

## TYPE II TRESTLE PROPOSAL, DEPARTMENT OF MATHEMATICS, DECEMBER 2015

### 1) Project entitled: "Transition to Statistics: Building a Quantitative Reasoning course for social science students en route to Statistics or Polynomial Calculus courses."

Submitted by Professor David Grant, Chair of the Department of Mathematics. x2-4989, grant@colorado.edu

**2) Rationale.** There is a national movement geared towards designing a mathematics curriculum that provides pathways for student success. The Carnegie Foundation for the Advancement of Teaching is building "pathways improvement communities." The Charles A. Dana Center at the University of Texas is promoting its "new pathways project." Complete College America is a national nonprofit that is working with states: "to significantly increase the number of Americans with quality career certificates or college degrees and to close attainment gaps for traditionally underrepresented populations." Colorado is part of that movement, and our colleague Robert Tubbs represents CU on a statewide taskforce in that effort. They are promoting "guided pathways to success," and just won a national award for their work.

In particular, the recommended pathway for STEM majors is to start in Calculus, or for students who need additional preparation, to take Precalculus and then Calculus.

Hence College Algebra is a course that is of little use for STEM majors: persistence in the sequence of courses Algebra  $\rightarrow$  Trigonometry  $\rightarrow$  Calculus is extremely low, so not effective in promoting student success.

This observation led the Department of Mathematics to investigate which other Departments advise their students to take College Algebra, and found that Social Science Departments like Economics and Psychology (as opposed to Neuroscience, which is in STEM) send their students to our College Algebra course, MATH 1011, but for reasons that have little to do with its content; instead these departments hope that College Algebra will help their students develop more mathematical maturity for later courses. PSYCH students go on to take Statistics, and ECON students go on to take "Polynomial Calculus" (ECON 1088 or MATH 1081) and Statistics. In any case, MATH 1011 is not a course designed to meet these students' needs.

This Proposal is to help garner the resources to build the appropriate course to meet the needs of these Social Science students in the College of Arts and Sciences: one that gives students the Quantitative Reasoning, Modeling, and Algebra skills to succeed in their future mathematics and major courses.

Our Department has a long history in building courses that employ Active Learning, since all studies indicate that this is more effective way to teach students than a traditional lecture format course. Incorporating active learning in the new course should lead to a great improvement in student learning.

### 3) Course development plan.

**a) Timeline.** The new course will be developed in Spring 2016, and all requested funding will be spent within that semester. The new course will be offered for the first time in AY 2016-17, and will be taught by Professor Robert Tubbs.

b) **Leadership plan.** Professor Robert Tubbs will lead the project, and will oversee the collaborate work of graduate student Erica Shannon on the project. As Chair, I will provide oversight of timelines and deliverables, and make sure that the commitments in this proposal are fulfilled.

c) **Assessment plan.** We plan on doing two types of assessments: one of students' attitudes and dispositions and another of students' success in subsequent Mathematics classes.

For the attitudes/dispositions assessment we will use the Colorado Learning Attitudes about Science Survey (CLASS) as it has been modified for Mathematics. This spring we will have the students in at least one section of College Algebra complete the survey at the beginning and end of the semester. We will also have students in College Algebra in Fall 2016 complete it. This will give us sufficient data to compare with the students' CLASS responses when we pilot the new course in 2016-17 and then again after it is fully launched.

Measuring student success in later courses is more difficult since this course is going to prepare them for multiple mathematics courses. To simplify matters, and maintain some control over the type of data we are comparing, we will only track student success in one of the possible follow-up courses, MATH 2510: Introduction to Statistics. We will compare that versus how students enrolled in MATH 1011 currently do in MATH 2510.

d) **Faculty & instructor involvement.** The personnel involved in this Proposal are (1) The proposer, who will serve to guarantee the work is done, and as Chair is rewarded with a supplemental stipend, (2) The Lead Developer, Professor Robert Tubbs, who will have a course reduction granted in Spring 2016 in light of his efforts on this Proposal, and (3) Graduate student Erica Shannon, who will be paid on this TRESSLE grant in Spring 2016 in lieu of her normal TA salary, tuition remission, and benefits.

e) **Sustainability.** The goal of the course development is to create sufficient materials so that once developed, the course can be taught by a wide variety of instructors. Indeed it will need to – we expect there will be more than 1000 students at CU taking this course every year in 30+ small sections. There will be a course coordinator for the course every semester who is an expert in the course, whose job it will be to mentor all the other instructors, observe their classes, and through weekly meetings, guide their delivery of the course. We have used this model successfully in a variety of other courses (MATH 1300, 1310, 2300, and 2510).

f) **Coordination across the Department.** This Proposal comes from the Department Chair, so should be considered to have the full support of the Department. Indeed, this new course grew out of year-long discussions of a 10-person Departmental taskforce consisting of TTT faculty and Instructors, and pertains to just one portion of a major redesign of our service-level courses to create pathways for student success. To relate this course development proposal to the whole curriculum, we detail the proposed Pathways for all the students we serve: (NEWALG denotes the course in this Proposal. NEWQRMS is another Quantitative Reasoning course to be developed later for students in the new CMCI.)

<b>Student major</b>	<b>Mathematical pathway</b>
STEM:	Precalculus (MATH 1150) → Calculus (MATH 1300 or 1310)
SOCIAL SCIENCE:	NEWALG → Introduction to Statistics (MATH 2510)
CMCI:	NEWQRMS
LEEDS:	MATH 1112
OTHER A&S Core:	Choice of MATH 1112, NEWQRMS, or NEWALG
ELEMENTARY ED:	MATH 1110 → MATH 1120 (Math for Elementary Educators)

**4) Broader impacts.** The impact on the Department will be tremendous. The proposed course may end up having a higher enrollment than any other course we teach, more than 1000 students a year. We expect it will change the required MATH course in a variety of Social Science majors. If the new course incorporates Learning Assistants into the classroom, it will be one of the larger LA assignments on Campus.

**5) Evidence of expertise.** The teaching efforts of the Lead Developer on this Proposal, Robert Tubbs, have been of paramount importance to the Department, its students, and the University. What Tubbs has done is nothing short of transformational.

- i) He worked as chair 20 years ago to convert our large lecture calculus classes to more effective small sections.
- ii) He began a decade ago (with colleague Eric Stade) to transform our calculus classes to ones that use inquiry-based learning, employing Learning Assistants to facilitate group work on projects they developed. This effort was recognized two years ago when the Mathematics Teacher Partnership of the AAPU named our Department's calculus course as one of 4 national models for how it should be taught. Along with Stade, he won a grant from the Helmsley Trust to develop and disseminate educational materials for the course.
- iii) He has redesigned our History of Mathematics class, turning it into a real course on the History of Mathematics ideas.
- iv) He developed and teaches our Functions and Modeling Course especially designed for future secondary educators in mathematics.
- v) For many years he taught our courses designed for Elementary Educators.
- vi) He represents CU on the Colorado Pathways Project, run by the CDHE. That effort was just recognized with a national award.
- vii) He served for over three years as the Director of MASP, coordinating all their educational efforts.

The Graduate Student, Erica Shannon, who will be working with Tubbs on the Proposal, is as decorated as any of our graduate students has ever been for her teaching.

- i) This year she was selected by CU's United Government of Graduate Students (UGGS) to receive the Top TA/GPTI Award for 2015 in recognition of her demonstrated dedication to excellence in teaching.
- ii) She was a 2015 recipient of the Department of Mathematics Burton W. Jones Teaching Excellence Award
- iii) As Lead TA, she was twice a student co-teacher of MATH 5905: Mathematics Teacher

Training, our graduate course for the training of all our graduate student instructors.

iv) She was an invited graduate student at the Nebraska Conference for Undergraduate Women in Mathematics.

**6) Resources requested:**

**a) Budget.** We are requesting salary for graduate student Erica Shannon to match what she would make in Spring 2016 as a 50% graduate teaching assistant, which is \$8954.82. (She will also need a tuition remission to cover 5 thesis hours so she can graduate with her PhD in May 2016, and cover 90% of her health care, as a TAship would.)

**b) Non-financial resources requested.** As a Fellow of CSL, Tubbs is well positioned to make use of CSL's educational advisors as the need arises.

**7) Resources leveraged.** The Department commits to provide Professor Robert Tubbs a course release to give him the time to work as Lead Developer on this proposal.

**8) Agreement to expectations.** We agree to fulfill the "expectations of successful applicants." Indeed, below we append an MOU to satisfy the first expectation:

Dear Professor Tubbs,

This Memorandum of Understanding is to specify what tasks in the development of a new introductory mathematics course (to replace MATH 1011) need to be completed by the end of Spring 2016, with you acting as Lead Developer on the course while working with the help of our graduate student, Erica Shannon.

1) Do "market research" (and consensus-building) on campus to see what the needs of social science students are in a mathematics course that will prepare them for a sophomore-level statistics course (or a "polynomial calculus" course like MATH 1081). Our preliminary discussions indicate it will be a course that would combine aspects of Quantitative Reasoning, Algebra, and Modeling.

2) Research what courses and materials exist at peer institutions for such a course to meet these needs.

3) Suggest a book and a set of topics for such a course.

4) Find the appropriate role for active learning, Learning Assistants, and other evidence-based teaching practices in the delivery of the course.

5) Gather or create sufficient materials so that the course can be offered as a trial for the first time in AY 2016-17.

6) Develop Learning Outcomes from the new course.

7) Working with the Department's Undergraduate Committee, prepare a course proposal for the new course.

8) Supervise Graduate student Erica Shannon as she assists you on all these efforts.

The Department will provide you with a course reduction in Spring 2016 to give you time to work

on these vital efforts. With many thanks in advance,

David Grant  
Professor and Chair  
Department of Mathematics