Exp. Paid Benefit	219,655	281,689		275,211	349,857		324,081	413,562	

Appendix 4.2 : Female Simulation Results(Continued)

Cohort 75-79	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(297,287)	414,660	18.93%	(296,652)	419,431	19.35%	(296,927)	414,551	19.24%
3 years									
Total Cost	(235,308)	364,650	12.29%	(221,263)	336,537	11.69%	(198,848)	304,800	9.91%
Premium	(23,203)	16,998		(29,196)	21,868		(34,964)	26,027	
LTC Cost	(295,560)	427,456		(297,113)	415,589		(288,494)	396,004	
Exp. Paid Benefit	83,456	81,246		105,046	102,253		124,610	120,470	
6 years									
Total Cost	(216,901)	297,368	10.00%	(197,531)	273,087	8.13%	(183,351)	265,221	6.96%
Premium	(32,435)	23,618		(40,070)	29,326		(48,542)	35,211	
LTC Cost	(291,036)	405,183		(290,618)	405,224		(294,702)	421,536	
Exp. Paid Benefit	106,570	124,493		133,157	155,431		159,893	188,742	
3 years with Inflation Protection									
Total Cost	(209,717)	316,883	10.30%	(182,603)	283,458	8.42%	(158,247)	271,661	6.77%
Premium	(32,452)	23,591		(40,343)	29,415		(48,595)	35,634	
LTC Cost	(301,175)	417,163		(294,111)	406,024		(291,383)	412,262	
Exp. Paid Benefit	123,909	127,706		151,850	157,866		181,730	190,752	
6 years with Inflation Protection									
Total Cost	(176,518)	215,070	5.24%	(146,970)	159,753	2.96%	(122,169)	143,483	1.54%
Premium	(44,380)	32,497		(55,356)	40,546		(66,798)	48,973	
LTC Cost	(288,300)	405,374		(287,778)	400,181		(294,632)	417,202	
Exp. Paid Benefit	156,162	209,663		196,164	265,742		239,260	321,758	

Appendix 4.2 : Female Simulation Results(Continued)

Age 80	Facility Benefit Amount								
	$4,000			$5,000			$6,000		
Benefit Duration	**Expected Cost**	**Std Dev**	**Risk≥ -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**	**Expected Cost**	**Std Dev**	**Risk>= -500,000**
Self-Insure									
Total Cost	(236,894)	338,803	13.75%	(242,775)	354,085	14.54%	(236,996)	343,212	13.98%
3 years									
Total Cost	(184,719)	280,957	9.40%	(170,877)	263,391	7.71%	(157,968)	260,567	6.95%
Premium	(22,207)	16,898		(27,966)	21,661		(33,359)	25,569	
LTC Cost	(236,303)	340,898		(235,957)	335,561		(234,344)	345,386	
Exp. Paid Benefit	73,791	75,907		93,046	94,202		109,735	113,216	
6 years									
Total Cost	(173,975)	239,378	6.80%	(161,038)	225,500	5.69%	(144,291)	203,016	4.52%
Premium	(31,032)	23,780		(38,544)	29,285		(46,762)	36,183	
LTC Cost	(234,514)	338,593		(237,870)	346,895		(233,944)	341,490	
Exp. Paid Benefit	91,572	113,690		115,376	142,822		136,416	168,465	
3 years with Inflation Protection									
Total Cost	(165,291)	258,634	6.60%	(149,036)	234,659	6.07%	(129,610)	217,880	4.70%
Premium	(29,819)	22,821		(37,506)	28,754		(45,032)	34,361	
LTC Cost	(235,684)	347,504		(237,933)	344,140		(235,572)	343,722	
Exp. Paid Benefit	100,212	111,891		126,403	140,421		150,994	167,931	
6 years with Inflation Protection									
Total Cost	(148,022)	178,518	3.83%	(130,670)	149,217	2.43%	(105,675)	113,443	0.93%
Premium	(41,170)	31,511		(51,773)	39,658		(61,635)	47,198	
LTC Cost	(233,764)	340,996		(242,795)	352,087		(236,381)	346,568	
Exp. Paid Benefit	126,912	179,910		163,898	229,630		192,341	274,344	

Appendix 5: Total Expected Cost and Risk for each cohort

Appendix 5.1 : Male Total Expected Cost and Risk

Total Expected Cost			
Cohort (40 -44)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(938,243)	(929,131)	(926,075)
3 years	(876,387)	(861,497)	(824,466)
6 years	(856,409)	(836,033)	(785,538)
3 years with Inflation Protection	(593,576)	(535,604)	(433,150)
6 years with Inflation Protection	(493,116)	(387,499)	(274,791)

Risk			
Cohort (40 -44)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	40.26%	39.71%	40.07%
3 years	38.85%	37.89%	36.75%
6 years	38.62%	38.12%	37.00%
3 years with Inflation Protection	28.49%	23.78%	16.47%
6 years with Inflation Protection	29.81%	23.21%	12.78%

Total Expected Cost			
Cohort (45 -49)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(721,696)	(729,794)	(717,364)
3 years	(674,199)	(640,495)	(635,851)
6 years	(639,444)	(611,978)	(598,762)
3 years with Inflation Protection	(483,791)	(424,826)	(365,996)
6 years with Inflation Protection	(399,964)	(315,663)	(230,424)

Risk			
Cohort (45 -49)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	36.31%	36.85%	36.02%
3 years	33.61%	32.91%	32.46%
6 years	33.86%	32.62%	31.88%
3 years with Inflation Protection	24.36%	19.31%	14.45%
6 years with Inflation Protection	24.30%	17.65%	8.28%

Total Expected Cost			
Cohort (50 -54)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(572,209)	(583,861)	(575,020)
3 years	(518,994)	(484,882)	(463,385)
6 years	(503,370)	(474,414)	(456,510)
3 years with Inflation Protection	(383,495)	(336,768)	(286,333)
6 years with Inflation Protection	(307,542)	(253,113)	(189,073)

Risk			
Cohort (50 -54)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	32.33%	32.19%	32.71%
3 years	29.15%	27.70%	26.16%
6 years	28.79%	28.09%	26.96%
3 years with Inflation Protection	20.08%	15.78%	11.62%
6 years with Inflation Protection	19.29%	13.05%	5.29%

Appendix 5.1 : Male Total Expected Cost and Risk(Continued)

Total Expected Cost			
Cohort (55-59)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(459,319)	(442,923)	(457,218)
3 years	(401,537)	(363,318)	(359,544)
6 years	(368,306)	(347,206)	(331,791)
3 years with Inflation Protection	(306,665)	(253,079)	(227,840)
6 years with Inflation Protection	(251,451)	(196,331)	(152,360)

Risk			
Cohort (55-59)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	28.53%	28.16%	27.99%
3 years	24.34%	22.02%	21.29%
6 years	22.66%	22.26%	19.91%
3 years with Inflation Protection	16.11%	12.14%	10.39%
6 years with Inflation Protection	14.38%	8.16%	3.13%

Total Expected Cost			
Cohort (60-64)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(359,068)	(364,967)	(349,341)
3 years	(293,129)	(282,433)	(276,798)
6 years	(289,462)	(273,577)	(255,501)
3 years with Inflation Protection	(238,173)	(208,462)	(184,350)
6 years with Inflation Protection	(209,752)	(169,389)	(129,113)

Risk			
Cohort (60-64)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	23.73%	23.92%	22.88%
3 years	17.88%	16.46%	16.04%
6 years	18.47%	16.74%	14.93%
3 years with Inflation Protection	12.60%	10.00%	8.54%
6 years with Inflation Protection	10.40%	5.80%	2.03%

Total Expected Cost			
Cohort (65-69)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(282,979)	(285,680)	(282,735)
3 years	(238,355)	(215,205)	(212,971)
6 years	(222,632)	(209,991)	(201,835)
3 years with Inflation Protection	(200,989)	(171,611)	(149,303)
6 years with Inflation Protection	(171,015)	(142,033)	(113,135)

Risk			
Cohort (65-69)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	18.93%	18.66%	19.17%
3 years	14.26%	12.52%	11.88%
6 years	12.44%	11.28%	10.04%
3 years with Inflation Protection	9.90%	7.50%	6.37%
6 years with Inflation Protection	6.40%	3.16%	1.22%

Total Expected Cost			
Cohort (70-74)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(236,462)	(239,665)	(237,164)
3 years	(186,713)	(176,107)	(164,357)
6 years	(180,510)	(166,606)	(153,487)
3 years with Inflation Protection	(160,433)	(144,794)	(126,554)
6 years with Inflation Protection	(148,680)	(122,150)	(102,039)

Risk			
Cohort (70-74)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	14.81%	15.51%	15.19%
3 years	9.90%	8.80%	7.98%
6 years	8.35%	6.82%	5.76%
3 years with Inflation Protection	7.27%	5.67%	4.67%
6 years with Inflation Protection	4.13%	1.82%	0.99%

Appendix 5.1 : Male Total Expected Cost and Risk(Continued)

Total Expected Cost			
Cohort (75-79)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(191,963)	(189,143)	(186,345)
3 years	(149,306)	(139,211)	(127,621)
6 years	(147,744)	(136,278)	(123,043)
3 years with Inflation Protection	(131,669)	(118,261)	(106,591)
6 years with Inflation Protection	(126,174)	(110,728)	(95,662)

Risk			
Cohort (75-79)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	10.73%	10.31%	10.07%
3 years	6.28%	5.45%	4.68%
6 years	5.06%	4.09%	3.05%
3 years with Inflation Protection	4.54%	3.60%	3.17%
6 years with Inflation Protection	2.40%	1.32%	0.66%

Total Expected Cost			
Age 80	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(158,963)	(161,109)	(160,897)
3 years	(124,975)	(116,223)	(110,259)
6 years	(121,214)	(113,593)	(105,834)
3 years with Inflation Protection	(114,766)	(104,122)	(94,405)
6 years with Inflation Protection	(112,182)	(98,039)	(86,652)

Risk			
Age 80	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	7.89%	8.10%	7.95%
3 years	4.92%	4.06%	3.87%
6 years	3.13%	2.68%	2.22%
3 years with Inflation Protection	3.48%	3.04%	2.64%
6 years with Inflation Protection	1.85%	0.94%	0.51%

Appendix 5.2 : Female Total Expected Cost and Risk

Total Expected Cost			
Cohort (40 -44)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(2,210,782)	(2,181,877)	(2,204,298)
3 years	(2,062,059)	(2,009,031)	(1,964,582)
6 years	(2,013,742)	(1,983,470)	(1,915,588)
3 years with Inflation Protection	(1,545,241)	(1,400,414)	(1,245,054)
6 years with Inflation Protection	(1,173,677)	(901,496)	(636,560)

Risk			
Cohort (40 -44)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	64.22%	64.00%	64.31%
3 years	61.75%	61.61%	61.35%
6 years	62.54%	62.44%	61.61%
3 years with Inflation Protection	53.37%	47.76%	38.75%
6 years with Inflation Protection	54.20%	47.55%	32.35%

Total Expected Cost			
Cohort (45 -49)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(1,707,302)	(1,676,280)	(1,671,441)
3 years	(1,550,032)	(1,532,322)	(1,511,749)
6 years	(1,493,039)	(1,470,942)	(1,410,157)
3 years with Inflation Protection	(1,169,054)	(1,062,794)	(973,502)
6 years with Inflation Protection	(891,845)	(689,416)	(485,620)

Risk			
Cohort (45 -49)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	60.32%	60.05%	59.99%
3 years	56.71%	57.47%	56.31%
6 years	57.00%	56.74%	56.12%
3 years with Inflation Protection	47.31%	41.90%	34.30%
6 years with Inflation Protection	47.87%	38.86%	23.37%

Total Expected Cost			
Cohort (50 -54)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(1,684,014)	(1,308,652)	(1,286,360)
3 years	(1,570,433)	(1,153,635)	(1,113,893)
6 years	(1,499,505)	(1,076,734)	(1,014,552)
3 years with Inflation Protection	(1,195,945)	(819,515)	(715,316)
6 years with Inflation Protection	(902,939)	(538,291)	(394,049)

Risk			
Cohort (50 -54)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	59.92%	55.60%	54.96%
3 years	57.25%	50.74%	50.08%
6 years	57.31%	51.12%	48.91%
3 years with Inflation Protection	47.20%	35.17%	29.64%
6 years with Inflation Protection	48.10%	32.64%	16.75%

Appendix 5.2 : Female Total Expected Cost and Risk(Continued)

Total Expected Cost			
Cohort (55-59)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(996,505)	(971,403)	(968,831)
3 years	(870,956)	(825,772)	(827,189)
6 years	(813,938)	(797,907)	(735,103)
3 years with Inflation Protection	(691,088)	(616,729)	(563,101)
6 years with Inflation Protection	(509,698)	(412,356)	(302,927)

Risk			
Cohort (55-59)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	50.04%	49.72%	49.66%
3 years	45.57%	43.92%	42.99%
6 years	45.00%	44.95%	41.53%
3 years with Inflation Protection	35.17%	29.76%	26.33%
6 years with Inflation Protection	32.72%	23.60%	11.23%

Total Expected Cost			
Cohort (60-64)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(745,152)	(736,324)	(736,932)
3 years	(651,712)	(611,190)	(595,403)
6 years	(585,228)	(567,178)	(532,463)
3 years with Inflation Protection	(520,133)	(466,959)	(406,059)
6 years with Inflation Protection	(394,373)	(316,050)	(227,403)

Risk			
Cohort (60-64)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	44.49%	44.02%	43.66%
3 years	37.97%	36.47%	34.39%
6 years	36.87%	35.48%	33.29%
3 years with Inflation Protection	29.56%	24.91%	21.69%
6 years with Inflation Protection	24.95%	15.98%	6.95%

Total Expected Cost			
Cohort (65-69)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(552,477)	(536,588)	(546,947)
3 years	(454,747)	(436,684)	(426,922)
6 years	(439,397)	(403,777)	(371,429)
3 years with Inflation Protection	(388,660)	(348,003)	(299,049)
6 years with Inflation Protection	(298,474)	(245,295)	(185,227)

Risk			
Cohort (65-69)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	37.30%	36.20%	36.65%
3 years	29.59%	28.19%	26.68%
6 years	28.28%	25.37%	23.24%
3 years with Inflation Protection	22.88%	19.42%	17.05%
6 years with Inflation Protection	17.02%	9.58%	4.88%

Total Expected Cost			
Cohort (70-74)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	(404,128)	(409,537)	(406,474)
3 years	(327,536)	(312,508)	(288,112)
6 years	(306,936)	(282,669)	(260,317)
3 years with Inflation Protection	(285,349)	(244,513)	(220,434)
6 years with Inflation Protection	(233,573)	(190,431)	(144,260)

Risk			
Cohort (70-74)	Facility Benefit Amount		
	$4,000	$5,000	$6,000
Self-Insure	28.74%	28.89%	28.44%
3 years	20.66%	19.50%	17.48%
6 years	18.59%	15.12%	12.88%
3 years with Inflation Protection	16.15%	13.21%	11.13%
6 years with Inflation Protection	10.09%	5.73%	2.66%

Appendix 5.2 : Female Total Expected Cost and Risk(Continued)

Total Expected Cost			
Cohort (75-79)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(297,287)	(296,652)	(296,927)
3 years	(235,308)	(221,263)	(198,848)
6 years	(216,901)	(197,531)	(183,351)
3 years with Inflation Protection	(209,717)	(182,603)	(158,247)
6 years with Inflation Protection	(176,518)	(146,970)	(122,169)

Risk			
Cohort (75-79)	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	18.93%	19.35%	19.24%
3 years	12.29%	11.69%	9.91%
6 years	10.00%	8.13%	6.96%
3 years with Inflation Protection	10.30%	8.42%	6.77%
6 years with Inflation Protection	5.24%	2.96%	1.54%

Total Expected Cost			
Age 80	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	(236,894)	(242,775)	(236,996)
3 years	(184,719)	(170,877)	(157,968)
6 years	(173,975)	(161,038)	(144,291)
3 years with Inflation Protection	(165,291)	(149,036)	(129,610)
6 years with Inflation Protection	(148,022)	(130,670)	(105,675)

Risk			
Age 80	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
Self-Insure	13.75%	14.54%	13.98%
3 years	9.40%	7.71%	6.95%
6 years	6.80%	5.69%	4.52%
3 years with Inflation Protection	6.60%	6.07%	4.70%
6 years with Inflation Protection	3.83%	2.43%	0.93%

Appendix 6: Ratio of Female Total Expected Cost to Male Total Expected Cost

Female to Male Ratio					
$4,000 Facility Monthly Benefit					
Cohort	Self-Insure	3 Years	6 Years	3 Years with Inflation Protection	6 years with Inflation Protection
40-44	2.4	2.4	2.4	2.6	2.4
45-49	2.4	2.3	2.3	2.4	2.2
50-54	2.9	3.0	3.0	3.1	2.9
55-59	2.2	2.2	2.2	2.3	2.0
60-64	2.1	2.2	2.0	2.2	1.9
65-69	2.0	1.9	2.0	1.9	1.7
70-74	1.7	1.8	1.7	1.8	1.6
75-79	1.5	1.6	1.5	1.6	1.4
80	1.5	1.5	1.4	1.4	1.3
Average	**2.0**	**2.1**	**2.1**	**2.1**	**1.9**

Female to Male Ratio					
$5,000 Facility Monthly Benefit					
Cohort	Self-Insure	3 Years	6 Years	3 Years with Inflation Protection	6 years with Inflation Protection
40-44	2.3	2.3	2.4	2.6	2.3
45-49	2.3	2.4	2.4	2.5	2.2
50-54	2.2	2.4	2.3	2.4	2.1
55-59	2.2	2.3	2.3	2.4	2.1
60-64	2.0	2.2	2.1	2.2	1.9
65-69	1.9	2.0	1.9	2.0	1.7
70-74	1.7	1.8	1.7	1.7	1.6
75-79	1.6	1.6	1.4	1.5	1.3
80	1.5	1.5	1.4	1.4	1.3
Average	**2.0**	**2.0**	**2.0**	**2.1**	**1.8**

Appendix 6: Ratio Female Total Expected Cost to Male Total Expected Cost (Continued)

Female to Male Ratio					
$6,000 Facility Monthly Benefit					
Cohort	**Self-Insure**	**3 Years**	**6 Years**	**3 Years with Inflation Protection**	**6 years with Inflation Protection**
40-44	2.4	2.4	2.4	2.9	2.3
45-49	2.3	2.4	2.4	2.7	2.1
50-54	2.2	2.4	2.2	2.5	2.1
55-59	2.1	2.3	2.2	2.5	2.0
60-64	2.1	2.2	2.1	2.2	1.8
65-69	1.9	2.0	1.8	2.0	1.6
70-74	1.7	1.8	1.7	1.7	1.4
75-79	1.6	1.6	1.5	1.5	1.3
80	1.5	1.4	1.4	1.4	1.2
Average	**2.0**	**2.0**	**2.0**	**2.1**	**1.8**

The Average of Total Expected Cost Ratio of Female to Male					
Coverage	**Self-Insure**	**LTC insurance options**			
		3 year	**6 year**	**3 year with Inflation Protection**	**6 year with Inflation Protection**
$4,000		2.1	2.1	2.1	1.9
$5,000	2.0	2.0	2.0	2.1	1.8
$6,000		2.0	2.0	2.1	1.8

Appendix 7: Ratio of Without Inflation Total Expected Cost to With Inflation Total Expected Cost

Appendix 7.1: Ratio of Without Inflation Total Expected Cost to With Inflation Total Expected Cost (Male)

3 years Total Expected Cost to 3 years with Inflation Total Expected Cost			
Cohort	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
40-44	1.48	1.61	1.90
45-49	1.39	1.51	1.74
50-54	1.35	1.44	1.62
55-59	1.31	1.44	1.58
60-64	1.23	1.35	1.50
65-69	1.19	1.25	1.43
70-74	1.16	1.22	1.30
75-79	1.13	1.18	1.20
80	1.09	1.12	1.17

6 years Total Expected Cost to 6 years with Inflation Total Expected Cost			
Cohort	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
40-44	1.74	2.16	2.86
45-49	1.60	1.94	2.60
50-54	1.64	1.87	2.41
55-59	1.46	1.77	2.18
60-64	1.38	1.62	1.98
65-69	1.30	1.48	1.78
70-74	1.21	1.36	1.50
75-79	1.17	1.23	1.29
80	1.08	1.16	1.22

Appendix 7.2: Ratio of Without Inflation Total Expected Cost to With Inflation Total Expected Cost (Female)

3 years Total Expected Cost to 3 years with Inflation Total Expected Cost			
Cohort	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
40-44	1.33	1.43	1.58
45-49	1.33	1.44	1.55
50-54	1.31	1.41	1.56
55-59	1.26	1.34	1.47
60-64	1.25	1.31	1.47
65-69	1.17	1.25	1.43
70-74	1.15	1.28	1.31
75-79	1.12	1.21	1.26
80	1.12	1.15	1.22

6 years Total Expected Cost to 6 years with Inflation Total Expected Cost			
Cohort	**Facility Benefit Amount**		
	$4,000	**$5,000**	**$6,000**
40-44	1.72	2.20	3.01
45-49	1.67	2.13	2.90
50-54	1.66	2.00	2.57
55-59	1.60	1.93	2.43
60-64	1.48	1.79	2.34
65-69	1.47	1.65	2.01
70-74	1.31	1.48	1.80
75-79	1.23	1.34	1.50
80	1.18	1.23	1.37

Appendix 8: Benefit to Premium Ratio

Appendix 8.1: Benefit to Premium Ratio(Male)

Male				
Benefit to Premium ($4,000 coverage)				
Cohort	**3 Years**	**6 Years**	**3 Years with Inflation Protection**	**6 years with Inflation Protection**
40-44	4.51	4.35	6.99	7.14
45-49	4.65	4.40	6.56	6.53
50-54	4.58	4.36	5.94	5.77
55-59	4.45	4.13	5.54	5.34
60-64	4.14	3.92	4.83	4.67
64-69	3.63	3.28	4.03	3.73
70-74	3.30	3.03	3.47	3.30
75-79	2.81	2.46	2.81	2.52
80	2.70	2.27	2.67	2.36

Male				
Benefit to Premium ($6,000 coverage)				
Cohort	**3 Years**	**6 Years**	**3 Years with Inflation Protection**	**6 years with Inflation Protection**
40-44	4.46	4.27	7.17	6.97
45-49	4.66	4.41	6.60	6.52
50-54	4.47	4.39	5.92	5.99
55-59	4.39	4.16	5.46	5.31
60-64	4.14	3.93	4.84	4.63
64-69	3.65	3.43	4.04	3.66
70-74	3.33	2.98	3.54	3.18
75-79	2.81	2.43	2.85	2.51
80	2.71	2.30	2.69	2.32

Male				
Benefit to Premium ($5,000 coverage)				
Cohort	**3 Years**	**6 Years**	**3 Years with Inflation Protection**	**6 years with Inflation Protection**
40-44	4.50	4.33	7.27	7.04
45-49	4.59	4.38	6.58	6.52
50-54	4.46	4.36	5.93	5.86
55-59	4.31	4.22	5.46	5.20
60-64	4.10	3.90	4.83	4.68
64-69	3.59	3.35	3.96	3.69
70-74	3.34	3.00	3.57	3.14
75-79	2.83	2.42	2.88	2.49
80	2.72	2.31	2.69	2.33

Male				
Average Benefit to Premium				
Cohort	**3 Years**	**6 Years**	**3 Years with Inflation Protection**	**6 years with Inflation Protection**
40-44	4.49	4.32	7.14	7.05
45-49	4.63	4.40	6.58	6.52
50-54	4.51	4.37	5.93	5.87
55-59	4.39	4.17	5.49	5.29
60-64	4.12	3.92	4.83	4.66
64-69	3.62	3.35	4.01	3.69
70-74	3.32	3.00	3.53	3.21
75-79	2.81	2.44	2.85	2.51
80	2.71	2.29	2.69	2.34

Appendix 8.1: Benefit to Premium Ratio (Female)

Female				
Benefit to Premium ($4,000 coverage)				
Cohort	3 Years	6 Years	3 Years with Inflation Protection	6 years with Inflation Protection
40-44	6.79	7.29	10.92	12.86
45-49	6.90	7.24	9.81	11.51
50-54	6.97	7.29	9.85	11.67
55-59	6.38	6.69	8.04	9.08
60-64	5.85	6.02	6.94	7.65
64-69	4.98	5.06	5.62	5.90
70-74	4.38	4.32	4.84	4.91
75-79	3.60	3.29	3.82	3.52
80	3.32	2.95	3.36	3.08

Female				
Benefit to Premium ($6,000 coverage)				
Cohort	3 Years	6 Years	3 Years with Inflation Protection	6 years with Inflation Protection
40-44	6.80	7.28	10.91	12.75
45-49	6.98	7.31	9.98	11.37
50-54	6.76	7.03	8.93	10.47
55-59	6.44	6.70	8.15	9.30
60-64	5.82	6.07	6.93	7.58
64-69	5.01	5.05	5.62	5.93
70-74	4.46	4.36	4.81	4.81
75-79	3.56	3.29	3.74	3.58
80	3.29	2.92	3.35	3.12

Female				
Benefit to Premium ($5,000 coverage)				
Cohort	3 Years	6 Years	3 Years with Inflation Protection	6 years with Inflation Protection
40-44	6.79	7.36	10.90	12.80
45-49	7.01	7.32	9.98	11.34
50-54	6.66	7.17	8.86	10.29
55-59	6.38	6.84	7.93	9.28
60-64	5.80	6.05	6.93	7.70
64-69	5.01	5.01	5.68	6.00
70-74	4.46	4.29	4.82	4.92
75-79	3.60	3.32	3.76	3.54
80	3.33	2.99	3.37	3.17

Female				
Average Benefit to Premium				
Cohort	3 Years	6 Years	3 Years with Inflation Protection	6 years with Inflation Protection
40-44	6.79	7.31	10.91	12.80
45-49	6.96	7.29	9.92	11.41
50-54	6.79	7.16	9.22	10.81
55-59	6.40	6.74	8.04	9.22
60-64	5.82	6.04	6.93	7.64
64-69	5.00	5.04	5.64	5.94
70-74	4.43	4.32	4.82	4.88
75-79	3.59	3.30	3.77	3.55
80	3.31	2.95	3.36	3.12

Appendix 9: Questionnaire 1

Memorandum

To: WPI Faculty
From: Kanokwan Unopas and George Georgiev
Re: Long Term Care Insurance
Date: July 10, 2003

Dear Sir or Madam,

You are receiving this e-mail, because you have expressed interest to Prof. Noonan to participate in a Long Term Care simulation study.

Since purchasing LTC insurance is a very difficult decision that could significantly impact one's financial planning, we, with the guidance of Prof. Noonan and Prof. Mistry, have built a Long Term Care probabilistic simulation model that attempts to address this decision on quantitative basis. More precisely, the purpose of our model is to aid people in making a guided decision on whether one should buy LTC insurance at a given age and sex, as well as, given one's preferences and risk tolerance, to suggest best amount and duration for which to insure.

Since WPI is offering a group plan with UnumProvident, we have built the simulation model based on UnumProvident group plan options and prices. Accordingly, the LTC insurance choices in the questionnaires are limited to no insurance and the options that Unum offers.

The attached questionnaire is the first of two, which will be used to conduct a study on how the developed LTC simulation model guides or impacts your purchasing decisions. The purpose of this particular Questionnaire 1 is to analyze which policy, if any, you will select without the benefit of any formal quantitative actuarial analysis. A LTC simulation will be performed based on how you fill out the questions attached. This questionnaire will be followed by a second one which will come along with statistical data generated by running the simulation model, as well as recommendations on best option to minimize possible future cost given your age, sex, and risk tolerance.

The goal of this and the following questionnaire is to explore the utility of the LTC model we have build in helping customers make guided decisions.

Due to time restraint we will not be able to respond to e-mails received after Thursday, July 17.

Thank you,
Kanokwan Unopas & George Georgiev

Appendix 9: Questionnaire 1 (Continued)

Memorandum

To: ......
From: George Georgiev & Kanokwan Unopas
Re: ASSURANCE OF CONFIDENTIALITY
Date: July 11, 2003

Dear ......,

We would like to indicate that if there is any question you feel uncomfortable to answer, please do not answer it.

We would like to further assure you that all the information you provide will be treated as strictly confidential. Only my-self, George Georgiev, and my colleague, Kanokwan Unopas, will have exposure to the data you provide, and no personal information will be released to third parties (including advising professors).

Once the results from the second questionnaire are obtained, all names will be eliminated. No information that can directly or indirectly identify you will be released.

Thank you,
George Georgiev & Kanokwan Unopas

Appendix 9: Questionnaire 1 (Continued)

Long Term Care Insurance Questionnaire 1

1 First Name .... Last Name ....

2 Sex ☐ Male ☐ Female

3 Current Age .... years old (40 or greater)

Please refer to the table below when answering Question 4

Annual Premium Cost for Selected Ages												
	No Inflation Protection						Inflation Protection					
Benefit Duration	3 years			6 year			3 years			6 year		
Monthly Benefit	$4,000	$5,000	$6,000	$4,000	$5,000	$6,000	$4,000	$5,000	$6,000	$4,000	$5,000	$6,000
Age												
40	220.8	276	331.2	302.4	378	453.6	624	780	936	840	1050	1260
50	364.8	456	547.2	499.2	624	748.8	859.2	1074	1288.8	1156.8	1446	1735.2
60	691.2	864	1036.8	945.6	1182	1418.4	1300.8	1626	1951.2	1761.6	2202	2642.4

4 1) I will self-insure (IF yes, please skip to Question 6) ☐ Yes ☐ No

or

2) Long Term Care Insurance (Choices limited to UnumProvident's group plan option provided to WPI)

- 4.1 Facility Monthly Benefit ☐ $4,000 ☐ $5,000 ☐ $6,000
- 4.2 Facility Benefit Duration ☐ 3years ☐ 6 years
- 4.3 Inflation Protection ☐ Yes ☐ No

5 Please select the annual increase in Long-Term care cost that you believe is most realistic (10 year historical average is 5%)

☐ 3% ☐ 5% ☐ 10%

Annual national average cost for nursing home care is $80,154; Annual Home care cost is estimated to $12,000 for three hours (three visits) three times a week (please refer to questions 7 and 8)

Appendix 9: Questionnaire 1 (Continued)

Long Term Care Insurance Questionnaire 1 (continued)

What are your expectations for a total life-time Long Tem Care expense?

☐ $100,000 ☐ $200,000 ☐ $300,000 ☐ $500,000 ☐ > 500,000

What do you consider a catastrophic amount for a total Long-Term Care expense?

☐ $100,000 ☐ $200,000 ☐ $300,000 ☐ $500,000 ☐ > 500,000

What is your risk tolerance? ☐ Low ☐ Medium ☐ High

9 Do you think you qualify (pass medical screening) for LTC insurance outside of the group plan offered by WPI?

☐ Very likely ☐ Moderately Likely ☐ Not sure ☐ Moderately unlikely ☐ Very unlikely

Appendix 10: Questionnaire 2

Memorandum

To: WPI Faculty
From: Kanokwan Unopas and George Georgiev
Re: Long Term Care Insurance Q2
Date: July 21, 2003

Dear *Specified Name*,

Please review the results attached and then proceed to fill out Questionnaire 2. Please submit back your filled out questionnaire.

If questions are unclear please do not hesitate to contact us or contact Prof. Noonan or Prof. Mistry.

Due to time restraint, we would appreciate if you could send the Questionnaire2 back by July 29,2003.

Thank you,
Kanokwan Unopas & George Georgiev

Appendix 10: Questionnaire 2 (Continued)

Modeling Assumptions

The LTC simulation is based on the Nursing Home and Home Care Cost in Worcester, MA. Moreover, the simulation is restricted to UnumProvident options provided to WPI. UnumProvident provides two plans: Base Plan option and Total Home Health care option. Because of uncertainties with the base plan benefits, we did not include the base plan option and decided to model for Total Home Health Care option with and without inflation. Under Total Home Health Care, Unum pays 50 % of selected nursing home monthly benefit amount for Home Care Benefit. Also, the Elimination Period is 90 days as indicated by Unum.

The simulation model uses transition probabilities to describe the progression of an individual's health status over time. Our data is derived from statistics published by Society of Actuaries, National Center for Health Statistics, and ABT Associates. Enclosed below are some examples of FEMALE transition probabilities from different health states. In the beginning of any given year a subject is in one of three possible states: healthy (W), undergoing institutional LTC (NH), undergoing home care (HC). At the end of the year the subject has transitioned to one of four states: healthy (W), undergoing institutional LTC (NH), undergoing home care (HC), or expired (E).

If you believe that your health state transition probabilities are significantly different from these national averages then the simulation results for you would be different.

AGE : 40-44 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9934	0.0031	0.0003	0.0031
HC	0.1752	0.7891		0.0356
NH	0.1472		0.7763	0.0764

AGE : 50-54 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9853	0.0072	0.0011	0.0064
HC	0.1346	0.8120		0.0534
NH	0.0888		0.7956	0.1156

AGE : 60-64 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9630	0.0165	0.0040	0.0165
HC	0.0991	0.8201		0.0808
NH	0.0535		0.7716	0.1748

AGE : 70-74 YEARS				
	Probability that you begin next year as			
Current Health Status	W	HC	NH	E
W	0.9087	0.0327	0.0163	0.0423
HC	0.0688	0.8113		0.1200
NH	0.0323		0.7243	0.2434

Since transition probabilities are not readily available and are very difficult to compute, it is our sense that IF there is bias in the simulation model it is one of overstating the likelihood of staying in a nursing home/ home care which in turn will overstate Total Expected Co

Appendix 10: Questionnaire 2 (Continued)

Long Term Care Insurance Questionnaire 2

1 First Name........................ Last Name ....

Price information is given below for possible help in answering Question 2

Annual Premium Cost ($) for Selected Ages												
	No Inflation Protection						Inflation Protection					
Benefit Duration	3 years			6 year			3 years			6 year		
Monthly Benefit	$4,000	$5,000	$6,000	$4,000	$5,000	$6,000	$4,000	$5,000	$6,000	$4,000	$5,000	$6,000
Age												
40	220.8	276	331.2	302.4	378	453.6	624	780	936	840	1050	1260
50	364.8	456	547.2	499.2	624	748.8	859.2	1074	1288.8	1156.8	1446	1735.2
60	691.2	864	1037	945.6	1182	1418.4	1300.8	1626	1951.2	1761.6	2202	2642.4

2 a) I will self-insure (IF yes, please skip to Question3) ☐ Yes ☐ No

or

b) Long Term Care Insurance (Choices limited to UnumProvident's group plan option provided to WPI)

2.1 Facility Monthly Benefit ☐ $4,000 ☐ $5,000 ☐ $6,000

2.2 Facility Benefit Duration ☐ 3 years ☐ 6 years

2.3 Inflation Protection ☐ Yes ☐ No

3 Did the provided quantitative information influence your decision making?

☐ Yes ☐ No

Please Elaborate :