

GEN ED#3 – REASON QUANTITATIVELY AND MATHEMATICALLY AS REQUIRED IN THEIR FIELDS OF INTEREST AND IN EVERYDAY LIFE	
QCC Example Outcomes:	Common Core Outcomes:
a. Identify problems that need a mathematical solution, and use computational methods in the mathematics applicable in everyday life b. Use the language, notation, and inductive and deductive methods of mathematics to formulate quantitative ideas and patterns c. Use mathematics appropriate to specific fields of study d. Estimate when doing mathematical calculations e. Employ technology to collect, process, and present mathematical information f. Describe mathematical, statistical and probabilistic models and methods, and identify how they are used to obtain knowledge g. Organize and interpret data and use the data to draw conclusions	Required Core: I.B – Mathematical and Quantitative Reasoning 1. Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables. 2. Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems. 3. Represent quantitative problems expressed in natural language in a suitable mathematical format. 4. Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form. 5. Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation. 6. Apply mathematical methods to problems in other fields of study.
GEN ED OUTCOMES ADDRESSED IN ASSESSMENT:	QCC 3. b. Use the language, notation, and inductive and deductive methods of mathematics to formulate quantitative ideas and patterns f. Describe mathematical, statistical and probabilistic models and methods, and identify how they are used to obtain knowledge g. Organize and interpret data and use the data to draw conclusions Required Core: I.B – Mathematical and Quantitative Reasoning 1. Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables. 2. Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.
EVIDENCE/ MEASURABLE DATA • GROUP SIZE: No. of students _____ No. of sections _____	
FINDINGS	In MA440 students did poorly in sections (2.2-2.7) (RATIONAL FUNCTIONS) (Learning Outcome: Students will be able to apply the profile of a function to graph the function: asymptotes, domain, range, intercepts). Next, students performance was only about 10% higher in sections (6.1, 6.2) (Learning Outcome: Students will be able to apply the law of cosines). Also students didn't do very well in sections (10.1-10.5) (Learning Outcome: Students will be able to expand series). Students' performance was overall poor.

	The MA-440 students did best in expanding series, though many had difficulty in simplifying the resulting expression. In Section 2, the MA-440 students had the most difficulty in determining the range of a rational function, while they did best in finding the asymptotes.
ACTION PLAN*	

*Include this information in the Department’s Year-End Report.

ASSESSMENT RESULTS FOR QCC EDUCATIONAL OUTCOME #3 – MA 336 COMPUTER-ASSISTED STATISTICS SPRING 2013

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EVIDENCE/ MEASURABLE DATA • GROUP SIZE: No. of students <u> 131 </u> No. of sections <u> 8 </u>	They administered a 20-25 minute quiz to assess how well the following outcomes were met. 1. Given the graphical representation of a distribution, the student will be able to draw conclusions about the distribution: estimate the mean, median, SD, and the percentage of scores within a range 2. Given two distributions, the student will be able to compare them with respect to mean, median, and SD. 3. Given the mean and SD of normal distributions the student will be able to estimate the percentage of scores within a range (for example, the 68-95-99.7 rule)

	4. The student will be able to match a distribution to its verbal description The quiz was distributed to all instructors teaching the course for their review and was discussed with senior faculty members who have taught the course. It contains several multiple choice questions and three questions requiring a brief explanation. The items were designed to require very little, if any, computation. All eight sections of MA336 participated in this assessment. Faculty administered the quiz and graded the written responses according to the following criteria: 1. In the written responses, no consideration will be given to grammar or syntax. 2. Question#3: Count as correct if the response at least alludes to more score clustering around the mean being “like” the mean. 3. Question#6: Count as correct if the response at least alludes to using the percentage of area of category A in the estimation. 4. Question#9: Count as correct if the response at least alludes to “early first marriage” having been more common 200 years ago and “late first marriage” being more common today.
FINDINGS	This assessment involved 131 students. The range of correct responses to the questions on the quiz ranged from 27% to 82%. With the exception of two questions (with correct responses of 82% and 72% respectively), students did not do well on the quiz.
ACTION PLAN*	Faculty met to discuss the results and recommend further actions in response. The following is a summary of the discussion. A) The instrument was biased towards conceptual understanding not reflecting current teaching practices B) We prefer that students perform better on questions of conceptual understanding. To this end, the following were offered for consideration: 1) Increase emphasis on teaching for conceptual understanding 2) Use low-stakes assignments with questions on concepts 3) Consider textbook with extra emphasis on concepts 4) Explore a list of learning outcomes for the course 5) Consider increasing uniformity of sections perhaps through a departmental midterm or partly uniform final 6) Increase awareness of existing practices perhaps through sharing of finals or other assessment instruments used for grading 7) In future assessments, consider including items with more emphasis on computation 8) Form a subgroup to discuss and collect data on strategies and best/practices for shifting more emphasis on conceptual understanding.

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EVIDENCE/ MEASURABLE DATA • GROUP SIZE: No. of students <u> 73 </u> No. of sections <u> </u>	The following student learning outcomes were assessed: (a) Students will be able to interpret graphical representation of the theory of subtractive color mixing, (b) Students will be able to calculate the number of protons, neutrons and electrons of atoms, (c) Students will be able to identify balanced chemical equations. Students will engage in the following activities:

	(a) Students will attend class to learn necessary concepts, including chemical terminology, and interpretation of art materials from a scientific and chemical perspective; and (b) Students will be evaluated during the semester of their knowledge of these concepts through graded and ungraded assignments with feedback from the instructor. The following tool was used to determine whether students met each student learning outcome: Students' responses to <i>eight exam problems of multiple choice format</i> on an assessment exam.
FINDINGS	The same student learning outcomes assessed in this report were assessed in the Fall 2012 semester. However, in the Fall 2012 semester the questions were a combination of short-answer and multiple-choice format. It was noticed that student skipped questions which called for a written explanation. It was inconclusive whether the students did not understand the concepts and thus could not answer the questions, or whether they did not have enough time to complete the questions. This semester, these questions were reworded into a complete multiple choice format. Questions related to students' understanding of graphical representation of subtractive color mixing were asked. Students scored 22 percentage points lower than expected (53% actual outcome) in simply remembering which two colors should be combined to give a red color. There was a 16 percentage point increase from expectation where students incorrectly believed that you should mix magenta, cyan and yellow to produce a red paint. Question 2 asked students to identify the correct absorption plot for the mixture of red paint. 52% of the students correctly identified this plot (only 2 percentage points above our expectations). Interestingly, there was a 12 percentage point increase from expectations (62% of students in all) who correctly understand that absorption peaks appear where light is absorbed, and thus we do not see these colors, and that there are no absorption peaks where light is reflected, thus we do see these colors. In question 4, students were asked to interpret reflection plots of combining artists' blue and yellow pigments. Remarkably, 23 percentage points above our expectations (73% of students in all) understood that one sees green when these two pigments are mixed since green light is reflected into one's eyes while all other colors are absorbed. In Fall 2012, a great number of students omitted this question, which led us to believe that this question may have been more difficult than the other subtractive color mixing questions. But the positive results obtained in the Spring 2013 semester indicate that the students probably understood the concept but may have difficulty explaining the concept in a written explanation. Question 5 assessed students understanding of balancing chemical equations. In the Fall 2012 semester, this question was asked to identify whether the chemical equation was balanced or unbalanced and to explain their answer. Students correctly answered this question 11 percentage points lower than expectation (39% of students). Remarkably when this question was reworded into a complete multiple choice format, 77% of the students correctly answered this question. Again, this may be an indication that the students understood the concept of balancing chemical equations but may have difficulty expressing this in writing.
ACTION PLAN*	Since the multiple choice format was administered for only one semester, it will be interesting to see if similar results could be replicated. Thus it is expected that this assessment exam will be given for the fall 2013 semester and an assessment report comparing all three semesters fall 2012, spring 2013 and fall 2013 will be done. Instructors who are teaching this course will also try to reinforce certain concepts of subtractive color mixing to improve student learning. In addition, more in-class and homework based practice on reading and interpreting scientific articles related to art conservation and writing to express scientific concepts will be done. One faculty teaching this course will experiment on teaching one section of this course as a writing intensive course. Students will continued to be encouraged to visit the campus writing center for further assistance in completing written assignments for this course.

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