TRESTLE Course Transformation Report: Math 1212

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Course name: MATH 1212: Data and Models

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1. Intro

The purpose of this project was to develop a course that specifically prepares students for a Statistics course. This role had traditionally been given to College Algebra, but that course's topics were more relevant to students who intend to later take a Calculus course.

In Spring 2016 two members of the mathematics department, Robert Tubbs, a professor, and Erica Shannon, a graduate student, began to develop this course to replace College Algebra for students intending to major in a subject that requires a Statistics course.

- Then in Fall 2016 and Spring 2017 two, essentially independent, pilot versions of the course that had been developed were offered, each developed and taught by an instructor in the mathematics department—one in a "Residential Academic Program (RAP)" (taught by Wafa Yacoub) and one in the "Student Academic Success Center (SASC)" (taught by Matthew Pass).
- In Fall 2017 the newly developed course will be fully implemented in the MATH department, using the approach developed by Wafa Yacoub. The SASC section will also likely continue.

2. Course specific information

A. About the course

- Course Description: Engages students in statistical and algebraic problem solving through modeling data and real world questions taken from the social and life sciences.

- Reason this course was chosen for transformation: The new course, Mathematics 1212: Data and Models, was designed to be an alternative to, and eventually a replacement for, College Algebra (MATH 1011), for students intending to enter a major that requires a Statistics course. The impetus for developing such a replacement of College Algebra came from the recommendation of the Colorado Math Pathways Task Force Research that College Algebra should not be the default general mathematics course but that institutions should design introductory courses that better prepare students for their chosen major. This push to replace College Algebra with specific math pathways courses emerged from the data that indicated that the standard College Algebra course is an ineffective course for most of the students who go on to take another math course, especially those who are bound for a STEM major that requires

Calculus, as measured by these students' persistence in math classes.

Students who are not headed for a major that requires Calculus, but whose major requires some mathematical thinking, are likely to find the tools of algebraic manipulation less useful than other quantitative skills such as modeling and quantitative reasoning. It is with these students in mind that MATH 1212 was proposed. Instead of focusing on symbolic and algebraic manipulations, the new course will focus more on real-world modeling problems and quantitative reasoning. This course will be specifically designed for students who plan to take statistics, (particularly MATH 2510, Introduction to Statistics) or a discipline-specific Statistics course (such as PSYC 3101), thus providing a more focused pathway to success in those curses.

- Course Structure: In the two pilot courses (SASC and RAP) the course was taught in small sections (~15 students/section) in Fall 2016 and Spring 2017. The SASC section is taught 5 days a week (3 lectures, 2 recitations). The RAP course was taught in a single small class in a flipped format meeting 3 times/week. In Fall 2017 the full implementation in MATH includes ~15 small sections of ~28 students meeting 2 or 3 days/week. The SASC version will likely continue in the same structure.

B . What did you do in the course transformation?

- **Initial development (Spring 2016):** We initially hoped that the new course might be able to include most of the material from the College Algebra course, which math faculty have traditionally viewed as the essential knowledge for any student, plus a great deal of additional material focused on analyzing data, modeling real-world situations using functions, and setting up word problems. We began the course development project by compiling an ambitious list of learning goals for the hypothetical course, including the full list of skills typically covered in College Algebra. We created a survey containing our proposed learning goals and mathematical skills for the new course, and sent it to the various departments that offer statistics courses and/or require mathematical reasoning but not Calculus. We received responses from most of the departments. We were surprised at how the respondents largely rated algebra skills as "unimportant" or "somewhat important". After reviewing the responses, we revised our course plan and learning goals to place more emphasis on modeling and to further de-emphasize skills of algebraic manipulation. (We also realized around this time that our full wish list of learning goals was not practical for a 3-credit course!)
- Robert and Erica developed course-level learning goals based on these responses, identified the mathematical skills necessary to support these goals, constructed a course topical outline that maps to these skills and goals, wrote a sample homework scoring rubric, a sample midterm exam, and chose an appropriate text. (See Appendix) They also produced several exemplary projects for the course.

- Then Pass and Yacoub independently produced other materials on-the-fly as they taught the course.
- **Course #1: Sewell Residential Academic Program (RAP); Wafa Yacoub**. This course was used as the course pilot prior to full implementation in the MATH department. Yacoub taught the course in Fall 2016 and Spring 2017. Yacoub received the sample syllabus, course objectives, recommended book and sections, and 3 sample projects from Rob Tubbs. She used the course objectives and the recommended book and sections. She taught the course as a flipped class; students read the book out of class and worked on problems in class. Using WebAssign, she assigned HW and reading from the e-book, and used reading quizzes consisting of 4-5 simple problems due before class. In class, students worked on worksheets. She worked to generate student buy-in to the new structure with a contract (indicating they are aware of pre-lecture requirements). She chose not to use Rob Tubbs' sample projects, but did give students an Excel project which they completed in groups. She required students to use a TI84 calculator, to prepare them for statistics. Assessments included reading quizzes, chapter reviews, weekly quizzes, in class daily worksheets, an Excel project, and midterm and final exams.
- **Course #2: Student Academic Success Center (SASC); Matthew Pass.** This course was independently offered by SASC. SASC, unlike MATH, is keeping college algebra, but sees MATH 1212 as a more appropriate preparation for students going into social sciences, and plans to offer it. SASC is also aimed at providing more support for students who are challenged. Pass used the book recommended by Tubbs. He used an interactive lecture approach (not flipped), where students were given fillable lecture notes or activities in each class (MWF), with a total of 45 fillable notes or worksheet activities. On the Tues/Thurs recitation days, students worked on homework or on additional activities. He had 3 undergraduate TA's (Instructional Assistants) in Spring, who helped facilitate those Tues/Thurs activities. He also used WebAssign, and experienced some technical difficulties with it, and students were not positive about WebAssign. In SASC, pre-lecture assignments were not used, as this was not expected to work well. SASC also has a help room. Assessments included homework, quizzes, 3 exams, and a final.

C . What assessments or documentation of impact were or will be used?

- What measures were (or will be) used to monitor student learning related to the course transformation efforts? (e.g., attitudinal surveys, two-stage learning exams, pre-post course surveys, gains in learning on exams related to active learning activities, in-class participation ratings, faculty evaluations, case studies, student interviews, ratings of learning-level based on Bloom's taxonomy, evaluation of student samples/work)
- The original course plan indicated: We will track their progress in later courses and compare their progress and outcomes with College Algebra students. The department plans to

obtain this information from Institutional Research, but I (Stephanie) am not clear on who has responsibility for gathering this data and when.

- Pass' SASC class received COPUS observations in Fall 2016.
- What were the results, if you have any?

No results on the impact, as above, however, in both versions of 1212, the instructors heard positive feedback from students who went on to take statistics the following semester. Additionally, Pass discussed the COPUS results from his course with other SASC instructors who received their results.

D. How will you maintain the changes over time and across structures?

- Location of Course Material Archive (how will others access your work)?

The archive was originally placed in Google Drive, and the original materials are still there. In MATH, the course materials have been put into a D2L course by Yacoub, which will be used by all section instructors. In SASC, there is no course archive.

- Plan for Sustainability
  - The multiple sections of MATH 1212 will be highly coordinated by a 'course coordinator." Yacoub Wafa, who has taught the course before, is acting as course coordinator. She expects to have a meeting with lecturers and LAs before the first day of classes, additional meetings if necessary, weekly meetings with LAs, class visits, weekly communication with lecturers via email, plus course materials in Google Drive and D2L. She is very familiar with the course, and this is the same approach used in Math 2510.
  - Additionally the department is planning to appoint an additional associate chair that will oversee all of the course coordinators for the multiple-section lower division courses.
  - In SASC, Pass will likely continue to teach the course, pending enrollment. Rebecca Machen thinks the course may be offered once per year.
- Challenges for sustainability

  Having the departmental administration ensure that the course coordinator and instructors for the various sections of course are on-board, an implement, the active learning model that has been developed for the course. Also, Yacoub has never served as course coordinator. She may be a bit optimistic in the adoption of the course approach, as she does not plan to meet in person with the instructors and foresees no problems in sustainability.

E. Plans for future work

What did and didn't work well in the course transformation?

- The two initial developers of the course, Robert and Erica, were not able to be involved with teaching the pilot sections.
- The TRESTLE PI was also not aware of the pilot sections except for Pass, and was not able to offer ongoing support, and thus the two instructors worked essentially independently and unsupported.
- In MATH, the flipped class approach worked well. Yacoub plans to implement a rental program for the TI84. She also plans to enrich the course more, include LAs in some

classes.

- In SASC the approach worked well, and prepared students for the things they will see in stats. Next time Pass would like to focus more on data and case studies to tie the techniques to real world problems.

What would you like to do next?

- Our "pathways" course for students intending to study a subject not involving statistics or calculus needs to be transformed
- In 1212, see above for next steps.

What are some unsolved challenges?

Mostly the administrative ones given above as "Challenges to sustainability."

3. Community and expertise building in the department

- How did you use or generate broader expertise and/or community in your work?

  Erica and Rob consulted with other members of the Mathematics Department, consulted with other ("client") departments, and attended ShInDiG. Yacoub and Pass met once prior to teaching the course.

- Expertise you drew on (yours, others)

  Robert and Erica attended some Trestle conferences and the Shindig discussions. We also drew on our experiences transforming Calculus 1 and 2 in recent years. They consulted with Stephanie a few times.

- Community built – were faculty across the department adequately involved?

  I do not think they were. A community of the graduate students and lecturers teaching this course will emerge from their meaningful weekly meetings.

- Did you engage in community building across departments or institutions?

  NO

- Future plans or room for improvement in this area

  Uncertain

4. The process and structure of the work in the department

- What worked well about the process and structure of the work?

  Yacoub based her course development on what the department had already done for Introduction to Statistics—a very strong model to follow.

- What could be improved?

  Supervision of the course coordinators who are supervision the course instructors (this supervision should be done by the proposed additional associate chair.)

- Consider the role of various experts leading and completing the work, whether you had adequate resources to do the work, whether roles were clear, and whether there was adequate

leadership within the project and the department.

There was NOT adequate leadership either within the project or the department.

- What are your open questions or concerns?

  Uncertainty over sustainability owing to weak or unaware departmental leadership.

5. Future Plans

- What future plans do you have related to the work, other than work on a specific course?

  Stay involved with the departmental leadership as best I can to promote a successful model for teaching this course.

Appendix

Course-level Learning Goals

1. **Thoughtfully read and think about** a problem before committing to a strategy.
2. **Choose** an appropriate mathematical model, given a description of real-world quantities.
3. **Choose** an appropriate mathematical model, given a data set.
4. **Analyze** and **interpret** real-world quantities or data, using the chosen mathematical approach.
5. **Defend** (verbally and in writing) the validity of various mathematical methods for a given task.
6. **Adapt** previously used methods to similar but new situations.
7. **Deploy** skills of algebraic manipulation in the context of modeling problems.
8. **Evaluate** whether a result is reasonable within the context of the original problem or data.
9. **Appreciate** and **enjoy** the power, practicality, and usefulness of quantitative tools for tackling problems.
10. **Develop confidence** in situations requiring quantitative reasoning and mathematical reasoning.

- **Mathematical Skills**

1. **Translate** a verbal description of a function into a graph, table, or formula.
2. **Identify** the independent variable, dependent variable, domain, and range in the context of a word problem.

3. **Use** different types of functions (linear, exponential, logarithmic, power, polynomial, rational) for modeling. **Identify** and **interpret** key features of the graphs of these functions.
4. **Use technology** to analyze data and to evaluate the appropriateness of a model.
5. **Deploy** algebra skills to solve problems:
    a. **Simplify** algebraic expressions.
    b. **Factor** linear and quadratic equations.
    c. **Write** and **solve** inequalities.
    d. **Write** and **solve** systems of equations in two unknowns.
    e. **Manipulate, evaluate**, and **graph** relationships.
    f. **Solve** equations involving exponents.
    g. **Solve** equations involving logarithms.
6. **Analyze** a data set, using simple characteristics:
    a. **Explain** what the data set represents.
    b. **Graph** or **visualize** data that has been given non-graphically (e.g., in a table or as generated by a formula).
    c. **Compute** and **interpret** mean, median and mode.
    d. **Assess** and **justify** which of the mean, median, or mode is most or least useful.