Chapter 35
Gender and Self-Selection Among Engineering Students

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ABSTRACT

Gender and graduation rates of first time engineering college students have been analyzed as a function of academic and demographic variables in order to investigate the hypothesis that an advantage to women with respect to student success might be attributed to their socioeconomic advantages as a student population. The authors present descriptive, graphical, and model-based evidence to support their ideas about gender and self-selection driven by other demographic factors that leave a disproportionate number of women out of higher education, but create a group of female students more likely than their male counterparts to succeed.

1. INTRODUCTION

An increased graduation rate is occurring for females in colleges and universities across the United States. Over the years not only have females caught up to males in graduation rates; some studies show that more females than males are graduating in the recent years. The U.S. Department of Education stated that as of 2004 females were awarded 58 percent of all bachelor's degrees in the United States (Buchmann, 2006). Worldwide, more women than men recently graduated in 75 of 98 countries (Church, 2009). The topic of gender equality is popular in modern research. Female graduation rates are climbing, and survival analysis of the same data described in this paper showed, "the significance of standardized math test scores, gender and science ACT scores in explaining variation in student graduation under different conditions (Chimka et al., 2007-2008)."

Many studies have been conducted involving gender differences in education. A main concern is that females are achieving more diplomas than men in the United States. In 2005, females accounted for 61% of graduates and 59% of students (OECD, 2008). Females are even starting to achieve gender parity in

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performance on standardized math tests (Wente, 2008), but at least one study has showed, "males are more likely than female students to be retained, but less likely to graduate (Wohlgemuth et al., 2006-2007, p. 471)." One interesting way to explain gender differences has been to examine a student's earlier years. A study on public education states, "73% males and 27% females receive discipline referrals in elementary school (Clark et al., 2008, p. 121)." Students who are eager to learn as much as possible are generally not the students getting discipline referrals. Discipline referrals also have consequences such as detention and suspension that inhibit the ability to be present in the classroom for new material. According to the Unesco Institute of Statistics (2010, p. 1), "persistent inequalities remain in many regions and at different levels across education."

While females are having great success with a rate of degrees earned, women are still underrepresented in technical fields such as science, math and engineering. There are some popular explanations for this based on differences in topic and content of the majors. One study on degree performance actually claimed, "on the whole females are better at verbal topics and males at mathematical topics, but even among mathematical topics there are some where females excel (Kornbrot, 1987, p. 516)."

Hartman and Hartman (2008, p. 253) showed, "relative to men, women in science and engineering programs face difficulties of a largely psycho-cultural nature." The glass ceiling still exists in some regions and can discourage females from applying themselves in technical fields. A social mindset that females belong in less technical fields can influence female children's encouragement and effort in math and science even at the elementary school level. Bystydzienski and Bird (2006) examined barriers to full participation of underrepresented groups in science, and addressed how departments and universities can right the situation. Equal participation in engineering occupations is a major challenge for Europe (Arrizabalaga, et al. 2012). In most of the EU female graduates outnumber male graduates, but attraction to engineering and technology differs, where the women's share remains relatively low. Roue (2007) examined barriers for women in engineering and technology: perceived social support, other perceptions, self-efficacy and self-esteem.

The gender gap between achievements by college students might be explained by socio-economic variables. The difference in graduation rates might be explained by more varied backgrounds in the males who are attending college. Imagine four would-be students: One male-female pair from a higher socioeconomic background, and another male-female pair from a lower socioeconomic background. If three out of the four go to college or university, then it would seem the male and female from the higher socioeconomic background and just the male from the lower socioeconomic background will be college bound. Now if we were to guess what two of the three students is more likely to graduate, they would be the one woman, and man from a higher socioeconomic background.

2. MATERIALS AND METHODS

The data featured in survival analysis by Chimka and Lowe (2008), and Chimka and Wang (2009) also used here recorded University of Oklahoma (OU) students who started their freshman year in the college of engineering and were admitted directly from high school in 1995. The dataset followed the students for six and one half years, or until graduation or drop out. The data had some time varying covariates that changed throughout the years for the students. The time periods were divided into semester periods with 0 being the first semester at OU. In order to perform binary logistic regression on the data they were collapsed into one row per student (Hosmer, et al., 2013); time varying covariates were deleted,