Ohio Mathematics Initiative

Fact Sheet 6

# FAST FACTS

**All Ohio public colleges and universities will offer pathways in mathematics that help students succeed, increase the percentage of students completing degree programs and promote the effective transfer of credits for students moving from one institution to another.**

## Quantitative Reasoning

*Building mathematics skills that students will need in classrooms, careers and life*

***ALERT: The Education Testing Service Center for Research on Human Capital and Education recently reported that U.S. students – millennials born between 1980 and the early 2000s – across all socioeconomic levels scored lower than students in most countries around the world in literacy, numeracy and problem-solving skills.***

*Eric Gaze, director of the Quantitative Reasoning (QR) Program at Bowdoin College, was not surprised by the report that America's millennials lacked the* 21st century skills needed to prosper professionally and to make measurable improvements in their lives. Yet, he noted a particular concern – the percentage of students scoring below the minimum numeracy standard (below level 3): 54 percent of White, 83 percent of Hispanic and 88 percent of Black millennials.[1]

For Professor Gaze, like many others, the solution is a robust curriculum that develops these skills that are so critical to the ways in which we use quantitative information in our daily lives.[2]

***What is Quantitative Reasoning?***

Quantitative Reasoning is the application of mathematics to the analysis and interpretation of real-world quantitative information, either in the context of a single discipline or interdisciplinary problems. The main objective is for students to learn how to interpret real-life situations in ways that allow mathematical tools to be used in a down-to-earth way to generate useful solutions. Highly refined traditional skills, such as intricate algebraic manipulations, take a back seat.

Traditional mathematics courses often look inward to the core of the discipline as they develop formal and/or symbolic skills and abstract reasoning, often using a specially designed language. On the other hand, QR courses always look outward, aiming to develop practical understanding using a language that is plain and straightforward. QR is all about promoting practical, robust mathematical habits of the mind.

***Why teach QR?***

Quantitative literacy is among several important 21st century intellectual skills all students should master, including analytic inquiry, critical and creative thinking, written and oral communication, information literacy, teamwork and problem solving. In this context, QR courses:[3]

***QUANTITATIVE REASONING, continued on back page***

In December 2015, the Ohio Articulation and Transfer Network (OATN) announced a new Ohio Transfer Module (OTM) course with learning outcomes in Quantitative Reasoning. The development of this course gives students three well-defined learning pathways in mathematics – a Statistics Pathway; a Quantitative Reasoning Pathway; and a Science, Technology, Engineering, Mathematics, Medicine (STEMM) Preparation Pathway – that yield increased success for students in mathematics, a higher percentage of students completing degree programs and effective transferability of credits for students moving from one institution to another.

Following the Quantitative Reasoning Pathway, the successful student should be able to demonstrate three essential outcomes (or competencies):

1. ***Numeracy.*** Students will develop and use the concepts of numeracy to investigate and explain quantitative relationships and solve problems in a variety of real-world contexts.
2. ***Mathematical Modeling.*** Students will make decisions by analyzing mathematical models, including situations in which the student must recognize and/or make assumptions.
3. ***Probability and Statistics.*** Students will use the language and structure of statistics and probability to investigate, represent, make decisions and draw conclusions from real-world contexts.

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## Five sample tasks for a QR course

- Interpret, analyze and explain a U.S. census report about smoking and distinguish between quantitative data referring to absolute changes and those referring to relative changes. *(Numeracy Outcome: Solve real-world problems relating to rates of change, distinguishing between and utilizing models that describe absolute change and relative change including growth and decay.)*

- Accurately describe the limitations of a model of growth (e.g., of a population) or decline (e.g., of the Social Security Trust Fund) over a long period of time. *(Mathematical Modeling Outcome: Create and use tables, graphs and equations to model real-world situations.)*

- Identify whether a news article is reporting on a 'random controlled experiment' or an observational study to decide if conclusions being made are correlational or causational. *(Probability and Statistics Outcome: Critically evaluate statistics being presented in the media.)*

- Calculate income taxes using federal tax tables. *(Numeracy Outcome: Solve real-world problems requiring the use and interpretation of ratios in a variety of contexts.)*

- Create a table and graph depicting a linear relationship between a loan or investment monthly interest amount and the balance owed or due at the beginning of the month. *(Mathematical Modeling Outcome: Model financial applications.)*

**SOURCE:** Ohio Articulation and Transfer Network, TMM011 – QUANTITATIVE REASONING (endorsed December 2, 2015)

***QUANTATIVE REASONING, continued from front page***

- Strengthen mathematical abilities that students will need in the classroom, in their careers and throughout their lives;
- Engage students in a meaningful intellectual experience that gives them an in-depth understanding of a relatively few concepts – and the ability to deal with quantitative information as citizens and in the workplaces;
- Improve students' quantitative and logical reasoning abilities, allowing them to use a variety of mathematical strategies – breaking difficult questions into component parts, looking at questions from a variety of perspectives and looking for patterns – in diverse settings;
- Improve students' ability to communicate quantitative ideas orally and in writing; and
- Encourage students to take other courses in the mathematical sciences.

It should be noted that numerous faculty across multiple institutions have requested that a QR course be included in the Ohio Transfer Module.

### *A new OTM course in Quantitative Reasoning*

The new Ohio Transfer Module (OTM) course with learning outcomes in Quantitative Reasoning (QR) TMM011 adopted in December 2015 is a challenging, rigorous, college-level course that builds upon the skills and knowledge required for high school graduation by the state of Ohio. It should be considered as part of institutions' general education requirement for majors in non-mathematics intensive fields that include communication, criminal justice, fine arts, and education, as well as the social and behavioral sciences.[4]

Quantitative Reasoning courses must achieve the core mathematical general education outcome – that is, critical thinking. More broadly, courses should support the following learning outcomes advanced by the Mathematical Association of America's Committee on the Undergraduate Program in Mathematics:[5]

- ***Interpretation*** – the ability to glean and explain mathematical information presented in various forms (e.g., equations, graphs, diagrams, tables, words).
- ***Representation*** – the ability to convert information from one mathematical form (e.g., equations, graphs, diagrams, tables, words) into another.
- ***Calculation*** – the ability to perform arithmetical and mathematical calculations.
- ***Analysis/Synthesis*** – the ability to make and draw conclusions based on quantitative analysis.
- ***Assumptions*** – the ability to make and evaluate important assumptions in estimation, modeling, and data analysis.
- ***Communication*** – the ability to explain thoughts and processes in terms of what evidence is used, how it is organized, presented and contextualized.

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[1] Gaze, Eric (2015) "Addressing the Skills Gap for Students and Young Adults," Diverse Issue in Higher Education. July 7, 2015. http://diverseeducation.com/article/76145/

[2] Ibid.

[3] Some of the following responses have been adapted from Mathematical Association of America (2015). MAA Committee on the Undergraduate Program in Mathematics. See http://www.maa.org/programs/faculty-and-departments/curriculum-department-guidelines-recommendations/cupm

[4] To view the full information about this new OTM course, see Ohio Transfer Module (OTM) Guidelines and Learning Outcomes at https://www.ohiohighered.org/transfer/transfermodule/learningoutcomes

[5] Mathematical Association of America (2015).

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