# Criteria for QR Course Distribution Requirement:

Quantitative Reasoning courses teach students to effectively use, explore, analyze, and communicate with numbers, data, and logical statements consistently throughout the course content. Both words are carefully chosen: “quantitative” suggests having to do with numbers and relations and logic, while “reasoning” refers to the creation and interpretation of arguments. Courses that focus on the analysis of and drawing of inductive inferences from quantitative data, as well as courses that concentrate on the formulation of deductive and analytical arguments, can satisfy this requirement. The following revised learning outcomes support this notion:

1. Students will formulate and/or analyze complex questions that can be addressed with numbers, symbols, or data.
2. Students will evaluate and interpret relevant quantitative information to support an argument.
3. Students will critically analyze quantitative research design and conclusions and communicate any biases, flaws, or misleading information in various approaches and presentation of results OR1 Students will interpret and translate between multiple representations of quantitative information.

# Proposed Competencies Associated with QR Learning Outcomes:

1. *Students will formulate and/or analyze complex questions that can be addressed with numbers, symbols, or data.* Disciplines teach and use quantitative information in a variety of forms including numerical, empirical, and symbolic. The complexity of these questions is determined by discipline-specific conventions. However, the iterative research process and quantitative evidentiary support are universal and may include the following:
   * developing or analyzing sophisticated, novel research questions that do not always have clear numerical answers;
   * connecting research questions to a broad range of quantitative and statistical techniques such as descriptive statistics, data and numerical visualizations, correlations, and regression analysis;
   * investigating and determining the properties of abstract objects such as mathematical functions, computer programs, and formal logical systems.
2. *Students will evaluate and interpret relevant quantitative information to support an argument.* To answer a quantitative research question, proper data must be collected and analyzed. Supporting a quantitative argument includes:
   * identifying and collecting appropriate quantitative data that aligns with the research question;
   * communicating quantitative evidence in support of an argument through graphs, charts, figures, maps, equations, and/or models;
   * practicing and refining quantitative skills with instructor and/or peer feedback.

1 This outcome was written as an ‘or’ statement to be inclusive of the wide variety of QR skills and knowledge that are taught at the college. Both statements may apply to traditional QR disciplines, such as mathematics or physics, but the first statement is more likely to apply in social science QR courses, and the second statement is more likely to apply to humanities QR courses.

1. *Students will critically analyze quantitative research design and conclusions and communicate any biases, flaws, or misleading information in various approaches and presentation of results OR Students will interpret and translate between multiple representations of quantitative information.* In this context, research refers to disciplinary- specific research conventions. Research design is rarely flawless and quantitative information has become increasingly prevalent and presents itself in various forms including words, numbers, equations, graphs, symbols, data, and more. Discussing imperfections in research design and analysis OR moving between these multiple representations may address the following:
   * critically evaluating how counts, measures, and associations are influenced by the way things are defined, grouped, and presented;
   * explaining the influence of confounding factors in experimental and/or observational studies;
   * understanding the difference between association and causation; OR
   * explaining the relationship between equations, graphs, words, and other general analytical representations;
   * interpreting quantitative assertions and their underlying assumptions.

# Guidelines for QR Course Designation:

* + QR courses can be offered by any department at the college.
  + Quantitative reasoning must be substantially and consistently integrated across the course. QR content should not occur in only one part of a course.
  + Faculty should include the QR distribution learning outcomes in course syllabi.
  + Senior seminar/thesis/colloquium courses and independent study/research courses at the 500-level (i.e., 500: independent study; 550: independent research; 560: student-faculty collaborative research) with quantitative content cannot fulfill the QR requirement.
  + If a course has a prerequisite with a QR designation, it cannot be assigned the QR designation. Exceptions will be made in cases where students are able to place out of the prerequisite or where the prerequisite can count as either a lab science or QR.

# QR Course Approval Form:

Date:

Instructor:

Department:

Proposed QR Course Title:

Proposed QR Course Subject and Number:

*Please choose one.* Are you seeking approval for:

* + - all sections of the course
    - this section only

If you are seeking approval for a particular section, which one?

*Please choose one.* Are you seeking an exception to the QR prerequisite guideline:

* + - Yes
    - No

If yes, please explain. Click or tap here to enter text.

*In your responses below, please use language that is accessible to people outside of your field.*

1. Content and Skills. Describe the content of the course which you believe renders it suitable for fulfilling the QR requirement.
   1. What of quantitative reasoning content, authentic to your discipline, will you teach students? Please be specific.
   2. How will students learn to:
      1. **formulate and/or analyze** complex questions that can be addressed with numbers, symbols, or data in this course?
      2. **evaluate and interpret** relevant quantitative information to support an argument in this course?
      3. **critically analyze** quantitative research design and conclusions and communicate any biases, flaws, or misleading information in various approaches and presentation of results OR2 interpret and translate between multiple representations of quantitative information in this course?

In your responses to this question, please identify specific parts of the course and include any assignments (e.g., exercises, labs, activities, problem sets, research) that will help achieve these learning outcomes.

2 This outcome was written as an ‘or’ statement to be inclusive of the wide variety of QR skills and knowledge that are taught at the college. Both statements may apply to traditional QR disciplines, such as mathematics or physics, but the first statement is more likely to apply in social science QR courses, and the second statement is more likely to apply to humanities QR courses.

1. Teaching QR. Describe the pedagogical methods and techniques you will use to teach QR.
   1. How do you plan to **implement the instruction** of quantitative reasoning skills? In your response, please identify specific teaching strategies.
   2. Describe the use of feedback as part of the learning process for QR. How will you **provide feedback** on quantitative assignments or activities? What opportunities will exist for students to **practice and refine** their quantitative skills?
2. Assessment. Describe your assessment strategy to evaluate students’ QR skills.
   1. How will you **assess** students’ quantitative reasoning achievement relative to the course grade? Please describe the types of assessments you will use.
   2. How many **assignments** will students need to use quantitative reasoning? (Include both formal assignments and in-class problem solving, discussions, activities, or labs.)
   3. What **percentage of the final grade** will be attributed to quantitative reasoning assignments?

*If you would like to discuss your answers to these questions, please make an appointment with Lorelei Koss* [*(koss@dickinson.edu).*](mailto:(koss@dickinson.edu).)