

Quantitative Thinking Requirement

Rationale

Quantitative thinking (QT) skills are an essential component of a liberal education. Critical thinking incorporates both qualitative and quantitative evidence and evaluation. In some fields quantitative approaches play a central role, while qualitative thinking dominates in others. Despite these differences in emphasis, critical thinking skills learned in one area often carry over and reinforce those learned in other areas. It is for this reason that the breadth of experience associated with a liberal arts education prepares students effectively to be active participants and leaders in government, civil society, business, and academia.

Many policy debates, scientific discussions, political issues, and personal and organizational decisions involve judgments about claims based upon quantitative evidence. To evaluate these claims, the individual must have basic familiarity with such concepts as counting, measurement, estimation, and data analysis. Equally important is the capacity to ask and answer questions in a manner appropriate to these quantitative tools and to understand when the use of quantitative tools is or is not appropriate. The purpose of the QT requirement is to ensure that students have the opportunity to develop such skills. Students should learn approaches to collecting, interpreting, and presenting information about the world based on numerical, logical, and statistical skills. These topics arise in a wide range of areas, and we invite faculty from a range of disciplines to teach courses that contribute to QT.

Motion: EPAG moves that the Faculty endorse the refined description (statement, course approval criteria) of the Quantitative Thinking as follows:

Quantitative Thinking Requirement: One or more course(s) that provide(s) broad exposure to a set of critical thinking skills of importance to individual and civic discourse and decision-making. Quantitative thinking consists of sophisticated reasoning built upon numerical, logical, and statistical skills.”

Students may take one or more courses with a Q3, Q2, or Q1 designation. (The number indicates how broadly the course covers quantitative concepts.) A single Q3 course completely satisfies the requirement, but some students may prefer to satisfy the requirement by taking a Q2 course together with any other Q2 or Q1 course, or by taking three Q1 courses.

- Q3** The great majority of material covered in Q3 course focuses on quantitative topics, and these courses will cover all or nearly all of the learning goals listed below.
- Q2** At least half of the material covered in Q2 courses will focus on quantitative topics, and these courses will cover the majority of learning goals listed below.
- Q1** Some range of quantitative topics are covered in Q1 courses, and quantitative thinking elements represent some of the overall material covered in the course.

Course Approval Criteria

QT courses (content, pedagogy, activities, assessment) will provide opportunities for students to enhance their abilities in the following areas:

- Describing the world quantitatively
- Evaluating sources and quality of data
- Distinguishing association from causation
- Understanding trade-offs,
- Understanding uncertainty and risk
- Using estimation and modeling to evaluate claims and test theories.

(These learning goals are explained in greater detail on the following page.)

Learning Goals

- **Describing the World Quantitatively:** Much of quantitative thinking involves quantitative or statistical descriptions of social and natural phenomena. This includes descriptions of patterns and variations and rates of change, such as linear or exponential growth. Understanding descriptive statistics and the various modes of presentation of quantitative data is central. Students should be able to distinguish when quantitative approaches are appropriate and when they are not.
- **Evaluating Sources and Quality of Data:** Students of quantitative thinking should also understand the sources of data, including the processes of collecting or producing data. This may involve understanding how to assess the reliability and validity of measurements and elements of probability and sampling, including sources of bias and error.
- **Association and Causation:** The quantitative thinker knows the ways that associations between factors are established by observation, experiment or quasi-experiment. It is important to be able to establish the meaning of an association or correlation and learn the protocols for weighing the statistical significance and theoretical importance of findings, including inferring causation.
- **Trade-Offs:** Most decisions, whether public or private, individual or societal, may be thought of as involving conflicting goals. Much of the debate on public issues involves disagreement about the value of the different goals. Where there are conflicting goals, quantitative thinking offers techniques for weighing the relative impact of policy options. While there rarely is a single correct outcome in the face of such conflicts, the quantitative thinkers can bring measure and balance to policy discussion.
- **Uncertainty and Risk:** Few things in life are certain; decisions and debate often revolve around unknowns. The quantitative thinker possesses skills that can be used to assess, compare and balance risks, and understands the limits and strengths of these techniques. The quantitative thinker knows that, in the face of the unknown, if not the unknowable, we often rely on conditional statements and probabilities in making decisions and can evaluate conclusions drawn from conditional statements.
- **Estimation, Modeling, and Scale:** The quantitative thinker understands that quantities vary over huge ranges; ‘big’ and ‘small’ are not absolute notions but depend on context or scale. Quantitative thinkers appreciate the value and limitations of abstracting out detail—constructing models—and that the sensitivity of model results to assumptions can and should be reported along with the model results.