Gender, Confidence, and Mark Prediction in Computer Science Examinations

Brian Harrington, Xiaomeng Jin, Shichong Peng, Minhaz Khan

University of Toronto

ABSTRACT

In this work, we asked students in an introductory CS course to predict their own grades on each question of their final examination. Analyzing the actual and predicted grades, and the differences between them leads to several interesting results. Poorer performing students are more likely to overestimate their grades, while better performing students are more likely to underestimate their grades. Furthermore, performance on the exam is strongly correlated with ability to correctly predict marks. Perhaps most interestingly, we found that while there was no difference in performance of male and female students on the exam, female students were more likely to under predict their performance than their male counterparts.

BACKGROUND

- Self-efficacy plays an important role in academic success [5, 8].
- Third person prediction studies show that female students were likely to under predict their own performance, and were less confident in predicting the performance of others [1].
- Using cognitive and metacognitive awareness tests has shown that certainty of unsure events could be used as a measurement of self-confidence[7].
- Overestimation of marks shown as a distinct factor of overconfidence[10].
- Self-rating agreement group studies have found that gender was not a statistically significant factor among students in general[12]
- Multiple studies have shown that female students are more likely to underestimate their performance in completing computer science courses and while completing programming tasks[2, 4, 6, 11, 13].

METHODOLOGY

Setup

- Final exam for CSCA08: Introduction to Computer Science I, Fall 2017
- Bonus Question:

Predict your mark on each question of this examination. If your estimate is within 10% of your actual grade, you get this bonus mark.

- Marks for each question and predicted marks recorded and correlated

Confidence Influencing Factors

- All students asked to self-report prior programming experience at start of term
- Self identification of gender (Male, Female, Transgender, Other, Prefer not to say)
- All students had expected exam mark calculated before exam (based on assignments, exercises, quizzes, term tests) with linear best-fit. Students classified as over/under performing based on exam score relative to expected score.
- Also calculated coursework-only expected mark (based only on assignments/exercises, not quizzes or term tests)

Analysis

- Magnitude of error used as proxy for predictive ability
- Directed error used as proxy for confidence
- Linear Correlation of predicted vs actual grade
- Spearman's rank-order correlation
- Two sample t-tests to evaluate impact of confidence factors on prediction

RESULTS

- Strong correlation between predicted and actual grades ($r = 0.69$, $\rho = 0.68$, $p < 0.001$)
- Most students over-predicted their marks, actual exam average = 53.3%, predicted average of 71.9%
- As grade increases, magnitude of error decreases ($r = -0.43$, $\rho = -0.48$, $p < 0.001$)

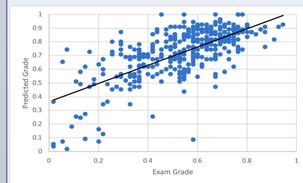

Figure 1: Predicted vs. Actual Grades

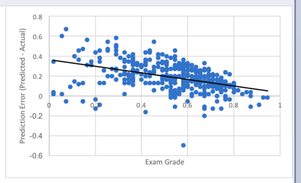

Figure 2: Prediction Error (Predicted Grade - Actual Grade) vs. Actual Grades

Prior Programming Experience

- Students with prior experience over predicted more (21.8% vs 16.8%)
- Results not statistically significant ($t = -1.8555$, $p = 0.67$).

Exam Performance Relative to Term Performance

- Under-performing students more likely to over-predict ($t = -3.9261$, $p < 0.001$).
- Predicted marks were almost identical in the two groups (75.2% for over-performers, 73.3% for under-performers)
- Predictions more strongly linked to course work than exam performance

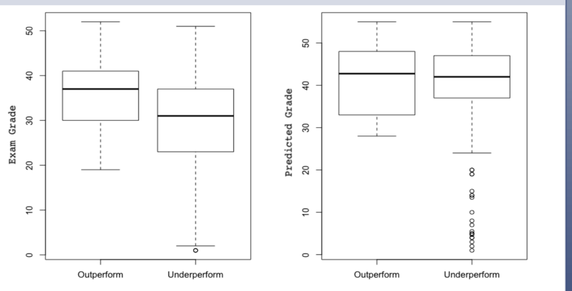

Figure 5: Actual and Predicted Grades by Exam Performance Relative To Expectations

Gender

- No statistically significant difference in the exam marks of the male and female students
- Female average predicted mark = 67.8%
- Male average predicted mark = 73.2%
- Statistically significant ($t = 2.442$, $p = 0.015$).

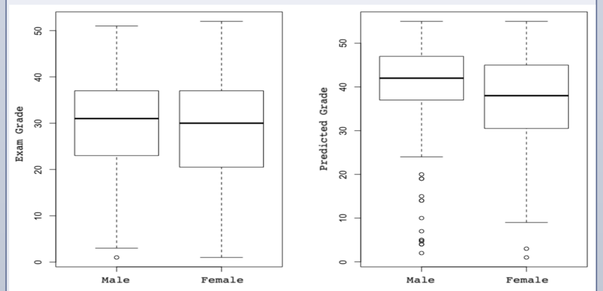

Figure 6: Actual and Predicted Grades by Gender

CONCLUSIONS

- Students mostly over predicted marks
- Prediction ability correlates with performance
- Prior programming experience led to more over prediction
- Predictions strongly anchored to prior term performance, over actual exam performance
- Female students less likely to over predict than males

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