

## DO GENDER DIFFERENCES AFFECT IN ADMISSION AND FINAL GRADES CORRELATION?

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### Abstract

Unequal gender roles and social norms impact us before the moment we are born, causing serious lifetime consequences. It is widely recognised that the academic and professional development of women is directly affected by gender bias. Because of that, women result to be still seriously underrepresented in the Science, Technology, Engineering, and Math (STEM) academic environment, which may affect their performance. Our main goal was to analyse and identify differences regarding gender before and during college education. To this end, university admission cut-off marks together with final course qualification from around 7099 students from STEM subjects were divided by terciles and analysed by gender. The 5 studied subjects were chosen from the following 5 STEM degrees: Biomedical Engineering; Technical Architecture; Aerospace Engineering; Electronic Engineering and Industrial Automation; and Mechanical Engineering. All subjects were undertaken at the *Universitat Politècnica de València*, and the compiled data covered the last 11 academic years (2011-2022). The results showed that admission cut-off marks rise from 1 to around 2 points more from 2011 to 2021. Nevertheless, the final course qualification remains constant, or slightly decreases, over time. Students from the tercile with higher cut-off marks continue to be outstanding during college evaluations. There is no difference between the lower tercile students' distributions regarding their final course qualifications. Regarding gender approaches, data show that women used to have greater cut-off marks than male students. On the other hand, when analysing the final course grades, male students show slightly higher results than women.

**Keywords:** *STEM disciplines, gender gap, gender differences, physics, cut-off marks.*

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### 1. Introduction

The university student and graduate profile in Spain is mostly female (56% and 60%, respectively). But, as in other nations, women are underrepresented in STEM (science, technology, engineering, and mathematics) (Verdugo-Castro et al., 2022). British data show that even in professions where women are overrepresented, like medical degrees, the percentage of women opting to specialise in sectors that need a solid foundation in mathematics and the natural sciences, like surgery, drops considerably (Hill & Vaughan, 2013). Sax et al. (Sax et al., 2016) analysed the percentage of female engineering majors from 1971 to 2011. They discovered that having a STEM father or good school grades boosted the probability of studying engineering, regardless of gender. The survey also revealed that activist-minded women (those who want to help others or change society) are more interested in engineering. However, women's mathematical confidence was a lesser predictor. Men with lower salaries are more likely to major in engineering, and extrinsic motives like a better job have become a significant predictor of why they do so. Gender matters when choosing role models, which help students build paradigmatic success pathways (Swafford & Anderson, 2020). Hill and Vaughan's (Hill & Vaughan, 2013) studied university medical school student's experiences and found that paradigmatic trajectories deter female students from becoming surgeons. Female STEM role models debunk misconceptions, improve girls' interest in STEM, and boost their mathematical confidence (González-Pérez et al., 2020). When female role models are present, success expectations in STEM careers are magnified, and girls are more inclined to enter STEM areas. Olsson and Martiny's (Olsson & Martiny, 2018) review of counterstereotypical gender models and their impact on observers' vocational goals and academic decisions highlights the need for interventions with boys. They found that girls would not pursue high-status or challenging occupations until boys' perceptions regarding home duties change. Governments should adopt equality measures to reduce the STEM gender gap in universities.

In this paper, the university admission cut-off marks and final course qualifications from around 7000 students from five STEM subjects of five engineering degrees at the Universitat Politècnica de València (UPV) were analysed. Students were divided by terciles, based on cut-off marks, and analysed by gender. Our study was based on two research questions:

RQ1) Are women and men evenly distributed in the three terciles?

RQ2) Are women and men evenly distributed in the final course marks?

To achieve this, we compare the qualifications for women and men entering university degrees with their qualifications in specific courses during the first four semesters.

## 2. Method

We studied the data of university entrance cut-off marks and final course grades collected between 2011 and 2022 (11 academic years) from the standpoint of gender equality. The sample consisted of 7099 students who were enrolled at the UPV in one of five different degrees (Table 1).

Table 1. Number of students enrolled in each course and degree.

Course	Degree	Number of students
Biophysics	Biomedical Engineering (BE)	714
Physics	Technical Architecture (TA)	1494
Physics	Mechanical Engineering (ME)	1784
Physics	Aerospace Engineering (AE)	1304
Physics	Electronic Engineering and Industrial Automation (EEIA)	1803

In Spain, the minimum score required to enter university is determined by a calculation that takes into account both the final grade received in secondary school and the score obtained on the examination required to enter university. The maximum number of points that can be awarded for these cut-off marks is 14. On the other hand, a score of ten was the highest possible for the final grade in the course.

To go deeper into our sample study, we analysed the university cut-off marks grouping the students in three terciles, 1T, 2T and 3T, ordered from lower to higher grades, in each of the degrees. We also studied gender distribution in each of the terciles.

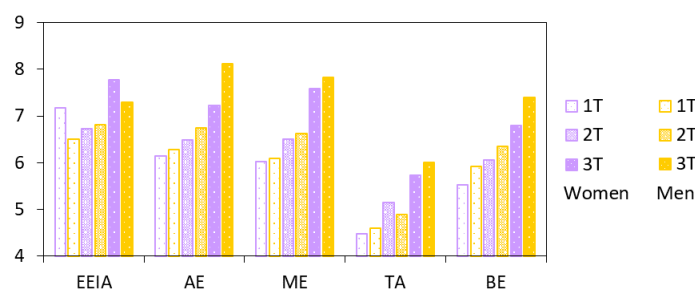
## 3. Results

The access qualifications of 7099 students starting from 2011-2012 to 2021-2022 academic years who were taking courses from the five grades have been analysed. Of these, 25% are women and 75% men, although with large differences between degrees ranging from 12% women in the ME degree to 60% in BE degree. We grouped the students in three terciles (1T, 2T and 3T) according to their cut-off marks (from lowest to highest) in each of the degrees analysed. We studied the distribution of women and men among each of the terciles. It can be observed how women increase their proportion in each growing tercile, from 30% in 1T to 36% in 3T, and men decrease, from 35% to 32%. This behaviour is similar in all grades except AE, in which the participation in each tercile of women and men is similar and close to 33%. It is worth noting the EEIA degree, in which women went from being 25% in 1T to 45% in 3T.

In all grades and terciles, the cut-off marks of women are higher than that of men, reaching a difference of 6% in some cases. Grouping the grades of all the students, the differences disappear, equalizing the global averages by gender of the five grades in all terciles.

We have calculated the average of the final grades in each grade and by gender. In figure 1 we have compared the values obtained by men and women. In most cases, the qualifications of men are higher than those of women, except in the EEIA degree.

Figure 1. Final qualification by cut-off mark terciles in each grade, comparing men and women.



When calculating the joint average of all grades and courses, from the values normalized to the course average, we can observe a significant difference in the third tercile score in favour of men.

In order to check whether these differences are significant, a two-way ANOVA analysis on final grade considering gender and tercile was performed. It is found that, globally, final grades depend significantly on the tercile ( $F(3,6220)=160.42$ ,  $p=0.001$ ), but not on gender ( $F(1,6220)=1.92$ ,  $p=0.17$ ), with no gender-tercile interaction. Analysing by degrees, we find the same behaviour except in the EEIA degree, in which there are also significant differences in gender ( $F(1,1636)=5.32$ ,  $p=0.02$ ).

### 3. Conclusions

The results presented in this study show how cut-off marks and final course qualifications seem to be independent assessment tools with no direct correlation. Although women's cut-off marks are higher than men's, in most cases, men's final grades are higher than women. This difference is more noticeable in the case of students with a higher cut-off grade (tercile 3). In addition, a gender gap has been demonstrated, mainly in the number of women in engineering degrees. Further analysis will be needed to identify the key parameters that are responsible for the existence of gender differences. Once these needs have been identified, teaching may be improved by adjusting the classroom environment and the student's evaluation towards a more gender-equal system.

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