**KWU Quantitative Reasoning Requirements**

QR Courses should meet the following learning outcomes:

1. Computation – Students should be able to perform calculations successfully at an appropriate level, including correct use of calculators or computers.
2. Numeracy – Students should be able to decide if numbers are appropriate. This includes comprehending the (comparative) sizes of large and small numbers, understanding percentages and fractions, and being able to determine the intuitive reasonableness of given solutions.
3. Interpretation – Students can interpret and explain information presented in mathematical ways. For instance, students should be able to read information from a given graph, understand mathematical equations and formula, use appropriate units on numerical answers, etc.
4. Representation – Students should be able to represent applicable information mathematically. For instance, students should be able to write an equation to represent a basic relationship, draw a simple graph to accurately represent important phenomena, etc.
5. Identify Assumptions – Students should be able to clearly identify assumptions being made in estimation, modeling, and data gathering. Students should also be able to identify the limits, drawbacks, and consequences of their assumptions.
6. Analysis – Students should be able to draw conclusions, make predictions, and draw conclusions, based on correct mathematical analysis.
7. Communication – Students should be able to explain all previous steps in a clear and effective manner, including using correct symbolism and equations as well as written explanation.

**Example Course Statement**

Description of Calculus I as a QR course:

Calculus is the mathematical study of change. As such, the main applications of calculus come from clearly modeling a physical system by making clear, correct **assumptions** (5), then **representing** (4)the relevant facts mathematically. After a valid representation has been made, the **calculations and computations** (1) come into play, as limits, derivatives, and/or integrals are used to gain new mathematical data. The resulting mathematical objects then must be **analyzed** (6) with reference back to the original question or problem. When this is a physical system, this requires participants to use general **numeracy** (2) skills to decide whether their answers are reasonable, compare different options, and decide if something has gone wrong. Finally, a problem is not finished until you **communicate** (7) the solution, which means explaining verbally and/or in writing, and using appropriate mathematical symbolism, exactly what you have concluded. Throughout, students will be expect to **interpret** (3) graphs (particularly, how they are related to limits, differentiation, and integration), formulas, and numerical data.

**Courses:**

After small modifications, the following would probably meet the QR Requirements:

1. Calculus I
2. Elementary Statistics
3. College Algebra
4. Precalculus
5. University Physics (?)

Ideally, (hopefully?) the Math 105: Survey of College Mathematics would be replaced by a course (or a few courses) which would meet the QR requirement. (A low-level Mathematical Modeling course? A graphs and networks course? It could be anything!)

**A couple of random example courses from other schools:**

King’s College – Mat 160: Quantitative Reasoning

Description: This is an introductory course in arithmetical, geometric and algebraic analysis that introduces students to the place of mathematics in the quest for truth in the conversation of Western civilization. It is designed to equip students to understand basic issues in economics, financial management, business, science, and public policy in a way that sensitizes them to the use and abuse of mathematical reasoning in the public square. Beginning with standard arithmetical, geometric and algebraic concepts and manipulations, quantitative analytical skills will be extended to more complex quantitative analysis focused on applications of linear, quadratic, exponential and logarithmic functions, as well as systems of linear equations, infinite sequences and series, basic combinatorial analysis, and elementary probability theory.

Willamette University – Mat 130: Contemporary Mathematics

Description: A survey of contemporary topics in mathematics such as: voting systems and power, apportionment, fair division of divisible and indivisible assets, efficient distribution, scheduling and routing, growth and decay in nature and economics, symmetry and fractal geometry, probability and statistics.  This is NOT a remedial course. Prerequisite: two years of high school algebra.

**Placement**

To determine which course(s) a student should take:

1. Many majors should specify exactly which course or courses would best meet the needs of the department. This becomes a better option after a robust set of course offerings is available.
2. New course design should start with QR and departmental needs in mind. Many departments may want to design their own QR course, or collaborate with the math department to design a suitable course. Of course, we probably can’t have separate QR courses for each major on campus, but we should be able to get some effective, interesting options that satisfy a variety of different majors.
3. Finally, for students in the “main sequence” of algebra-precalculus-calculus, it would benefit the students as well as the school to have some sort of placement testing in place so that students are placed into the correct course. This also allows the option of “testing out” if students do well on a placement test.

**Main Sources:**

1. MAA recommendations: (from http://www.maa.org/programs/faculty-and-departments/curriculum-department-guidelines-recommendations/quantitative-literacy/quantitative-reasoning-college-graduates#Part2)

In short, every college graduate should be able to apply simple mathematical methods to the solution of real-world problems. A quantitatively literate college graduate should be able to:

1. Interpret mathematical models such as formulas, graphs, tables, and schematics, and draw inferences from them.
2. Represent mathematical information symbolically, visually, numerically, and verbally.
3. Use arithmetical, algebraic, geometric and statistical methods to solve problems.
4. Estimate and check answers to mathematical problems in order to determine reasonableness, identify alternatives, and select optimal results.
5. Recognize that mathematical and statistical methods have limits.
6. The Association of American Colleges and Universities VALUE Rubric: Quantitative Literacy

From [www.aacu.org/value/rubrics](http://www.aacu.org/value/rubrics)

1. The common core Standards for Mathematical Practice

[www.corestandards.org/Math/Practice/](http://www.corestandards.org/Math/Practice/)

1. *Peer Review*, vol 16, no. 3. All about quantitative reasoning.