Quantitative Reasoning in General Education

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Workshop Agenda

• Introductions: what do you hope to learn today?
• Define Quantitative Reasoning
  – In General Education
  – At Hostos
  – QR Value Rubric
• QL Metarubrics at Hostos
• Ten QR Questions
• Ideas to Try
Key words

(Association of American Colleges & Universities)

• Mathematical → Numerical (data)
• Abstract → Everyday life situations
• Algorithms → Ad hoc methods
• Generality → Particular application
• Few → Many practice opportunities outside classroom
• Disciplinary → Interdisciplinary
In 1997, the Washington State Legislature directed the Higher Education Coordinating Board (HEC Board) to implement a budget-based accountability system. From this directive, four assessment initiatives were developed. Writing and critical thinking - are familiar concepts to most educators. Two others - information technology literacy & quantitative reasoning.
Quantitative Reasoning

“QR is a "habit of mind," competency, and comfort in working with numerical data.”

“Individuals with strong QR skills possess the ability to reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations.” - AAC&U
Quantitative Reasoning

“They understand and can create sophisticated arguments supported by quantitative evidence and they can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc., as appropriate).”

- AAC&U
Correlation?

**Divorce rate in Maine** correlates with

**Per capita consumption of margarine**

Correlation: 99.26% (r=0.992558)
Correlation?

Per capita consumption of mozzarella cheese correlates with Civil engineering doctorates awarded

Correlation: 95.86% (r=0.958648)
QR in GenEd

“The world of the twenty-first century is a world awash in numbers.” (Steen 1997)

“...numeracy is not something mastered in a single course. The ability to apply quantitative methods to real-world problems requires a faculty and an insight and intuition that can be developed only through repeated practice.” (Bok 2006)
Working definition of QR at Hostos

QR is the ability to reason and solve quantitative problems from various real-life contexts. Students who possess QR skills can read and communicate information presented in various forms, using words, tables, graphs, mathematical equations, etc. They can also select appropriate quantitative information to craft solutions, arguments, and/or conclusions. Students can perform calculations and assess quantitative evidence for its accuracy, reasonableness, and limitations. QR is also the ability to make reasonable inferences from quantitative data and understand limitations of the data and their inferences.
Exercise

Suppose there is a population of 10,000 individuals in this country in 1995. During this year, 200 couples became married, 100 couples were issued a divorce, and there were 400 existing marriages (not counting those which only occurred in this year). Which number best reflects the divorce rate?

A. 1%
B. 25%
C. 16.67%
D. 50%
E. None of the Above
Exercise

- According to the Cable News Network (CNN), the number of injured in-line skaters (or "roller-bladers") was 184% larger in 1994 than it was in 1993. Did the number of injured skaters almost double, almost triple, or more than triple?

- Officials estimate that 320,000 Boston-area party-goers attended the 1995 Independence Day celebration on the banks of the Charles River. They also estimate that the party-goers left behind 40 tons of garbage. Given that a ton equals 2,000 pounds, how many pounds of garbage did the average party-goer leave behind?
QR Value Rubric

- Interpretation
- Representation
- Calculation
- Application / Analysis
- Assumptions
- Communication
Quantitative Literacy Metarubrics – Spring 2009
Evaluators are encouraged to assign a zero to any performance that does not meet level one performance.

<table>
<thead>
<tr>
<th>Interpretation Ability to explain information presented in mathematical form (e.g. equations, graphs, diagrams)</th>
<th>4 Incorporating skill</th>
<th>3 Mastering skill</th>
<th>2 Developing skill</th>
<th>1 Attempting skill</th>
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<tbody>
<tr>
<td>Skillfully explains information presented in mathematical form (e.g. equations, graphs, diagrams). Consistently provides clear explanation with no errors.</td>
<td>Competently explains information presented in mathematical form (e.g. equations, graphs, diagrams).</td>
<td>Developing the ability to explain information presented in mathematical form (e.g. equations, graphs, diagrams). Sometimes makes errors or gives unclear explanation.</td>
<td>Attempts to explain information in mathematical form (e.g. equations, graphs, diagrams), but has trouble doing so correctly. Frequently makes errors or gives unclear explanation.</td>
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<tr>
<td>Representation Ability to convert relevant information into various mathematical forms (e.g. equations, graphs, or diagrams)</td>
<td>Consistently demonstrates fluency in converting relevant information into mathematical forms (e.g. equations, graphs or diagrams, tables). Reliably chooses the best form for the problem at hand.</td>
<td>Generally able to convert relevant information into various mathematical forms (e.g. equations, graphs, diagrams)</td>
<td>Developing the ability to convert relevant information into mathematical form (e.g. equations, graphs, diagrams). Sometimes makes errors or uses forms that are not the best for the problem at hand.</td>
<td>Attempts to identify relevant information, but has difficulty converting it into mathematical form (e.g. equations, graphs, diagrams). Frequently makes errors or uses forms that are not the best for the problem at hand.</td>
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<tr>
<td>Calculation</td>
<td>Successfully complete all calculations for the task at hand with consistency.</td>
<td>Successfully complete most calculations for the task at hand.</td>
<td>Ability to complete successfully calculations for the task at hand is limited. Perhaps the students can do a few of these calculations very well, but others are inconsistently completed and still others cannot be completed at all.</td>
<td>Attempts to complete calculations for the task at hand are rarely and inconsistently successful.</td>
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<td>Application/Analysis Ability to make judgment based on quantitative analysis of data</td>
<td>Makes informed judgment based on quantitative analysis data. Consistently draws appropriate conclusions from the data and recognizes the limits of analysis used.</td>
<td>Makes informed judgments based on quantitative analysis of data.</td>
<td>Makes judgments based on quantitative analysis of data. Sometimes makes errors or draws unwarranted conclusions.</td>
<td>Attempts to make judgments based on quantitative analysis or data. Frequently makes errors or draws unwarranted conclusion.</td>
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<td>Estimation/reasonableness checks Reality check</td>
<td>Consistently checks calculated answers for reasonableness; makes good assumptions for estimation problems that involve unknown quantities; performs reality checks on numbers reported by others, as appropriate</td>
<td>Often checks calculated answers for reasonableness; Makes good assumptions for estimation problems that involve unknown quantities; performs reality checks on numbers reported by others as appropriate.</td>
<td>Sometimes checks calculated answers for reasonableness; confident about making estimates that require assumptions about unknown quantities; performs reality checks on numbers reported by others, as appropriate.</td>
<td>Rarely checks answers for reasonableness, confident in making estimates that require assumptions about unknown quantities, performs reality checks on numbers reported by others, as appropriate.</td>
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<tr>
<td>Communication Expressing a solution so that an audience understands what the solution means</td>
<td>Clearly communicate quantitative information shaping it into an argument, solution, or conclusion as appropriate, using a well-chosen, effective format and placing values in context</td>
<td>Clearly communicates quantitative information, although information may not cohere as argument, solution or conclusion, may not be in the most effective format or with necessary context</td>
<td>Communicates quantitative information, but does not constitute a clear or coherent point, chosen format is neither most effective nor in the context.</td>
<td>Attempts to communicate quantitative information, but is unsuccessful in making argument, selecting an appropriate format, or placing in context.</td>
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QR Questions
(from the Carleton College QuIRK Initiative)

1. What do the numbers show?
2. How typical is that?
3. Compared to what?
4. Are findings those of a single study (source) or of multiple studies (sources)?
5. How were the main characteristics measured?
QR Questions

6. Who or what was studied?
7. Is the outcome of a study anything more than noise or chance?
8. How large is the result of a study?
9. What was the design of the study?
10. What else might be influencing the findings?
Ideas to Try

• Graphing Stories: [http://graphingstories.com/](http://graphingstories.com/)
• Quantitative Writing (Carleton College) [http://serc.carleton.edu/quirk/quantitative_writing/index.html](http://serc.carleton.edu/quirk/quantitative_writing/index.html)
• Course-specific QR activities (Mathematics Across the Community College Curriculum) [http://www.mac3.matyc.org/projects.htm](http://www.mac3.matyc.org/projects.htm)
• Teaching with Spreadsheets (Carleton College) [http://serc.carleton.edu/sp/library/ssac/examples.html](http://serc.carleton.edu/sp/library/ssac/examples.html)
Thank you!

• Visit me: A-115, Mon & Wed
• Email me: gpark@hostos.cuny.edu
• Our website: http://tinyurl.com/hostosqr
  (QR initiative under CTL)