



Student Self-Assessment as a Learning Tool in Calculus

Mario Banelos

Department of Applied Mathematics, University of California, Merced,

Email: mbanuelos4@ucmerced.edu

Council of Graduate Schools

Abstract

For many undergraduate students, Calculus I or II may be the first mathematics course they take at the university level. This course provides a foundation for students in solving mathematical problems analytically. Although instructors apply many different assessment methodologies, students generally appear to be unsuspecting of their performance. In support of quantifying the relation between student self assessment and their performance as well as using assessment to inform teaching, students completed surveys after weekly quizzes. Responses to these surveys reflect an overall *underestimation* of performance. In contrast, pre-semester and mid-semester surveys indicated an overestimation of actual class achievement. The results informed instruction, served as self-feedback for students, and suggest a discrepancy in students' own expectations as they begin their undergraduate career.

Introduction

At UC Merced, Calculus II serves as an introductory course to meet the program learning outcome (PLO) of "solv[ing] mathematical problems using analytical methods." Asking students to be cognizant of their performance encourages them to be more sophisticated learners. Previous studies suggest students are overconfident in their mathematical skills. The cognitive bias wherein people overestimate their knowledge of a given topic has become known as the Dunning-Kruger effect.



Figure 1 Example of categorical self-evaluation, which can be implemented as a self-assessment survey.

The goal of this project was to determine if there was a relationship between student confidence and performance through administering self-assessment surveys. In turn, these results informed my teaching through mini-lectures at the beginning of each discussion section.

Methods

For the Spring 2014 Semester, two sections of Calculus II (Math 22) were considered. The following components were implemented:

- Needs Assessment Survey
 - This survey gathered data regarding students' past math courses, expectations important to succeed in Calculus II, and grade expectancy.
- Self-Assessment on Weekly Quizzes
 - Weekly self-assessments were administered after each quiz beginning the third week of instruction.
- Mid-Semester Survey
 - The follow-up questionnaire asked students about the effectiveness of group work, mini-lectures, and self-reflection.

Self-Assessment Survey

Below, we present a sample self-assessment quiz and survey used in this study.

Sketch the curve and find the area it encloses

$$r = 2 \sin(\theta), \quad 0 \leq \theta \leq 2\pi$$

What have you done for prepare for this quiz and what is your comfort level with the material?

Quiz Grade Prediction	9-10	8	7	6	5 or lower
I predict to receive a grade of	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Needs Assessment Survey Results

Figure 2 Selected Needs Assessment results for both sections describing grade expectancy and important factors for succeeding in Calculus II.

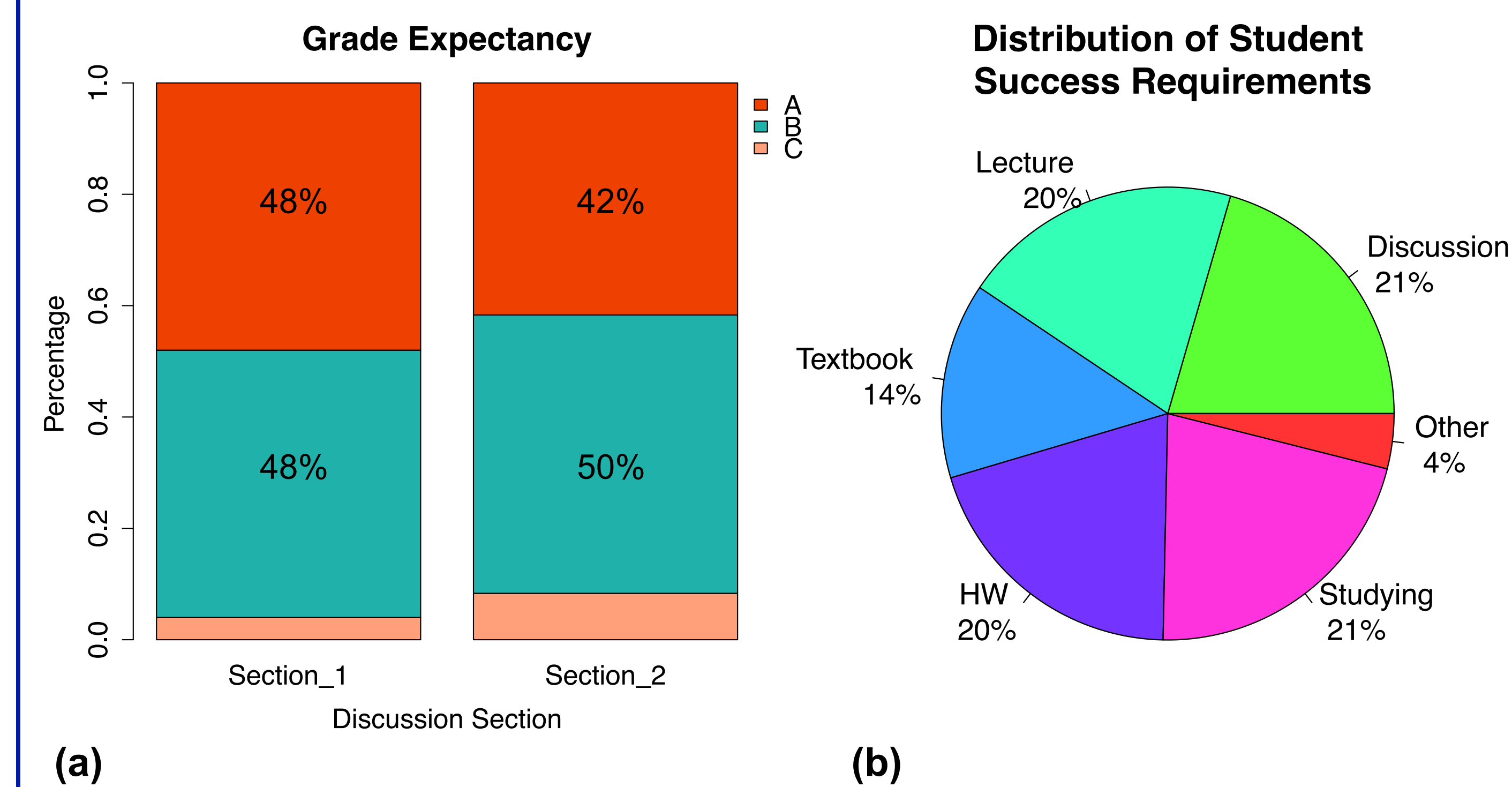


Figure 2a Grade expectancy at the beginning of the semester. **2b** Pie chart describing which factors students believed were important for success in the course. We note that reading the textbook ranked lowest on available choices.

Mid-Semester Survey Results

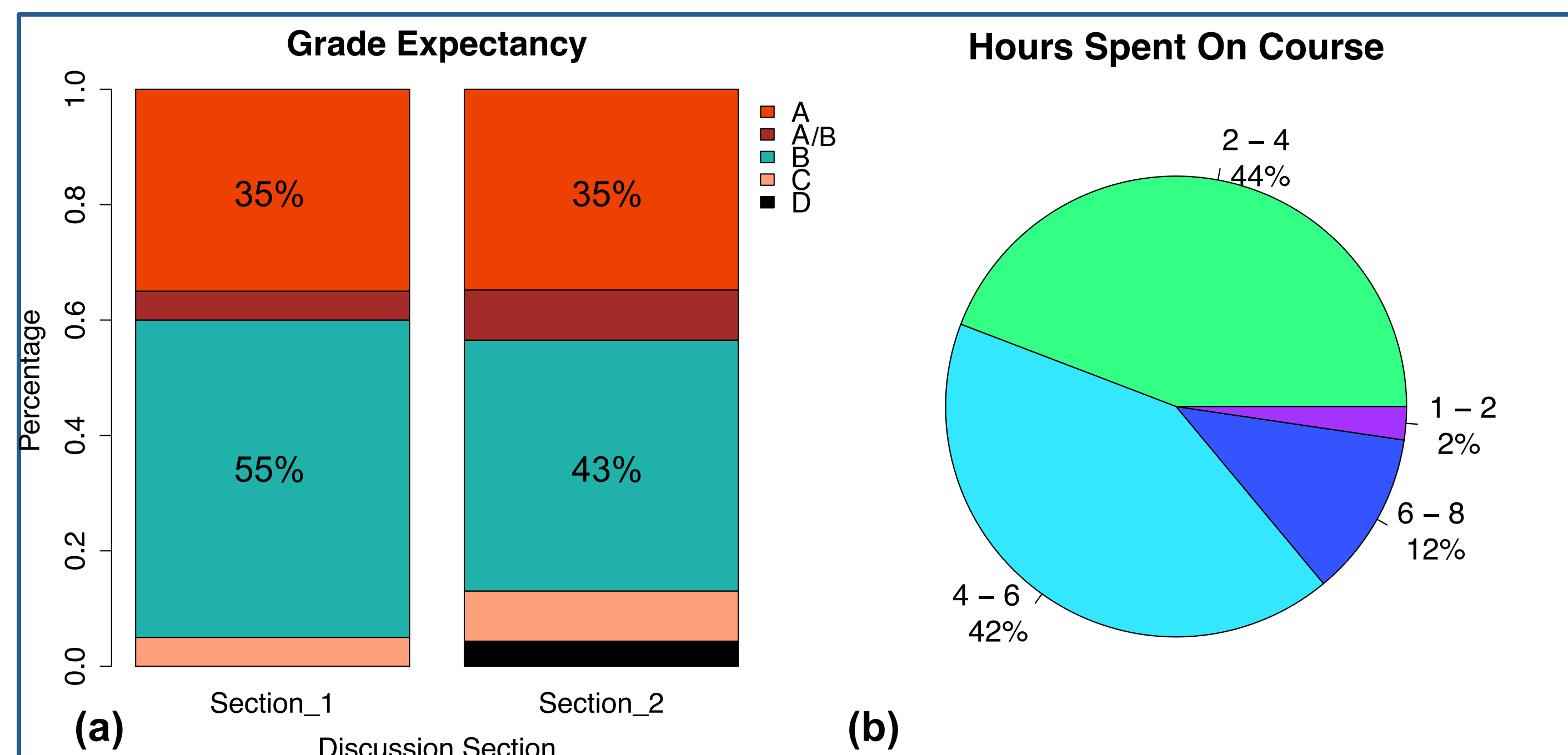


Figure 3a Grade expectancy at mid-semester. (Note: the qualitative difference from the beginning of the semester is minimal). **3b** Pie chart depicting hours spent (per week) outside of lecture and discussion section.

Self-Assessment Results

Figure 4 Plot of each discussion section mean scores and mean predicted scores for quizzes 1 - 7.

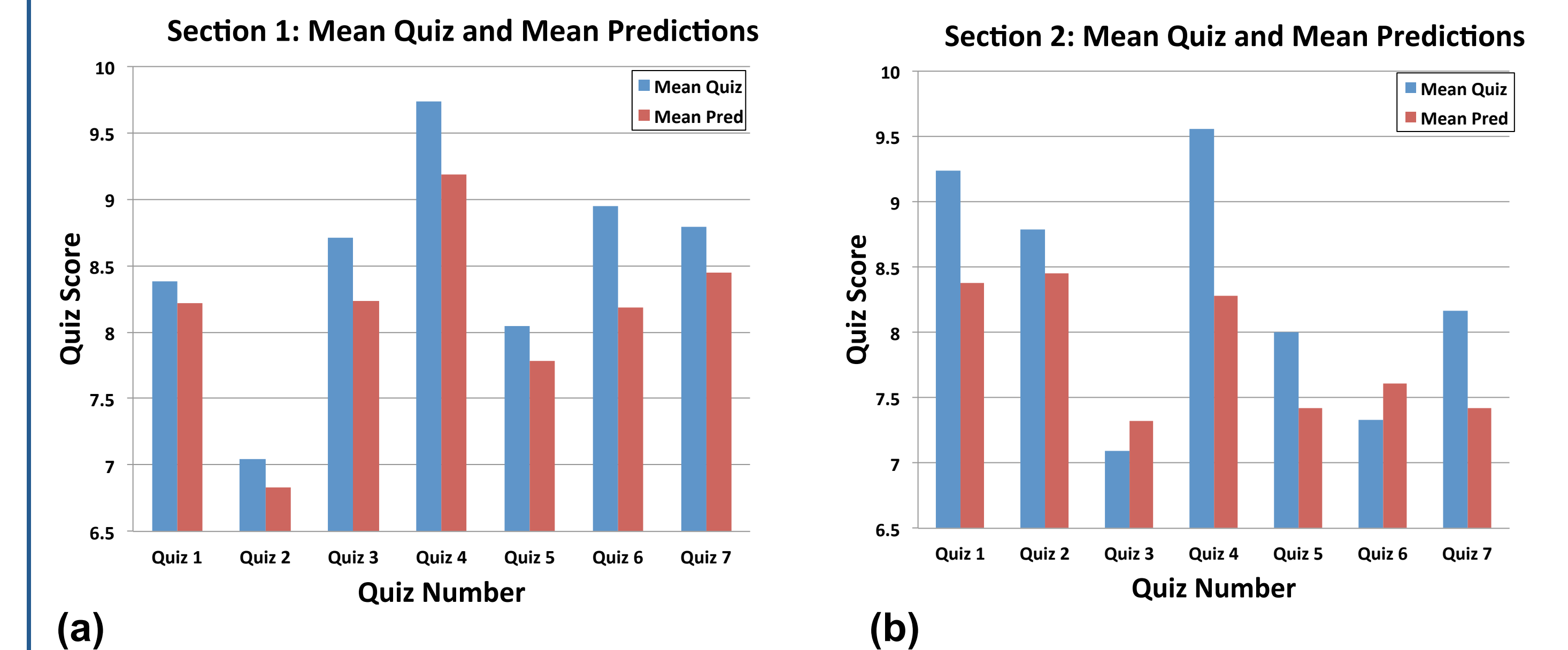


Figure 4a Section 1 mean predicted scores illustrate an overall underestimation of their quiz scores. **4b** Section 2 follows a similar pattern as the previous section. (Note: the average score for all quiz is higher than 80%).

Final Grade Distribution

- With the adjusted grade scale of 5%, we report the final grades of students in both sections.

Discussion Section	A	B	C	D	F
Section 1	30.4%	34.8%	34.8%	0%	0%
Section 2	12.5%	33.3%	41.7%	4.2%	8.3%

Table 1 Percentages of students in Section 1 and 2 receiving the corresponding letter grade.

- In comparison to Figure 4, we note a slight discrepancy in overall performance. This is particularly true for Section 2, where the grade expectancy did not agree with exam scores and final grades at the end of the semester.

Conclusion

- Written responses on self assessment surveys indicated that most students did not change their study habits during the semester.
- Students, more often than not, **underestimated** their quiz scores. Students scored relatively well, but this was not represented in exam scores and final grade distribution.
- Students correctly identified their quiz scores within one letter grade.
- Further exploration is warranted to draw conclusions about UC Merced students underrating their performance in mathematics.

References

- Huba, M.E.; Freed, J.E. Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning. Pearson, 32-63, 2000.
- Karatjas, A.G. Comparing College Students' Self-Assessment of Knowledge in Organic Chemistry to Their Actual Performance. *Journal of Chemical Education*, 90: 1096 - 1099, 2013.
- Kruger, J.; Dunning, J. Unskilled and Unaware of It; How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments. *Journal of Personality and Social Psychology*, 77 (6): 1121 - 1134, 1999.
- Tariq, V.N; Durrani, N. Factors influencing undergraduates' self-evaluation of numerical competence. *IJMEST*, 43 (6): 337 - 356, 2012.

Acknowledgements

This research was supported under the CGS Grant Assessment Project. I would like to gratefully acknowledge SATAL, and Professors Laura E. Martin, Anne Zanzucchi, and Angela Winek for their guidance in the course of this research.