

A Study of Women Working in the Actuarial Field

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Student's Name: Jillian Emberg
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ABSTRACT

The goal of this project is to examine how women fit into the actuarial career path and how cultural expectations, biological factors, and personal aspirations affect their experiences in the field. Dramatic changes in the profession have occurred since its emergence in the nineteenth century to become more welcoming to women who choose to enter the profession. However, despite the equalizing demographic shifts of the field, it is still a male-dominated profession. This paper attempts to analyze why some of the changes in the demographics of the field have occurred as well as explain what factors contribute to women's underrepresentation as actuarial professionals by referring to previous research regarding gender roles in mathematics, which arguably arise from both biological and sociological sources. To help tie these arguments into the specific field of actuarial mathematics, an independent survey was administered to current and former actuaries that tested their beliefs about the degree to which gender can influence success in the actuarial field, and the results were compared to existing theories about women in mathematics. The survey participants were selected using the names from the online data base ActuarialDirectory.org as well as using a list of Bryant Alums who graduated with a degree in Actuarial Sciences that was provided from Bryant's Alumni Network. The test results were analyzed using two tail t-tests, and further detail about the testing processes can be found in appendix C.

INTRODUCTION

Women have been consistently underrepresented in many math and science fields due to both perceived biological and cultural factors. These beliefs, present in both hiring managers as well as job applicants, may be preventing women from entering these fields. However, as new evidence and expectations about the role of women in the workforce are emerging, the gender gap in these fields is narrowing. This project examines these shifting gender differences in the specific field of actuarial mathematics. Research focuses on the biological differences of the male and female brains and the cultural obstacles facing women entering the field.

The actuarial profession is a diverse field. Actuaries can choose among careers in various industries including insurance, finance, and consulting. The skills that actuaries need to advance are as varied as the career itself. An aptitude in mathematics is undoubtedly the most critical factor in determining one's ability in the field. However, other skills are necessary to become a successful actuary.

In the insurance industry, actuaries are so influential that they have the ability to reach the highest levels of management within their companies. Edmund Kelly, for example, started out as an actuary at Liberty Mutual and is now CEO of the Fortune 500 company. Therefore, actuaries working in insurance who demonstrate strong leadership skills experience remarkable opportunities for advancement. When entering the financial side of the actuarial profession, it is crucial to be able to make decisions that are logical and rational under stressful situations. A consulting actuary must have adept interpersonal skills and know how to interact and communicate with clients.

Women, as it turns out, have strong abilities in these areas of skill needed for the actuarial profession. Women generally perform well in leadership positions because, according to research, they typically value cooperation and altruism, which increases their responsiveness and concern when placed in management positions (Nelson, 10). These attributes also assist women's communication skills, as their cooperation skills make them more likely to engage in talk that aims to increase social connection and therefore increase connectivity and

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collaboration among coworkers (Carli, 70). Gender studies conducted in recent years have also shown that women are less risk-averse than men, less prone to overconfidence and tend to focus more on a long-term perspective than men, which often leads to more rational decision making (Nelson, 3). Combined with women's mathematical talent, which has been consistently proven to be equal with men's, women have the potential to succeed in the many functions entailed in the actuarial profession. However, demographics of the field show that women are underrepresented as actuaries, and suggest that some combinations of factors are inhibiting women from reaching their potential in the actuarial field.

WOMEN IN THE ACTUARIAL FIELD – AN AMERICAN PERSPECTIVE

The actuarial career path has remained consistently male dominated in the United States. In 1910, women made up just ten of the 286 actuaries in the country (Adams, 269). A publication from the 1920s quotes a female actuary stating that “[s]ome insurance companies are willing to take a small number of picked young college women into their actuarial departments for training, but such opportunities are limited” (Adams, 269). These limited opportunities continued for decades. In 1947, women accounted for 13 of the 562 Fellows and 11 of the 301 Associates in the U.S. (Zapoleon, 17).¹ Around this time, another prominent female actuary remarked, “A woman can succeed in this field, but she has to be 50 percent better than her nearest male counterpart to do it” (Zapoleon, 17). A decade later, in 1957, women still only made up 25 of the 1,000 or so actuaries employed in the country (Braley, 54). In 1960, women made up 2.2% of SOA members², and their representation rose to just 2.6% in 1970. Even in 1978, as women began to gain more prominence in the workforce, they accounted for just 5.8% of SOA members, which although showed improvement, still demonstrated a strong possibility of gender discrimination in the actuarial

¹ Associate and Fellow are designations assigned to actuaries based on criteria set forth by the Society of Actuaries. The SOA requires an actuary to have passed five preliminary exams and to have had five or more years experience before becoming an ASA. FSA requirements vary depending on the actuarial track chosen and require additional exams, modules, and more years experience before receiving the designation.

² SOA membership is open for anyone who is pursuing actuarial studies, and membership is determined by the Board of Directors. The organization targets actuaries who are pursuing attainment of their ASA (Associate of the Society of Actuaries), CERA (Chartered Enterprise Risk Analyst), or FSA (Fellow of the Society of Actuaries). These designations are determined by the amount of education and the number of exams passed.

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field (Milnes, 5). As an SOA publication from 1980 noted, it was common for female actuaries to not be taken seriously and be mistaken for secretaries.

Despite these adversities, prominent female actuaries have had an impact in the field and have paved the way for future generations of aspiring women. Lucy Jane Wright is the first recorded female actuary in the U.S., and was hired by Union Life Insurance Company in Portland, Maine in 1866 (The Actuary, 4). Since then, women have progressed in the field and managed to hold leadership positions in times of obvious discrimination and significant underrepresentation. In 1921, Estella King became the first woman admitted to take an actuarial examination. Anna M. Rappaport became the first woman elected treasurer of the SOA in 1974 and Barbara J. Lautzenheiser became the first woman elected Vice President of the organization in 1978. (Milnes, 5)

Even more encouraging, the gap between men and women in the field is narrowing. Currently, women make up about 30% of the SOA members, which is about five times greater than their percentage just a few decades ago (Eckart). Furthermore, in 2008 women received 38.92% of the Bachelor's degrees in actuarial statistics nationwide. Surprisingly, women have even outnumbered men in the number of Master's degrees received in certain years. In 2004, for example, women received an astounding 60.71% of the master's degrees in actuarial sciences. Here at Bryant, women nearly equal men in enrollment, currently making up 47% of the actuary majors in the undergraduate program (Jones). These statistics become even more encouraging when considering that in the overall student body, women are underrepresented at Bryant, comprising just 40% of students. Thus, females are actually more represented in the actuarial program than they are in the school overall. These numbers are promising and show that women have made great strides. However, despite approaching equality with men at the academic level, women are still outnumbered in the American workforce.

WOMEN IN THE ACTUARIAL FIELD – A GLOBAL PERSPECTIVE

Women's success in the actuarial field varies greatly around the globe, supporting the argument that socio-cultural factors affect women's level of actuarial representation. The demographics of the actuarial field in many parts of the world are much less favorable for women than the conditions observed in the U.S., where women's rights in the workforce are heavily valued relative to other nations.

In Sri Lanka, for example, there are very few actuaries in general, but as of 2011, there was just one female Associate Actuary in the entire country. This title belongs to Saroja Gunetilleke, who graduated with a degree in mathematics from the University of Manchester before going on to receive her Masters in actuarial science from the University of Kent in the UK. As of 2011, Gunetilleke had completed all 15 exams necessary to receive her Fellowship and simply needed more experience before being able to receive the Fellowship title (Mascarenhas).

In 2010, women accounted for just 15% of Fellow members of the Actuarial Society in South Africa. Not surprisingly, women in South Africa are receiving fewer degrees in actuarial sciences than are men, accounting for 36.6% of the actuarial students in 2011. However, the outlook for female actuaries in South Africa has improved over the years and will most likely continue to progress. In the 1980s, women accounted for just 2% of actuaries in the country, showing how remarkably the demographics have improved over the past few decades. Additionally, in 2003, Janina Slawski became the first female President of South Africa's Actuarial Society, a groundbreaking feat proving that capable female actuaries can be successful, despite being so heavily outnumbered (Dreyer, Ramjee, and Sibiya).

In Korea, the first female actuary did not emerge until 2009, when Cho Eui-joo was hired by the Prudential Life Insurance Company of Korea. Cho decided to start studying to become an actuary after realizing that there were no other female actuaries. Her pioneering success in the field has led her to be named one of the "70 Power Women" by the Ministry of Gender Equality (Chosun).

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In Australia, women weren't even allowed to sit for exams until 1920, and it was not until 1971 that a woman gained her Fellowship (Bellis). This achievement can be credited to Catherine Mary Prime, who went on to be named "Actuary of the Year" and to become President of the Institute of Actuaries in Australia in 1991 (Pollard). Despite Prime's success, women remained underrepresented in the field overall. Even in 2002, women only made up 17% of Fellow members in Australia (Dreyer, Sibiya, and Ramjee).

When analyzing women's limited numbers in the actuarial profession, it is important to keep in mind the range of success achieved throughout the globe. This highlights just how important culture can be. Furthermore, the great success of the few women who do manage to break into the field in these countries emphasize that is more likely culture, and not women's capabilities, that are limiting their entrance into the actuarial field. However, it is still necessary to consider all factors contributing to women's underrepresentation, including possible biological factors.

DIFFERENCES IN THE MALE AND FEMALE BRAIN

For generations, false information about the female brain has been accepted by society, leading many to believe that women are less intelligent than men and that they are especially inferior to men in the areas of math and science. However, as revelations about the female brain are emerging, these stereotypes are becoming outdated and women's intellectual capabilities are finally being recognized.

Adding to these arguments are the discussions distinguishing sex and gender. Sex is defined as the biological attributes that make someone male or female. Characteristics caused by sex are innate. Gender, however, is categorized by the properties that identify an individual as a man or a woman. Gender is different from sex in that it is not inherent, but is learned. Gender identification is influenced by societal factors, while sex is based solely on biological characteristics. For the purposes of this paper, gender is particularly important, because it is the combination of the biological and societal factors (i.e., gender) that is responsible for affecting women's career decisions.

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As more understanding of the male and female brain surfaces, it is becoming clear that there are far more similarities between the genders than previously thought. In fact, more than 99 percent of male and female genetic coding is exactly the same (Brizendine, 1). However, differences between men and women still exist. These differences do not make one gender superior to the other, but allow each gender to have unique strengths to apply in the workforce.

The female brain has a larger hippocampus than the male brain, which means that women have higher levels of emotion and memory formation than men. Additionally, women have more brain circuitry in the areas that control language and observing emotions (Brizendine, 5). These increased abilities in communication and memory, in addition to equal mathematical capabilities, give women the cognitive requirements they need to be just as successful as men in the actuarial field.

It is important to note, however, that these brain differences cannot be attributed exclusively to biological factors. It is possible that socio-cultural forces have an effect on brain circuitry and development, thereby contributing to the differences in men's and women's brains. A major topic of sociological and psychological discussion revolves around this very argument. It is unknown whether innate biological differences cause the brains to form in certain ways, which then affects how the different sexes operate in society, or whether it is how each gender is treated in society that causes their brains to develop as they do.

Although it is true that the male brain is larger than the female brain, there is no difference in intellectual ability as was believed in the nineteenth century. The female brain, though smaller, contains just as many brain cells as the male brain, and is simply more densely packed to fit into a smaller skull, providing scientific evidence that just because women are generally smaller than men, this is not a grounds for justifying women's intellectual inferiority to men (Brizendine, 1).

Research has confirmed this notion that men and women are equally intelligent, even when it comes to mathematics. Researchers have been studying the differences between men's and women's mathematical skills for years, and the results seem to consistently conclude

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equivalence. Recent combined studies on mathematical abilities that span 242 articles and include statistics on 1,286,350 people reveal that there is no significant difference between men's and women's mathematical talent at any age (University of Wisconsin-Madison, Science Daily). Results of mathematical tests have repeatedly shown that women perform as equally well as men (University of Michigan, Science Daily).

However, this equality does not seem to hold at the highest levels of mathematical abilities. In the top 1% of scores for the mathematic section of the SATs, men outnumber women 2 to 1, and this gap grows to 7 to 1 at the top .1% of the distribution (Ceci and Williams, x). Additionally, men's math results often have a greater variance than women's scores, meaning that their scores vary much more significantly. One argument for this is that men may have greater spatial ability than women which increases their mathematical abilities at the top levels. In fact, studies have shown that women who are given male hormones become better at mental rotation and math skills (Ceci and Williams, 13). It has even been shown through EEG studies that men and women approach spatial tasks very differently. Male brains perform more asymmetrically, meaning that they use the right hemisphere of their brain while female brains access both hemispheres when performing spatial tasks (Penner, S143). Despite the differences in brain functions, it is important to remember that it is unknown to what degree the differences in brain function are caused by biological factors or by socio-cultural factors, and that it is likely cultural factors, combined with brain differences, that are responsible for these large discrepancies in gender performance.

Nonetheless, even taking into account men's superior mathematical ability in the extreme right-tail of the distributions of math scores, men should not comprise such a vast majority of mathematical professionals, especially in the actuarial field, which, although math-intensive, does not require one to reach the top 1% of the distribution.

Interestingly, women outperform men in both high school and college. Additionally, when looking at academic performance, women show the same level of motivation as men, have greater self-discipline than men, and are receiving Bachelor's and Master's degrees at comparable rates to men (Hyde, Shibley, and King 365; Ceci and Williams, 32). As noted earlier this even holds true for degrees in actuarial mathematics. However, women are still

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underrepresented in the profession, demonstrating that factors beyond cognitive ability are hindering their success as actuaries.

SUPPORT FOR SOCIAL AND CULTURAL EFFECTS

Despite women's ability to gain equality in the overall workforce, they are still struggling in their pursuit of equality in math and science related fields (Penner, S139). While there are valid arguments that differences in male and female cognitive abilities contribute to this gender discrepancy, it is clear that various social and cultural factors are somewhat responsible for hindering their potential.

The argument for social effects on women's mathematical abilities is supported by a 2008 study conducted by Andrew Penner. This study tested the mathematical skills of men and women throughout the world and found a high degree of variation in performance from country to country. The study contradicted the widely held beliefs that men always have greater variance in their mathematical skills and that women are always underrepresented in the upper right tail of the distribution. While these beliefs hold true for the United States, they do not apply in other countries. In Germany, Lithuania, and the Netherlands, for example, women's math scores have a greater variance than men's (Penner, S151).

Additionally, the distributions of women's scores vary greatly from country to country. In Austria, Israel, Russia, Slovenia, and South Africa, women were better represented in the 90th percentile than they were above the 75th percentile. In other countries, such as France, gender differences remained stable at both the top and bottom extremes of the distribution, while women were underrepresented in both of the extremes in Hungary, while in other countries, such as the Czech Republic, women outnumbered men in both extremes (Penner, S154).

The study also proved that gender differences in math at the bottom of the distribution is affected mostly by gender differences in education, labor representation, and labor force equality, while gender differences at the middle and top of the distribution is influenced by women's representation in the labor force and labor force equality (Penner, S158).

Additionally, women performed more equally with men in countries where women are less

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associated with home and children, and where there is greater gender equality in education and in the labor force (Penner, S158). Overall, Penner's study showed that because there is such a significant difference in how women's math scores compare to men's throughout the world, the social effects on women's mathematical abilities are extremely influential and cannot be ignored.

OBSTACLES FOR WOMEN

Despite women's proven skills in the areas of math and science, men continue to outnumber women in these fields. One major argument for this is that culture tends to push boys into these professions while driving girls away. Many parents and teachers have held on to the stereotype that men are better than women at math (University of Wisconsin-Madison). As a result, boys are taught at a young age that they will excel in math, while girls are not. When girls grow up being taught that they are inferior to boys in math, it makes them doubt their abilities to be successful in the field and makes them far less likely to pursue such a career (Jacobs, 90).

Parents reinforce gender stereotypes by providing more support to their sons than to their daughters when it comes to nurturing their mathematical inclinations. Recent studies show that parents buy their sons more math and science toys than they do their daughters in addition to spending more time on math and science activities with them. This makes young boys more confident in their mathematical skills than their female counterparts and strips girls of the motivation to do well in math (University of Michigan, Science Daily).

It has been shown that women are more successful in math in countries where gender equality is more heavily emphasized, suggesting that culture plays a critical role in determining women's influence in mathematical careers. Many scientists now agree that if given the same attention and education as boys, in addition to strong female role models, women could achieve equality with men in math (Association for Psychological Science, Science Daily).

Unfortunately, cultures in the United States and in some other countries continue to devalue women's potential in mathematics. The idea of gender essentialism, which states that males

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and females are interested in and better suited for different areas of study and work, still exist (England and Li, 660). Essentialist beliefs state that the differences between the genders are biological, and although often inaccurate, these beliefs are widely held by both children and adults in the United States (Smiler and Gelman, 865).

The roles that women are qualified for are considered less desirable than men's roles. When women gain prominence in a given field, the value of this field declines (England and Li, 658). This notion is supported by evidence that women are more likely to try to enter traditionally masculine occupations than males are to try to break into traditionally feminine occupations (England, 150). It is likely that this fact is partially attributable to feminine jobs being underpaid relative to masculine jobs, even when these jobs require equal amounts of work (England, 153).

Women avoid mathematical careers in particular because they mean entering a male-dominated, traditionally "unfeminine" environment. A recent study has shown that when placed in male-dominated fields, women's mental health may suffer as they face gender stereotypes and increased scrutiny (Gardiner and Tiggermann, 303). Gender essentialism contributes to these unpleasant stereotypes, as essentialism has been shown to correlate with the formation and justification of stereotypes (Smiler and Gelman, 864). These resulting stereotypes place stress on women, making them feel as if they cannot escape from being judged based on their gender, a phenomenon that Claude Steele describes as stereotype threat.

Steele argues that we are all born with identities that make it impossible to avoid categorization, leading to obstacles based on these given social identities known as identity contingencies (Steele, 3). Stereotype threat, Steele argues, is a particular kind of identity contingency that puts us under constant pressure because we are being continually judged on what degree we adhere to or veer from stereotypes about our identity (Steele, 4). The effects of stereotype threat are so strong that they can affect the math performances of women who feel threatened by the stereotype that their mathematical skills are inferior to men's. These stereotypes are difficult to escape because they exist explicitly and implicitly. Explicitly, women may doubt their math skills because of their gender. Implicitly, they may reject this belief, but still have a tendency to associate math with men more than they would with

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women (Kiefer and Sekaquaptewa, 13). A study conducted in 2007 revealed that women's math scores and desires to pursue mathematical careers suffered when either implicit or explicit stereotypes were present, and that in order to eliminate stereotype threat, both factors would have to be absent (Kiefer and Sekaquaptewa, 16).

Numerous studies have revealed how important is to recognize the effects of stereotype threat because of how strongly it can affect women's math performances. One study, conducted by Micheal Inzlicht and Avi Ben-Zeev, showed that women's performances on math tests suffered by even just having a man present in the testing room, and that as the number of men present increased, the more women's scores were lowered (referenced in Steele, 143). These results are particularly troubling to women working in the actuarial profession. If the results Inzlicht's and Zeev's test transfer into the workforce, women's performances in the actuarial profession may suffer because of the pressures they feel from trying to advance in such a male-dominated work environment.

Another study, conducted by Paul Davies and Steve Spencer revealed that being shown video clips of women acting in gender stereotypically ways affected not just women's math performances, but their decisions to pursue mathematics. After being shown the stereotypical videos, women reported being less interested in pursuing math-related careers, and performed worse on math problems than women not shown these images (referenced in Steele, 144).

It has also been shown that, unfortunately, women do generally accept these harmful beliefs that they are inferior to men in math and science in the real world as well. A survey conducted at Stanford University of Science, Engineering, and Medical Students showed that women are much more likely than men to doubt their own judgment, believe that speaking will reveal their inadequacies, question their abilities in their chosen fields, and doubt their abilities to negotiate their needs. Another study showed that women are more likely than men to underestimate their grades in undergraduate courses and less likely to overestimate them. (Nolan, 269). Additionally when told that they are inferior to men in mathematics, women's scores on math examinations are lowered (Penner, S145). All of this suggests that women believe in the cultural notions that they are inferior to men and are therefore more likely to doubt their abilities in math and are thus less likely to succeed in these fields.

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Some propose that women pursuing mathematics face additional stress because they feel as if they must sacrifice their female identity to do so (Association for Psychological Society). This is because STEM fields tend to promote values associated with men, such as intense competition, assertiveness, anonymity, and an obsession with winning. They also tend to ignore female values such as cooperation, interdependency, democracy, concern for others, and the minimization of stress (Ceci and Williams, 45). Because these values are not emphasized in the mathematical pursuits, women in advanced math classes often feel as if their feminine characteristics cause them to not be taken seriously and to have their performances scrutinized (Steele, 31). In some cases, women feel as if they must make a choice between their feminine identity and mathematical talent. One study showed that girls taking higher level math classes are willing to act less intelligent around their male peers because they feel threatened that success in the field will contradict with their female identity (Mukhopadhyay, 463).

The underrepresentation of women in math can also be explained by women's personal decisions to pursue aspirations that do not align with careers in these fields. As with many other professions, women may choose not to pursue a career as an actuary so that they can maintain a family life. Even in today's society, it is especially difficult for women to balance a work life with a family life (Kopecki). Statistics show that on average, women work fewer hours than men, arguably due to the fact that they value family needs over career needs (Ceci and Williams, 34).

The role of women in the workforce and the household has shifted significantly in the 1970s and 1980s for it to become more standardized and acceptable for women to enter the workforce and to not simply be stay at home moms. However, the rate of such growth has slowed in the 1990s, possibly as a result of what is known as "egalitarian essentialism", which attributes the choice to be stay at home moms to the combination of both feminist equality and traditional gender roles. In the 1990s, women were more progressively choosing to have both careers and raise families, leading to overwhelming responsibilities that forced women to make a choice between their careers and their families. It is at this same time that the idea of egalitarianism was added to this argument, which recognized that women who were choosing

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to be stay-at-home moms had the power to make this determination. Additionally, in the 1990s, the role of motherhood was elevated so that being a stay-at-home mom was recognized as an admirable and difficult feat that was as respectable as pursuing a career. In this sense, women who choose to be stay at home moms are not victims of sexism or should even feel confined by gender roles, but are willingly entering into an admirable path of motherhood (Cotter, Hermesen, and Vanneman). This means that women, even in today's environment of gender equality, are still likely to choose motherhood over professional careers.

Another factor contributing to women's underrepresentation is women's inclination for communication, which makes them less likely to pursue careers where they would work mostly in solitude, as would occur in most mathematical professions (Brizendine, 7). Perhaps the lack of communication traditionally found in an actuarial job can explain, at least partially, why women are 2.8 times more likely than men to leave Science, Technology, Engineering and Mathematic (STEM) fields to pursue other occupations (Ceci and Williams, 7).

ADMINISTRATION OF ACTUARIAL SURVEY

To gain a more targeted perspective on women in the actuarial field, a survey was administered to both males and females who pursued a career in the actuarial profession. Actuaries were chosen by randomly selecting contacts from the Actuarial Directory (available at ActuarialDirectory.org), as well as using a list of Bryant University alums who graduated with a degree in Actuarial Science provided by Bryant's alumni network. The selected participants came from a variety of backgrounds and represented an assortment of industries, educational backgrounds, and years of experience in the field. The survey was divided into those who are currently working in the actuarial field, those who have left the field, and those who never entered the field. The survey was taken by 245 individuals and included both quantitative and qualitative measures to draw comparisons between male and female actuaries and to attempt to find possible explanations for why women are underrepresented in the actuarial profession. A copy of the survey can be found in Appendix C.

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Of the 245 actuaries who responded, 212 are still currently in the actuarial field. Only 24 respondents are former actuarial employees who have left the profession, and just nine of the survey takers have never been employed in the actuarial field. Because the later two surveys yielded such small results, the data could not be adequately analyzed using quantitative analysis.

QUANTITATIVE ANALYSIS OF SURVEY DATA

Of those who are currently working in the field, 105 females and 107 males accounted for the total 212 participants. These participants were asked to rank criteria on a scale of 1 to 5, with 1 meaning “Strongly Disagree”, 2 meaning “Disagree”, 3 meaning “Neither Agree nor Disagree”, 4 meaning “Agree”, and 5 meaning “Strongly Agree”. The goal of this part of the survey was to measure quantitatively if there was any difference in how men and women view their roles in the actuarial profession based on what they have experienced throughout their careers.

To interpret the data, the results were analyzed statistically using independent two-tail t-tests comparing male and female responses. The null hypothesis for each test was that the average response for females was equal to the average response for males and was tested with a two-tailed alternative. The hypothesis was rejected for p-values less than 0.05. A detailed look of the t-tail tests and the mathematical results can be found in Appendix C. Overall, males and females answered similarly throughout the survey, with most questions showing no significant difference between male responses and female responses, suggesting that the two genders share a common outlook on the profession and have received similar treatment.

When asked to rank the comprehensive statement “I am satisfied with my career”, there was no statistically significant difference between male and female responses, with an overall average value of 4.443 for all respondents. When analyzing the other survey responses, it is easy to understand why women feel such great satisfaction with their careers in the actuarial profession. Looking at the opportunities for success and advancement within the profession, for example, the total average of all respondents came out to 4.443, with the average for women showing no significant difference from that for men.

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Women also agree, on comparable levels with men, that their inputs and opinions are valued by co-workers with no significant difference from men, with the average of both genders being 4.184. Additionally, women believe, with no significant difference from men, that they receive reinforcement for their achievements, which yielded an overall average of 3.915. They even agree more than men that they feel a sense of camaraderie with co-workers, with an average score of 4.229, which is significantly greater average than the male average of 3.981 and produces a p-value of 0.032. Women also agree on comparable levels with men that they have experienced adequate levels of social interaction in the workplace, with an overall average of 4.236, contradicting the argument that women may be leaving the profession because their jobs are not social enough.

The survey results also contradicted the notion that women are underrepresented in the actuarial profession because they feel threatened when entering a male dominated environment. Both men and women disagree that they even believe women are underrepresented in the actuarial profession. Men and women answered the prompt “Overall, I believe women are underrepresented in the actuarial profession”, with an overall average score of 2.637, with no statistically significant difference between men’s and women’s responses.

Interestingly, however, there was a statistically significant difference between men’s and women’s responses for the underrepresentation of women only when evaluating the underrepresentation of women among upper level employees. However, neither gender strongly agreed that women are underrepresented, even among upper level employees, with the average of female responses being 3.30 and male responses being 2.80, resulting in a significant p-value of 0.002. This all suggests that in general, women working in the actuarial profession do not feel as if they are underrepresented, which may ease the pressures associated with entering a male-dominated environment.

To compare perceived differences in the representation of women at the lower level and the upper level of employment, paired t-tests were used. It is interesting to note, that a significant difference was found when looking at perceived underrepresentation of women among lower level employees, which averaged 1.698 and perceived underrepresentation of women among

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upper level employees, which averaged 3.0472, resulting in a p-value of 0.00. Studying these values shows that actuarial employees believe that women became noticeably less represented as you move up the ranks of the actuarial profession.

Another argument challenged by the survey data was the idea that women are less confident in their abilities to succeed in mathematical fields. When asked to rank the statement “I believe I have strong mathematical and problem solving abilities” women agreed that this is true with an average not significantly different from the male average. Thus, this idea that women believe they are inferior to men when it comes to math does not seem to be true, at least for women who are pursuing a career in actuarial math. However, it may be the case that women working in the actuarial field have more confidence in their abilities than women in the general. This is a plausible hypothesis, since only women who believe they are mathematically gifted would pursue a career in actuarial math in the first place.

When asked outright whether they believed they received either preferential or unfair treatment in their careers due to gender, both males and females disagreed with both of these statements. Males and females responded, with no significant difference, that they disagree with having received preferential treatment, with an overall average of 1.585. Males disagreed to receiving unfair treatment in their careers with an average score of 1.458. Females answered this question with an average score of 1.876. Although low, this score was significantly higher than the male responses, with a p-value of 0.001. Therefore, it appears that although female actuaries believe they are receiving more unfair treatment due to their gender relative to male actuaries, they still disagree overall that gender discrimination is occurring in the field.

QUALITATIVE ANALYSIS OF SURVEY DATA

Qualitative results of the survey yielded similar conclusions that discriminatory practices against women in the actuarial profession are not occurring. Participants in the survey were asked to describe any additional comments they may have about how gender may affect one’s success in the actuarial profession. Many of the comments in this open-ended section of the

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survey explained that opportunities for advancement in the actuarial profession are equal among men and women.

Advancement in the actuarial profession is based largely on examination process³. As many of the respondents explained, because the field relies on a measure as objective as the number of exams passed, gender has less of an opportunity to have an effect on advancement and makes the actuarial field “gender neutral” or “gender blind”. As one respondent commented, “The exams are a great equalizer. Once you pass them, you will be given many opportunities regardless of your gender”.

In fact, some of the survey respondents seemed to believe that female actuaries may actually be at an advantage. Although men and women reported no significant difference in receiving preferential treatment in their career due to their gender, some of the respondents thought otherwise when considering hiring practices. A few comments suggested that because fewer women are choosing to enter the field, those that do may be more attractive to employers.

Another common theme among the responses was that the field has changed to become more welcoming to women over the years. Those who have been in the profession and seen how it has shifted over the years noted that the demographics of the field have become more equal than they were in the 1970s, and have even shown noteworthy improvement over just the last decade. Perhaps that is why, in today’s work environment, female actuaries are just as satisfied with their careers as their male coworkers, receive equal amounts of reinforcement for their achievements, and believe just as much as men that their inputs and opinions are valued.

If, as the survey suggests, gender discrimination is a non-issue in the field, then there must be another explanation for the underrepresentation of women, especially among upper-level employees, where the survey reports women being significantly more underrepresented relative to lower-level employees. A common belief as to why this is happening is that

³ The actuarial exams are administered using computer-based and pencil and paper examinations. The exams are scored on a scale of 1-10 and the pass rates vary by exam, depending upon the overall performance of each administration and the nature of the exam. The exams are graded anonymously, and many use multiple choice questions, making the scoring of the exams completely objective.

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women are making personal choices to not enter or to leave the field, most of the time due to a commitment to family and raising children. One of respondents said on this matter, “The exam process is grueling and time consuming over a period of many years. I believe it is harder for women to continue through to Fellowship once they become mothers than it is for men once they become fathers”.

Managing both an actuarial career and a family may become more difficult the further the career progresses. One respondent commented, “Although in my workplace there is much equity between men and women in entry level/lower level positions, there is difficulty for women particularly as they enter the upper level exams in their late twenties to balance work responsibilities and familial responsibilities.”

Surprisingly, male and female respondents showed no significant difference in the difficulty they have with balancing their work demands with their family demands. A few respondents even noted that the actuarial profession, relative to other careers, actually makes committing to both responsibilities manageable. This is mainly thanks to the examination process, which makes it easier for working moms who have left the field to reenter, thanks to the enduring credentials that passed exams give actuaries. If an actuary receives his or her Associates or Fellowship, this accreditation will remain valid regardless of how many years taken off from the profession. It seems, then, that women’s underrepresentation in the actuarial profession is not caused by discrimination or even by conflict from women’s commitment to family life, but is actually caused by women making personal and voluntary choices to, for some reason, abandon their pursuits of a career in the actuarial profession.

CONCLUSIONS

The results of the survey can lead to two outlooks on the future of women in the actuarial profession. The results can be interpreted optimistically, as gender discrimination does not seem to be occurring in the actuarial profession. However, the results can also lead to some troubling questions as to why women continue to be outnumbered, given that discrimination is not preventing them from becoming successful in the actuarial field.

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On a positive note, the study showed that the actuarial profession is welcoming to both genders and provides equal opportunities for men and women to progress in their careers. A career as an actuary gives women flexibility, job satisfaction, and a chance to prove themselves as valuable workers and leaders. Additionally, the demographics of the field have become considerably more equal than they were just a few decades ago. Because the actuarial profession provides such a promising and satisfying work environment for male and female employees alike, it is expected that the demographics will continue this trend of approaching gender equality.

Despite the welcoming environment, however, women remain underrepresented in the profession, still comprising just 30% of SOA membership. The reasons for this are baffling, especially when recalling that men and women are pursuing degrees in actuarial sciences at near equal levels. The ratio of females to males receiving bachelor's degrees has hovered around 40:60 for the past few years, while women have even outnumbered men in the amount of master's degrees received in some years.

Women must be making choices somewhere along their professional pursuits to abandon their careers. It may be that more women than men who receive degrees in actuarial sciences are choosing not to seek employment in the actuarial field. Another cause could be that women who have started actuarial careers are more likely than men to quit, either to pursue other interests or to raise a family.

However, the survey results concluded that women are satisfied with their actuarial careers and that women do not find it particularly difficult to balance work demands with family demands. It is thus troubling and difficult to explain why women become less represented in the field the further they progress past the undergraduate level. A possible explanation could be that women who originally pursue actuarial professions eventually give up their careers for family obligations. These decisions are likely driven by societal expectations to be stay at home moms, which appears to be a more likely culprit than pressures from an actuarial career.

This idea traces back to the concept of egalitarian essentialism, which states that women who do make the decisions to be full time moms are making these personal choices themselves,

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and thus this pattern is likely to continue to occur despite the gains in equality women have made. The concepts behind egalitarian essentialism, however, must be questioned. Although it is true that women are making these choices on their own, their choices are limited, given the maternity care offered in the U.S. The United States is the one of the only industrialized nations to not offer government mandated paid maternity leave, and often, the options for new fathers are even less, making it necessary for new moms to have to stay at home and raise their newborn babies.

Additionally, there is still the possibility that discrimination is occurring in the field, but perhaps at a more subtle level. This type of discrimination cannot be discredited based on this research alone, and to make conclusions about this would require analysis beyond the scope of this project.

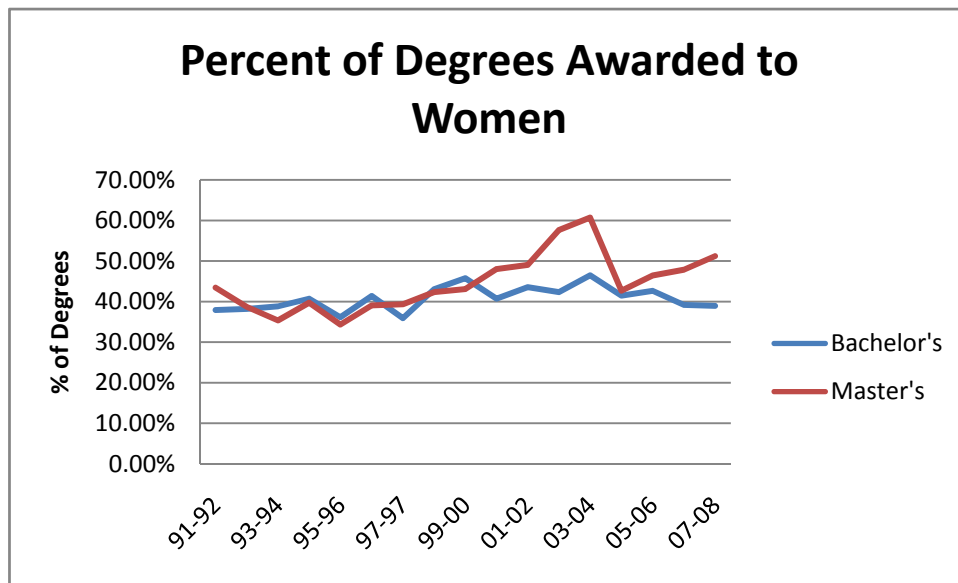
Whatever the reasoning for women's underrepresentation, diversification in the Actuarial field is extremely important. Through a combination of different biological and social influences, males and females operate differently in the workforce. Both genders have unique strengths, and it is crucial to have a combination of both male and female influences, especially in the actuarial field, a career path that is becoming increasingly significant in the economic and financial world.

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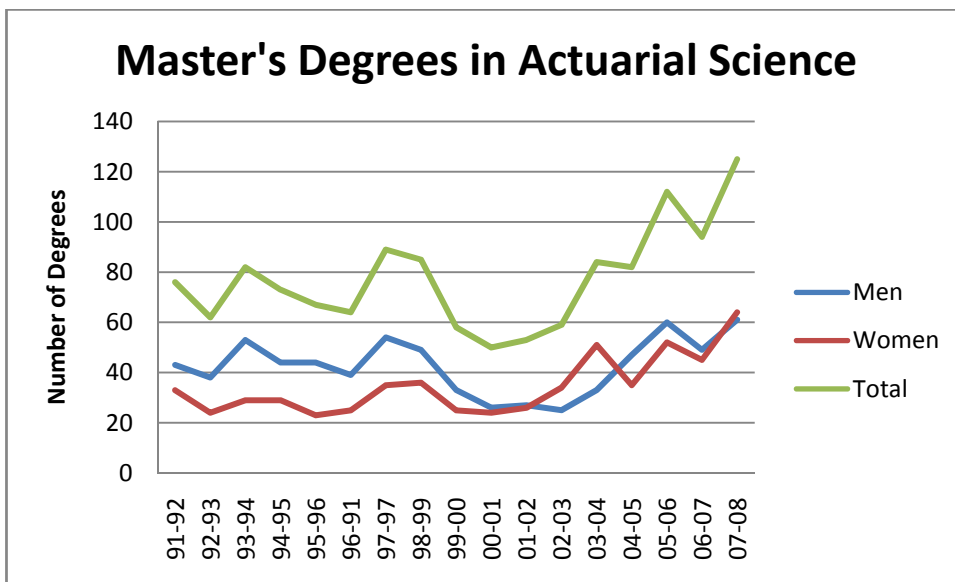
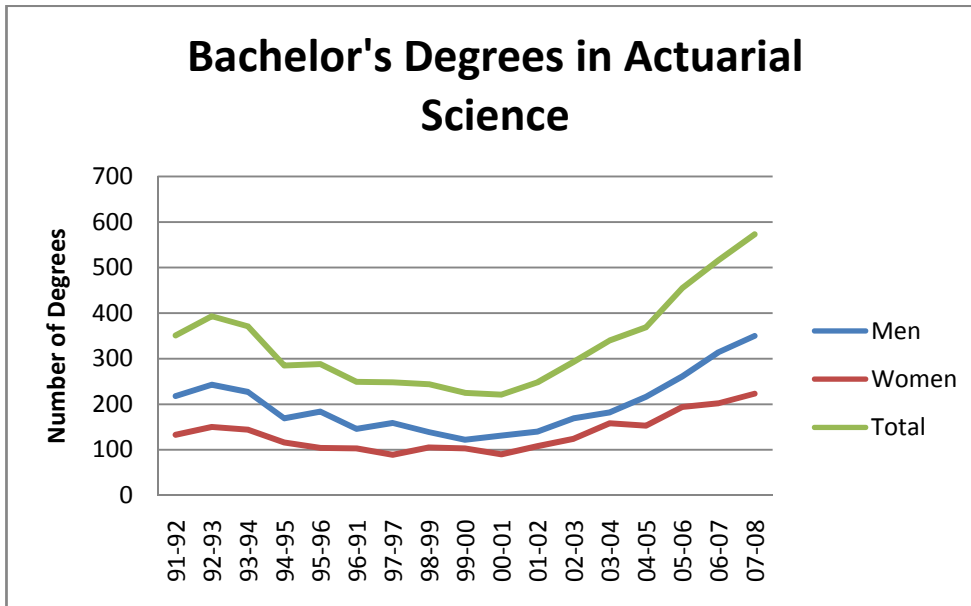
APPENDICES

Appendix A – Actuarial Science Degrees Nationwide

Year	Bachelor's Degrees				Master's Degrees			
	Men	Women	Total	% Women	Men	Women	Total	% Women
91-92	218	133	351	37.89%	43	33	76	43.42%
92-93	243	150	393	38.17%	38	24	62	38.71%
93-94	227	144	371	38.81%	53	29	82	35.37%
94-95	169	116	285	40.70%	44	29	73	39.73%
95-96	184	104	288	36.11%	44	23	67	34.33%
96-91	146	103	249	41.37%	39	25	64	39.06%
97-97	159	89	248	35.89%	54	35	89	39.33%
98-99	139	105	244	43.03%	49	36	85	42.35%
99-00	122	103	225	45.78%	33	25	58	43.10%
00-01	131	90	221	40.72%	26	24	50	48.00%
01-02	140	108	248	43.55%	27	26	53	49.06%
02-03	169	124	293	42.32%	25	34	59	57.63%
03-04	182	158	340	46.47%	33	51	84	60.71%
04-05	216	153	369	41.46%	47	35	82	42.68%
05-06	261	194	455	42.64%	60	52	112	46.43%
06-07	314	202	516	39.15%	49	45	94	47.87%
07-08	350	223	573	38.92%	61	64	125	51.20%



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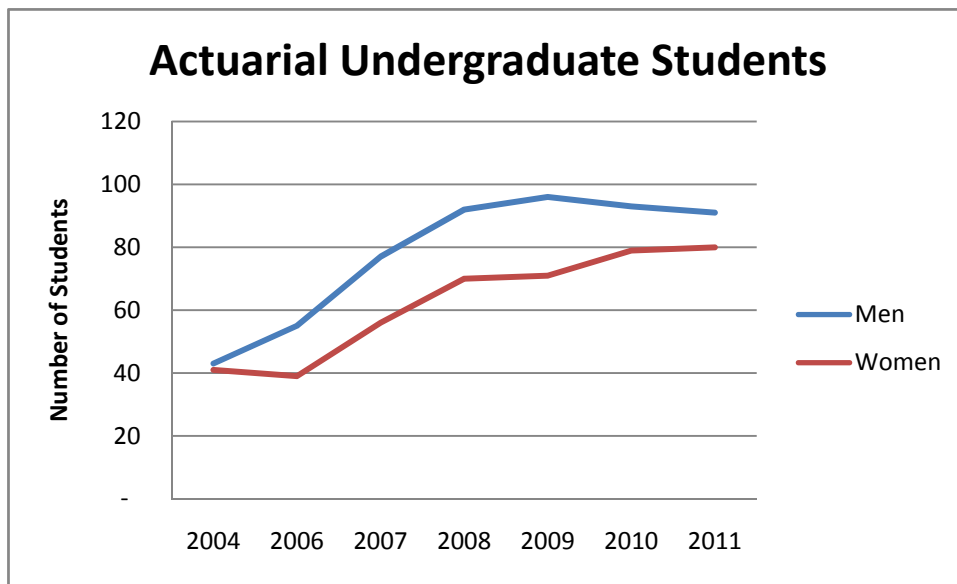
Source: Digest of Education Statistics
 Table: Bachelor's, Master's, and Doctor's
 degrees conferred by Institutions of higher
 education by sex of student and field of
 study

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Appendix B – Actuarial Mathematics Majors at Bryant

Year		2004	2006	2007	2008	2009	2010	2011
Gender	Female	41	39	56	70	71	79	80
	Male	43	55	77	92	96	93	91
Total		84	94	133	162	167	172	171

Year	%Female	%Male
2004	0.488095	51.19%
2006	0.414894	58.51%
2007	0.421053	57.89%
2008	0.432099	56.79%
2009	0.42515	57.49%
2010	0.459302	54.07%
2011	0.467836	53.22%



Source: Office of Planning and Institutional Research at Bryant University
 Contact: Robert Jones

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Appendix C – Survey Results

The following tables show the t-tail results for the survey questions. Tables 1-13 compare the averages of male responses relative to the averages of female responses using two-tail tests. When the tests resulted in a p-value less than the 0.05, the conclusion was to reject this hypothesis and to assume that there was a statistically significant difference between the female averages and the male averages. If the p-value was greater than alpha equal to 0.05, however, the hypothesis that the female and male averages are equal was assumed to be true and it was concluded that the results yielded no significant difference.

The test in shown in the last table is different from the others because it compares the total average (including both male and female data) of question 11 and to that of question 12. This required use of a paired t-test that deemed a p-value less than 0.05 to be significant.

Question	Overall Average	Female Average	Male Average	T-Value	P-Value
I am satisfied with my career	4.321	4.305	4.336	-0.340	0.736
I have experienced opportunities for success and advancement within my profession	4.443	4.410	4.477	-0.790	0.430
I have experienced adequate levels of social interaction in the workplace	4.236	4.314	4.159	-1.670	0.097
I feel a sense of camaraderie with my co-workers	4.104	4.229	3.981	2.160	0.032
It is difficult to balance my work demands with my family demands	3.038	3.143	2.935	1.330	0.185
I receive reinforcement for my achievements at work	3.915	4.010	3.822	1.670	0.097
I believe my co-workers value my input and opinions	4.184	4.238	4.131	1.100	0.271
I believe I have strong mathematical and problem solving abilities	4.382	4.419	4.346	0.780	0.438
Overall, I believe women are underrepresented in the actuarial profession	2.637	2.752	2.523	1.610	0.109
I believe women are underrepresented among lower-level actuarial employees	1.698	1.533	1.860	-2.050	0.042
I believe women are underrepresented among upper-level actuarial employees	3.047	3.295	2.804	3.180	0.002
I believe I have received preferential treatment in my career due to my gender	1.585	1.581	1.589	-0.070	0.945
I believe I have received unfair treatment in my career due to my gender	1.665	1.876	1.458	3.510	0.001

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I believe women are underrepresented among:	
<i>Lower Level Employees</i>	1.6981
<i>Upper Level Employees</i>	3.0472
<i>T-Value</i>	-12.03
<i>P-Value</i>	0.00

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Appendix D – Administered Actuarial Survey

The survey was created at SurveyBuilder.com and was sent to prospective participants via e-mail. The survey allowed participants to answer on a completely voluntary and anonymous basis.

The survey was accompanied with the following message in the body of the e-mail:

To whom it may concern,

I am a student at Bryant University in Smithfield, RI currently completing an Honors Capstone Project, working with Professor Judith McDonnell. I have gathered your contact information from the Actuarial Directory [or from Bryant's Alumni Relations] to ask if you would be willing to take a short survey to assist with this project. The goal of this survey is to examine the role that gender plays in the actuarial profession. Should you choose to participate, you may access the online survey [here](#). All surveys will remain completely anonymous.

If you have any further questions or concerns about the survey, please feel free to contact me at Jemberg@bryant.edu or Professor McDonnell at Jmcdonne@bryant.edu.

Thank you for your assistance. Your participation in this survey is extremely helpful and greatly appreciated.

The survey was divided into 3 parts: Those currently working in the actuarial field, those who left the actuarial field, and those who were never employed in the actuarial field. All three surveys stemmed from the same first page and branched out according to the participants' responses as outlined below.

Page 1:

Are you currently employed in the actuarial field?

Yes

No

- If Yes, participants were directed to *Survey 1*
- If No, participants were directed to *Page 2*

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Survey 1:

Gender

Male

Female

In what area did you receive your undergraduate degree?

Actuarial Sciences

Mathematics

Economics

Other, please specify:

In what year did you receive your undergraduate degree?

In what area did you receive your master's degree?

None (Do not have a master's degree)

Actuarial Sciences

Mathematics

Economics

Other, please specify:

Total years experience in the actuarial field

0-5 years

5-10 years

10-15 years

15-20 years

>20 years

How many actuarial exams have you passed?

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Type of actuarial work you are currently employed in

- Life Insurance
- Health Insurance
- Property and Casualty Insurance
- Consulting
- Other, please specify:

Type of actuarial work you have previously been employed in (select all that apply)

- Life Insurance
- Health Insurance
- Property and Casualty Insurance
- Consulting
- Other, please specify:

Please rank the following criteria with 1 meaning "Strongly Disagree" and 5 meaning "Strongly Agree". When answering these questions, please consider your entire actuarial career, not just what you have experienced with your current employer.

	1 (Strongly Disagree)	2 (Disagree)	3 (Neither Agree nor Disagree)	4 (Agree)	5 (Strongly Agree)
I am satisfied with my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have experienced opportunities for success and advancement within my profession	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have experienced adequate levels of social interaction in the workplace	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel a sense of camaraderie with my co-workers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is difficult to balance my work demands with my family demands	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I receive reinforcement for my achievements at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I believe my co-workers value my input and opinions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I believe I have strong mathematical and problem solving abilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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Overall, I believe women are underrepresented in the actuarial profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe women are underrepresented among lower-level actuarial employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe women are underrepresented among upper-level actuarial employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I have received preferential treatment in my career due to my gender	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I have received unfair treatment in my career due to my gender	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please describe any additional comments you may have about how gender may affect one's decisions and success in the actuarial profession.

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Page 2:

Have you ever been a part of the actuarial profession?

Yes

No

- If Yes, participants were directed to *Survey 2*
- If No, participants were directed to *Survey 3*

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Survey 2:

Gender

Male

Female

Please describe your reasons for leaving the actuarial profession

In what area did you receive your undergraduate degree?

Actuarial Sciences

Mathematics

Economics

Other, please specify:

In what year did you receive your undergraduate degree?

In what area did you receive your master's degree?

None (Do not have master's degree)

Actuarial Sciences

Mathematics

Economics

Other, please specify:

Total years spent working in the actuarial field

0-5 years

5-10 years

10-15 years

15-20 years

>20 years

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How many actuarial exams have you passed?

Type of actuarial work you were employed in (select all that apply)

- Life Insurance
- Health Insurance
- Property and Casualty Insurance
- Consulting
- Other, please specify:

Please rank the following criteria with 1 meaning "Strongly Disagree" and 5 meaning "Strongly Agree". When answering these questions, please consider what you experienced during your total time spent working in the actuarial field.

	1 (Strongly Disagree)	2 (Disagree)	3 (Neither Agree nor Disagree)	4 (Agree)	5 (Strongly Agree)
I was satisfied with my career	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experienced opportunities for success and advancement within my profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experienced adequate levels of social interaction in the workplace	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt a sense of camaraderie with my co-workers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found it difficult to balance my work demands with my family demands	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I received reinforcement for my achievements at work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe my co-workers valued my input and opinions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe I have strong mathematical and problem solving abilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I believe women are underrepresented in the actuarial profession	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe women are underrepresented among lower-level actuarial employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe women are underrepresented among upper-level actuarial employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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I believe I received preferential treatment in my career due to my gender	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I believe I received unfair treatment in my career due to my gender	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please describe any additional comments you may have about how gender may affect one's decisions and success in the actuarial profession.

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Survey 3:

Gender

Male

Female

In what area did you receive your undergraduate degree?

Actuarial Sciences

Mathematics

Economics

Other, please specify:

In what year did you receive your undergraduate degree?

In what area did you receive your master's degree?

None (Do not have a master's degree)

Actuarial Sciences

Mathematics

Economics

Other, please specify:

How many actuarial exams have you passed?

Why have you chosen not to pursue a career in the actuarial field?

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