

Quantitative Reasoning – Scoring Results & Brief Analysis

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Overview: In February 2015, senior students (n = 117) in ES Capstone courses volunteered to take a specially designed “performance task” that asked them to use their quantitative reasoning. The task was designed by UND faculty members to see how well students could apply their QR to a real-world practical problem that required thinking through and with numerical information. The task was aligned with both UND’s QR criteria and UND’s QR assessment rubric. The task and rubric were the same as that used in the February 2014 assessment week session and subsequent scoring. In December 2015, faculty and academic staff (n = 15) participated in a “scoring session” in which they assessed the students’ QR work from February 2015. Below are summarized the results from both of these scoring sessions.

Total Score Results from December 2015 Scoring Session (range 0-24)

0-5 = 1% 6-10 = 6% 11-15 = 37% 16-20 = 44% 21-24 = 12%

Scores for Individual Criteria on the QR Rubric

Rubric Criteria	Student Scores (Percentage)					
	1: Unsatisfactory		2: Developing		3: Accomplished	
	2014	2015	2014	2015	2014	2015
Confidence with Math	21	15	38	57	42	28
Interpreting Data	13	9	47	74	40	18
Problem Solving in Context	15	12	48	63	37	25
Number Sense	14	12	38	62	48	26

As compared with 2014, students from 2015 were more likely to achieve at the “developing” level – with lower percentages achieving in the “unsatisfactory” or “accomplished” categories. Note that although the QR rubric contains a “technology” criterion, the performance task does not involve assessment in this area, and therefore scores were not assigned. The applicable rubric criteria definitions are:

Rubric Criteria Definitions

CONFIDENCE WITH MATHEMATICS: Student is comfortable using quantitative ideas and applying quantitative methods.

INTERPRETING DATA: Student is able to interpret data, including that drawn from graphs and maps. Most or all critical elements are recognized and irrelevant data is not included.

PROBLEM SOLVING IN CONTEXT: Student competently identifies and applies appropriate mathematical or numerical tools to solve problems.

NUMBER SENSE: Student recognizes when proposed solutions or analyses are unreasonable and is able to self-correct if needed.

Quantitative Reasoning Performance Task

Designed for Essential Studies by UND faculty: Jeff Carmichael (Biology), Anne Kelsch (History & Instructional Development), Alena Kubatova (Chemistry), Kathy Smart (Teaching & Learning) & Ryan Zerr (Mathematics), with Christopher Atkinson (Geography).

Task summary: A UND senior is about to graduate, has received an employment offer from a company that has offices in three different cities, and is able to choose which position to take. The student's parents (always willing to provide advice) are strongly encouraging the student to take the New York job based on multiple factors including salary, cost of living, and quality of life. The student realizes their parents may have some valid points but also wants to consider additional information before making their decision.

Student's role: You are the lucky student! Your task is to evaluate your parents' claims and answer the following questions using only the supporting documents provided: 1) What are the strengths and weaknesses of your parents' argument? 2) Which job will you accept? Your answers should include quantitative summaries of any relevant data drawn from the documents provided to support your position, making calculations and summary charts or graphs to support a solid case. A strong response will include relevant data summarized and presented in a format that you create (e.g., text, graph, table). There is no single correct response to the questions. Instead, your ability to interpret quantitative data and make sound conclusions is most relevant.

Document library:

- For New York, for Chicago, and for Los Angeles:
 - Job offers with salary, relocation assistance, and benefits detailed by city;
 - Maps showing commuting distances from popular residential districts to downtown office location;
 - Table of commuting costs, home sales data and prices, and rents;
 - Quality of life statistics (crime rates, air quality index, average temperature & rainfall, average home costs) and health care indices.

Summary Notes from Campus Debriefing

(thoughts from faculty and staff discussions immediately following the scoring session)

1. What characteristics of student work did scorers notice?
 - a. Students who took the time to explain their answer, even if the data they used was incorrect, scored higher. Scorers valued the explanation.
 - b. Some scorers expected more students to show their work – to make explicit the calculations they used to get their answers.
 - c. The ability of students to recognize the reasonability of answers was disappointing.
2. Students' abilities in the area of "number sense":
 - a. Strongest papers were able to put data interpretations into perspective.
 - b. Strongest papers involved a more sophisticated discussion than just a focus on the performance task's explicitly asked questions.
3. What do UND students need more of in the area of QR?
 - a. Some students have very limited exposure to QR. A single course is not enough for some students.

- b. It would be helpful to see more about how students analyzed the answer; more about the process of finding a solution. NOTE: This matches closely a point raised during the May 2014 QR scoring session, in which scorers described wanting a reflective component to students' work.
 - c. Students were not always good at basing their reasons solely on the data/information in the performance task library. For instance, they would have a bias or preconception about which city would be most desirable, and even when the data led them to a different conclusion, they would still end by choosing their preferred city. This led to instances where students were contradicting themselves as part of their work without seeming to be aware of it.
4. Suggestions for improving the performance task:
- a. Perhaps change the cities to be fictional to avoid student biases based on other information or experiences with known cities.
 - b. There was some discussion of the labeling on the air quality graph; whether it should be more explicit. After discussion there was consensus to leave the graph as is because we learn something by seeing how students handle the potential ambiguity.
 - c. Perhaps adding intentionally incorrect information to the document library would help determine if students can reasonably sort out what is/isn't correct; relates to their number sense.
 - d. Sending the performance task to faculty in advance of the scoring session might be helpful.
5. Suggestions for improving the rubric:
- a. Make it simpler; it is not always clear how to differentiate between rubric criteria.
 - b. Although not discussed because of a lack of time, there was a suggestion to revise the rubric to include criteria like:
 - i. Data Use – Ability to identify and manipulate relevant data
 - ii. Data Interpretation and Synthesis – Ability to use relevant data to analyze and draw meaningful conclusions
 - iii. Mathematical Reasoning – Demonstrated application of mathematical and quantitative methodsAdditionally, ideas related to “successful application” were raised – the idea that, although not necessarily the most important consideration, getting the correct answer should carry some significance.
6. Each of the 117 student work products was scored by at least two scorers. If total scores differed by more than 5 points (out of 24 total possible points), a third scorer was utilized.
- a. 18% required a third scoring (21/117)
 - b. 35% (41/117) had both scorers differ by 0 or 1 total points
 - c. These two statistics together suggest a rubric that is well-matched to the task, that was easy to apply consistently, and/or a pre-scoring norming session that was effective at helping scorers properly apply the rubric.