

Demographic Assumptions

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by

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Table of Contents

Abstract.....	I
Executive Summary.....	II
Background	1
Hewitt.....	1
Pension Overview	1
Defined Benefit Plans.....	1
Defined Contribution Plans.....	2
Cash Balance Plans.....	2
Pension Benefit Guarantee Corporation (PBGC)	2
Demographic Assumptions	2
Mortality	2
Disability.....	3
Retirement	3
Turnover.....	4
Statistical Tests.....	5
Hypothesis Testing.....	5
The Z-Test.....	6
Chi-Square Test	7
Fisher’s Exact Test	8
Exact Confidence Intervals.....	9
P-Values	10
Multiple Test Corrections.....	11
False Discovery Rate	11
Type I and II Errors	12
Power	12
Methodology.....	14

Creation of Computer Program	14
Uses of the Program	14
Creation of Data Reconciliation and Counts Macros	15
Application of Hypothesis Testing to Demographic Assumptions.....	15
Z-test	16
Chi-Square Goodness of Fit Test	16
Exact Confidence Intervals.....	16
P-Values	17
Multiple Test Correction and False Discovery Rates.....	18
Compiling Results.....	18
Conclusions and Suggestions	19
Works Cited.....	23
Appendix	i
Manual for Use of Tool	i
Codes.....	xiii

Table of Figures

Figure 1: Snapshot of “Run” tab from Demographic Assumption Analysis Tool.....	19
Figure2: Representation of Color Coded System for Termination Results.....	24

Abstract

Hewitt Associates, in order to perform valuations on pension plans, must make certain demographic assumptions. These assumptions include the probability that plan participants will retire, die, and terminate for a given year. The objective of this project was to choose statistical tests to analyze the accuracy of these assumptions, and to provide the sponsor with an automated tool to use on an ongoing basis. This MQP created a tool within Microsoft Excel that works with Hewitt's current pension valuation software to analyze the statistical accuracy of Hewitt's demographic assumptions. The analysis compares how well Hewitt's expected demographic probabilities performed using exact confidence intervals and the calculation of p-values adjusted for False Discovery Rate. This tool flags assumptions that need to be reassessed and will aid Hewitt in improving the accuracy of their demographic assumption.

Executive Summary

Hewitt Associates specializes in the outsourcing of corporate human resources programs including retirement programs in which they assist clients in determining the annual contributions necessary for their pension plans. As a part of the pension valuation process, Hewitt must set certain demographic assumptions. These assumptions, which include mortality, retirement, and turnover, are vital for the pricing and fiscal liability of pension plans. The objective of this project was to develop an automated Microsoft Excel tool that would analyze the accuracy of these assumptions.

The first step in creating such a tool was to determine how the accuracy of the assumptions could best be analyzed. Statistical tests such as the Chi-square Goodness of Fit test, the Z-test, confidence intervals, and Fisher's exact test were all considered. Because of constraints, such as the size of the data and the software available to Hewitt, our team determined that the calculation of exact confidence intervals and p-values would best evaluate the accuracy of the demographic assumptions.

After determining which statistical tests would be used, our team began to develop the tool that would complete this analysis. Macros were written in Microsoft Visual Basic for Applications. These macros, which operate in Microsoft Excel, manage the entire analysis process. The process begins with importing data from Hewitt's pension valuation software, ProVal. Exact confidence intervals are then calculated to provide an initial analysis of the assumptions. To supplement the information gained from these confidence intervals, p-values are also calculated. The number of statistical tests required for this analysis necessitated the need to correct for multiple testing errors. For our project, we were concerned with controlling the number of Type I errors, or False Discovery Rates. There are many methods that have been theorized for handling False Discovery Rates but the Benjamini-Hochberg method, which ranks and adjusts p-values, was deemed most appropriate. The final macro created summarized all of the results obtained from the statistical analysis into a user-friendly format. For each decrement, a color-coded table was created that listed the adjusted p-values for each assumption.

Lastly, interpretation of these statistical tests needed to be considered. The tool created by our team highlighted the demographic assumptions that have sufficient evidence to reject the null hypothesis (i.e. this particular assumption was consistent with the observed data). However, this does not necessarily mean that the highlighted assumptions should be adjusted or changed. There are many other factors that the actuary might need to consider before deciding to revise a particular demographic assumption. For one year of data, the tool might show failures for a number of assumptions within the decrements. The actuary needs to know if these assumptions are indeed incorrect or if the results were caused by some other event. As anticipated, the analysis tool created does not provide a guarantee that demographic assumptions should be changed. Rather, this tool acts as a litmus test to highlight problems.

Background

Hewitt

Hewitt Associates was founded in 1940 by Edwin "Ted" Hewitt, as a brokerage house focusing on insurance and personal financial services. Headquartered in Lincolnshire, Illinois; Hewitt is currently located in 33 countries around the world and employs approximately 23,000 associates. They consult with more than 3,000 large and mid-size companies. Clients include over half the Fortune 500 and a third of the Fortune Global 500.

Hewitt's services include Investment Consulting, Legal Consulting, Administrative and Communication Services, and Actuarial Consulting. Specializing in the outsourcing of corporate human resources (HR) programs such as healthcare benefits, payroll administration, stock options and investment accounts, retirement programs, and severance packages, Hewitt provides clients with human resources consulting and outsourcing services. (Hewitt Associates)

For many companies, retirement benefits are a large and growing investment. However, because of corporate governance issues and globalization, retirement programs are also an increased financial risk. Hewitt offers retirement programs that have proven to be secure and sustainable.

Pension Overview

The basic definition of a pension is a series of payments made to a person who retires from employment. Typically these payments are made for the remainder of the individual's lifetime and are valued based on a set formula that often takes into account age, years of service, earnings, and contributions. The basic idea behind a pension is to reward employees for service by providing some level of retirement security. Additionally, when pension plans were first created they were viewed as a means to release employees who were no longer productive. More recently, the view on pensions has shifted, and they are seen more as part of the total compensation of the employee in the form of deferred wages. Two main types of pension plans exist: defined benefit (DB) and defined contribution (DC) plans. Among these two main types of plans, companies can elect any of a number of plan features. The Employee Retirement Income Security Act of 1974 set forth the rules governing employer-sponsored pension plans. The legislation that governs specific types of retirement plans is found in sections of the Internal Revenue Code. (Allen Jr., Melone, Rosenbloom, & Mahoney, 2008)

Defined Benefit Plans

In a defined benefit plan the employer promises to provide a benefit to the employee at retirement based on the employee's years of service and earnings history. There are a number of different formulas that are used for determining this benefit depending upon the specific features of the plan. A maximum annual benefit does exist for defined benefit plans. The benefits are typically paid in the form of a life annuity with payments made periodically (monthly, annually, etc.) Married employees are generally given the option of electing beneficiary status where the spouse would receive at least 50% and up to 100% of the pension benefit upon death of the employee. Some plans do have provisions that allow for benefits to be taken in a single lump sum upon retirement.

The employer must maintain the plan by making contributions in order to meet the defined benefit. The calculation of the required contributions takes into account a number of factors including the employee's life expectancy, changes in interest rates, annual retirement benefit amounts, and the rate of employee turnover. (New York Life Insurance Company, 2009)

Defined Contribution Plans

In a defined contribution plan, the employer makes a regular contribution into the retirement account of the employee. The employee is also able to make contributions into this plan. The money in this account is then invested into any number of securities, most often at the discretion of the employee. Companies typically provide a listing of investment options for employees to choose. In this arrangement, the investment risk is born solely by the employee. This is the inherent benefit of defined contribution plans for employers, unlike the defined benefit plan where the employer holds all the risk of maintaining the fund. Funding a defined contribution plan for an employer simply requires them to make the periodic payments into the account of the employee. Both the contributions of the employer and the employee are tax deductible and the investment in the account accrues tax-free. (DB vs. DC) There are many types of defined contribution plans as the legislation allows for considerable variety of structure. These include: money purchase pension plans, profit sharing plans, stock ownership plans, and 401(k) plans. (Allen Jr., Melone, Rosenbloom, & Mahoney, 2008)

Cash Balance Plans

The cash balance plan is a type of defined benefit pension plan that is often viewed as a hybrid with a defined contribution plan. The reason is because the benefit is viewed as a lump sum that exists in a “hypothetical” account which grows over time. This account is typically credited annually with a certain percentage of pay and an imputed rate of return. The employer makes contributions to the plan just as in other defined benefit plans and bears the responsibility of investing the fund and managing the assets of the plan. (AARP, 2005)

Pension Benefit Guarantee Corporation (PBGC)

The Pension Benefit Guarantee Corporation (PBGC) is a federal corporation that was established in 1974 to protect pension plans. The organization currently protects almost 44 million Americans in over 30,000 defined benefit pension plans. The PBGC receives its funding from insurance premiums paid by employers with insured pension plans. It also holds investments and funding from pension plans that were taken over. Upon termination of an insured pension plan the PBGC steps in and will pay the retirement benefits promised to each individual. There is a maximum benefit that the PBGC will pay to retirees which is set every year. (PBGC)

Demographic Assumptions

In order to calculate the pension obligations of a certain company, an actuary must predict the present value of future benefits that will be paid to the plan’s participants. An actuary uses demographic assumptions to evaluate the projected benefits of all the participants in a certain plan. These demographic assumptions include assumptions about mortality, disability, termination of employment, and retirement. According to ASOP 35, “the actuary should select reasonable demographic assumptions in light of the particular characteristics of the defined benefit plan that is the subject of measurement” (Actuarial Standards Board, 2007).

Mortality

In order to predict the future lifetime of the plan’s participants, an actuary uses a mortality table which provides the probability of dying by a person’s next birthday based on that person’s age. There are many different types of mortality tables available that can be used. Therefore, in choosing an appropriate table, an actuary must consider several factors: if mortality can be assumed to be consistent before and after retirement, the possibility of future improvements in mortality, if a different mortality

should be used for disabled lives, and if different mortality assumptions should be used for different subgroups and beneficiaries (Actuarial Standards Board, 2007).

GAM-83

The 1983 Group Annuity Mortality table (GAM-83) was created by the Society of Actuaries when its predecessor, GAM-71, was proven insufficient. The same data collected from 1964 to 1968, from GAM-71 was used. That data was then projected forward to 1983 based on mortality improvements seen in the population of the United States between 1966 and 1975. The table also included a 10 percent margin for conservatism.

UP-94 and GAM-94

The 1994 Uninsured Pensioner Mortality Table (UP-94) and GAM-94 were also created by the Society of Actuaries to replace UP-84 and GAM-83 respectively. Studies conducted on mortality experience between 1985 and 1990 revealed that both tables were not representative enough of the current mortality at the time. In developing the table, researchers calculated mortality rates by using mortality experience from different groups of people for different age brackets.

The RP-2000 Mortality Tables

Lastly, the RP-2000 mortality tables were created by the Society of Actuaries in response to the Retirement Protection Act of 1994 (RPA), which required that standard tables had to be used in calculating the current liabilities of pension plans. The Society of Actuaries commissioned the Retirement Plans Experience Committee (RPEC) to conduct the study in creating these tables. The data used to create these tables are comprised of nearly 11 million life-years of exposures and more than 190,000 deaths. Individual mortality tables were created separated by gender for current employees, healthy annuitants or retirees currently receiving benefits, and disabled retirees (The Society of Actuaries).

Disability

In order to estimate the future financial obligation to the plan's participants, an actuary uses many tables, one of which is a table that describes disability assumptions. Within the disability assumption there is more than one type of assumption that needs to be made. The probability of a plan member becoming disabled within a given year is the disability incidence rate. The disability termination rate is the probability that a disabled plan member will change from disability status during a given year. This includes changes in status due to recovery and or death. Finally, the disability mortality rate is the probability of a permanently disabled plan member dying. (Hewitt Associates, 2006)

Retirement

A company's financial obligation to pay retirement benefits to the plan participant typically begins on the day of the participant's retirement. However this date is not known in advance, and so in order to estimate the future financial obligation to the plan's participants, an actuary uses retirement tables. These tables include the probability of a participant retiring at each age so that the financial obligation can be priced accordingly.

Early Retirement Factors

In the past, most pension plans were valued on the assumption that a participant will work until age 65, but in recent history people have begun to retire at various ages. Because of this change in retirement ages, the valuation process had to be modified; including the incorporation of termination early retirement factors, also known as ERF's.

Many plans are now allowing retirement at an age prior to 65; however this results in a reduced amount of pension for the participant. This reduction is dependent on the number of years between the participant's current age and age 65, and is called an early retirement factor. These factors vary by company and pension plan.

In many instances, the early retirement factors are "subsidized"; that is, the actuarial present value of reduced benefits upon early retirement will often exceed the present value of unreduced benefits defined by a participant's normal retirement age. Some plans even allow unreduced benefits at age 62 or 60. Such features can be tools to help employers maintain their workforce at a desired level.

Retirement Tables

Hewitt sets their retirement rates based on actual and anticipated plan experience, using the most recent plan data available. If the actual plan experience is not credible, then retirement assumptions can be made by considering factors such as if the plan offers incentives to influence when employees retire, availability of retiree medical, defined contribution plans, and or social security. Also, there may be multiple tables for a single plan. These multiple tables would be used to reflect the plan offering more, or different, benefits to certain groups of plan participants. (Hewitt Associates, 2008)

Turnover

As mentioned previously, a company's financial obligation to the plan participants typically begins upon the participants' retirements. However, not every employee will make it to retirement. Many employees will choose to change careers, change companies, move, stop working, etc. This employee turnover needs to be considered when looking in total at a company's financial obligation to its employees.

Withdrawal Tables

In 2003, the SOA completed the more recent Pension Plan Turnover Study. This study presented strong evidence that there were great differences in turnover rates between the three employment status categories; Hourly Non-Union, Salaried, and Hourly Union. This evidence resulted in the development of three new standard withdrawal tables for Hewitt. These tables are created to include both age and years of service and the select period can range from 1 to 10 years. This is important because the SOA study also showed that withdrawal rates correspond greatly to years of service, especially at younger ages. (Hewitt Associates, 2004)

Statistical Tests

Hypothesis Testing

Hypothesis testing is used to choose between two competing theories; a null hypothesis, which represents a theory that has already been put forward, and an alternative hypothesis which opposes the null. These are often statements about population parameters, like mean and variance. The tester is using a distribution with known area, to estimate the probability of obtaining a certain value by chance. Typically this is a bet that the probability will be low because that means it's likely that the test result was not a mere coincidence but occurred because the hypothesis is correct. Hypothesis testing has only two possible outcomes; rejection of the null hypothesis, or failure to reject the null hypothesis. (Weisstein, Hypothesis Testing)

Steps

- 1) State the Hypotheses:

Case	Null Hypothesis H_0	Alternate Hypothesis H_A
1	$\mu_1 = \mu_2$	$\mu_1 \neq \mu_2$
2	$\mu_1 \leq \mu_2$	$\mu_1 > \mu_2$
3	$\mu_1 \geq \mu_2$	$\mu_1 < \mu_2$

(Gallagher)

- 2) Choose alpha:
 - a. The alpha value determines the level of significance, L.
 - i. $1-\alpha=L$
 - b. The most common significance levels chosen are 0.01, 0.05, or 0.10
- 3) Compute the Test Statistic:
 - a. The random variable X whose value is tested to arrive at a decision.
 - b. The choice of the test statistic will depend on the assumed probability model and the hypotheses being tested.
 - c. A binomial distribution, with parameters n and p, can be assumed to be approximately normal for large enough n and p not too close to 1 or 0. The most common rule of thumb is to only use this approximation if np and n(1-p) are both greater than 5.
 - i. In this case a z-statistic is used.
 - ii. Otherwise, a t-curve can be used.
- 4) Decision by comparison:
 - a. Compare the value of the test statistic to the critical value obtained for the chosen alpha.
 - i. If the test statistic falls into the rejection region, H_0 is rejected.
 - ii. Else, the test fails to reject.

The Z-Test

The Z-test is used to determine whether the mean of a sample and the population mean are significantly different. The Z-test is based on the Central Limit Theorem which states that the sum of many independent random variables will tend to be normally distributed. The test relies on comparing the computed test statistic to a critical value obtained from a Z-Score Table, which is based on the percent of area between the mean and the z-score under a normal curve. Thus in order to use this statistical test, one must have sufficiently large enough data to assume a normal distribution. (Petrucci, Nandram, & Chen, 1999)

Steps

- 1) State the Hypothesis:

Set	Null hypothesis	Alternative hypothesis	Number of tails
1	$\mu = M$	$\mu \neq M$	2
2	$\mu \geq M$	$\mu < M$	1
3	$\mu \leq M$	$\mu > M$	1

- 2) Choose alpha:

- a. The most common significance levels chosen are 0.01, 0.05, or 0.10

- 3) Compute the Z-Score Test Statistic: $z = \frac{(x - M)}{(\sigma/\sqrt{n})}$

- a. X is the observed sample mean
- b. M is the hypothesized population mean (from H_0)
- c. σ is the standard deviation of the population

- i. $\sigma = \sqrt{E(x^2) - (E(x))^2}$

- 4) Compute the Critical Value: Use the Normal Distribution Table to assess the z-score.

- 5) Decision by Comparison:

- a. Reject the Null Hypothesis when Critical Value \leq | Test Statistic |
- b. Else, fail to reject

Example:

Given Data:	Retirement:
Expected Proportion:	0.80
Observed Proportion:	0.75

1. State the Hypotheses:

- a. H_0 : The Expected and Observed Proportions are Equal.
- b. H_a : The Expected and Observed Proportions are Not Equal.

2. Alpha = 0.05

3. Compute the Test Statistic:

- a. Test Statistic: $z = \frac{(x - M)}{(\sigma/\sqrt{n})}$

- b. $\sigma = 0.1265$
 - c. $n = 100$
 - d. $|z| = 3.953$
4. P-Value: 1.96
 5. Conclusion: We reject the null hypothesis because $3.953 > 1.96$

Note: In order for the test to fail to reject the null hypothesis, the observed proportion of people entering retirement would need to be between: 0.776 & 0.824

Chi-Square Test

The Chi-Square Goodness of Fit Test is used to determine how “close” the observed data is to the expected model. This test can be applied to any univariate distribution for which the cumulative distribution function can be calculated, including discrete and continuous distributions.

Certain considerations must be made when applying this test. First, the sample values must be independent and identically distributed. Also, the sample values must be grouped into C categories. For each category the number of expected values should be recorded. In each group the expected number of successes must be at least 5, and the total expected count must be at least 20 for the test to be valid. Also, the test is sensitive to the choice of groups. Finally the expected distribution must be specified in advance. (Stat Trek Inc)

Steps:

- 1) Hypotheses:
 - a. H_0 : The data are consistent with a specified distribution.
 - b. H_a : The data are not consistent with a specified distribution
- 2) Choose alpha:
 - a. The most common significance levels chosen are 0.01, 0.05, or 0.10
- 3) Find the P- Value:
 - a. Compute the Test Statistic: $\chi^2 = \sum [(O_i - E_i)^2 / E_i]$
 - b. Degrees of Freedom: Number of Categories -1
 - c. Calculate the P-Value: Using the degrees of freedom and the alpha level, this can be found on a Chi-Square Distribution Table
- 4) Decision by Comparison
 - a. Reject the Null Hypothesis when P-Value \leq Significance Level
 - b. Else, fail to reject

Example:

Given Data:	Living/Working	Mortality	Retirement	Turnover	Total
Expected:	800	100	50	50	1000
Observed:	750	100	50	100	1000

1. Hypotheses:
 - a. H_0 : Expected data are consistent with observed data distribution
 - b. H_a : Expected data are not consistent with observed data distribution
2. Alpha = 0.05
3. P- Value:

- a. Test Statistic: $\chi^2 = \sum [(O_i - E_i)^2 / E_i] = 53.125$
 - b. Degrees of Freedom: 4
 - c. P-Value: 0.352
4. We reject the null hypothesis because $0.352 < 53.125$

Fisher's Exact Test

Much like the Chi-Square Goodness of Fit Test, Fisher's Exact Test is used to determine if there are associations between two sets of categorical data. However, unlike the Chi-Square test, there are no minimum sample sizes required, and rather than use a known distribution as an approximation, Fisher's Exact Test allows one to exactly calculate the significance of deviation from the null hypothesis. This test is most commonly used on 2 x 2 contingency tables; however its principles can be extended to calculate any m x n table. (Garson, 2008)

Steps:

- 1) Set Up the Contingency Table:

a.

	Column 1	Column 2	Total
Row 1	A	B	A + B
Row 2	C	D	C + D
Total	A + C	B + D	n

- 2) Hypotheses:

- a. H_0 : There is a non-random association between the two sets of categorical data
 - i. The two sets of categorical data are: Column 1 and Column 2.
- b. H_a : There is not a non-random association between the two sets of categorical data.

- 3) Choose alpha:

- a. The most common significance levels chosen are 0.01, 0.05, or 0.10

- 4) Find the P- Value:

- a. Compute the Conditional Probability of getting the given matrix: $P_{cut\ off}$
 - i. $P_{cut\ off} = \frac{(A+B)!(C+D)!(A+C)!(B+D)!}{n!A!B!C!D!}$
 - ii. This is given by the hyper-geometric distribution
- b. Simulate multiple tables so that although A, B, C and D can change, the Total column and row remain constant.
 - i. Calculate the $P_{cut\ off}$ for each of these new tables.
- c. Calculate the P-Value by summing any $P_{cut\ off}$ value which is less than or equal to the $P_{cut\ off}$ value of the original table.

- 5) Decision by Comparison

- a. Reject the Null Hypothesis when P-Value \leq Alpha
- b. Else, fail to reject

Example:

- 1) Set Up the Contingency Table: (Weisstein, Fisher's Exact Test)

a.

Given Data:	Male	Female	Total
Living/Working	5	0	5
Retired	1	4	5
Total	6	4	10

- 2) Hypotheses:

- a. H_0 : There is a non-random association between the Male and Female data sets
- b. H_a : There is not a non-random association between the Male and Female data sets

- 3) Alpha : 0.05
- 4) Find the P- Value:
 - a. Conditional Probability: $P_{cut\ off} = 0.0238195238$
 - i. $P_{cut\ off} = \frac{(6)!(4)!(5)!(5)!}{10!5!4!1!0!}$
 - ii. This is given by the hyper-geometric distribution
 - b. Simulate multiple tables so that although A, B, C and D can change, the Total column and row remain constant. All possible tables are shown, including the actual observed table shown above.
 - i. $\begin{matrix} 4 & 1 \\ 2 & 3 \end{matrix} = 0.2381$
 - ii. $\begin{matrix} 3 & 2 \\ 3 & 2 \end{matrix} = 0.4762$
 - iii. $\begin{matrix} 2 & 3 \\ 4 & 1 \end{matrix} = 0.2381$
 - iv. $\begin{matrix} 1 & 4 \\ 5 & 0 \end{matrix} = 0.0238$
 - c. P-Value = $0.0238 + 0.0238 = 0.0476$
- 5) Decision by Comparison: Reject the Null Hypothesis because $0.0476 \leq 0.05$ Therefore we can conclude that the expected data are not consistent with the observed data distribution.

Exact Confidence Intervals

A random sample follows a binomial distribution when the total number of successes in a given number of independent Bernoulli trials has a set probability of success. Demographic assumptions prescribe a predetermined probability of success to a given set of data and thus can be modeled with a binomial distribution. One method for hypothesis testing of a binomial distribution is to construct an exact confidence interval. (Petrucci, Nandram, & Chen, 1999)

Steps

1. Hypotheses:
 - a. H_0 : The expected proportion and the observed proportion are equal.
 - b. H_a : The expected proportion and the observed proportion are not equal.
2. A level α must be set to obtain a $(1-\alpha)\%$ confidence interval:
 - a. For example, $\alpha=0.05$ would result in a 95% confidence interval. The way to interpret the result is to say that you are 95% certain that the true population proportion is within the range given by your interval.
3. Compute the exact confidence interval for the observed proportion $q : (q_L, q_U)$
 - a. Where q_L is the unique solution to:
 - i. If $Y > 0$: $\sum_{y=Y}^n \frac{n!}{y!(n-y)!} q_L^y (1 - q_L)^{n-y} = \frac{\alpha}{2}$
 - ii. If $Y=0$: 0
 - b. Where q_U is the unique solution to:
 - i. If $Y < n$: $\sum_{y=0}^Y \frac{n!}{y!(n-y)!} q_U^y (1 - q_U)^{n-y} = \frac{\alpha}{2}$
 - ii. If $Y=n$: 1
4. Interpret the results:

- a. Reject the null hypothesis when the expected proportion does not fall within the confidence interval. We can conclude that the expected and observed proportions are equal.
- b. Else, fail to reject. We cannot conclude that the expected and observed proportions are equal.

Example:

Given Data:	Mortality
Expected Proportion:	0.045
Observed Proportion:	0.055

Want to obtain an exact level 0.95 confidence interval for the true proportion of deaths for a company of 50,000 people. To do this, a random group of 200 employees was chosen, out of which 11 people died.

1. Hypotheses:
 - a. H_0 : The expected proportion and the observed proportion are equal.
 - b. H_a : The expected proportion and the observed proportion are not equal.
2. Alpha: 0.05, creating a 95% confidence interval
3. 95% Confidence Interval: (0.028, 0.096)
 - a. $\sum_{y=11}^{200} \frac{200!}{y!(200-y)!} q_L^y (1 - q_L)^{200-y} = 0.025$
 - b. $\sum_{y=0}^{11} \frac{200!}{y!(200-y)!} q_U^y (1 - q_U)^{200-y} = 0.025$
4. Fail to reject the null hypothesis because $0.028 \leq 0.045 \leq 0.096$

P-Values

The p-value in a hypothesis test is used to determine how consistent the observed result is with the expected assumption. The p-value provides you with the proportion of values from the distribution that provide at least as much evidence to reject the null hypothesis as the observed value. The way to interpret the p-value is to say that if the null hypothesis is true, then the percentage given by the p-value is the probability of observing a value at least as extreme as you observed. The smaller the p-value, the more evidence you have to reject the null hypothesis. (Petrucelli, Nandram, & Chen, 1999)

Steps

1. Choose Alpha:
 - a. The alpha level should already be set by the hypothesis test for which this p-value is being calculated.
 - b. The most common significance levels chosen are 0.01, 0.05, or 0.10
2. Calculate the probability associated with your observed result.
3. Calculate the P-Value:
 - a. Sum all the probabilities that are as small or smaller (i.e. results that are more extreme) than your observed result.
4. Decision by Comparison:
 - a. Reject the null hypothesis if the p-value is less than α .
 - b. Else, fail to reject

Go through an example

Working with the exact confidence interval example above:

Given Data:	Mortality
Expected Proportion:	0.045
Observed Proportion:	0.055

Alpha: 0.05 and N: 200

1. Alpha: 0.05
2. Observed Probability:
3. P-Value: 0.49174
4. Fail to reject the null hypothesis because $0.49174 \geq 0.05$

Note: The P-value test will always give the same accept or reject conclusion as that of the confidence interval.

Multiple Test Corrections

Multiple Test Corrections are necessary because multiple comparison problems occur when considering a hypothesis test on many hypotheses. These problems most often involve hypothesis tests that incorrectly reject the null hypothesis.

To give an example; when considering a single true hypothesis, one would expect a typical 5% hypothesis test to wrongly reject the true null hypothesis only 5% of the time. However, when considering 100 true hypotheses one would expect to incorrectly reject at least one true null hypothesis. In fact, because the test level is 5%, one would expect 5 of the 100 true hypotheses to be wrongly rejected.

Simply stated, when using a single hypothesis test multiple times on many hypotheses, one should expect to see type I errors, rejection of a true null hypothesis. Multiple test corrections help to control the number of these errors that occur.

False Discovery Rate

The False Discovery Rate (FDR) Method is one way to correct for multiple test errors, it controls the expected proportion of type I errors (rejection of the null hypothesis when one should have accepted) when using multiple hypothesis tests. Benjamini and Hochberg developed a method whereby the calculated p-values are adjusted based on their rank and the total number of tests being run. (Agilent Technologies, 2005)

Steps

1. List all p-values from smallest to largest.
 - a. This will determine each p-value's rank.
2. Multiply each p-value by the total number of tests divided by its rank
 - a.
$$\left(\frac{\text{Total Number of Tests}}{\text{Rank of P-Value}} \right) \times (P - \text{Value})$$
3. The adjusted p-values will reject the null hypothesis less often, thus reducing the number of type I errors, falsely rejected true null hypotheses.

Go through an example

Given Data: 5 P-values: 0.002, 0.107, 0.018, 0.051, 0.043

1. Rank:

Rank:	P-Value:	Result:
1	0.002	Reject Ho
2	0.018	Reject Ho
3	0.043	Reject Ho
4	0.051	Fail to Reject Ho
5	0.107	Fail to Reject Ho

2. Adjustment:

Rank:	Adjustment:
1	0.002*(5/1)
2	0.018*(5/2)
3	0.043*(5/3)
4	0.051*(5/4)
5	0.107*(5/5)

3. Result

Rank:	P-Value	Result:	Adjusted P-Value:	Adjusted Result:
1	0.002	Reject Ho	0.010	Reject Ho
2	0.018	Reject Ho	0.045	Reject Ho
3	0.043	Reject Ho	0.072	Fail to Reject Ho
4	0.051	Fail to Reject Ho	0.064	Fail to Reject Ho
5	0.107	Fail to Reject Ho	0.107	Fail to Reject Ho

A FDR method can only make it less likely to reject a particular outcome, meaning that it will only increase the number of accepted outcomes.

Type I and II Errors

Type I Error

A type I error occurs when the null hypothesis is actually true, but the null hypothesis is rejected in the hypothesis test. A type I error is commonly known as a “false positive.” The probability of a type I error occurring is alpha (α) or the significance level of the hypothesis test. A type I error is considered more serious than a type II error; as a result, the significance level of the hypothesis test is chosen prior to testing and collecting data (Easton & McColl). The significance level must be chosen before data is collected because otherwise bias will be introduced into the test (Allen).

Type II Error

A type II error occurs when the null hypothesis is actually false, but the null hypothesis is not rejected in the hypothesis test. A type II error is commonly known as a “false negative.” The probability of a type II error occurring is beta (β). A type II error is typically caused by having too small of a sample size (Easton & McColl).

Power

The power of the hypothesis test is $1-\beta$ or the probability of rejecting the null hypothesis when the null hypothesis is false. The power of the test is affected by (Plonsky, 1997):

1. Alpha: Type I and type II errors are inversely related (Easton & McColl). Therefore, an increase in the likelihood of one type would cause a decrease in the other type.
2. Sample size: Sample size is directly related to the power of the test.
3. Type of test: Metric tests are more powerful than nonparametric tests because their assumptions are more restraining.
4. Variability: The greater the variability, the less powerful the test.
5. Test direction: One-tailed tests are more powerful than two-tailed tests.
6. Robustness of effect

Methodology

Creation of Computer Program

In evaluating the effectiveness of Hewitt’s demographic assumption setting, a standardized procedure was needed to enable Hewitt to perform statistical tests easily and efficiently. The result was the development of a computer program to perform the desired statistical analysis. This model was designed in Microsoft Excel using Visual Basic for Applications because Hewitt has direct access to this software. The use of other statistical software was considered but Hewitt does not use these systems and thus we decided to perform all analyses within Microsoft Excel. Lack of access to more robust statistical software had implications for which testing methods could be performed.

Uses of the Program

Our computer model was designed to perform all analyses automatically. The “Run” tab of the model breaks the analysis down into five steps for each of the three demographic assumptions. A separate macro is linked to each of these steps to perform one specific part of the overall procedure. The user has the option to simply run each decrement in total, or he or she can run each step separately. The reason the model was designed in such a way was to allow the user to see exactly how the program works. A snapshot of the “Run” tab is shown below in Figure 1.1



Figure 1: Snapshot of “Run” tab from Demographic Assumption Analysis Tool

As shown in Figure 1.1, the first step in the analysis is “Import ProVal Results.” ProVal is a system produced by Winklevoss Technologies that Hewitt uses to perform valuations and projections for pension and OPEB plans. ProVal uses the demographic assumptions set by Hewitt as part of its valuation. ProVal produces a comprehensive set of results from this valuation which can be written to Microsoft Excel. In order to use the computer program, the results for the Mortality, Retirement, and Termination assumptions must be output. The “Import ProVal Results” button then takes this output and converts it into a usable form. The remaining steps in the analysis are based off the data gathered from ProVal. The methodology for the remaining parts of the program is described in the following sections.

Creation of Data Reconciliation and Counts Macros

Prior to working with Hewitt’s ProVal system, our team was given a set of data in Microsoft Excel and asked to perform tests on this data. Unfortunately the format of the data was such that it needed to be adapted for our purposes. We created a data reconciliation macro that fixed errors and inconsistencies in the data in order to provide more accurate results. This macro was based on several predetermined rules of thumb to follow:

1. If a date of birth or date of hire was missing for an entry, the entry was erased
2. If the date of retirement or date of termination were prior to the year 2004, the entry was erased
3. If an entry had both a date of retirement and date of termination present, then the date that corresponded with the appropriate early retirement provisions was used and the other was erased
4. If the entry was listed as retired or terminated but no date was provided, a standard date of 6/30/200# was used depending on the year.
5. If a retirement, termination, or death date was shown that was in an upcoming year, it was erased from the current year’s entry

The data reconciliation macro helped to eliminate some problems with the smaller data set but was not efficient enough to be run on a very large set of data. The code for this macro is shown in the Appendix

The counts macro was used to convert dates of birth, dates of hire, etc. into ages. It also calculated every entry’s age at retirement, age at termination, and age at death. This was done so that the statistical tests could be run easier. The code for this macro is shown in the Appendix.

Both the counts macro and the data reconciliation macro were eventually scrapped from use by the project when we began to work with ProVal. ProVal automatically provides reconciled data as well as counts that are in an easy-to-use format. These two macros, however, provided the team with a great learning experience as to how to write macros in Microsoft Excel and what to look for in the data.

Application of Hypothesis Testing to Demographic Assumptions

Hewitt Associates, in valuing pensions, deals primarily with four assumptions: mortality, employee turnover, retirement, and disability. Assumptions are also made about the interest rate and salary scale but these are relatively standard and will not be considered in this paper. Additionally, we discovered that employees decrementing due to disability occurs so infrequently as to provide no sound basis for performing a statistical test on this assumption. Thus, for our purposes we will evaluate the effect of the three main assumptions on a group of individuals: mortality, termination, and retirement. The methods for analyzing data using hypothesis testing have been discussed in detail. These methods provide a sound statistical measure for the accuracy of our assumptions. We observed the outcome of

the data over a period of time and evaluated how closely our assumptions matched the actual experience of the population. There are several ways to break down the data to test the effectiveness of the assumptions. The goal was to provide, with reasonable certainty, a determination as to whether or not the assumptions were satisfactory in providing a close fit to the data.

Z-test

The first test that was considered for the statistical analysis was the standard Z-test for a population proportion. The Z-test is based on the Central Limit Theorem which states that a large enough sample of independently distributed random variables will be normally distributed. The Z-test is a good measure for comparing an expected proportion to an actual population proportion. This test can be applied directly to demographic assumptions as these are estimated proportions of the population. However, a problem arises with the Z-test when the sample is not large enough to be considered normally distributed. We found that with certain assumptions for individual ages our sample size and our estimated proportion were too small for the Z-test to be accurate. Thus we decided to forgo the use of this test.

Chi-Square Goodness of Fit Test

The Chi-Square Goodness of Fit Test is used to compare an observed set of data with an expected model. The benefit to using a Chi-Square test is that it allows you to compare more than one result. This test allows you to group the data into any number of prescribed categories and analyze how consistent the data is to what your model had expected. This can be applied to Hewitt's demographic assumptions as these are often broken into various age, service, and gender buckets. However, there are several problems with the Chi-Square test. First, much like the Z-test, there must be a large enough number of expected results per category for the test to be accurate. In order to follow the Chi-Square distribution, at least 5 results must be expected in each bucket. This created problems with some of the decrements where the probabilities associated with a specific age, service, and gender bucket were very small. Additionally, the Chi-Square GOF Test looks at the results of the observed data in aggregate. It indicates whether or not the assumptions were valid for the whole set. Hewitt determines its assumption on a much more granular level and, therefore, needs to know how each individual bucket performed. The Chi-Square Test demonstrates if a problem exists but does not identify in which bucket the problem occurs. Thus, we decided that this test would not be very useful for the purpose of our project, which was to provide Hewitt with a determination as to whether their individual assumptions were statistically accurate.

Exact Confidence Intervals

In response to the problems created by the restriction on the Z-test and Chi-Square Goodness of Fit test with regards to the number of expected results, we employed a means of computing an exact test. Because demographic assumptions assign a predetermined probability of success to a given set of data, they can be modeled using a binomial distribution. The exact confidence interval approach calculates a lower and upper bound around the expected proportion (see Page 11 for further information). These bounds are determined by setting an alpha level for the hypothesis test. The way to interpret the results of the exact confidence interval is to observe if the expected proportion falls within the range of the interval. If this is the case, then we do not reject the hypothesis that the expected proportion and observed proportion are equivalent. Essentially, if the expected proportion is contained in the confidence interval, then the observed data was a good fit to the expected model. However, if

expected proportion falls outside of the range, then we reject our hypothesis and the data is said to be a poor fit of the model.

The benefit to using an exact confidence interval is that it can be used regardless of the size of the sample and the expected number of results because it solves an exact formula for the binomial distribution. It also allows the user to back solve for the expected proportion that would be needed to see a specific result. For example, we assume that Hewitt's retirement assumption for a given age was 0.1 or 10% and a 95% exact confidence interval around the observed proportion from the data was (0.02, 0.08). Having set alpha to 0.05, we can say that we were 95% certain that the null hypothesis was incorrect because our expected proportion of 0.1 did not fall within the interval. However, we are also able to say that had Hewitt set its assumption anywhere from 2% to 8%, then the test would not have failed. The confidence interval is easy to use and to interpret.

Unfortunately, the overall analysis of the data requires many hypothesis tests to be performed. This brings into consideration the problem of multiple testing and false discovery rates (refer to Page 13). Exact confidence intervals are not easily adjusted to fix these problems and therefore not as useful for the overall analysis. However, they were still used in this project as a good first glance to see how well the data fits the model.

Creating the Macro for Exact Confidence Intervals

To automate the process of calculating exact confidence intervals a macro in Microsoft Visual Basic for Applications was created. This is Step 2 on the "Run" tab. The macro works off the data provided by ProVal and imported into the proper format with Step 1. The macro uses a goal seek function in Microsoft Excel to find the solution to the equations for the upper and lower bounds on the binomial distribution. These formulas are extremely complex and cannot be solved easily. Thus, the guess and check method provided by the goal seek tool was the fastest and most accurate way available to solve these equations. The macro was programmed to recognize specific strings in the worksheet and to run until all the data has been analyzed. This macro also runs separately for each of the three demographic assumptions. The columns were listed as Q_l and Q_u to represent the upper and lower bound of the interval.

P-Values

As a precursor to dealing with the issue of multiple testing, another method for performing a statistical analysis was proposed. The p-value approach was selected as a way to use the exact results from the binomial distribution to determine how consistent an observed outcome in the data was with the expected model. The p-value is the probability of seeing values from the distribution that are at least as extreme as what you observed. A smaller p-value indicates that your result was more extreme and thus provides more evidence for rejecting the null hypothesis. The p-value can be linked to the alpha level that you set for your hypothesis test. For example, if alpha was set to 0.05 then a p-value less than 0.05 would lead to a rejection of the null hypothesis. The larger the p-value, the more consistent your result is with what you expected.

The p-value is very useful for the purposes of this project because it is easily calculated and can also be adjusted for multiple testing. The resulting p-values for each test are compared to the alpha level to determine if a statistically significant difference exists between the observed proportions and the expected demographic assumptions.

Creating the Macro for P-Values

The mathematics behind determining a p-value relied on our ability to calculate the results of the binomial distribution for every possible observation. For example, given a sample of 200 people with 10 observed retirements and an underlying assumption of 0.01, we would need to calculate the probability of seeing 0 to 200 retirements and compare these to our observed result of 10. Any probability at least as extreme as the probability of seeing 10 retirements is summed up. The resulting sum is the p-value. Because the number of people changes for every separate test, we needed a spreadsheet that could handle this. In the Demographic Assumption Analysis Tool we have created a sheet labeled “P-values” that performs these calculations. The macro that we wrote to automate the process takes the number of people in each age, service, and gender bucket, the observed number of decrements, and the assumed probability and plugs them into the “P-values” sheet. The macro loops through all three demographic assumptions, pulling every result in these sheets. The p-values are then copied to a new column in the results sheet for each assumption.

Multiple Test Correction and False Discovery Rates

Hewitt’s demographic assumptions are broken down into numerous age, service, and gender buckets with a different statistical test being performed on each one. The large number of hypothesis tests leads to the issues of multiple test correction. For a standard 5% alpha level hypothesis test you would expect to have an error 5% of the time for one specific test. Therefore, given 100 tests you would expect 5 of these tests to be wrong. This means that you could either falsely reject the null hypothesis when it was in fact true (a Type I error) or not reject the null hypothesis when it was false (a Type II error). The idea behind multiple test correction is to control the number of errors when many hypothesis tests are performed. Typically statisticians are concerned with controlling Type I errors which are also known as the False Discovery Rates.

There are many methods that have been theorized for handling False Discovery Rates but the Benjamini-Hochberg method was deemed most appropriate for our analysis. This method ranks p-values based on their size and adjusts them using their rank and the total number of tests being run. For the exact mathematics behind this method see Page 13. The basic idea is that the p-values are enlarged so as to make the possibility of Type I errors more unlikely. The adjusted p-values are then compared to the alpha level of the hypothesis test to determine whether or not to reject the null hypothesis.

Creating the Macro for False Discovery Rates

Having already calculated the p-values for each test, a macro was needed to rank and adjust these p-values using the Benjamini-Hochberg method. This macro takes all of the p-values across the three decrements and ranks them from largest to smallest. Then it applies the adjusting factor which is based on the rank and total number of p-values. The largest p-value stays the same and each subsequent smaller p-value is increased by $(\frac{\text{Total Number of Tests}}{\text{Rank of } p\text{-value}}) \times (p - \text{value})$. The resulting adjusted p-values are shown in the results sheet for each decrement. As is the case with all of the other macros, this macro is broken down into three pieces to enable it to be run separately for each decrement. However, because the rank is dependent on the total number of tests being performed, each individual macro takes into consideration the p-values for all three decrements as part of its calculation process.

Compiling Results

The final step for our model was to create a macro that would compile all of the results we had obtained from our statistical analysis into an easily understood format for Hewitt to use. The results

were based upon our adjusted p-values. For each of the three decrements, a table was created where the adjusted p-value for every age, service, and gender bucket was listed. Then a color coded system was created to interpret these results. A p-value of approximately 0.1 was highlighted in green, 0.05 was made yellow, and 0.01 was shown as red. The purpose of formatting the data in such a way was to show Hewitt how good or bad the assumptions were for each individual test. The bigger the p-value, the more consistent the observed data was with the expected model. As the p-value got smaller the results became more inconsistent. This is represented with the green, yellow, and red color coded system. This system allows Hewitt to observe at what alpha level their assumptions fail. A snapshot of the table for the termination results from one of our data samples is shown in Figure 1.2 below.

	A	B	C	D	E	F	G	H	I	J
1										
2		Key								
3			0.05 ≤ p-value							
4			0.01 ≤ p-value < 0.05							
5			p-value < 0.01							
6			No Exposed Lives							
7										
8		Termination Results								
9		By Age, Sex, and Service								
10		Age	Male		Female					
11			<5	5+	<5	5+				
12		<20								
13		20								
14		21	0.8695		0.8695	0.6331				
15		22	0.1763		0.1763	0.5030				
16		23	1.0000		1.0000	1.0000				
17		24	1.0000	0.9670	1.0000	0.0014				
18		25	0.0076	0.7138	0.0058	0.0000				
19		26	0.0004	1.0000	0.0009	0.0000				
20		27	0.0009	1.0000	0.0030	0.0000				
21		28	0.0000	0.4857	0.0000	0.0001				
22		29	0.0000	0.3808	0.0000	0.0002				
23		30	0.0079	0.2287	0.0033	0.0000				
24		31	0.3268	0.4072	1.0000	0.0010				
25		32	0.0015	0.0002	0.0000	0.0000				
26		33	0.0000	1.0000	0.0034	0.0070				
27		34	0.0001	1.0000	0.0037	0.0000				
28		35	0.0116	0.0001	0.0000	0.1801				
29		36	0.0549	0.2370	0.0222	0.0086				
30		37	0.0029	0.9693	0.2138	0.0246				
31		38	0.0818	1.0000	0.5780	0.0083				
32		39	0.0055	0.2384	0.0071	0.0616				
33		40	0.0578	0.8936	0.3995	0.0096				

Decrement: 5
 # Exposed: 19
 Expected Q: 0.127

Figure2: Representation of Color Coded System for Termination Results

Conclusions and Suggestions

Aggregate Tests on the Data

The output from this project is a process by which Hewitt's demographic assumptions can be evaluated at every age, service, and gender cut-off. However, some discussion has gone into whether the creation of a test on the aggregate data would be appropriate. As a general rule of thumb, statisticians often look at the overall fit of the data before breaking down into more detail. Our group, in contrast, chose to skip the first step and focus on the quality of the assumptions at the granular level. The main reason we took this approach was because the assumptions are determined at the individual level, and in order to be changed we would need to determine an error in a particular age, service, and gender bucket. An overall test may tell us something about the assumption set as a whole, but would provide no direction as to how the assumptions would need to be changed.

The second reason we chose to avoid the aggregate test on the data was because of its complexities. Because assumptions are set separately for each bucket, the underlying distribution of each could be fundamentally different. According to the Central Limit Theorem, the condition for normality is a sum of independent and identically distributed random variable with finite mean and variance. If the sequence is not identically distributed then the Lypapunov and Lindeberg Conditions must be met. However, because the range of variances in our assumption set is so large, these conditions would most likely not hold. Thus, we could not assume a normal distribution for the aggregate data.

Without normality, we are unable to run the Z-test and are left with either the Chi-Square Goodness of Fit Test or Fisher's Exact Test. The Chi-Square test can only be used if we expect at least five results in each bucket. This would certainly not hold at every level and thus could not be used effectively. Fisher's Exact Test is the one aggregate test that would meet all of the conditions necessary to be performed on our data set. Fisher's simulates a large number of possible outcomes on the data based on the assumptions that are made. The actual observed results are compared to these simulations, and a determination is made as to whether the observed results are significantly more extreme than what we would have expected.

Fisher's Exact Test is extremely computation heavy and needs statistical software to be run. In order for Hewitt to use this test on the aggregate data, they would need access to SAS, R, or some other software. There is a third-party statistical analysis software addition available for Microsoft Excel called *Analyse-It* which appears to have the capability to run Fisher's Test. However, the project team is not aware of its use and application to this project. (Analyse-It, 2009)

In summary, testing on the whole set of data was deemed secondary to the need for statistical analysis on the individual age, service, and gender buckets for the reasons listed above. The project team has provided a standardized means to analyze the data at the assumption setting level. More direction as to how to interpret the results of the Demographic Assumption Analysis Tool are provided in the subsequent sections.

Interpreting the Results

The Demographic Assumption Analysis Tool (DAAT) presents a statistical analysis of a specified set of data. The results are generated for each demographic assumption at every age, service, and gender cut-off. The p-values produced by this statistical approach show the user how each assumption performed at a predetermined confidence level, most often 5%. Any p-value that is less than the confidence level is highlighted as sufficient evidence to reject the initial hypothesis that this particular assumption was consistent with our observed data. The question that follows from this is: What do we do with all the assumptions that are shown to be inconsistent with the data?

There are many other factors that the actuary might need to consider before deciding to change a particular demographic assumption. For one year of data, DAAT might show failures for a number of assumptions within the three decrements. The actuary needs to know if these assumptions are indeed

incorrect or if the results were caused by some other event. First, the accuracy of the data being input is vital. The first step should be ensuring that ProVal is analyzing the correct data. Also, some related events could cause unusual swings within the decrements. For example, changes to company policies, changes to the pension plan, financial issues, etc. could result in more lay-offs, more people retiring early, or other such phenomenon.

As anticipated, DAAT does not provide a guarantee that demographic assumptions should be changed. Rather, this tool acts as a litmus test to highlight problems. Further analysis is needed to determine if there is sufficient evidence to change an assumption. The following section provides some recommendations that our project team has come up with to deal with this issue.

Recommendations

The first suggestion for addressing the issue of when it is appropriate to change an assumption is to look at the results of DAAT over several years. Because one year might prove to be an anomaly, it will be necessary to observe if the same assumptions fail over the course of several years on the same group of data. For example, if DAAT shows that for a particular pension plan the retirement assumptions for ages 55-60 are being set lower than the observed rates for five straight years, then this would provide significant evidence to change these assumptions. Thus we recommend that Hewitt use DAAT every year and compare the results over the course of several years to determine if changes are needed.

One issue that has been discussed at great length is how to handle pension plans with relatively small amounts of data. The issue in looking at these smaller plans on an individual assumption level is that each bucket may only contain a few people. A statistical analysis then will not prove all that beneficial, especially when the probabilities of decrement are low. In such situations, DAAT will indicate that the assumptions are accurate because there will not be enough evidence to reject the initial hypothesis. For this scenario we have two recommendations. First, the actuary should use his or her judgment to observe how accurate the assumptions are for the given data. In many instances, actuaries who have experience in working with these plans will be able to judge the overall effectiveness of the assumptions. Second, we suggest that Hewitt look into developing a tool to run Fisher's Exact Test on the aggregate results of these smaller data sets. Fisher's test will provide an analysis of the assumptions as a whole and, with the proper statistical software, can be used to make some conclusions about the assumptions on the individual age, service, and gender buckets.

Ultimately, Hewitt is most concerned with how the change in demographic assumptions will affect the liabilities for the pension valuations. Knowing this, we suggest that Hewitt use the results from DAAT to create a new valuation. This valuation would be run with the corrected assumptions at a specified confidence level. The resulting liabilities that are produced from re-running the data should then be compared to the initial liabilities. Again, we recommend that Hewitt use this approach on several years of data to gain a better experience study. The impact on the liabilities will provide Hewitt with a better understanding of how much effect changing the demographic assumptions will have.

One final experience study that we believe Hewitt can perform in conjunction with DAAT is to analyze the impact of salaries on the pension valuation. The reasoning behind this approach is that an assumption made on a group of individuals will have much more impact on the final liabilities if those individuals have very large salaries. In the same way, assumptions that are incorrectly made will have a much greater impact if they happened to be made on highly paid individuals. Thus, it might be useful for Hewitt to create a study that looks at the results from DAAT as well as the salaries of the individuals and creates a method for handling different scenarios.

As stated in previous sections, DAAT is a very useful tool for analyzing data. However, there are a variety of other studies that can be performed alongside DAAT to provide Hewitt with an even deeper understanding of the impact to the valuation process for its pension plans. We leave much of this up to

the discretion of the actuaries who have experience in these areas. The tool we have created can provide a stepping stone for future analysis of the demographic assumptions used by Hewitt.

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Appendix

Manual for Use of Tool

Demographic Assumption Analysis Tool

User's Guide

Worcester Polytechnic Institute

Table of Contents

Background:

Hypothesis Testing	iii
Exact Confidence Intervals.....	iii
P-Values	iv
Multiple Test Correction	iv
False Discovery Rate	iv

User's Guide:

Import ProVal Results	v
Calculate Exact Confidence Intervals	vii
Calculate P-values	ix
Adjust P-values with FDR	ix
Compile Results.....	x
Analysis of Results.....	xi

Background

The following includes brief descriptions of the various concepts utilized in the Demographic Assumption Analysis Tool. For a more detailed explanation or examples of the terms, please refer to the WPI Team's final project paper.

Hypothesis Testing

Hypothesis testing is used to choose between two competing theories: the null hypothesis which represents a proposed theory, and an alternative hypothesis that opposes the null. In the case of demographic assumption analysis, the null hypothesis (H_0) states that the assumed probability for a given set of data is the same as the actual probability that was observed. The alternative hypothesis (H_A) then is that the true probability is different than the expected probability. There are a number of different tests that statisticians use in hypothesis testing to evaluate the accuracy of their assumptions. In evaluating the difference between two proportions, the exact confidence interval for a binomial distribution is used.

Exact Confidence Intervals

A random sample follows a binomial distribution when the total number of successes in a given number of independent Bernoulli trials has a set probability of success. Demographic assumptions prescribe a predetermined probability of success to a given set of data and thus can be modeled with a binomial distribution. One method for hypothesis testing of a binomial distribution is to construct an exact confidence interval. First, a level α must be set to obtain a $100(1-\alpha)\%$ confidence interval. For example, $\alpha=0.05$ would result in a 95% confidence interval. The way to interpret the result is to say that there is 95% certainty that the true population proportion is within the range given by the confidence interval. If the expected result falls outside this interval then the null hypothesis is rejected.

An exact confidence interval for q is (q_L, q_U) ,

1. Where q_L is the unique solution to:
 - If $Y > 0$: $\sum_{y=Y}^n \frac{n!}{y!(n-y)!} q_L^y (1 - q_L)^{n-y} = \frac{\alpha}{2}$
 - If $Y = 0$: 0
2. And where q_U is the unique solution to:
 - If $Y < n$: $\sum_{y=0}^Y \frac{n!}{y!(n-y)!} q_U^y (1 - q_U)^{n-y} = \frac{\alpha}{2}$
 - If $Y = n$: 1

Y is the number of plan participants that were observed with a decrement and certain specified properties such as age, gender, and service. Furthermore, n is the total number of exposed participants with the same properties as Y .

P-Values

The p-value in a hypothesis test is used to determine how consistent the observed result is with the expected assumption. The p-value provides you with the proportion of values from the distribution that provide at least as much evidence to reject the null hypothesis as the observed value. The way to interpret the p-value is to say that if the null hypothesis is true, then the percentage given by the p-value is the probability of observing a value more extreme than you observed. The smaller the p-value, the more evidence you have to reject the null hypothesis.

For a binomial distribution, the p-value is calculated as follows:

First, calculate the probability associated with your observed result. Then, sum up all the probabilities that are as small or smaller (i.e. results that are more extreme) than your observed result. The sum of these results is the p-value. Then compare the p-value to the level of α that was determined for the test. If the p-value is less than α , you reject the null hypothesis.

Multiple Test Correction

Multiple Test Corrections are necessary because multiple comparison problems occur when considering a hypothesis test on many hypotheses. These problems most often involve hypothesis tests that incorrectly reject the null hypothesis, a type I error.

To give an example; when considering a single true hypothesis, one would expect a typical 5% hypothesis test to wrongly reject the true null hypothesis only 5% of the time. However, when considering 100 true hypotheses one would expect to incorrectly reject at least one true null hypothesis. In fact, because the test level is 5%, one would expect 5 of the 100 true hypotheses to be wrongly rejected.

Simply stated, when using a single hypothesis test multiple times on many hypotheses, one should expect to see type I errors, rejection of a true null hypothesis. Multiple test corrections help to control the number of these errors that occur. The test correction being used within this program is the Benjamini and Hochberg False Discovery Rate, it is described below.

False Discovery Rate

False Discovery Rate (FDR) controls the expected proportion of type I errors (rejection of the null hypothesis when one should have accepted) when using multiple hypothesis tests. . Benjamini and Hochberg have created a proven method that is simple to apply, whereby the calculated p-values are adjusted based on their rank and the total number of tests being run.

When using the Benjamini and Hochberg False Discovery Rate correction, the first step is to list all p-values from smallest to largest. This will determine each p-value's rank. Then each p-value will be multiplied by the total number of tests divided by its rank. The result will be adjusted p-values that will

reject the null hypothesis less often, thus reducing the number of type I errors, falsely rejected true null hypotheses.

User's Guide

Import ProVal Results

First, import the ProVal results into .xls format. Insert that sheet into the Demographic Assumption Analysis Tool (DAAT) and label the worksheet as "ProVal".

	A	B	C	D	E	F	G	H	I	J	K
1	Experience Study					HEWITT ASSOCIATES					a81318 f
2											Printed: February 23, 2009 3:46 PM
3											
4											
5	-----										
6	Experience Studies Library										
7	-----										
8											
9	Name: 2006-2007										
10											
11	Client 1										
12	Project: <U.S. Qualified Pension>										
13	Date created: February 18, 2009 1:18 PM										
14	Date last modified: February 18, 2009 3:27 PM										
15	Run Date: February 23, 2009 3:45 PM										
16											
17											
18	----- Assumptions to Study -----										
19											
20	Decrements (actives)										
21	Salary Growth (actives)										
22	Mortality (inactives)										
23											
24											
25	----- Databases -----										
26											
27	Beginning valuation date: 1/1/2006										
28	Ending valuation date: 1/1/2007										
29											
30	Databases:										
31	1/1/2006: Data 2006										
32	1/1/2007: Data 2007										
33											
34	Key Field(s): ID										
35											
36	Match case in keys: No										
37											
38											

Now refer to the "Run" Worksheet. Here there are two options: you can either run all steps at once by clicking the bottom button "Run All" or you can run each step separately. Each of these steps

will be explained in further detail for the remainder of this section. If you choose to run the steps individually, you must run all steps in one sitting. The workbook cannot be closed in between steps.



Click the button “1. Import ProVal Results”. This will automatically set up the corresponding worksheets for each decrement with the proper headings. A sheet labeled “Mort” will be created for the mortality results, a sheet labeled “Ret” will be created for retirement results, and a sheet labeled “Term” will be created for termination results. Additionally, the following information will be extracted from the ProVal results: the number of participants at each age who experienced the decrement; the number of participants at each age who were exposed to the decrement; and the expected probability of participants who would decrement according to Hewitt’s assumptions. Lastly, the observed probability of participants who decremented is calculated.

The following figure shows a portion of the sheet “Term” generated from this button. This segment of the worksheet shows the results for males who terminated with less than five years of service. The headings were automatically generated in the first two rows of the sheet. “Obs Term” is the number of participants at each age specified who retired. “Exposed” is the number of participants at

each specified age that could have experienced the decrement. “Obs p” is the ratio of participants who terminated to the total participants exposed. “Exp p” is the probability of participants who were expected to terminate according to Hewitt’s assumptions. DAAT will create the same set of information for each segment of the data. For example, the same information will be imported for males with over five years of service, females with less than five years of service, and females with more than five years of service and will be displayed in the columns to the right of those listed below.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Sex: Male, Service: <5												
2	Age	Obs Term	Exposed	Obs Q	Exp Q	1-a/2	a/2	QI	Qu	p-value	Rank	FDR	Adj. p-val
3	<20	0	0	#DIV/0!	0.0000								
4	20	0	0	#DIV/0!	0.0000								
5	21	1	5	0.2000	0.1416								
6	22	5	19	0.2632	0.1270								
7	23	8	55	0.1455	0.1292								
8	24	17	131	0.1298	0.1270								
9	25	36	172	0.2093	0.1286								
10	26	49	221	0.2217	0.1271								
11	27	34	172	0.1977	0.1046								
12	28	40	160	0.2500	0.0980								
13	29	40	135	0.2963	0.0928								
14	30	22	132	0.1667	0.0873								
15	31	13	114	0.1140	0.0800								
16	32	18	100	0.1800	0.0753								
17	33	21	104	0.2019	0.0700								
18	34	20	106	0.1887	0.0660								
19	35	15	112	0.1339	0.0620								
20	36	13	111	0.1171	0.0600								
21	37	15	100	0.1500	0.0600								
22	38	10	87	0.1149	0.0590								
23	39	13	87	0.1494	0.0596								
24	40	7	72	0.0972	0.0570								
25	41	11	68	0.1618	0.0560								
26	42	17	84	0.2024	0.0550								
27	43	9	81	0.1111	0.0540								
28	44	9	61	0.1475	0.0530								
29	45	7	67	0.1045	0.0520								
30	46	15	78	0.1923	0.0510								
31	47	4	52	0.0769	0.0500								
32	48	5	52	0.0962	0.0548								

Calculate Exact Confidence Intervals

In returning to the “Run” worksheet, the first button is now disabled and the font is black to indicate that the step has already been run. The “Run All” button is also now disabled. The “2. Calculate Confidence Intervals” button will be the only button able to be clicked. After clicking this button, upper and lower limits of an exact confidence interval for each age within each decrement will be calculated. Within each decrement worksheet, “QI” refers to the lower limit of the confidence interval and “Qu” refers to the upper limit of the confidence interval. “1-a/2” is used to solve for “QI” and “a/2” is used to solve for “Qu”. “1-a/2” should consist only of 0 or values close to $1 - \frac{\alpha}{2}$. “a/2” should only consist of 1 or values close to $\frac{\alpha}{2}$.

If a manual check of the results is desired at this point, check to see if the “Exp p” falls within the range between “QI” and “Qu”. If so, the expected result does not fail. For example, in looking at a 21

year old male with less than five years of service, the exact confidence interval is (0.0051, 0.7145). There was an expected probability of 0.1416 that an individual with those properties would turnover. This expected probability falls within the confidence interval, so you fail to reject H_A . A conclusion cannot yet be drawn from those ages in which the expected probability of decrement does not fall within the confidence interval. The two steps will calculate p-values and adjust the p-values with the false discovery rate, in essence widening the span of the confidence intervals and allowing for more expected probabilities to pass the hypothesis test.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1						Sex: Male, Service: <5							
2	Age	Obs Term	Exposed	Obs Q	Exp Q	1-a/2	a/2	Ql	Qu	p-value	Rank	FDR	Adj. p-val
3	<20	0	0	#DIV/0!	0.0000	0.0000	1.0000	0.0000	1.0000				
4	20	0	0	#DIV/0!	0.0000	0.0000	1.0000	0.0000	1.0000				
5	21	1	5	0.2000	0.1416	0.9748	0.0256	0.0051	0.7145				
6	22	5	19	0.2632	0.1270	0.9759	0.0251	0.0906	0.5118				
7	23	8	55	0.1455	0.1292	0.9752	0.0242	0.0649	0.2675				
8	24	17	131	0.1298	0.1270	0.9744	0.0253	0.0777	0.1994				
9	25	36	172	0.2093	0.1286	0.9755	0.0248	0.1509	0.2779				
10	26	49	221	0.2217	0.1271	0.9753	0.0245	0.1686	0.2826				
11	27	34	172	0.1977	0.1046	0.9748	0.0255	0.1410	0.2648				
12	28	40	160	0.2500	0.0980	0.9751	0.0256	0.1850	0.3241				
13	29	40	135	0.2963	0.0928	0.9751	0.0247	0.2208	0.3811				
14	30	22	132	0.1667	0.0873	0.9754	0.0255	0.1073	0.2410				
15	31	13	114	0.1140	0.0800	0.9740	0.0245	0.0625	0.1874				
16	32	18	100	0.1800	0.0753	0.9756	0.0247	0.1100	0.2697				
17	33	21	104	0.2019	0.0700	0.9755	0.0241	0.1293	0.2927				
18	34	20	106	0.1887	0.0660	0.9751	0.0248	0.1192	0.2764				
19	35	15	112	0.1339	0.0620	0.9754	0.0254	0.0768	0.2110				
20	36	13	111	0.1171	0.0600	0.9760	0.0249	0.0635	0.1920				
21	37	15	100	0.1500	0.0600	0.9752	0.0252	0.0864	0.2351				
22	38	10	87	0.1149	0.0590	0.9751	0.0245	0.0565	0.2016				
23	39	13	87	0.1494	0.0596	0.9741	0.0257	0.0824	0.2414				
24	40	7	72	0.0972	0.0570	0.9756	0.0258	0.0398	0.1894				
25	41	11	68	0.1618	0.0560	0.9757	0.0243	0.0833	0.2717				
26	42	17	84	0.2024	0.0550	0.9751	0.0252	0.1225	0.3039				
27	43	9	81	0.1111	0.0540	0.9746	0.0252	0.0522	0.2003				

Calculate P-values

Now return to the “Run” worksheet and click the button “3. Calculate P-values”. Using the “p-values” worksheet, this will generate the p-value associated with each age within the decrements. The p-value calculated can be found in the column entitled “p-value”.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1						Sex: Male, Service: <5							
2	Age	Obs Term	Exposed	Obs Q	Exp Q	1-a/2	a/2	QI	Qu	p-value	Rank	FDR	Adj. p-val
3	<20	0	0	#DIV/0!	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000			
4	20	0	0	#DIV/0!	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000			
5	21	1	5	0.2000	0.1416	0.9748	0.0256	0.0051	0.7145	0.5339			
6	22	5	19	0.2632	0.1270	0.9759	0.0251	0.0906	0.5118	0.0835			
7	23	8	55	0.1455	0.1292	0.9752	0.0242	0.0649	0.2675	0.6872			
8	24	17	131	0.1298	0.1270	0.9744	0.0253	0.0777	0.1994	0.8956			
9	25	36	172	0.2093	0.1286	0.9755	0.0248	0.1509	0.2779	0.0029			
10	26	49	221	0.2217	0.1271	0.9753	0.0245	0.1686	0.2826	0.0001			
11	27	34	172	0.1977	0.1046	0.9748	0.0255	0.1410	0.2648	0.0003			
12	28	40	160	0.2500	0.0980	0.9751	0.0256	0.1850	0.3241	0.0000			
13	29	40	135	0.2963	0.0928	0.9751	0.0247	0.2208	0.3811	0.0000			
14	30	22	132	0.1667	0.0873	0.9754	0.0255	0.1073	0.2410	0.0030			
15	31	13	114	0.1140	0.0800	0.9740	0.0245	0.0625	0.1874	0.1686			
16	32	18	100	0.1800	0.0753	0.9756	0.0247	0.1100	0.2697	0.0005			
17	33	21	104	0.2019	0.0700	0.9755	0.0241	0.1293	0.2927	0.0000			
18	34	20	106	0.1887	0.0660	0.9751	0.0248	0.1192	0.2764	0.0000			
19	35	15	112	0.1339	0.0620	0.9754	0.0254	0.0768	0.2110	0.0047			

Adjust P-values with FDR

After that, the p-values will be adjusted with FDR. Click the button “4. Adjust P-values with FDR”. This will create a new worksheet, titled “rank,” which lists all the p-values across all decrements. Within each decrement’s worksheet, the column “Rank” gives the rank of each p-value in the worksheet “rank” from largest to smallest. “FDR” is the adjustment factor for each p-value. Lastly, “Adj. p-val” is the final p-value after being adjusted with “FDR”.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1						Sex: Male, Service: <5							
2	Age	Obs Term	Exposed	Obs Q	Exp Q	1-a/2	a/2	QI	Qu	p-value	Rank	FDR	Adj. p-val
3	<20	0	0	#DIV/0!	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000			
4	20	0	0	#DIV/0!	0.0000	0.0000	1.0000	0.0000	1.0000	1.0000			
5	21	1	5	0.2000	0.1416	0.9748	0.0256	0.0051	0.7145	0.5339	111.0000	1.6286	0.8695
6	22	5	19	0.2632	0.1270	0.9759	0.0251	0.0906	0.5118	0.0835	151.0000	2.1111	0.1763
7	23	8	55	0.1455	0.1292	0.9752	0.0242	0.0649	0.2675	0.6872	95.0000	1.4921	1.0000
8	24	17	131	0.1298	0.1270	0.9744	0.0253	0.0777	0.1994	0.8956	88.0000	1.4394	1.0000
9	25	36	172	0.2093	0.1286	0.9755	0.0248	0.1509	0.2779	0.0029	179.0000	2.6636	0.0076
10	26	49	221	0.2217	0.1271	0.9753	0.0245	0.1686	0.2826	0.0001	209.0000	3.7013	0.0004
11	27	34	172	0.1977	0.1046	0.9748	0.0255	0.1410	0.2648	0.0003	204.0000	3.4756	0.0009
12	28	40	160	0.2500	0.0980	0.9751	0.0256	0.1850	0.3241	0.0000	239.0000	6.0638	0.0000
13	29	40	135	0.2963	0.0928	0.9751	0.0247	0.2208	0.3811	0.0000	249.0000	7.7027	0.0000
14	30	22	132	0.1667	0.0873	0.9754	0.0255	0.1073	0.2410	0.0030	178.0000	2.6389	0.0079
15	31	13	114	0.1140	0.0800	0.9740	0.0245	0.0625	0.1874	0.1686	139.0000	1.9388	0.3268
16	32	18	100	0.1800	0.0753	0.9756	0.0247	0.1100	0.2697	0.0005	198.0000	3.2386	0.0015
17	33	21	104	0.2019	0.0700	0.9755	0.0241	0.1293	0.2927	0.0000	221.0000	4.3846	0.0000
18	34	20	106	0.1887	0.0660	0.9751	0.0248	0.1192	0.2764	0.0000	216.0000	4.0714	0.0001

Compile Results

Finally, return to the “Run” worksheet and click the button labeled “5. Compile Results”. The following sheets will be created to summarize the results of their respective decrement: “MortResults”, “TermResults”, and “RetResults”. Each Results worksheet will generate a legend of the color coding that is used to classify the p-values. For mortality, the α -level is 10%, so p-values greater than 0.10 will be green, p-values that fall between 0.05 and 0.10 will be yellow, and p-values that are less than 0.05 will be red. For retirement and termination, the α -level is 5%, so p-values greater than 0.05 will be green, p-values that fall between 0.01 and 0.05 will be yellow, and p-values that are less than 0.01 will be red. A cell that is blank represents no exposed lives. Additionally, the p-values for each age will be compiled. You can mouse over the p-values to reveal a comment. This comment will display the number of participants who experienced the decrement and also the total participants who were exposed.

The following is a screenshot of termination results:

	A	B	C	D	E	F	G	H	I	J
1										
2		Key								
3			0.05 ≤ p-value							
4			0.01 ≤ p-value < 0.05							
5			p-value < 0.01							
6			No Exposed Lives							
7										
8		Termination Results								
9		By Age, Sex, and Service								
10		Age	Male		Female					
11			<5	5+	<5	5+				
12		<20								
13		20								
14		21	0.8695		0.8695	0.6331				
15		22	0.1763		0.1763	0.5030				
16		23	1.0000		1.0000	1.0000				
17		24	1.0000	0.9670	1.0000	0.0014				
18		25	0.0076	0.7138	0.0058	0.0000				
19		26	0.0004	1.0000	0.0009	0.0000				
20		27	0.0009	1.0000	0.0030	0.0000				
21		28	0.0000	0.4857	0.0000	0.0001				
22		29	0.0000	0.3808	0.0000	0.0002				
23		30	0.0079	0.2287	0.0033	0.0000				
24		31	0.3268	0.4072	1.0000	0.0010				
25		32	0.0015	0.0002	0.0000	0.0000				
26		33	0.0000	1.0000	0.0034	0.0070				
27		34	0.0001	1.0000	0.0037	0.0000				
28		35	0.0116	0.0001	0.0000	0.1801				
29		36	0.0549	0.2370	0.0222	0.0086				
30		37	0.0029	0.9693	0.2138	0.0246				
31		38	0.0818	1.0000	0.5780	0.0083				
32		39	0.0055	0.2384	0.0071	0.0616				
33		40	0.2578	0.8936	0.3896	0.0096				

Decrement: 5
 # Exposed: 19
 Expected Q: 0.127

Analysis of Results

The Demographic Assumption Analysis Tool (DAAT) presents a statistical analysis of a specified set of data. The results are generated for each demographic assumption at every age, service, and gender cut-off. The p-values produced by this statistical approach show the user how each assumption performed at a predetermined confidence level α -level.

A blank or uncolored cell indicates that there were no exposed lives. Therefore, no statistical conclusion can be inferred from the data for that age. A green color-coding represents strong results meaning that Hewitt's demographic assumption for that particular age was consistent with the observed probability of decrementing at the age. A yellow color-coding means that the particular assumption is not consistent with the observed probability of decrement, but the assumption does not require additional analysis at this point. Any p-value with a red color-coding is sufficient evidence to reject the initial hypothesis that this particular assumption was consistent with the observed data. These

assumptions should be investigated further to decide if an adjustment is needed for that particular assumption.

Codes

Data Reconciliation Macros

```
Sub DataRecon()
```

```
'
```

```
' DataRecon Macro
```

```
'
```

```
Application.ScreenUpdating = False
```

```
Sheets("2004").Select
```

```
For i = 5 To 32866
```

```
If Cells(i, 5) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 6) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2004 > Year(Cells(i, 8)) Then Rows(i).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2004 > Year(Cells(i, 9)) Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2004 < Year(Cells(i, 8)) Then Cells(i, 8).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2004 < Year(Cells(i, 9)) Then Cells(i, 9).ClearContents
```

```
If Cells(i, 12) = "" Then Cells(i, 12) = "" Else If 2004 < Year(Cells(i, 12)) Then Cells(i, 12).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2004 - Year(Cells(i, 5)) >= 55 And 2004 - Year(Cells(i, 6)) >= 5
```

```
Then Cells(i, 8).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2004 - Year(Cells(i, 5)) < 55 Or 2004 - Year(Cells(i, 6)) < 5
```

```
Then Cells(i, 9).ClearContents
```

```
If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2004 -
```

```
Year(Cells(i, 5)) >= 55 And 2004 - Year(Cells(i, 6)) >= 5 And Cells(i, 9) = "" Then Cells(i, 9) = "6/30/2004"
```

```
If Cells(i, 8) = "" Then If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET"
```

```
Then If 2004 - Year(Cells(i, 5)) < 55 Or 2004 - Year(Cells(i, 6)) < 5 Then Cells(i, 8) = "6/30/2004"
```

```
Next i
```

```
Sheets("2005").Select
```

```
For i = 5 To 32874
```

```
If Cells(i, 5) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 6) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2005 > Year(Cells(i, 8)) Then Rows(i).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2005 > Year(Cells(i, 9)) Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2005 < Year(Cells(i, 8)) Then Cells(i, 8).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2005 < Year(Cells(i, 9)) Then Cells(i, 9).ClearContents
```

```
If Cells(i, 12) = "" Then Cells(i, 12) = "" Else If 2005 < Year(Cells(i, 12)) Then Cells(i, 12).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2005 - Year(Cells(i, 5)) >= 55 And 2005 - Year(Cells(i, 6)) >= 5
```

```
Then Cells(i, 8).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2005 - Year(Cells(i, 5)) < 55 Or 2005 - Year(Cells(i, 6)) < 5
```

```
Then Cells(i, 9).ClearContents
```

```
If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2005 - Year(Cells(i, 5)) >= 55 And 2004 - Year(Cells(i, 6)) >= 5 And Cells(i, 9) = "" Then Cells(i, 9) = "6/30/2005"
If Cells(i, 8) = "" Then If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2005 - Year(Cells(i, 5)) < 55 Or 2004 - Year(Cells(i, 6)) < 5 Then Cells(i, 8) = "6/30/2005"
```

Next i

```
Sheets("2006").Select
```

```
For i = 5 To 33244
```

```
If Cells(i, 5) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 6) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2006 > Year(Cells(i, 8)) Then Rows(i).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2006 > Year(Cells(i, 9)) Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2006 < Year(Cells(i, 8)) Then Cells(i, 8).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2006 < Year(Cells(i, 9)) Then Cells(i, 9).ClearContents
```

```
If Cells(i, 12) = "" Then Cells(i, 12) = "" Else If 2006 < Year(Cells(i, 12)) Then Cells(i, 12).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2006 - Year(Cells(i, 5)) >= 55 And 2006 - Year(Cells(i, 6)) >= 5 Then Cells(i, 8).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2006 - Year(Cells(i, 5)) < 55 Or 2006 - Year(Cells(i, 6)) < 5 Then Cells(i, 9).ClearContents
```

```
If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2006 - Year(Cells(i, 5)) >= 55 And 2004 - Year(Cells(i, 6)) >= 5 And Cells(i, 9) = "" Then Cells(i, 9) = "6/30/2006"
```

```
If Cells(i, 8) = "" Then If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2006 - Year(Cells(i, 5)) < 55 Or 2004 - Year(Cells(i, 6)) < 5 Then Cells(i, 8) = "6/30/2006"
```

Next i

```
Sheets("2007").Select
```

```
For i = 5 To 33008
```

```
If Cells(i, 5) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 6) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2007 > Year(Cells(i, 8)) Then Rows(i).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2007 > Year(Cells(i, 9)) Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2007 < Year(Cells(i, 8)) Then Cells(i, 8).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2007 < Year(Cells(i, 9)) Then Cells(i, 9).ClearContents
```

```
If Cells(i, 12) = "" Then Cells(i, 12) = "" Else If 2007 < Year(Cells(i, 12)) Then Cells(i, 12).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2007 - Year(Cells(i, 5)) >= 55 And 2007 - Year(Cells(i, 6)) >= 5 Then Cells(i, 8).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then If 2007 - Year(Cells(i, 5)) < 55 Or 2007 - Year(Cells(i, 6)) < 5 Then Cells(i, 9).ClearContents
```

```
If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2007 - Year(Cells(i, 5)) >= 55 And 2004 - Year(Cells(i, 6)) >= 5 And Cells(i, 9) = "" Then Cells(i, 9) = "6/30/2007"
If Cells(i, 8) = "" Then If Cells(i, 2) = "LS" Or Cells(i, 2) = "TV" Or Cells(i, 2) = "NVT" Or Cells(i, 2) = "RET" Then If 2007 - Year(Cells(i, 5)) < 55 Or 2004 - Year(Cells(i, 6)) < 5 Then Cells(i, 8) = "6/30/2007"
```

Next i

```
Sheets("2008").Select
```

```
For i = 5 To 30614
```

```
If Cells(i, 4) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 5) = "" Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2008 > Year(Cells(i, 8)) Then Rows(i).ClearContents
```

```
If Cells(i, 11) = "" Then Cells(i, 11) = "" Else If 2008 > Year(Cells(i, 11)) Then Rows(i).ClearContents
```

```
If Cells(i, 8) = "" Then Cells(i, 8) = "" Else If 2008 < Year(Cells(i, 8)) Then Cells(i, 8).ClearContents
```

```
If Cells(i, 11) = "" Then Cells(i, 11) = "" Else If 2008 < Year(Cells(i, 11)) Then Cells(i, 11).ClearContents
```

```
If Cells(i, 9) = "" Then Cells(i, 9) = "" Else If 2008 < Year(Cells(i, 9)) Then Cells(i, 9).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 11) <> "" Then If 2008 - Year(Cells(i, 4)) >= 55 And 2008 - Year(Cells(i, 5)) >= 5 Then Cells(i, 8).ClearContents
```

```
If Cells(i, 8) <> "" And Cells(i, 11) <> "" Then If 2008 - Year(Cells(i, 4)) < 55 Or 2008 - Year(Cells(i, 5)) < 5 Then Cells(i, 11).ClearContents
```

Next i

```
Application.ScreenUpdating = True
```

```
End Sub
```

```
Sub DataRecon2()
```

```
'
```

```
' DataRecon2 Macro
```

```
'
```

```
'
```

```
Sheets("2004").Select
```

```
For i = 5 To 32866
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then Cells(i, 8).ClearContents
```

```
Next i
```

```
Sheets("2005").Select
```

```
For i = 5 To 32874
```

```
If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then Cells(i, 8).ClearContents
```

Next i

Sheets("2006").Select

For i = 5 To 33244

If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then Cells(i, 8).ClearContents

Next i

Sheets("2007").Select

For i = 5 To 33008

If Cells(i, 8) <> "" And Cells(i, 9) <> "" Then Cells(i, 8).ClearContents

Next i

Sheets("2008").Select

For i = 5 To 30614

If Cells(i, 8) <> "" And Cells(i, 11) <> "" Then Cells(i, 8).ClearContents

Next i

End Sub

Count Macros

Sub CountMort()

,

' CountMort Macro

,

' Counts the number of data entries at each age who died or did not die.

,

Application.ScreenUpdating = False

Sheets.Add After:=Sheets(Sheets.Count) 'opens new worksheet

Sheets(ActiveWorkbook.Sheets.Count).Select

ActiveSheet.Name = "Mort"

'Inputs headings

Range("A1:E1").Select

Selection.Merge

ActiveCell.FormulaR1C1 = "Male"

With Selection

.HorizontalAlignment = xlCenter

.VerticalAlignment = xlBottom

.WrapText = False

.Orientation = 0

```

        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("A2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("B2").Select
    ActiveCell.FormulaR1C1 = "Obs Mort"
    Range("C2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("D2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("E2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

    Range("G1:K1").Select
    Selection.Merge
    ActiveCell.FormulaR1C1 = "Female"
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("G2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("H2").Select
    ActiveCell.FormulaR1C1 = "Obs Mort"
    Range("I2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("J2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("K2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

```

```

' Counts for males only.
For i = 1 To 106
age = 14 + i
Sheets("Mort").Select
Cells(i + 2, 1).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(10), age, Columns(2), "M") _
+ WorksheetFunction.Countifs(Columns(21), age, Columns(13), "M") _
+ WorksheetFunction.Countifs(Columns(32), age, Columns(24), "M") _
+ WorksheetFunction.Countifs(Columns(43), age, Columns(35), "M") _
+ WorksheetFunction.Countifs(Columns(54), age, Columns(46), "M")
Sheets("Mort").Select
Cells(i + 2, 2).Select
ActiveCell.Formula = Count

Sheets("compilation").Select ' Counts living/working
Count = WorksheetFunction.Countifs(Columns(3), age, Columns(2), "M", Columns(8), "", Columns(9), "",
Columns(10), "") + WorksheetFunction.Countifs(Columns(8), age, Columns(2), "M") +
WorksheetFunction.Countifs(Columns(9), age, Columns(2), "M") _
+ WorksheetFunction.Countifs(Columns(14), age, Columns(13), "M", Columns(19), "", Columns(20), "",
Columns(21), "") + WorksheetFunction.Countifs(Columns(19), age, Columns(13), "M") +
WorksheetFunction.Countifs(Columns(20), age, Columns(13), "M") _
+ WorksheetFunction.Countifs(Columns(25), age, Columns(24), "M", Columns(30), "", Columns(31), "",
Columns(32), "") + WorksheetFunction.Countifs(Columns(30), age, Columns(24), "M") +
WorksheetFunction.Countifs(Columns(31), age, Columns(24), "M") _
+ WorksheetFunction.Countifs(Columns(36), age, Columns(35), "M", Columns(41), "", Columns(42), "",
Columns(43), "") + WorksheetFunction.Countifs(Columns(41), age, Columns(35), "M") +
WorksheetFunction.Countifs(Columns(42), age, Columns(35), "M") _
+ WorksheetFunction.Countifs(Columns(47), age, Columns(46), "M", Columns(52), "", Columns(53), "",
Columns(54), "") + WorksheetFunction.Countifs(Columns(52), age, Columns(46), "M") +
WorksheetFunction.Countifs(Columns(53), age, Columns(46), "M")
Sheets("Mort").Select
Cells(i + 2, 3).Select
ActiveCell.Formula = Count

Cells(i + 2, 4).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Range("D3").Select 'sets 4 decimal places
Range(Selection, Selection.End(xlDown)).Select

```

```
Selection.NumberFormat = "0.0000"  
Next i
```

```
' Repeats counts for females only.
```

```
For i = 1 To 106
```

```
age = 14 + i
```

```
Sheets("Mort").Select
```

```
Cells(i + 2, 7).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(10), age, Columns(2), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(21), age, Columns(13), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(32), age, Columns(24), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(43), age, Columns(35), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(54), age, Columns(46), "F")
```

```
Sheets("Mort").Select
```

```
Cells(i + 2, 8).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts living/working
```

```
Count = WorksheetFunction.Countifs(Columns(3), age, Columns(2), "F", Columns(8), "", Columns(9), "",  
Columns(10), "") + WorksheetFunction.Countifs(Columns(8), age, Columns(2), "F") +
```

```
WorksheetFunction.Countifs(Columns(9), age, Columns(2), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(14), age, Columns(13), "F", Columns(19), "", Columns(20), "",
```

```
Columns(21), "") + WorksheetFunction.Countifs(Columns(19), age, Columns(13), "F") +
```

```
WorksheetFunction.Countifs(Columns(20), age, Columns(13), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(25), age, Columns(24), "F", Columns(30), "", Columns(31), "",
```

```
Columns(32), "") + WorksheetFunction.Countifs(Columns(30), age, Columns(24), "F") +
```

```
WorksheetFunction.Countifs(Columns(31), age, Columns(24), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(36), age, Columns(35), "F", Columns(41), "", Columns(42), "",
```

```
Columns(43), "") + WorksheetFunction.Countifs(Columns(41), age, Columns(35), "F") +
```

```
WorksheetFunction.Countifs(Columns(42), age, Columns(35), "F") _
```

```
+ WorksheetFunction.Countifs(Columns(47), age, Columns(46), "F", Columns(52), "", Columns(53), "",
```

```
Columns(54), "") + WorksheetFunction.Countifs(Columns(52), age, Columns(46), "F") +
```

```
WorksheetFunction.Countifs(Columns(53), age, Columns(46), "F")
```

```
Sheets("Mort").Select
```

```
Cells(i + 2, 9).Select
```

```
ActiveCell.Formula = Count
```

```
Cells(i + 2, 10).Select 'calculates p
```

```
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
```

```

Range("J3").Select 'sets 4 decimal places
Range(Selection, Selection.End(xlDown)).Select
Selection.NumberFormat = "0.0000"
Next i

' Enters expected proportions from assumptions
Range("E3").Select 'male
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R84C1:R189C5,3)"
Selection.AutoFill Destination:=Range("E3:E108")
' Selection.NumberFormat = "0.0000"

Range("K3").Select 'female
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R84C1:R189C5,5)"
Selection.AutoFill Destination:=Range("K3:K108")
' Selection.NumberFormat = "0.0000"

Application.ScreenUpdating = True

End Sub

```

```

Sub CountRetirement()
'
' CountRetirement Macro

' Counts the number of data entries at each age based on their year of birth.
'

Application.ScreenUpdating = False

Sheets.Add After:=Sheets(Sheets.Count)
Sheets(ActiveWorkbook.Sheets.Count).Select
ActiveSheet.Name = "Ret"

' Inputs headings
Range("A1:E1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Born Before 1955"
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0

```

```

        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("A2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("B2").Select
    ActiveCell.FormulaR1C1 = "Obs Ret"
    Range("C2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr" ' counts all decrements and living/working if did not retire
    Range("D2").Select
    ActiveCell.FormulaR1C1 = "Obs p" ' porportion of total that retired
    Range("E2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

Range("G1:K1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Born Between 1955 and 1964"
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("G2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("H2").Select
    ActiveCell.FormulaR1C1 = "Obs Ret"
    Range("I2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("J2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("K2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

```

```
Range("M1:Q1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Born After 1964"
```

```
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
```

```
End With
```

```
Range("M2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("N2").Select
ActiveCell.FormulaR1C1 = "Obs Ret"
Range("O2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("P2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("Q2").Select
ActiveCell.FormulaR1C1 = "Exp p"
```

```
' Counts for born before 1955.
```

```
For i = 1 To 10
```

```
age = 54 + i
```

```
Sheets("Ret").Select
```

```
Cells(i + 2, 1).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(9), age, Columns(6), "<1955") +
```

```
WorksheetFunction.Countifs(Columns(20), age, Columns(17), "<1955") +
```

```
WorksheetFunction.Countifs(Columns(31), age, Columns(28), "<1955") +
```

```
WorksheetFunction.Countifs(Columns(42), age, Columns(39), "<1955") +
```

```
WorksheetFunction.Countifs(Columns(53), age, Columns(50), "<1955")
```

```
Sheets("Ret").Select
```

```
Cells(i + 2, 2).Select
```

```
ActiveCell.Formula = Count
```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(3), age, Columns(6), "<1955", Columns(8), "",
Columns(9), "", Columns(10), "") + WorksheetFunction.Countifs(Columns(8), age, Columns(6), "<1955")
+ WorksheetFunction.Countifs(Columns(10), age, Columns(6), "<1955") _
+ WorksheetFunction.Countifs(Columns(14), age, Columns(17), "<1955", Columns(19), "", Columns(20),
"", Columns(21), "") + WorksheetFunction.Countifs(Columns(19), age, Columns(17), "<1955") +
WorksheetFunction.Countifs(Columns(21), age, Columns(17), "<1955") _
+ WorksheetFunction.Countifs(Columns(25), age, Columns(28), "<1955", Columns(30), "", Columns(31),
"", Columns(32), "") + WorksheetFunction.Countifs(Columns(30), age, Columns(28), "<1955") +
WorksheetFunction.Countifs(Columns(32), age, Columns(28), "<1955") _
+ WorksheetFunction.Countifs(Columns(36), age, Columns(39), "<1955", Columns(41), "", Columns(42),
"", Columns(43), "") + WorksheetFunction.Countifs(Columns(41), age, Columns(39), "<1955") +
WorksheetFunction.Countifs(Columns(43), age, Columns(39), "<1955") _
+ WorksheetFunction.Countifs(Columns(47), age, Columns(50), "<1955", Columns(52), "", Columns(53),
"", Columns(54), "") + WorksheetFunction.Countifs(Columns(52), age, Columns(50), "<1955") +
WorksheetFunction.Countifs(Columns(54), age, Columns(50), "<1955")
Sheets("Ret").Select
Cells(i + 2, 3).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 4).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Range("D3").Select 'sets 4 decimal places
Range(Selection, Selection.End(xlDown)).Select
Selection.NumberFormat = "0.0000"
Next i

```

```

' Counts for born between 1955 and 1964.
For i = 1 To 10
age = 54 + i
Sheets("Ret").Select
Cells(i + 2, 7).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(9), age, Columns(6), "<=1964") -
WorksheetFunction.Countifs(Columns(9), age, Columns(6), "<=1955") _
+ WorksheetFunction.Countifs(Columns(20), age, Columns(17), "<=1964") -
WorksheetFunction.Countifs(Columns(20), age, Columns(17), "<=1955") _
+ WorksheetFunction.Countifs(Columns(31), age, Columns(28), "<=1964") -
WorksheetFunction.Countifs(Columns(31), age, Columns(28), "<=1955") _

```

```

+ WorksheetFunction.Countifs(Columns(42), age, Columns(39), "<=1964") -
WorksheetFunction.Countifs(Columns(42), age, Columns(39), "<=1955") _
+ WorksheetFunction.Countifs(Columns(53), age, Columns(50), "<=1964") -
WorksheetFunction.Countifs(Columns(53), age, Columns(50), "<=1955")
Sheets("Ret").Select
Cells(i + 2, 8).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(3), age, Columns(6), "<=1964", Columns(8), "",
Columns(9), "", Columns(10), "") - WorksheetFunction.Countifs(Columns(3), age, Columns(6), "<=1955",
Columns(8), "", Columns(9), "", Columns(10), "") + WorksheetFunction.Countifs(Columns(8), age,
Columns(6), "<=1964") - WorksheetFunction.Countifs(Columns(8), age, Columns(6), "<=1955") +
WorksheetFunction.Countifs(Columns(10), age, Columns(6), "<=1964") -
WorksheetFunction.Countifs(Columns(10), age, Columns(6), "<=1955") _
+ WorksheetFunction.Countifs(Columns(14), age, Columns(17), "<=1964", Columns(19), "", Columns(20),
"", Columns(21), "") - WorksheetFunction.Countifs(Columns(14), age, Columns(17), "<=1955",
Columns(19), "", Columns(20), "", Columns(21), "") + WorksheetFunction.Countifs(Columns(19), age,
Columns(17), "<=1964") - WorksheetFunction.Countifs(Columns(19), age, Columns(17), "<=1955") +
WorksheetFunction.Countifs(Columns(21), age, Columns(17), "<=1964") -
WorksheetFunction.Countifs(Columns(21), age, Columns(17), "<=1955") _
+ WorksheetFunction.Countifs(Columns(25), age, Columns(28), "<=1964", Columns(30), "", Columns(31),
"", Columns(32), "") - WorksheetFunction.Countifs(Columns(25), age, Columns(28), "<=1955",
Columns(30), "", Columns(31), "", Columns(32), "") + WorksheetFunction.Countifs(Columns(30), age,
Columns(28), "<=1964") - WorksheetFunction.Countifs(Columns(30), age, Columns(28), "<=1964") +
WorksheetFunction.Countifs(Columns(32), age, Columns(28), "<=1964") -
WorksheetFunction.Countifs(Columns(32), age, Columns(28), "<=1964") _
+ WorksheetFunction.Countifs(Columns(36), age, Columns(39), "<=1964", Columns(41), "", Columns(42),
"", Columns(43), "") - WorksheetFunction.Countifs(Columns(36), age, Columns(39), "<=1955",
Columns(41), "", Columns(42), "", Columns(43), "") + WorksheetFunction.Countifs(Columns(41), age,
Columns(39), "<=1964") - WorksheetFunction.Countifs(Columns(41), age, Columns(39), "<=1955") +
WorksheetFunction.Countifs(Columns(43), age, Columns(39), "<=1964") -
WorksheetFunction.Countifs(Columns(43), age, Columns(39), "<=1955") _
+ WorksheetFunction.Countifs(Columns(47), age, Columns(50), "<=1964", Columns(52), "", Columns(53),
"", Columns(54), "") - WorksheetFunction.Countifs(Columns(47), age, Columns(50), "<=1955",
Columns(52), "", Columns(53), "", Columns(54), "") + WorksheetFunction.Countifs(Columns(52), age,
Columns(50), "<=1964") - WorksheetFunction.Countifs(Columns(52), age, Columns(50), "<=1955") +
WorksheetFunction.Countifs(Columns(54), age, Columns(50), "<=1964") -
WorksheetFunction.Countifs(Columns(54), age, Columns(50), "<=1955")
Sheets("Ret").Select
Cells(i + 2, 9).Select

```

```
ActiveCell.Formula = Count
```

```
Cells(i + 2, 10).Select 'calculates p
```

```
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
```

```
Range("D3").Select 'sets 4 decimal places
```

```
Range(Selection, Selection.End(xlDown)).Select
```

```
Selection.NumberFormat = "0.0000"
```

```
Next i
```

```
' Counts for born after 1964.
```

```
For i = 1 To 10
```

```
age = 54 + i
```

```
Sheets("Ret").Select
```

```
Cells(i + 2, 13).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.CountIfs(Columns(9), age, Columns(6), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(20), age, Columns(17), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(31), age, Columns(28), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(42), age, Columns(39), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(53), age, Columns(50), ">1964")
```

```
Sheets("Ret").Select
```

```
Cells(i + 2, 14).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts other
```

```
Count = WorksheetFunction.CountIfs(Columns(3), age, Columns(6), ">1964", Columns(8), "",
```

```
Columns(9), "", Columns(10), "") + WorksheetFunction.CountIfs(Columns(8), age, Columns(6), ">1964")
```

```
+ WorksheetFunction.CountIfs(Columns(10), age, Columns(6), ">1964") _
```

```
+ WorksheetFunction.CountIfs(Columns(14), age, Columns(17), ">1964", Columns(19), "", Columns(20),
```

```
"", Columns(21), "") + WorksheetFunction.CountIfs(Columns(19), age, Columns(17), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(21), age, Columns(17), ">1964") _
```

```
+ WorksheetFunction.CountIfs(Columns(25), age, Columns(28), ">1964", Columns(30), "", Columns(31),
```

```
"", Columns(32), "") + WorksheetFunction.CountIfs(Columns(30), age, Columns(28), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(32), age, Columns(28), ">1964") _
```

```
+ WorksheetFunction.CountIfs(Columns(36), age, Columns(39), ">1964", Columns(41), "", Columns(42),
```

```
"", Columns(43), "") + WorksheetFunction.CountIfs(Columns(41), age, Columns(39), ">1964") +
```

```
WorksheetFunction.CountIfs(Columns(43), age, Columns(39), ">1964") _
```

```
+ WorksheetFunction.Countifs(Columns(47), age, Columns(50), ">1964", Columns(52), "", Columns(53),
"", Columns(54), "") + WorksheetFunction.Countifs(Columns(52), age, Columns(50), ">1964") +
WorksheetFunction.Countifs(Columns(54), age, Columns(50), ">1964")
Sheets("Ret").Select
Cells(i + 2, 15).Select
ActiveCell.Formula = Count
```

```
Cells(i + 2, 16).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Range("J3").Select 'sets 4 decimal places
Range(Selection, Selection.End(xlDown)).Select
Selection.NumberFormat = "0.0000"
Next i
```

```
' Enters expected proportions from assumptions
Range("E3").Select '<1955 birthday
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R10C1:R20C7,3)"
Selection.AutoFill Destination:=Range("E3:E12")
' Selection.NumberFormat = "0.0000"
```

```
Range("K3").Select '<1964 and >1955 birthday
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R10C1:R20C7,5)"
Selection.AutoFill Destination:=Range("K3:K12")
' Selection.NumberFormat = "0.0000"
```

```
Range("Q3").Select '>1964 birthday
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R10C1:R20C7,7)"
Selection.AutoFill Destination:=Range("Q3:Q12")
' Selection.NumberFormat = "0.0000"
```

```
Application.ScreenUpdating = True
```

```
End Sub
```

```
Sub CountTermPT()
```

```
'
```

```
' CountTermPT Macro
```

```
'
```

```
' Counts the number of part-time data entries at each age who terminated with 0, 1, 2, 3, 4, or 5+ years
of service.
```

```
'
```

```
Application.ScreenUpdating = False
```

```
Sheets.Add After:=Sheets(Sheets.Count) 'opens new worksheet  
Sheets(ActiveWorkbook.Sheets.Count).Select  
ActiveSheet.Name = "TermPT"
```

```
'Inputs headings
```

```
Range("A1:E1").Select
```

```
Selection.Merge
```

```
ActiveCell.FormulaR1C1 = "Male w/ 0 Serv"
```

```
With Selection
```

```
.HorizontalAlignment = xlCenter
```

```
.VerticalAlignment = xlBottom
```

```
.WrapText = False
```

```
.Orientation = 0
```

```
.AddIndent = False
```

```
.IndentLevel = 0
```

```
.ShrinkToFit = False
```

```
.ReadingOrder = xlContext
```

```
.MergeCells = True
```

```
End With
```

```
Range("A2").Select
```

```
ActiveCell.FormulaR1C1 = "Age"
```

```
Range("B2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs Term"
```

```
Range("C2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs Otr"
```

```
Range("D2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs p"
```

```
Range("E2").Select
```

```
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("G1:K1").Select
```

```
Selection.Merge
```

```
ActiveCell.FormulaR1C1 = "Female w/ 0 Serv"
```

```
With Selection
```

```
.HorizontalAlignment = xlCenter
```

```
.VerticalAlignment = xlBottom
```

```
.WrapText = False
```

```
.Orientation = 0
```

```
.AddIndent = False
```

```

        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("G2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("H2").Select
    ActiveCell.FormulaR1C1 = "Obs Term"
    Range("I2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("J2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("K2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

    Range("M1:Q1").Select
    Selection.Merge
    ActiveCell.FormulaR1C1 = "Male w/ 1 Serv"
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("M2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("N2").Select
    ActiveCell.FormulaR1C1 = "Obs Term"
    Range("O2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("P2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("Q2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

```

```
Range("S1:W1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Female w/ 1 Serv"
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
  End With
Range("S2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("T2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("u2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("V2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("W2").Select
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("Y1:AC1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Male w/ 2 Serv"
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
  End With
Range("Y2").Select
ActiveCell.FormulaR1C1 = "Age"
```

```
Range("Z2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("AA2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("AB2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("AC2").Select
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("AE1:AI1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Female w/ 2 Serv"
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
```

```
End With
Range("AE2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("AF2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("AG2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("AH2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("AI2").Select
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("AK1:AO1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Male w/ 3 Serv"
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
```

```

.Orientation = 0
.AddIndent = False
.IndentLevel = 0
.ShrinkToFit = False
.ReadingOrder = xlContext
.MergeCells = True
End With
Range("AK2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("AL2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("AM2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("AN2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("AO2").Select
ActiveCell.FormulaR1C1 = "Exp p"

Range("AQ1:AU1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Female w/ 3 Serv"
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
End With
Range("AQ2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("AR2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("AS2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("AT2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("AU2").Select

```

```
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("AW1:BA1").Select
```

```
Selection.Merge
```

```
ActiveCell.FormulaR1C1 = "Male w/ 4 Serv"
```

```
With Selection
```

```
    .HorizontalAlignment = xlCenter
```

```
    .VerticalAlignment = xlBottom
```

```
    .WrapText = False
```

```
    .Orientation = 0
```

```
    .AddIndent = False
```

```
    .IndentLevel = 0
```

```
    .ShrinkToFit = False
```

```
    .ReadingOrder = xlContext
```

```
    .MergeCells = True
```

```
End With
```

```
Range("AW2").Select
```

```
ActiveCell.FormulaR1C1 = "Age"
```

```
Range("AX2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs Term"
```

```
Range("AY2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs Otr"
```

```
Range("AZ2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs p"
```

```
Range("BA2").Select
```

```
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("BC1:BG1").Select
```

```
Selection.Merge
```

```
ActiveCell.FormulaR1C1 = "Female w/ 4 Serv"
```

```
With Selection
```

```
    .HorizontalAlignment = xlCenter
```

```
    .VerticalAlignment = xlBottom
```

```
    .WrapText = False
```

```
    .Orientation = 0
```

```
    .AddIndent = False
```

```
    .IndentLevel = 0
```

```
    .ShrinkToFit = False
```

```
    .ReadingOrder = xlContext
```

```
    .MergeCells = True
```

```
End With
```

```
Range("BC2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("BD2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("BE2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("BF2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("BG2").Select
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("BI1:BM1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Male w/ 5+ Serv"
With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
```

```
End With
Range("BI2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("BJ2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("BK2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("BL2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("BM2").Select
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("BO1:BS1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Female w/ 5+ Serv"
With Selection
    .HorizontalAlignment = xlCenter
```

```

.VerticalAlignment = xlBottom
.WrapText = False
.Orientation = 0
.AddIndent = False
.IndentLevel = 0
.ShrinkToFit = False
.ReadingOrder = xlContext
.MergeCells = True
End With
Range("BO2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("BP2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("BQ2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("BR2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("BS2").Select
ActiveCell.FormulaR1C1 = "Exp p"

' Counts for males with no service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 1).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"0") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"0") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"0") _
+ WorksheetFunction.Countifs(Columns(41), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"0") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"0")
Sheets("TermPT").Select
Cells(i + 2, 2).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "0") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "0") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "0") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "0")
-
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "0") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "0") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "0")
-
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "0") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "0") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "0")
-
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "0") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "0") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "0")
Sheets("TermPT").Select
Cells(i + 2, 3).Select
ActiveCell.Formula = Count

Cells(i + 2, 4).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-3]/SUM(RC[-3],RC[-1])"
Next i

' Counts for females with no service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 7).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
"0") _

```

```

+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
"0") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
"0") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
"0") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
"0")
Sheets("TermPT").Select
Cells(i + 2, 8).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), "0") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), "0") + WorksheetFunction.Countifs(Columns(18), "PT",
Columns(20), age, Columns(13), "F", Columns(15), "0") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(21), age, Columns(13), "F", Columns(15), "0") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "0") + WorksheetFunction.Countifs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "0") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "0") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "0") + WorksheetFunction.Countifs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "0") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "0") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "0") + WorksheetFunction.Countifs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "0") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "0")
Sheets("TermPT").Select
Cells(i + 2, 9).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 10).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-3]/SUM(RC[-3],RC[-1])"
Next i

```

Call CountTermPT2

Call CountTermPT3

Application.ScreenUpdating = True

End Sub

Sub CountTermPT2()

'

' CountTermPT2 Macro

'

' Continuation of CountTermPT macro. Counts the number of part-time data entries at each age who terminated with 0, 1, 2, 3, 4, or 5+ years of service.

'

' Counts for males with 1 year service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 13).Select

ActiveCell.Formula = age

Sheets("compilation").Select

Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4), "1") _

+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15), "1") _

+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26), "1") _

+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37), "1") _

+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48), "1")

Sheets("TermPT").Select

Cells(i + 2, 14).Select

ActiveCell.Formula = Count

Sheets("compilation").Select ' Counts other

Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8), "", Columns(9), "", Columns(10), "", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT",

```

Columns(9), age, Columns(2), "M", Columns(4), "1") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "1") _
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "1") + WorksheetFunction.CountIfs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "1") +
WorksheetFunction.CountIfs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "1")
-
+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "1") + WorksheetFunction.CountIfs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "1") +
WorksheetFunction.CountIfs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "1")
-
+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "1") + WorksheetFunction.CountIfs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "1") +
WorksheetFunction.CountIfs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "1")
-
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "1") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "1") +
WorksheetFunction.CountIfs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "1")
Sheets("TermPT").Select
Cells(i + 2, 15).Select
ActiveCell.Formula = Count

Cells(i + 2, 16).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

' Counts for females with 1 year service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 19).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
"1") _
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
"1") _

```

```

+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
"1") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
"1") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
"1")
Sheets("TermPT").Select
Cells(i + 2, 20).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), "1") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), "1") + WorksheetFunction.Countifs(Columns(18), "PT",
Columns(20), age, Columns(13), "F", Columns(15), "1") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(21), age, Columns(13), "F", Columns(15), "1") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "1") + WorksheetFunction.Countifs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "1") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "1") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "1") + WorksheetFunction.Countifs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "1") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "1") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "1") + WorksheetFunction.Countifs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "1") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "1")
Sheets("TermPT").Select
Cells(i + 2, 21).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 22).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

```

' Counts for males with 2 years service.
For i = 1 To 42 'counts term

```

```

age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 25).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"2") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"2") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"2") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"2") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"2")
Sheets("TermPT").Select
Cells(i + 2, 26).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "2") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "2") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "2") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "2") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "2") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "2")
-
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "2") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "2") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "2")
-
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "2") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "2") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "2")
-
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "2") + WorksheetFunction.Countifs(Columns(51),

```

```
"PT", Columns(53), age, Columns(46), "M", Columns(48), "2") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "2")
Sheets("TermPT").Select
Cells(i + 2, 27).Select
ActiveCell.Formula = Count
```

```
Cells(i + 2, 28).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i
```

```
' Counts for females with 2 years service.
```

```
For i = 1 To 42 'counts term
```

```
age = 14 + i
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 31).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4), "2") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15), "2") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26), "2") _
```

```
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37), "2") _
```

```
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48), "2")
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 32).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts other
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8), "", Columns(9), "", Columns(10), "", Columns(4), "2") + WorksheetFunction.Countifs(Columns(7), "PT",
```

```
Columns(9), age, Columns(2), "F", Columns(4), "2") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(10), age, Columns(2), "F", Columns(4), "2") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "", Columns(20), "", Columns(21), "", Columns(15), "2") + WorksheetFunction.Countifs(Columns(18), "PT",
```

```
Columns(20), age, Columns(13), "F", Columns(15), "2") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "F", Columns(15), "2") _
```

```

+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "2") + WorksheetFunction.Countifs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "2") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "2") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "2") + WorksheetFunction.Countifs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "2") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "2") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "2") + WorksheetFunction.Countifs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "2") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "2")
Sheets("TermPT").Select
Cells(i + 2, 33).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 34).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for males with 3 years service.

For i = 1 To 42 'counts term

age = 14 + i

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 37).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"3") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"3") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"3") _
```

```
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"3") _
```

```
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"3")
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 38).Select
```

```
ActiveCell.Formula = Count
```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "3") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "3") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "3") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "3")
-
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "3") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "3") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "3")
-
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "3") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "3") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "3")
-
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "3") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "3") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "3")
Sheets("TermPT").Select
Cells(i + 2, 39).Select
ActiveCell.Formula = Count

Cells(i + 2, 40).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

' Counts for females with 3 years service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 43).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
"3") _

```

```

+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
"3") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
"3") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
"3") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
"3")
Sheets("TermPT").Select
Cells(i + 2, 44).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), "3") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), "3") + WorksheetFunction.Countifs(Columns(18), "PT",
Columns(20), age, Columns(13), "F", Columns(15), "3") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(21), age, Columns(13), "F", Columns(15), "3") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "3") + WorksheetFunction.Countifs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "3") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "3") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "3") + WorksheetFunction.Countifs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "3") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "3") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "3") + WorksheetFunction.Countifs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "3") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "3")
Sheets("TermPT").Select
Cells(i + 2, 45).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 46).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

```

' Counts for males with 4 years service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 49).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"4") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"4") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"4") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"4") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"4")
Sheets("TermPT").Select
Cells(i + 2, 50).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "4") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "4") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "4") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "4") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "4") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "4")
-
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "4") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "4") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "4")
-
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "4") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "4") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "4")
-

```

```

+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "4") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "4") +
WorksheetFunction.CountIfs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "4")
Sheets("TermPT").Select
Cells(i + 2, 51).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 52).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for females with 4 years service.

```

For i = 1 To 42 'counts term

```

```

age = 14 + i

```

```

Sheets("TermPT").Select

```

```

Cells(i + 2, 55).Select

```

```

ActiveCell.Formula = age

```

```

Sheets("compilation").Select

```

```

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
"4") _

```

```

+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
"4") _

```

```

+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
"4") _

```

```

+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
"4") _

```

```

+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
"4")

```

```

Sheets("TermPT").Select

```

```

Cells(i + 2, 56).Select

```

```

ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other

```

```

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "4") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), "4") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), "4") _

```

```

+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), "4") + WorksheetFunction.CountIfs(Columns(18), "PT",

```

```

Columns(20), age, Columns(13), "F", Columns(15), "4") + WorksheetFunction.CountIfs(Columns(18),
"PT", Columns(21), age, Columns(13), "F", Columns(15), "4") _
+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "4") + WorksheetFunction.CountIfs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "4") + WorksheetFunction.CountIfs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "4") _
+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "4") + WorksheetFunction.CountIfs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "4") + WorksheetFunction.CountIfs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "4") _
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "4") + WorksheetFunction.CountIfs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "4") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "4")
Sheets("TermPT").Select
Cells(i + 2, 57).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 58).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for males with 5+ years service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 61).Select

ActiveCell.Formula = age

Sheets("compilation").Select

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
">=5") _

+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
">=5") _

+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
">=5") _

+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37),
">=5") _

+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
">=5")

Sheets("TermPT").Select

Cells(i + 2, 62).Select

ActiveCell.Formula = Count

Sheets("compilation").Select ' Counts other

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),  
"", Columns(9), "", Columns(10), "", Columns(4), ">=5") + WorksheetFunction.Countifs(Columns(7), "PT",  
Columns(9), age, Columns(2), "M", Columns(4), ">=5") + WorksheetFunction.Countifs(Columns(7), "PT",  
Columns(10), age, Columns(2), "M", Columns(4), ">=5") _  
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),  
"", Columns(20), "", Columns(21), "", Columns(15), ">=5") + WorksheetFunction.Countifs(Columns(18),  
"PT", Columns(20), age, Columns(13), "M", Columns(15), ">=5") +  
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15),  
>=5") _  
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),  
"", Columns(31), "", Columns(32), "", Columns(26), ">=5") + WorksheetFunction.Countifs(Columns(29),  
"PT", Columns(31), age, Columns(24), "M", Columns(26), ">=5") +  
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26),  
>=5") _  
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),  
"", Columns(42), "", Columns(43), "", Columns(37), ">=5") + WorksheetFunction.Countifs(Columns(40),  
"PT", Columns(42), age, Columns(35), "M", Columns(37), ">=5") +  
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37),  
>=5") _  
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),  
"", Columns(53), "", Columns(54), "", Columns(48), ">=5") + WorksheetFunction.Countifs(Columns(51),  
"PT", Columns(53), age, Columns(46), "M", Columns(48), ">=5") +  
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48),  
>=5")
```

Sheets("TermPT").Select

Cells(i + 2, 63).Select

ActiveCell.Formula = Count

Cells(i + 2, 64).Select 'calculates p

ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"

Next i

' Counts for females with 5+ years service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 67).Select

ActiveCell.Formula = age

```

Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
">=5") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
">=5") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
">=5") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
">=5") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
">=5")
Sheets("TermPT").Select
Cells(i + 2, 68).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), ">=5") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), ">=5") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), ">=5") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), ">=5") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "F", Columns(15), ">=5") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "F", Columns(15),
">=5") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), ">=5") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "F", Columns(26), ">=5") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "F", Columns(26),
">=5") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), ">=5") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "F", Columns(37), ">=5") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "F", Columns(37),
">=5") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), ">=5") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "F", Columns(48), ">=5") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "F", Columns(48),
">=5")
Sheets("TermPT").Select

```

```
Cells(i + 2, 69).Select
ActiveCell.Formula = Count
```

```
Cells(i + 2, 70).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i
End Sub
```

```
Sub CountTermPT()
```

```
,
```

```
' CountTermPT Macro
```

```
,
```

```
' Counts the number of part-time data entries at each age who terminated with 0, 1, 2, 3, 4, or 5+ years
of service.
```

```
,
```

```
Application.ScreenUpdating = False
```

```
Sheets.Add After:=Sheets(Sheets.Count) 'opens new worksheet
```

```
Sheets(ActiveWorkbook.Sheets.Count).Select
```

```
ActiveSheet.Name = "TermPT"
```

```
'Inputs headings
```

```
Range("A1:E1").Select
```

```
Selection.Merge
```

```
ActiveCell.FormulaR1C1 = "Male w/ 0 Serv"
```

```
With Selection
```

```
.HorizontalAlignment = xlCenter
```

```
.VerticalAlignment = xlBottom
```

```
.WrapText = False
```

```
.Orientation = 0
```

```
.AddIndent = False
```

```
.IndentLevel = 0
```

```
.ShrinkToFit = False
```

```
.ReadingOrder = xlContext
```

```
.MergeCells = True
```

```
End With
```

```
Range("A2").Select
```

```
ActiveCell.FormulaR1C1 = "Age"
```

```
Range("B2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs Term"
```

```
Range("C2").Select
```

```
ActiveCell.FormulaR1C1 = "Obs Otr"  
Range("D2").Select  
ActiveCell.FormulaR1C1 = "Obs p"  
Range("E2").Select  
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("G1:K1").Select  
Selection.Merge  
ActiveCell.FormulaR1C1 = "Female w/ 0 Serv"  
With Selection  
    .HorizontalAlignment = xlCenter  
    .VerticalAlignment = xlBottom  
    .WrapText = False  
    .Orientation = 0  
    .AddIndent = False  
    .IndentLevel = 0  
    .ShrinkToFit = False  
    .ReadingOrder = xlContext  
    .MergeCells = True  
End With  
Range("G2").Select  
ActiveCell.FormulaR1C1 = "Age"  
Range("H2").Select  
ActiveCell.FormulaR1C1 = "Obs Term"  
Range("I2").Select  
ActiveCell.FormulaR1C1 = "Obs Otr"  
Range("J2").Select  
ActiveCell.FormulaR1C1 = "Obs p"  
Range("K2").Select  
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("M1:Q1").Select  
Selection.Merge  
ActiveCell.FormulaR1C1 = "Male w/ 1 Serv"  
With Selection  
    .HorizontalAlignment = xlCenter  
    .VerticalAlignment = xlBottom  
    .WrapText = False  
    .Orientation = 0  
    .AddIndent = False  
    .IndentLevel = 0
```

```

        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("M2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("N2").Select
    ActiveCell.FormulaR1C1 = "Obs Term"
    Range("O2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("P2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("Q2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

    Range("S1:W1").Select
    Selection.Merge
    ActiveCell.FormulaR1C1 = "Female w/ 1 Serv"
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("S2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("T2").Select
    ActiveCell.FormulaR1C1 = "Obs Term"
    Range("u2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("V2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("W2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

    Range("Y1:AC1").Select

```

```

Selection.Merge
ActiveCell.FormulaR1C1 = "Male w/ 2 Serv"
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
  End With
Range("Y2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("Z2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("AA2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("AB2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("AC2").Select
ActiveCell.FormulaR1C1 = "Exp p"

```

```

Range("AE1:AI1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Female w/ 2 Serv"
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
  End With
Range("AE2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("AF2").Select

```

```
ActiveCell.FormulaR1C1 = "Obs Term"  
Range("AG2").Select  
ActiveCell.FormulaR1C1 = "Obs Otr"  
Range("AH2").Select  
ActiveCell.FormulaR1C1 = "Obs p"  
Range("AI2").Select  
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("AK1:AO1").Select  
Selection.Merge  
ActiveCell.FormulaR1C1 = "Male w/ 3 Serv"  
With Selection  
    .HorizontalAlignment = xlCenter  
    .VerticalAlignment = xlBottom  
    .WrapText = False  
    .Orientation = 0  
    .AddIndent = False  
    .IndentLevel = 0  
    .ShrinkToFit = False  
    .ReadingOrder = xlContext  
    .MergeCells = True  
End With  
Range("AK2").Select  
ActiveCell.FormulaR1C1 = "Age"  
Range("AL2").Select  
ActiveCell.FormulaR1C1 = "Obs Term"  
Range("AM2").Select  
ActiveCell.FormulaR1C1 = "Obs Otr"  
Range("AN2").Select  
ActiveCell.FormulaR1C1 = "Obs p"  
Range("AO2").Select  
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("AQ1:AU1").Select  
Selection.Merge  
ActiveCell.FormulaR1C1 = "Female w/ 3 Serv"  
With Selection  
    .HorizontalAlignment = xlCenter  
    .VerticalAlignment = xlBottom  
    .WrapText = False  
    .Orientation = 0
```

```

        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("AQ2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("AR2").Select
    ActiveCell.FormulaR1C1 = "Obs Term"
    Range("AS2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("AT2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("AU2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

Range("AW1:BA1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Male w/ 4 Serv"
    With Selection
        .HorizontalAlignment = xlCenter
        .VerticalAlignment = xlBottom
        .WrapText = False
        .Orientation = 0
        .AddIndent = False
        .IndentLevel = 0
        .ShrinkToFit = False
        .ReadingOrder = xlContext
        .MergeCells = True
    End With
    Range("AW2").Select
    ActiveCell.FormulaR1C1 = "Age"
    Range("AX2").Select
    ActiveCell.FormulaR1C1 = "Obs Term"
    Range("AY2").Select
    ActiveCell.FormulaR1C1 = "Obs Otr"
    Range("AZ2").Select
    ActiveCell.FormulaR1C1 = "Obs p"
    Range("BA2").Select
    ActiveCell.FormulaR1C1 = "Exp p"

```

```

Range("BC1:BG1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Female w/ 4 Serv"
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
  End With
Range("BC2").Select
ActiveCell.FormulaR1C1 = "Age"
Range("BD2").Select
ActiveCell.FormulaR1C1 = "Obs Term"
Range("BE2").Select
ActiveCell.FormulaR1C1 = "Obs Otr"
Range("BF2").Select
ActiveCell.FormulaR1C1 = "Obs p"
Range("BG2").Select
ActiveCell.FormulaR1C1 = "Exp p"

```

```

Range("BI1:BM1").Select
Selection.Merge
ActiveCell.FormulaR1C1 = "Male w/ 5+ Serv"
  With Selection
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlBottom
    .WrapText = False
    .Orientation = 0
    .AddIndent = False
    .IndentLevel = 0
    .ShrinkToFit = False
    .ReadingOrder = xlContext
    .MergeCells = True
  End With
Range("BI2").Select

```

```
ActiveCell.FormulaR1C1 = "Age"  
Range("BJ2").Select  
ActiveCell.FormulaR1C1 = "Obs Term"  
Range("BK2").Select  
ActiveCell.FormulaR1C1 = "Obs Otr"  
Range("BL2").Select  
ActiveCell.FormulaR1C1 = "Obs p"  
Range("BM2").Select  
ActiveCell.FormulaR1C1 = "Exp p"
```

```
Range("BO1:BS1").Select  
Selection.Merge  
ActiveCell.FormulaR1C1 = "Female w/ 5+ Serv"  
With Selection  
    .HorizontalAlignment = xlCenter  
    .VerticalAlignment = xlBottom  
    .WrapText = False  
    .Orientation = 0  
    .AddIndent = False  
    .IndentLevel = 0  
    .ShrinkToFit = False  
    .ReadingOrder = xlContext  
    .MergeCells = True  
End With  
Range("BO2").Select  
ActiveCell.FormulaR1C1 = "Age"  
Range("BP2").Select  
ActiveCell.FormulaR1C1 = "Obs Term"  
Range("BQ2").Select  
ActiveCell.FormulaR1C1 = "Obs Otr"  
Range("BR2").Select  
ActiveCell.FormulaR1C1 = "Obs p"  
Range("BS2").Select  
ActiveCell.FormulaR1C1 = "Exp p"
```

```
' Counts for males with no service.  
For i = 1 To 42 'counts term  
age = 14 + i  
Sheets("TermPT").Select  
Cells(i + 2, 1).Select  
ActiveCell.Formula = age
```

```

Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"0") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"0") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"0") _
+ WorksheetFunction.Countifs(Columns(41), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"0") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"0")
Sheets("TermPT").Select
Cells(i + 2, 2).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "0") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "0") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "0") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "0")
—
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "0") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "0") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "0")
—
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "0") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "0") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "0")
—
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "0") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "0") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "0")
Sheets("TermPT").Select
Cells(i + 2, 3).Select

```

```
ActiveCell.Formula = Count
```

```
Cells(i + 2, 4).Select 'calculates p
```

```
ActiveCell.FormulaR1C1 = "=RC[-3]/SUM(RC[-3],RC[-1])"
```

```
Next i
```

```
' Counts for females with no service.
```

```
For i = 1 To 42 'counts term
```

```
age = 14 + i
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 7).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4), "0") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15), "0") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26), "0") _
```

```
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37), "0") _
```

```
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48), "0")
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 8).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts other
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8), "", Columns(9), "", Columns(10), "", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(9), age, Columns(2), "F", Columns(4), "0") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(10), age, Columns(2), "F", Columns(4), "0") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "", Columns(20), "", Columns(21), "", Columns(15), "0") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(20), age, Columns(13), "F", Columns(15), "0") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "F", Columns(15), "0") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "", Columns(31), "", Columns(32), "", Columns(26), "0") + WorksheetFunction.Countifs(Columns(29), "PT", Columns(31), age, Columns(24), "F", Columns(26), "0") + WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "F", Columns(26), "0") _
```

```

+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "0") + WorksheetFunction.CountIfs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "0") + WorksheetFunction.CountIfs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "0") _
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "0") + WorksheetFunction.CountIfs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "0") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "0")
Sheets("TermPT").Select
Cells(i + 2, 9).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 10).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-3]/SUM(RC[-3],RC[-1])"
Next i

```

Call CountTermPT2

Call CountTermPT3

Application.ScreenUpdating = True

End Sub

Sub CountTermPT2()

,

' CountTermPT2 Macro

,

' Continuation of CountTermPT macro. Counts the number of part-time data entries at each age who terminated with 0, 1, 2, 3, 4, or 5+ years of service.

,

' Counts for males with 1 year service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 13).Select

ActiveCell.Formula = age

Sheets("compilation").Select

```

Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"1") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"1") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"1") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"1") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"1")
Sheets("TermPT").Select
Cells(i + 2, 14).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "1") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "1") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "1") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "1")
-
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "1") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "1") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "1")
-
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "1") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "1") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "1")
-
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "1") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "1") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "1")
Sheets("TermPT").Select
Cells(i + 2, 15).Select
ActiveCell.Formula = Count

```

```
Cells(i + 2, 16).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i
```

```
' Counts for females with 1 year service.
```

```
For i = 1 To 42 'counts term
```

```
age = 14 + i
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 19).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48), "1")
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 20).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts other
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8), "", Columns(9), "", Columns(10), "", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(9), age, Columns(2), "F", Columns(4), "1") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(10), age, Columns(2), "F", Columns(4), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "", Columns(20), "", Columns(21), "", Columns(15), "1") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(20), age, Columns(13), "F", Columns(15), "1") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "F", Columns(15), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "", Columns(31), "", Columns(32), "", Columns(26), "1") + WorksheetFunction.Countifs(Columns(29), "PT", Columns(31), age, Columns(24), "F", Columns(26), "1") + WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "F", Columns(26), "1") _
```

```
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "", Columns(42), "", Columns(43), "", Columns(37), "1") + WorksheetFunction.Countifs(Columns(40), "PT",
```

```

Columns(42), age, Columns(35), "F", Columns(37), "1") + WorksheetFunction.CountIfs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "1") _
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "1") + WorksheetFunction.CountIfs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "1") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "1")
Sheets("TermPT").Select
Cells(i + 2, 21).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 22).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for males with 2 years service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 25).Select

ActiveCell.Formula = age

Sheets("compilation").Select

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4), "2") _

+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15), "2") _

+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26), "2") _

+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37), "2") _

+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48), "2")

Sheets("TermPT").Select

Cells(i + 2, 26).Select

ActiveCell.Formula = Count

Sheets("compilation").Select ' Counts other

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8), "", Columns(9), "", Columns(10), "", Columns(4), "2") + WorksheetFunction.CountIfs(Columns(7), "PT", Columns(9), age, Columns(2), "M", Columns(4), "2") + WorksheetFunction.CountIfs(Columns(7), "PT", Columns(10), age, Columns(2), "M", Columns(4), "2") _

```
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),  
"", Columns(20), "", Columns(21), "", Columns(15), "2") + WorksheetFunction.CountIfs(Columns(18),  
"PT", Columns(20), age, Columns(13), "M", Columns(15), "2") +  
WorksheetFunction.CountIfs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "2")
```

–

```
+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),  
"", Columns(31), "", Columns(32), "", Columns(26), "2") + WorksheetFunction.CountIfs(Columns(29),  
"PT", Columns(31), age, Columns(24), "M", Columns(26), "2") +  
WorksheetFunction.CountIfs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "2")
```

–

```
+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),  
"", Columns(42), "", Columns(43), "", Columns(37), "2") + WorksheetFunction.CountIfs(Columns(40),  
"PT", Columns(42), age, Columns(35), "M", Columns(37), "2") +  
WorksheetFunction.CountIfs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "2")
```

–

```
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),  
"", Columns(53), "", Columns(54), "", Columns(48), "2") + WorksheetFunction.CountIfs(Columns(51),  
"PT", Columns(53), age, Columns(46), "M", Columns(48), "2") +  
WorksheetFunction.CountIfs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "2")  
Sheets("TermPT").Select  
Cells(i + 2, 27).Select  
ActiveCell.Formula = Count
```

```
Cells(i + 2, 28).Select 'calculates p  
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"  
Next i
```

' Counts for females with 2 years service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 31).Select

ActiveCell.Formula = age

Sheets("compilation").Select

```
Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),  
"2") _
```

```
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),  
"2") _
```

```
+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),  
"2") _
```

```

+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
"2") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
"2")
Sheets("TermPT").Select
Cells(i + 2, 32).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "2") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), "2") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), "2") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), "2") + WorksheetFunction.Countifs(Columns(18), "PT",
Columns(20), age, Columns(13), "F", Columns(15), "2") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(21), age, Columns(13), "F", Columns(15), "2") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "2") + WorksheetFunction.Countifs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "2") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "2") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "2") + WorksheetFunction.Countifs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "2") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "2") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "2") + WorksheetFunction.Countifs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "2") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "2")
Sheets("TermPT").Select
Cells(i + 2, 33).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 34).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

```

' Counts for males with 3 years service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select

```

```

Cells(i + 2, 37).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4),
"3") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15),
"3") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26),
"3") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37),
"3") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48),
"3")
Sheets("TermPT").Select
Cells(i + 2, 38).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "3") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "3") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "3") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "3")
-
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "3") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "3") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "3")
-
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "3") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "3") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "3")
-
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "3") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "3") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "3")

```

```
Sheets("TermPT").Select
Cells(i + 2, 39).Select
ActiveCell.Formula = Count
```

```
Cells(i + 2, 40).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i
```

```
' Counts for females with 3 years service.
```

```
For i = 1 To 42 'counts term
```

```
age = 14 + i
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 43).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4), "3") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15), "3") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26), "3") _
```

```
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37), "3") _
```

```
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48), "3")
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 44).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts other
```

```
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8), "", Columns(9), "", Columns(10), "", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(9), age, Columns(2), "F", Columns(4), "3") + WorksheetFunction.Countifs(Columns(7), "PT", Columns(10), age, Columns(2), "F", Columns(4), "3") _
```

```
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "", Columns(20), "", Columns(21), "", Columns(15), "3") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(20), age, Columns(13), "F", Columns(15), "3") + WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "F", Columns(15), "3") _
```

```
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "", Columns(31), "", Columns(32), "", Columns(26), "3") + WorksheetFunction.Countifs(Columns(29), "PT",
```

```

Columns(31), age, Columns(24), "F", Columns(26), "3") + WorksheetFunction.CountIfs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "3") _
+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "3") + WorksheetFunction.CountIfs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "3") + WorksheetFunction.CountIfs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "3") _
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "3") + WorksheetFunction.CountIfs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "3") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "3")
Sheets("TermPT").Select
Cells(i + 2, 45).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 46).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for males with 4 years service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 49).Select

ActiveCell.Formula = age

Sheets("compilation").Select

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4), "4") _

+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15), "4") _

+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26), "4") _

+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37), "4") _

+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48), "4")

Sheets("TermPT").Select

Cells(i + 2, 50).Select

ActiveCell.Formula = Count

Sheets("compilation").Select ' Counts other

```

Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "4") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(9), age, Columns(2), "M", Columns(4), "4") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(10), age, Columns(2), "M", Columns(4), "4") _
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19),
"", Columns(20), "", Columns(21), "", Columns(15), "4") + WorksheetFunction.CountIfs(Columns(18),
"PT", Columns(20), age, Columns(13), "M", Columns(15), "4") +
WorksheetFunction.CountIfs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "4")

-
+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30),
"", Columns(31), "", Columns(32), "", Columns(26), "4") + WorksheetFunction.CountIfs(Columns(29),
"PT", Columns(31), age, Columns(24), "M", Columns(26), "4") +
WorksheetFunction.CountIfs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "4")

-
+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41),
"", Columns(42), "", Columns(43), "", Columns(37), "4") + WorksheetFunction.CountIfs(Columns(40),
"PT", Columns(42), age, Columns(35), "M", Columns(37), "4") +
WorksheetFunction.CountIfs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "4")

-
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), "4") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), "4") +
WorksheetFunction.CountIfs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48), "4")
Sheets("TermPT").Select
Cells(i + 2, 51).Select
ActiveCell.Formula = Count

Cells(i + 2, 52).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

' Counts for females with 4 years service.
For i = 1 To 42 'counts term
age = 14 + i
Sheets("TermPT").Select
Cells(i + 2, 55).Select
ActiveCell.Formula = age
Sheets("compilation").Select
Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
"4") _

```

```

+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
"4") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
"4") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
"4") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
"4")
Sheets("TermPT").Select
Cells(i + 2, 56).Select
ActiveCell.Formula = Count

```

```

Sheets("compilation").Select ' Counts other
Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), "4") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), "4") + WorksheetFunction.Countifs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), "4") _
+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), "4") + WorksheetFunction.Countifs(Columns(18), "PT",
Columns(20), age, Columns(13), "F", Columns(15), "4") + WorksheetFunction.Countifs(Columns(18),
"PT", Columns(21), age, Columns(13), "F", Columns(15), "4") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), "4") + WorksheetFunction.Countifs(Columns(29), "PT",
Columns(31), age, Columns(24), "F", Columns(26), "4") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(32), age, Columns(24), "F", Columns(26), "4") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), "4") + WorksheetFunction.Countifs(Columns(40), "PT",
Columns(42), age, Columns(35), "F", Columns(37), "4") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(43), age, Columns(35), "F", Columns(37), "4") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), "4") + WorksheetFunction.Countifs(Columns(51), "PT",
Columns(53), age, Columns(46), "F", Columns(48), "4") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(54), age, Columns(46), "F", Columns(48), "4")
Sheets("TermPT").Select
Cells(i + 2, 57).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 58).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for males with 5+ years service.

For i = 1 To 42 'counts term

age = 14 + i

Sheets("TermPT").Select

Cells(i + 2, 61).Select

ActiveCell.Formula = age

Sheets("compilation").Select

Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(8), age, Columns(2), "M", Columns(4), "
">=5") _

+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(19), age, Columns(13), "M", Columns(15), "
">=5") _

+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(30), age, Columns(24), "M", Columns(26), "
">=5") _

+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(41), age, Columns(35), "M", Columns(37), "
">=5") _

+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(52), age, Columns(46), "M", Columns(48), "
">=5")

Sheets("TermPT").Select

Cells(i + 2, 62).Select

ActiveCell.Formula = Count

Sheets("compilation").Select ' Counts other

Count = WorksheetFunction.Countifs(Columns(7), "PT", Columns(3), age, Columns(2), "M", Columns(8), "
"", Columns(9), "", Columns(10), "", Columns(4), ">=5") + WorksheetFunction.Countifs(Columns(7), "PT", "
Columns(9), age, Columns(2), "M", Columns(4), ">=5") + WorksheetFunction.Countifs(Columns(7), "PT", "
Columns(10), age, Columns(2), "M", Columns(4), ">=5") _

+ WorksheetFunction.Countifs(Columns(18), "PT", Columns(14), age, Columns(13), "M", Columns(19), "
"", Columns(20), "", Columns(21), "", Columns(15), ">=5") + WorksheetFunction.Countifs(Columns(18), "
"PT", Columns(20), age, Columns(13), "M", Columns(15), ">=5") +

WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "M", Columns(15), "
">=5") _

+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "M", Columns(30), "
"", Columns(31), "", Columns(32), "", Columns(26), ">=5") + WorksheetFunction.Countifs(Columns(29), "
"PT", Columns(31), age, Columns(24), "M", Columns(26), ">=5") +

WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "M", Columns(26), "
">=5") _

+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "M", Columns(41), "
"", Columns(42), "", Columns(43), "", Columns(37), ">=5") + WorksheetFunction.Countifs(Columns(40), "
"PT", Columns(42), age, Columns(35), "M", Columns(37), ">=5") +

WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "M", Columns(37), "
">=5") _

```

+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(47), age, Columns(46), "M", Columns(52),
"", Columns(53), "", Columns(54), "", Columns(48), ">=5") + WorksheetFunction.CountIfs(Columns(51),
"PT", Columns(53), age, Columns(46), "M", Columns(48), ">=5") +
WorksheetFunction.CountIfs(Columns(51), "PT", Columns(54), age, Columns(46), "M", Columns(48),
">=5")
Sheets("TermPT").Select
Cells(i + 2, 63).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 64).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i

```

' Counts for females with 5+ years service.

For i = 1 To 42 'counts term

age = 14 + i

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 67).Select
```

```
ActiveCell.Formula = age
```

```
Sheets("compilation").Select
```

```
Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(8), age, Columns(2), "F", Columns(4),
">=5") _
```

```
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(19), age, Columns(13), "F", Columns(15),
">=5") _
```

```
+ WorksheetFunction.CountIfs(Columns(29), "PT", Columns(30), age, Columns(24), "F", Columns(26),
">=5") _
```

```
+ WorksheetFunction.CountIfs(Columns(40), "PT", Columns(41), age, Columns(35), "F", Columns(37),
">=5") _
```

```
+ WorksheetFunction.CountIfs(Columns(51), "PT", Columns(52), age, Columns(46), "F", Columns(48),
">=5")
```

```
Sheets("TermPT").Select
```

```
Cells(i + 2, 68).Select
```

```
ActiveCell.Formula = Count
```

```
Sheets("compilation").Select ' Counts other
```

```
Count = WorksheetFunction.CountIfs(Columns(7), "PT", Columns(3), age, Columns(2), "F", Columns(8),
"", Columns(9), "", Columns(10), "", Columns(4), ">=5") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(9), age, Columns(2), "F", Columns(4), ">=5") + WorksheetFunction.CountIfs(Columns(7), "PT",
Columns(10), age, Columns(2), "F", Columns(4), ">=5") _
```

```
+ WorksheetFunction.CountIfs(Columns(18), "PT", Columns(14), age, Columns(13), "F", Columns(19), "",
Columns(20), "", Columns(21), "", Columns(15), ">=5") + WorksheetFunction.CountIfs(Columns(18),
```

```

"PT", Columns(20), age, Columns(13), "F", Columns(15), ">=5") +
WorksheetFunction.Countifs(Columns(18), "PT", Columns(21), age, Columns(13), "F", Columns(15),
">=5") _
+ WorksheetFunction.Countifs(Columns(29), "PT", Columns(25), age, Columns(24), "F", Columns(30), "",
Columns(31), "", Columns(32), "", Columns(26), ">=5") + WorksheetFunction.Countifs(Columns(29),
"PT", Columns(31), age, Columns(24), "F", Columns(26), ">=5") +
WorksheetFunction.Countifs(Columns(29), "PT", Columns(32), age, Columns(24), "F", Columns(26),
">=5") _
+ WorksheetFunction.Countifs(Columns(40), "PT", Columns(36), age, Columns(35), "F", Columns(41), "",
Columns(42), "", Columns(43), "", Columns(37), ">=5") + WorksheetFunction.Countifs(Columns(40),
"PT", Columns(42), age, Columns(35), "F", Columns(37), ">=5") +
WorksheetFunction.Countifs(Columns(40), "PT", Columns(43), age, Columns(35), "F", Columns(37),
">=5") _
+ WorksheetFunction.Countifs(Columns(51), "PT", Columns(47), age, Columns(46), "F", Columns(52), "",
Columns(53), "", Columns(54), "", Columns(48), ">=5") + WorksheetFunction.Countifs(Columns(51),
"PT", Columns(53), age, Columns(46), "F", Columns(48), ">=5") +
WorksheetFunction.Countifs(Columns(51), "PT", Columns(54), age, Columns(46), "F", Columns(48),
">=5")
Sheets("TermPT").Select
Cells(i + 2, 69).Select
ActiveCell.Formula = Count

```

```

Cells(i + 2, 70).Select 'calculates p
ActiveCell.FormulaR1C1 = "=RC[-2]/SUM(RC[-2],RC[-1])"
Next i
End Sub

```

```

Sub CountTermPT3()
'
' Inputs expected porportions for part-time termed. Called during CountTermPT().
'
'
' Enters expected proportions from assumptions
Range("E3").Select 'male with 0 service
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,7)"
Selection.AutoFill Destination:=Range("E3:E44")
Selection.NumberFormat = "0.0000"

Range("K3").Select 'female with 0 service
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,14)"
Selection.AutoFill Destination:=Range("K3:K44")

```

Selection.NumberFormat = "0.0000"

Range("Q3").Select 'male with 1 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,8)"

Selection.AutoFill Destination:=Range("Q3:Q44")

Selection.NumberFormat = "0.0000"

Range("W3").Select 'female with 1 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,15)"

Selection.AutoFill Destination:=Range("W3:W44")

Selection.NumberFormat = "0.0000"

Range("AC3").Select 'male with 2 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,9)"

Selection.AutoFill Destination:=Range("AC3:AC44")

Selection.NumberFormat = "0.0000"

Range("AI3").Select 'female with 2 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,16)"

Selection.AutoFill Destination:=Range("AI3:AI44")

Selection.NumberFormat = "0.0000"

Range("AO3").Select 'male with 3 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,10)"

Selection.AutoFill Destination:=Range("AO3:AO44")

Selection.NumberFormat = "0.0000"

Range("AU3").Select 'female with 3 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,17)"

Selection.AutoFill Destination:=Range("AU3:AU44")

Selection.NumberFormat = "0.0000"

Range("BA3").Select 'male with 4 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,11)"

Selection.AutoFill Destination:=Range("BA3:BA44")

Selection.NumberFormat = "0.0000"

Range("BG3").Select 'female with 4 service

ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,18)"

Selection.AutoFill Destination:=Range("BG3:BG44")

Selection.NumberFormat = "0.0000"

```
Range("BM3").Select 'male with 5+ service
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,12)"
Selection.AutoFill Destination:=Range("BM3:BM44")
Selection.NumberFormat = "0.0000"
```

```
Range("BS3").Select 'female with 5+ service
ActiveCell.FormulaR1C1 = "=VLOOKUP(RC[-4],assumps!R32C1:R73C19,19)"
Selection.AutoFill Destination:=Range("BS3:BS44")
Selection.NumberFormat = "0.0000"
```

End Sub

Final Macros

All macros that were used in the final Demographic Assumptions Analysis Tool are in the attached Excel spreadsheet titled DAAT.xls.