PUMAS
Pathways to Understanding and MAstery of Statistics

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Introduction

The most mature of the data sciences, statistics provides the path to turn data into knowledge because of its sophisticated methods for statistical inference, prediction, uncertainty quantification, experimental design, and communication. Students and faculty across campus are recognizing and responding to the increasing importance of statistics by increasing demands for training in statistics[1]. This includes not only the traditional introductory statistics courses in the classic models and methods, but sophisticated advanced courses specialized to specific kinds of data, problems, and applications.

Campus Engagement

In order to be prepared to respond to the rapidly changing importance of data in many fields and the increasing demands, Statistics undertook a systematic campaign of engagement with faculty, departments and colleges to discuss the statistics curriculum. This included surveys and numerous in-person meetings. As part of our evolving graduate certificate programs, we undertook a thorough evaluation of applied statistics graduate courses taught across campus. These discussions were informed by the significant interdisciplinary research activities of Statistics faculty, who are engaged with scientists and engineers in multiple dimensions. We also conducted an analysis of the performance of students in the introductory courses to identify key issues affecting student success.

The Department plans to continue this engagement in the future by building networks among faculty, student success coordinators, and advisors that advise students about Statistics courses.

Student Population

An important factor in constructing a modern Statistics curriculum is dealing with a student population that spans a wide range of prior preparation, confidence, and motivation and interest. An important practical consideration is that student time is highly constrained, so statistics courses must deliver content in a flexible and efficient manner.

Evolution of the Statistics Curriculum and Supporting Effort

We developed a two-pronged response to meet campus needs that we call ***Pathways to Understanding and MAstery of Statistics (PUMAS)***. The overarching goal of PUMAS is to extend accessibility to training in statistics to all students at Colorado State University.

The first dimension of *PUMAS* is to arrange the statistics curriculum in such a way that there are entrance points into the curriculum for students of all backgrounds and preparation and subsequent pathways through the statistics curriculum that enable students of all backgrounds to continue studies as long as

[1] In 2018, more than 4700 seats in Statistics undergraduate and graduate courses were occupied by non-Statistics majors each year with roughly 4000 seats in introductory courses and 700 in advanced courses.

desired. In order to pursue this goal, Statistics is dedicated to providing conditions that support student success in Statistics courses at all levels.

The second dimension of *PUMAS* is a significant redesign of the statistics curriculum with the goals of increasing understanding of statistical methodology and applicability, improving discussion of the conditions under which statistical models and methods work and do not work, increasing availability of courses on advanced approaches for complex applications, and improving the training in appropriate statistical computing we provide. In this dimension, we aim to meet the American Statistical Association's (ASA) 2016 Guidelines for Assessment and Instruction in Statistics (GAISE) recommendations[2].

Addressing Student Success

Statistics has implemented specific strategies for improving conditions for student success in specific parts of the curriculum. But overarching strategies include:

- Adopting the American Statistical Association's (ASA) 2016 Guidelines for Assessment and Instruction in Statistics (GAISE) recommendations for statistics course content and goals.
- Reducing maximum course sizes to the largest size consistent with strong student success at each level.
- Offering supplemental materials to support student self-study.
- Implementing active learning techniques, where appropriate and feasible.
- Providing fine-grained course content to match student interests and needs in multiple fields.
- Offering video-delivered course that reduce demands for students to physically attend lectures at the graduate level.

Implementation

The Statistics Success Center is fully operational. The implementation of maximum course sizes is also complete. There is significant progress on the creation of supplemental materials, but this is an on-going task. We plan to implement video-delivered sections of specific courses next year. The changes to the Statistics courses and the new Statistics courses are being rolled out next year on an experimental basis. We are working with the Registrar on developing a mechanism for the formal adoption. We plan to submit the formal paperwork for the changes in Fall of 2019.

In the meantime, we have engaged in a campaign to explain the changes and related issues for advising that will continue through the summer and fall semesters. This includes making a presentation to Faculty Council in Spring, 2019.

[2] https://www.amstat.org/asa/education/Guidelines-for-Assessment-and-Instruction-in-Statistics-Education-Reports.aspx