BACHELOR OF SCIENCE IN DATA SCIENCE

ASSESSMENT REPORT
ACADEMIC YEAR 2023 – 2024

I. LOGISTICS & PROGRAM LEARNING OUTCOMES

1. **Please indicate the name and email of the program contact person to whom feedback should be sent (usually Chair, Program Director, or Faculty Assessment Coordinator).**

   Program Director: Daniel O'Connor (doconnor@usfca.edu)

2. **Were any changes made to the program mission statement since the last assessment cycle in October 2023? Kindly state "Yes" or "No." Please provide the current mission statement below. If you are submitting an aggregate report, please provide the current mission statements of both the major and the minor program.**

   No

   To deliver a high-quality data science program that instructs students in the theory and practice of mathematical and computational analysis of applied data driven problems, and to graduate students with appropriate experience in industry-standard data science tools.

3. **Were any changes made to the program learning outcomes (PLOs) since the last assessment cycle in October 2023? Kindly state "Yes" or "No." Please provide the current PLOs below. If you are submitting an aggregate report, please provide the current PLOs for both the major and the minor programs.**

   No

   - [PLO1] Analyze information critically and logically in a mathematical setting.
   - [PLO2] Reformulate and solve problems in an abstract framework.
   - [PLO3] Express mathematical results verbally, working individually and in collaborative groups.
   - [PLO4] Apply mathematical techniques to specific problem domains
   - [PLO5] Demonstrate competence with programming concepts, including software development techniques and data structures
   - [PLO6] Apply mathematical and computational techniques to real-world problems involving large, complex data sets.
   - [PLO7] Visualize, present and communicate analytical results.

4. **Which particular Program Learning Outcome(s) did you assess for the academic year 2022-2023?**

   PLO1, PLO4, PLO5

II. METHODOLOGY

5. **Describe the methodology that you used to assess the PLO(s).**

   For example, "the department used questions that were inputted in the final examination pertaining directly to the <said PLO>. An independent group of faculty (not teaching the course) then evaluated the responses to the questions and gave the students a grade for responses to those questions."

   We directly assessed graduating seniors with an end-of-degree exam given in the Spring 2024 semester. This exam consisted of 14 multiple choice questions spanning topics from the required curriculum. This exact exam, with the same 14 questions, was also given to previous cohorts of graduating seniors in the Spring 2023, Spring 2022, Spring 2021, Spring 2019, Spring 2018, and Spring 2017 semesters. Note that this exit exam was not given during the Spring 2020 semester due to the pandemic. It is our intention to continually assess our students and, by extension, the program by annually giving the graduating seniors the same exam. This will provide objective and comparable year-over-year data with which we can evaluate the effectiveness of the program. We presently have seven years of data whose results and findings I will discuss in the next section. The exit exam is attached as a separate document.

6. What are the major takeaways from your assessment exercise?

This section is for you to highlight the results of the exercise. Pertinent information here would include:

Exit exam results from the years 2017 – 2019, 2021 - 2024 are summarized in Figure 1.

Graduating seniors who took the assessment test performed better on the exam in 2024 than in previous years. Some possible explanations for the jump in test scores will be discussed below. The mean test score from 2024 was 11.38, whereas the mean test score from 2023 was 10.17. A two-sample t-test of the hypothesis that the difference in mean scores for the years 2024 and 2023 is not zero yields a p-value of .16, so we can't claim to have a statistically significant increase in mean test score from the previous year.

However, the exit exam scores in 2024 were stronger overall than in all previous years. A two-sample t-test of the hypothesis that the mean score from 2024 is greater than the mean of the exit exam scores from the years 2017-2019, 2021-2023 yields a p-value of 1.3×10^{-7}, indicating that the difference in mean scores is statistically significant.

There is an important caveat, though – the exit exams were taken remotely and self-proctored in both 2023 and 2024. This likely contributed to the boost in 2023 and 2024 test scores. We should also note that the 2024 sample size n = 8 is fairly small, and several of our top data science majors were included in this sample. The stronger students may have been more likely to take the exam. Another possible contributing factor for the boost in test scores is that, after a period of high faculty turnover, our data science professors have gained experience. Moreover, our most experienced data science professors James Wilson and Steve Devlin have both returned to the USF Math & Statistics department. And our new professor Cody Carroll, a truly great teacher, taught key courses for this cohort.

In Table 1 we define four levels of mastery, map those to ranges of test scores and identify the percentage of students achieving each level. Table 1 includes all test scores from the years 2017-2019, 2021-2024. This information is also depicted in Figure 2. In summary, 74% of the students scored either satisfactory, good, or excellent. It remains an important goal to find ways to bring these scores up.

Level of Mastery	Exam Scores	No. Students	% Students
Poor	0-6	15	26%
Satisfactory	7-9	22	38%
Good	10-11	15	26%
Excellent	12-14	6	10%

Table 1: BSDS Levels of Mastery (2017 – 2019, 2021-2024 aggregate)

Year-Over-Year Exit Exam Performance
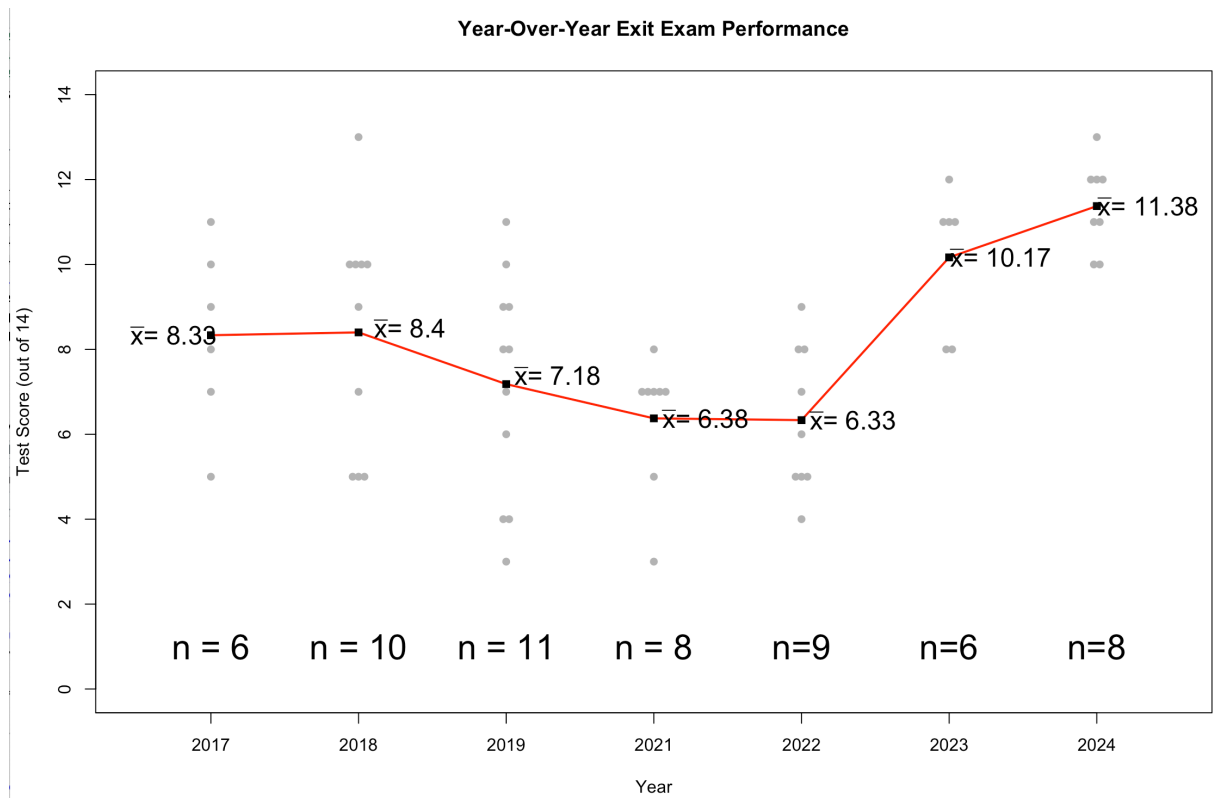
Figure 1: BSDS Exit Exam Scores Year over Year

Distribution of Levels of Mastery

Figure 2: BSDS Levels of Mastery (2017 – 2019, 2021-2024 aggregate)

IV. CLOSING THE LOOP

7. Based on your results, what changes/modifications are you planning in order to achieve the desired level of mastery in the assessed learning outcome? This section could also address more long-term planning that your department/program is considering and does not require that any changes need to be implemented in the next academic year itself.

The students have most often struggled with questions 1, 11, 12 and 13, which are technical questions about probability, statistics, and linear algebra. Students have also had trouble with problems 3, 6, and 8, which indicates a struggle with PLO4 (applying mathematical techniques to specific problem domains). The topics being tested by these questions are:

- Conditional probability
- Eigenvalue calculation
- Least squares
- Likelihood estimation

All of these topics are tied to specific classes (MATH 230, MATH 370, MATH 371, MATH 372). Based on these findings our plan has been to ensure these topics (in these classes) are clearly emphasized and that their importance beyond the classroom is highlighted. This should help to improve student performance on these questions and the level of mastery associated with this learning outcome. Our new term professor Sam Roven has been doing a great job teaching linear algebra (among other classes), and it's very helpful that James Wilson is back at USF, now solely teaching undergraduate data science majors.

8. What were the most important suggestions/feedback from the FDCD on your last assessment report (for academic year 2022-2023, submitted in October 2023)? How did you incorporate or address the suggestion(s) in this report?

We always appreciate the insightful & thoughtful feedback. The main suggestions were:

- "the faculty lump together three PLOs and assess them by evaluating the overall score of the exit exam. How does this provide you with sufficient information to know which aspects of the three PLOs are evaluated as successful and which may need additional attention? It seems that you could learn more from this exit exam by considering which question relates to which PLO and evaluating the result by question rather than the sum. There is an indication that three of the questions 3, 6, & 8) relate to PLO 4, this may further support the idea of linking specific questions in the exam to a single

PLO. If the questions are insufficient to link to a single PLO, then could you potentially rewrite the exam to align the questions with a single PLO?"

- "Regarding PLO 7, slide decks of student submissions for their final projects were scored on three different aspects, clarity, level of technical detail, and storytelling. How this evaluation was completed is not explained. One possible approach, one that is considered to be the best approach by assessors, is to have a small number of faculty evaluate the student work products using a standardized rubric and then reporting their mean scores."

These are good suggestions. For the time being, we've left the assessment test unaltered, which allows for a direct comparison with previous years. It's worth considering making a fresh start with a revised exam, though. We also didn't evaluate PLO7 this year, but the method suggested would no doubt be a good approach. Thank you again for your insightful feedback.

V.   ADDITIONAL MATERIALS

Below we include the following additional materials:

- End of the degree exam

- Curricular maps