# Econometrics and Gender: Do Women Score Better in Econometrics? Evidence from Slovakia.

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**Abstract.** Knowledge of econometrics and the use of quantitative methods improve the outputs of undergraduate students, especially their final theses. The question that this paper deals with is whether women and men achieve different results from the study subject Introduction to quantitative methods. The research was carried out at the end of 2022 in the months of November and December on a sample of 165 Slovak students through two questionnaires. They completed the course in their native language.
The research results showed that men had a better average score during the first mid-term test. The results were carried out based on the summary statistics and the construction of a simple regression model. A month later, women scored on average better and had a better median value on the Advanced Statistical Tests test. However, these results were not statistically significant. Differences could be also observed in the preparation for the seminars. Women were preparing more during the semester while men spent more time preparing before the test itself.

**Keywords:** Econometrics, Gender Differences, GRETL, Study Results, Quantitative Methods

**JEL classification:** *A22, C01,* C21

## 1 Introduction

Econometrics is widely recognized as an important research methodology in the field of economics, and it is also commonly used in other social science disciplines. Economics faculties and business schools focus more and more on teaching quantitative methods and some even more advanced courses in econometrics usually working with statistical software. The skills related to this field are more and more required both in the public and private sectors.

This research is part of a larger research on indicators that have an impact on study results in econometrics since the determinants of student performance in this field continue to be a topic of ongoing discussion not only among lecturers but also policymakers.

The data was collected on undergraduate degree students. This paper focuses on the issue of gender differences in learning and achievement. The aim of the article is to analyze the main differences between men and women based on the obtained data. Students' preparation for the seminars, their participation, the length of the preparation, as well as their study results were considered. Moreover, in the literature review, an overview of the available literature related to the research is presented. The methodology is adapted to serve future students in acquiring new knowledge from econometrics.

## 2 Literature review

Differences between men and women are an issue that is widely discussed not only in the public sector but also in the academic area. A wide variety of authors focus their research on econometrics scoring.

Already in the 70s of the 20th century, the American professor at the Pennsylvania State University Cohn (1972) tested the main characteristics and performance of his students from the subject "Introduction to Econometrics". He used a sample of the graduates of his course during the winter semester of 1971. The purpose of this study was the reorganization of the subject. Mainly in terms of class size, frequency of course offering, student mix, and number of sections. The sample he used was relatively small. Only 43 students were included and only 5 of them were women. However, he proceeded in a similar way to the research in this article. He provided the students with a short questionnaire with questions about their student background in subjects such as economics, mathematics, and statistics. In addition, he had official records from the university. Thirdly, he had his own data on student performance. This study includes many limitations, such as the already mentioned small sample of students and, at the same time, a possible problem with multicollinearity. However, the results indicated that the grade in mathematics largely influences success in econometrics, while knowledge in economics does not guarantee suitable prerequisites for econometrics. The study does not suggest that women perform better than men. Women achieved higher, but it was not significant.

A decade later, Paul (1982) at Towson State University conducted similar research to determine results from macroeconomic principles. During the years 1976-1979, he collected data for 836 students, which he obtained via questionnaire form. Students filled in information about their age, race, gender, marital status, and information about their academic studies to date. In addition, a question regarding their outside employment was added to the questionnaire. The results indicate that there is a statistically significant association between outside employment and academic performance.

Romer (1993) focused mainly on the relationship between class attendance and study results. He stated that lectures and tutorials or class meetings are the primary means of instruction for students at the academic level and in reality the attendance is "*far from perfect*" (p. 167). Therefore, he investigated the evidence, of whether the university should do something about absenteeism. The paper suggests that there is very strong statistically significant evidence that there is a relationship between attendance and class performance.

Dancer (2003) used a sample of 696 first-year university students in Sydney, Australia. 53,6% of them were males (373 students) and the rest 323 were females. The author investigated the differences in the teaching and performance of women and men in two basic courses - an economics course and an econometrics course. The author assumed that women would achieve higher and that the level of mathematics undertaken at school will affect econometrics performance, but not economics. The results show that in terms of gender effect, women achieved better results in econometrics, but men scored higher in economics.

In the latest study, Cladera (2021) devoted herself to evaluating the approach to econometrics on a sample of 87 students in 2018. The students completed a statistics course before the econometrics course. The content of the introductory course was devoted to the introduction to the linear regression model and topics related to its specifications such as multicollinearity, specification errors, dummy variables, autocorrelation, and heteroscedasticity.

## 3 Data and methodology

The purpose of this section is to outline the data collection process for analysis and description of the research sample. The aim of this article is to test the hypothesis of whether there are differences in study results in econometrics and statistics between both sexes. Moreover, the article focuses on the differences between preparation, participation in seminars, the lectures. Thus, it includes variables that could be related to the study result from the course.

The research was carried out as part of the course "Introduction to Quantitative Methods" on 2nd-year undergraduate students at the University of Economics in Bratislava. The course was taught in the Slovak language in statistical software GRETL (Gnu Regression, Econometrics and Time-series Library) during the winter semester. All enrolled students had to take two midterm tests, the first one in November and the second one in December 2022.

After each test, students were asked to fill in a questionnaire. The data obtained from the questionnaire were paired with other data we already possessed and then they were later anonymized. The questionnaire´s return rate was high up to 99.39% and 164 of the total number of 165 students completed it. Data collection was completed in January 2023.

As presented in Table 1, the gender representation in the research was slightly in favor of men, who represented up 53% of the respondents. Men were the most dominant in Study Group 2 (73%), Study Group 1 (63%), Study Group 6 (61%) and Study Group

3 (57%). They had a slightly higher representation in Study Group 7, where there were 11 men and 10 women. Women dominated in the Study Group 4 (63%), Study Group 5 (58%) and Study Group 8 (57%).

The article follows previous study Vojtasová, Solej (2023) and it focuses on the analysis of the results using simple statistical methods. The results of our study are presented graphically using box plots. The results of the mid-term tests by gender and study groups in which the students completed their studies are mainly presented.

**Table 1.** Distribution of econometric students by gender and study group

| | MALE | % | FEMALE | % | TOTAL |
|---|---|---|---|---|---|
| **Study group 1** | **12** | ***63%*** | 7 | *37%* | *19* |
| **Study group 2** | **16** | ***73%*** | 6 | *27%* | *22* |
| **Study Group 3** | **12** | ***57%*** | 9 | *43%* | *21* |
| **Study Group 4** | 7 | *37%* | **12** | ***63%*** | *19* |
| **Study Group 5** | 10 | *42%* | **14** | ***58%*** | *24* |
| **Study Group 6** | **11** | ***61%*** | 7 | *39%* | *18* |
| **Study Group 7** | **11** | ***52%*** | 10 | *48%* | *21* |
| **Study Group 8** | 9 | *43%* | **12** | ***57%*** | *21* |
| **TOTAL** | **88** | ***53%*** | **77** | ***47%*** | **165** |

To compare the differences between the sexes, we used boxplots, where we had a comparison between the study groups for both tests and then the differences between men and women in both tests. Our research assumes that women have better academic results. We tested these claims with two statistical t-tests. The null hypothesis of the t-test is that there are no differences between men and women.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1{}^2}{n_1} + \frac{\sigma_2{}^2}{n_2}}}$$

- $\bar{x}1$ is the mean of the first sample (male)
- $\bar{x}2$ is the mean of the second sample (female)
- σ1 is the standard deviation of the first population (male)
- σ2 is the standard deviation of the second population(female)
- n1 is the number of the data points in the first sample (male)
- n2 is the number of the data points in the second sample (female)

$H_1$ hypothesis: The is no gender difference in mid-term test I. results.
$H_2$ hypothesis: The is no gender difference in mid-term test II. results.

## 4 Results

The beginning of this chapter is devoted to the results from both mid-term tests. Based on the obtained test results, presented in Figure 1 we can conclude that men achieved from mid-term test 1 a better average result in five out of the eight groups. Mid-term test 1 contained 2 tasks, which were dedicated to the examination of the knowledge of summary statistics, work with boxplots and histograms. Furthermore, they included an exercise for conducting a model in statistical software and testing the significance of the model, the significance of selected variables, heteroskedasticity and autocorrelation of residuals.

In the groups where there were predominantly women, men achieved a better average in two out of three cases. On the contrary, in groups that were represented by more men, women achieved a better result in two out of 5 cases.

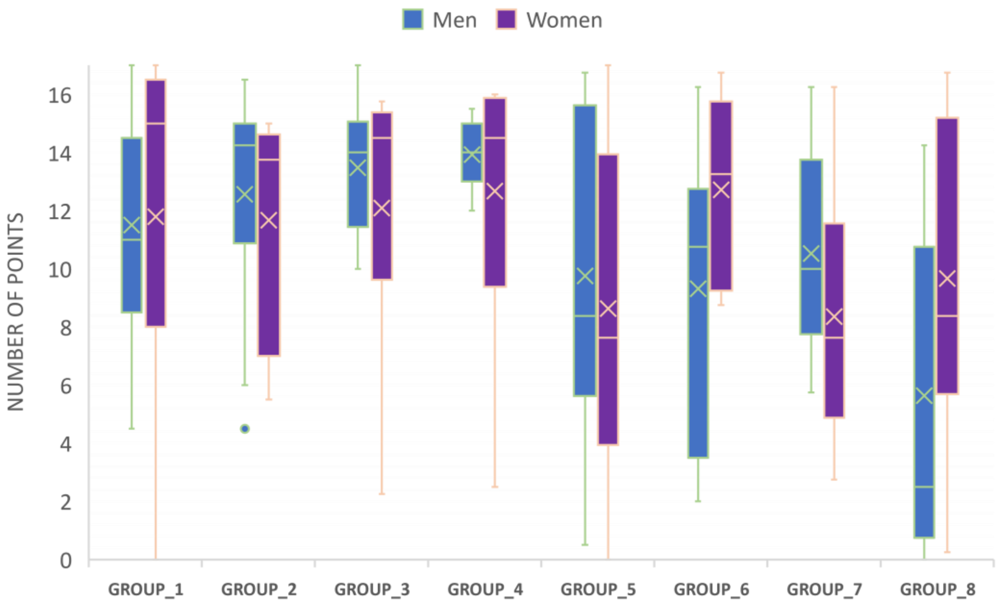


**Fig. 1.** Results from the mid-term test 1 based on groups and gender.

Study Group number 1 was relatively equal in terms of average, men achieved an average of 11.5 points and women achieved an average of 11.79 points. Women have a higher median value by up to 4 points. In Study Group 2, men had a better average and median than women. Their average result was 12.56 points, while the women's score was 11.67 points. The male median of 14.25 points was 0.5 points higher than the female median. In Study Group 3, men achieved a better mean but a worse median. Out of all analyzed study groups, the men achieved the best average result in Study Group 4 (13.93 points). Women from Study Group 4 obtained on average 12.67 points.

Other groups achieved weaker results, especially among men. The men from Study Group 5 achieved an average of 9.75 points, while the women 8.63 points. Men also had a better median. This group consisted of 24 students, which is the largest number of students per group. In Study Group 6, women achieved better results than men. Women achieved a result of 12.71 points and men 9.32 points. In group 7, the men achieved an average of 10.52 points and the women 8.35 points. The worst result was achieved by Study Group 8. Men scored on average only 5.63 points and women 9.67 points. In this group, the biggest difference in the result in favor of women was recorded.

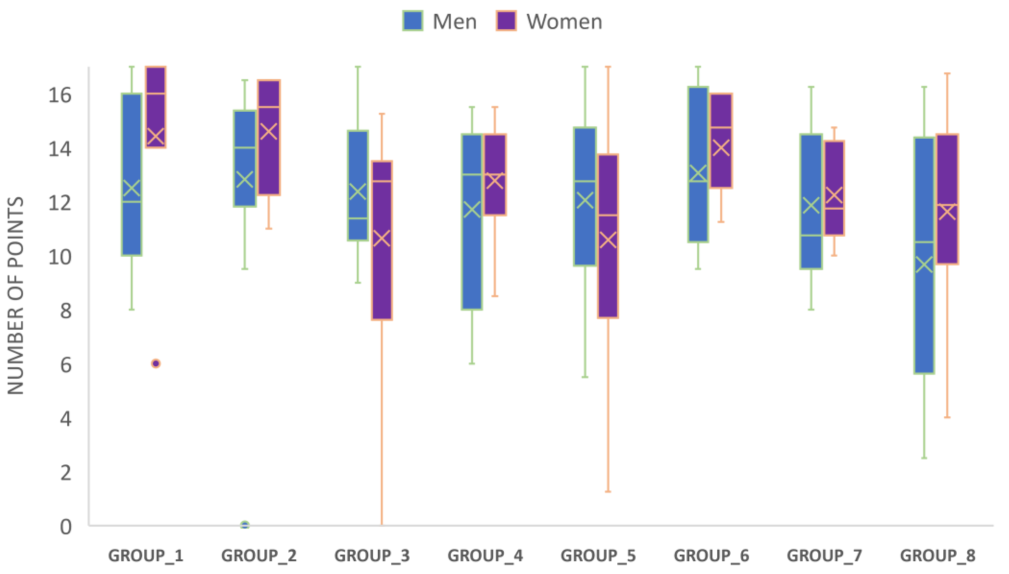


**Fig. 2.** Results from the mid-term test 2 based on groups and gender.

Figure 2 shows the results from mid-term test 2, which included more extensive statistical tests and was based on tasks related to a simple regression model, multicollinearity, interpretations of artificial variables and econometric model specification. Students could obtain a maximum of 17 points in 3 tasks. The second test took place about a month after the first one.

In this test, women achieved better results than men in 6 out of 8 Groups. In groups predominantly occupied by women, men achieved a better average only once, also once in groups with more men. Moreover, women also achieved better median values than men in 75% of cases, once the median was equal (Study Group 4) and once in Study Group 5 the median was in favor of men.

The average result in Study Group 1 was 15.85 points for women, compared to 12.85 points for men. Women in another Study Group 2 scored on average 14.6 points which is 1,77 more than men (12.83 points). Study Group 3 achieved a female average score of 10.64 points, which was one of the lowest averages together with Study Group 5 (female average of 10.59 points). The men in Study Group 3 had higher average results (12.38 points), together with men from Study Group 5 (12.06 points).

The Study Group 4 reached an average of 12.77 points as for women and an average of 11.71 points for men. Study Group 6 had an average of 14 points for women and almost a point lower for men (13.07 points). In Study Group 7, only a slight difference in gender results was recorded. Women achieved 12.25 points and men 11.86 points. The last Study Group had better results from the second midterm exam than from the first one. The average result for men was only 9.67 points. The women from this group once again had a significantly better result, almost by two points (11.625 points).

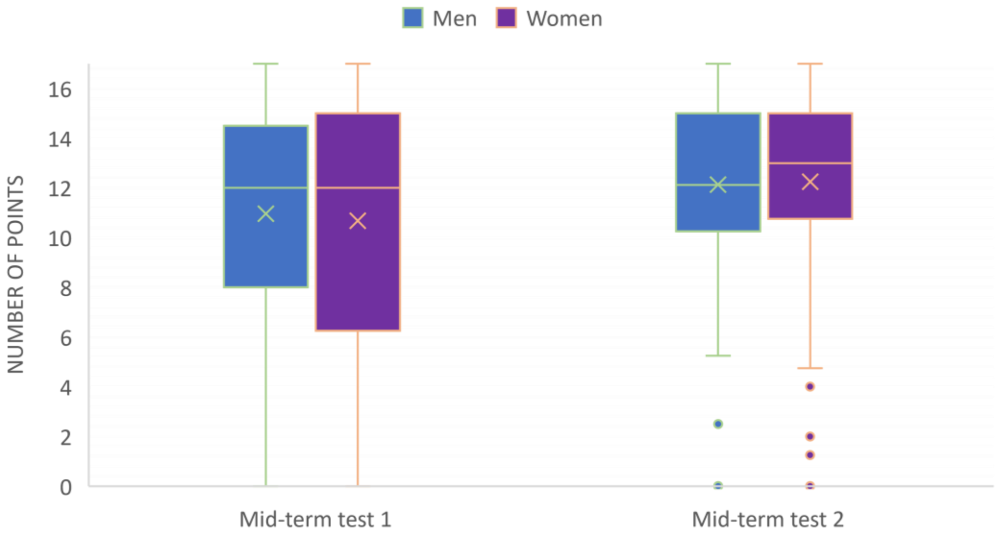


**Fig. 3.** Results from the mid-term test 1 and mid-term test 2 based on gender.

The following Figure 3 can answer the question of whether men or women have better results in econometrics. The figure displays a boxplot showing the comparison of the results of men and women from both tests across all groups. When the average value was very similar in the first test.

Men had a better average score of 10.95 points. Women scored on average 10,68 points. The median was the same for both genders at 12 points. On the other hand, in mid-term test 2, women were more successful, and their average score was 12.25 points, which was 0.13 points higher than the average score of men. Men achieved an average of 12,12 points.

Other values were always very similar, but always better in favor of women. Half of the women obtained from the test more than 13 points, for men it was approximately one point less (the median was 12,125 points).

**Table 2.** Statistical tests for hypothesis

| | |
|---|---|
| $H_1$ hypothesis: | The is no gender difference in mid-term test I. results |
| Test statistic: t(156) | = (10,9569 - 10,6818)/0,742573 = 0,37044 |
| Two-tailed p-value | = 0,7116 |
| $H_2$ hypothesis: | The is no gender difference in mid-term test II. results |
| Test statistic: t(155) | = (12,1279 - 12,2467)/0,562988 = -0,210945 |
| Two-tailed p-value | = 0,8332 |

Table 2 shows the results of the t-test and the test statistics, through which the two hypotheses were verified. In the first hypothesis, we have had statistically verified the difference between women and men in the mid-term test I. The second hypothesis tested this difference in mid-term test II. Both tests confirmed that there is no statistically significant impact of gender on the test score from econometrics. The two tailed p-value is higher than 0.05. Therefore, null hypothesis for both hypotheses cannot be rejected.

**Table 3.** The mean of selected variables

| Variable | Mid-term test I. | | Mid-term test II. | |
|---|---|---|---|---|
| | Men | Women | Men | Women |
| Tutorial activity | 2,61 | 2,18 | 3,76 | 3,51 |
| Tutorial attendance | 5,49 | 5,57 | 4,64 | 4,58 |
| Lecture attendance | 2,52 | 3,08 | 1,21 | 1,51 |
| Preparation before tutorial *(in minutes)* | 17,49 | 22,34 | 22,41 | 29,89 |
| Preparation before mid-term *(in minutes)* | 287,66 | 261,47 | 197,24 | 177,84 |

The last Table 3 is used to evaluate the basic supporting statistics that were part of the questionnaire. We can see that men were slightly more active in the seminars and scored slightly more points than women before both tests. Regarding attendance in tutorials, no big gender differences were found. However, women attended lectures on average more often than men throughout the academic year. Moreover, we identified that women were preparing more for seminars during the semester. On average, 22 minutes in the first part of the winter semester, and a little less than 30 minutes in the second part of the semester. Men spent less time on ongoing preparation for seminars before both mid-term tests. At the same time, they studied longer before the mid-term test itself. On average, women spent 20 to 25 minutes less getting ready before mid-term tests.

## 5 Conclusion

Research on the determinants of grades is a valuable insight for teachers and universities. This article is devoted to proving gender differences in the mid-term test result from econometrics. Our main hypothesis was constructed based on the literature is that women will achieve better academic results. The analysis included data from 165 students who enrolled in the course entitled "Introduction to Quantitative Methods". Through the questionnaires, the students provided answers that are in sufficient quantity and enable detailed examination of the determinants of the study results.

The study exanimated results of two mid-term tests, which included tasks from descriptive statistics, boxplots, histograms, simple regression model, multicollinearity, interpretations of artificial variables and econometric model specification.

Based on the results, students performed on average better in the first mid-term test. Men scored 10.95 points; women scored 10.68 points. In terms of the median, both sexes obtained the same number of 12 points. Women had a better upper quartile, meaning that the top 25% of women had a better result than the top 25% of men. On the contrary, men had a better result in the lower quartile. In terms of groups, men had a better result in 5 out of 8 cases.

In the second mid-term test, the women achieved better results. This test was more extensive. Women had an average of 12.25 points and men 12.12 points. Moreover, women also had a better median result than men and their result was better in 6 out of 8 groups. Additionally, statistical tests showed that these differences were not statistically significant. Finally, based on the summary statistics, some differences in attendance at seminars and participation in lectures were highlighted. Women prepared more intensively during the semester and went to lectures more often, men, on the other hand, prepared longer for the exam itself and earned more points on average for the activity during the lessons.

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