

## BACHELOR OF SCIENCE IN DATA SCIENCE

### ASSESSMENT REPORT ACADEMIC YEAR 2021 – 2022

#### 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 2021? 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 2021? 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 2021-2022?

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 all graduating seniors with an end-of-degree exam given in the Spring 2022 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 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 five years of data whose results and findings I will discuss in the next section. The exit exam is attached as a separate document.

### III. RESULTS & MAJOR FINDINGS

#### 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, and 2022 are summarized in Figure 1.

Graduating seniors performed about the same on the exam in 2022 as in 2021. The mean test score from 2022 was 6.33, whereas the mean test score from 2021 was 6.38. A two-sample t-test of the hypothesis that the mean score from 2022 is less than the mean of the exit exam scores from 2021 yields a p-value of .95, indicating that the difference in mean test scores is not statistically significant.

However, the exit exam scores in 2022 were slightly worse (on average) than in the pre-pandemic years 2017, 2018, and 2019. A two-sample t-test of the hypothesis that the mean score from 2022 is less than the mean of the exit exam scores from 2017-2019 yields a p-value of .027, meeting the traditional threshold of statistical significance.

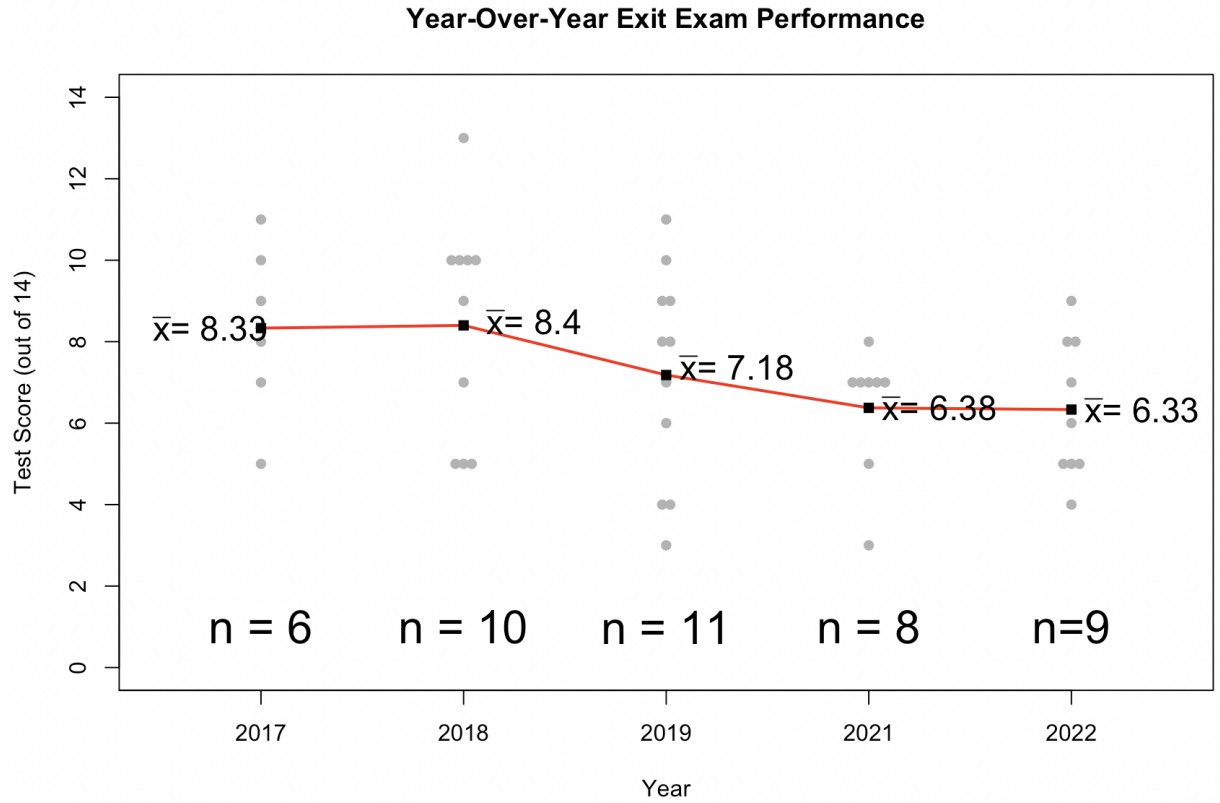
It's difficult to draw conclusions about why the exit exam scores dipped in 2021 and 2022, particularly given the small sample size (8 students took the exam in 2021 and 9 students took the exam in 2022). However, an obvious potential factor is that the pandemic happened, and students who took the exit exam had over a year of online classes. Another factor could be that we lost some excellent data science professors – David Uminsky and Nathaniel Stevens. James Wilson, another key faculty member, was on leave for the 2021-2022 academic year. Moreover, Steve Devlin was occupied for a couple years as the directors of the MSDS program. So, we have had some instability with our faculty, and we are still in a rebuilding phase.

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, and 2022. This information is also depicted in Figure 2. In summary, 66% of the students scored either satisfactory, good, or excellent. It's an important goal to find ways to bring these scores up.

| Level of Mastery | Exam Scores | No. Students | % Students |
|------------------|-------------|--------------|------------|
| Poor             | 0-6         | 15           | 34%        |
| Satisfactory     | 7-9         | 20           | 46%        |
| Good             | 10-11       | 8            | 18%        |

|           |       |   |    |
|-----------|-------|---|----|
| Excellent | 12-14 | 1 | 2% |
|-----------|-------|---|----|

**Table 1: BSDS Levels of Mastery (2017 – 2019, 2021, 2022 aggregate)**



**Figure 1: BSDS Exit Exam Scores Year over Year**



**Figure 2: BSDS Levels of Mastery (2017 – 2019, 2021, 2022 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 most often struggled with questions 1, 3, 11, 12 and 13. The students' difficulty with these questions indicates a struggle specifically with PLO4. 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 we plan 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. We have also hired a new term professor to help with 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 2020-2021, submitted in October 2021)? How did you incorporate or address the suggestion(s) in this report?**

We always appreciate the insightful & thoughtful feedback. There were helpful comments about the effectiveness of using an exit exam for assessment:

“The point being that while the ETS exam gives you a score, it doesn't give you any way to know or reflect on where improvements in your curriculum could be made, or if it does, you are not using the results in that way.”

I'll note that, for the BSDS assessment, we do analyze which specific problems the students struggled with the most, and which courses teach the relevant concepts, which gives a clue about how we might be able to improve the curriculum. For the 2021-2022 academic year we did continue to use the exit exam for assessment. One benefit of this approach, I think, is that it suggests clearly (Figure 1) that there has been a post-pandemic dip – something that we need to be working to reverse.

(Or did the dip begin in 2018-2019? It's possible that the pandemic is a red herring in this case.)

## V. ADDITIONAL MATERIALS

Below we include the following additional materials:

- End of the degree exam
- Curricular maps