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Review of *Quantitative Reasoning: Tools for Today's Informed Citizen* by A. Sevilla and K. Somers

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Abstract

Alicia Sevilla and Kay Somers, *Quantitative Reasoning: Tools for Today's Informed Citizen*. (Emeryville CA: Key College Publishing, 2007). 626 pp. Softcover with Student CD. \$79.95 (USA) ISBN 1-931914-90-1. http://www.keycollege.com/catalog/titles/quantitative_reasoning.html

From charts and graphs (Topic 1) to decision making (Topic 21), *Quantitative Reasoning* offers a good selection of topics that students in a general education mathematics course and other individuals in our society should understand. Organizing the 21 chapters (topics) under the headings of numerical reasoning, logical reasoning, and statistical reasoning, Sevilla and Somers focus their chapters on examples and devote the last 224 pages to 21 Excel activities. Parallel graphic-calculator activities are on the Student CD, together with the data bank for the Excel activities. The strong orientation toward exercises and activities will assist instructors in making their course an engaging numeracy experience for their students; however, it also likely means that some instructors will find that some explanations are not as fully developed as they would like. With the selection, structure, exercises and activities provided by Sevilla and Somers, instructors can easily add supplemental material according to their own interests and priorities.

KEYWORDS: quantitative reasoning, textbook, review

Introduction

Quantitative Reasoning: Tools for Today's Informed Citizen by Alicia Sevilla and Kay Somers is one of the many new texts that aim at providing students with the quantitative and reasoning skills that they will need in order to function in today's society. This review will present a rough outline of the topics contained in the text as well as some comments about the book's contents from the perspective of a general education mathematics course.

Topics Covered

The text contains many of the topics that one would expect in a quantitative literacy text. In total, there are 21 topics divided into three broad categories: Numerical Reasoning, Logical Reasoning, and Statistical Reasoning.

Numerical Reasoning begins with an introduction to bar graphs, pie charts, histograms, and stemplots (Topic 1). After this, it moves on to scatterplots relating a dependent variable to an independent variable (Topic 2). Features of general graphs of functions are explored, with a brief introduction to the concepts of increasing, decreasing, concave up, concave down, and rates of change (Topic 3). Multiple-variable functions are introduced next (Topic 4). After this, the book presents linear (Topic 5), exponential (Topic 6), and logarithmic (Topic 7) functions. As a final example of functions, the book presents information about indices (e.g., the Consumer Price Index, Topic 8). This introduction to functions is then applied to problems in personal finance (Topics 9 and 10).

Logical Reasoning begins with information about decision making that presents two methods: cutoff screening and weighted sums (Topic 11). Following this is an introduction to inductive reasoning (Topic 12) and deductive reasoning (Topic 13). The section finishes with applications to apportionment (Topic 14) and problem-solving techniques (Topic 15).

Statistical Reasoning begins with measures of central tendency: averages, quartiles (Topic 16) and the normal distribution (Topic 17). The text then discusses probability (Topic 18) and conditional probability (Topic 19) including examples focusing on false positives. The text concludes with a discussion of sampling and surveys (Topic 20) and a final discussion of decision making (Topic 21).

Personally, I feel that these topics are very appropriate for a text in quantitative literacy. Many of them will have direct impact on the students' future decision making (in particular, understanding mortgages, the consumer price index, and conditional probability) and few are included that could not be directly related to potential situations the students will face in their lives.

Book Style and Tone

The text does have a style and tone different than many traditional mathematics texts. The contents rely heavily on examples (with very little discussion outside of the context of an example). The writing tone is conversational with very few formulas or mathematical derivations. In addition to the examples and explorations in the text, the book also offers activities using Microsoft Excel that are tied to the material in the text. Below are two topics covered in the book that I feel are particularly good examples of how this style is used.

Topic 9: Personal Finances

The topic begins with an introduction to the idea of interest and then presents a series of examples that develop the ideas around compound interest that affect most people during their lifetime. The first example presents a case of simple interest; the second presents a case where the interest is compounded quarterly and the balance is computed quarter-by-quarter. The “standard” compound interest formula is then presented and two examples are presented that use this formula. The first is relatively short term (2 years) while the second example spans 220 years to demonstrate the effect of changing the frequency of compounding. Examples then proceed with more complicated ideas such as annual percentage yield, annuities, future value, installment loans, and open-end installment loans (credit cards). The topic ends with a summary and a number of explorations for the student to complete.

In addition to all of this material in the text, there is an Excel activity that works with the idea of mortgage payments. The Instructor’s Manual ties together the examples, the activity, and the explorations. The text also refers students back to the work they did in an Activity associated with Topic 4 on credit card payments. However, I did not see any tie to the Exponential material presented in Topic 6 (Exponential Functions) which might have been appropriate.

Topic 19: Conditional Probability and Tables

The topic begins with a short introduction describing how to read a two-way table. An example presents data in the table and poses (and then answers) a series of questions using those data. Some terminology (but little notation) is introduced after the example and then a new example using data is introduced to reinforce the idea of conditional probability. After this, there is text discussing how the probability of compound events is related to the probabilities of the simple events, and then another example, the introduction of the notion of independent events, and a succession of three examples discussing the concept of false positives

(introducing the terminology of “sensitivity” and “specificity”). The topic is concluded with a summary and a collection of explorations.

In addition to this material in the text, there are Excel Activities (with data provided on the accompanying CD-ROM) that allow students to further explore these ideas. The topic content, the activities and the explorations are all tied together in the Instructor’s Manual.

Personally, I think this approach is better than a more traditional format of providing definitions, theorems, and then applications. The text is conversational and the examples are carefully presented and provide adequate models for the exploration at the end of the topic. Furthermore, the decision to use Excel as a tool when exploring the data provided is a good decision in my opinion. Once many of the students in a Quantitative Literacy course get out of college, it is likely that the tool of choice for their work will be a spreadsheet rather than a calculator. Given the ubiquitous presence of Microsoft Excel as well as free software that mimics Excel, the choice of presenting the data in this format will increase the ability of students to transfer their quantitative skills to other aspects of their life.

Content Coverage

It is always easier to criticize an existing text than to create a better text. My biggest disappointment with this new book is that some of the topics might be too minimally developed for the information to be adequately understood or useful. I will present three examples where I feel the text is missing some of the meat of the subject.

Topic 6: Modeling with Linear and Exponential Functions

After a good introduction to identifying linear and exponential growth (comparing differences or quotients of successive values), the discussion about the relation between these models consists of a single sentence:

Through several examples, we saw that a quantity that grows exponentially grows more quickly than one that grows linearly.

My first issue is that the sentence is misleading, as the rate of growth for an exponential model is not constant. In fact, all linear models with positive slope will grow faster than all exponential models for adequately small input values. More importantly, this idea (that exponential functions always overtake linear functions and in a dramatic fashion) is important enough to deserve more than a single sentence in the discussion. Understanding how exponential functions behave is important to understanding many of the problems facing society today,

because it explains why early adoption of solutions is so crucial in many cases. For example, although it will have taken millennia for us to populate a single planet to capacity, it would require less than a century to completely populate the planet twice-over (with current estimates on doubling-time). Some exploration of this idea can be found in the Activities and the Instructor's Manual, but I would have liked to see more explicit analysis in the text on how exponential processes can snowball much more rapidly than most people anticipate.

Topic 14: Apportionment

Apportionment is placed in the Logical Reasoning section; however, it does not seem to contain any material that directly relates to either inductive or deductive reasoning topics. The text explains several different apportionment methods (Hamilton's, Lowndes', Jefferson's, Adam's, Webster's, and Huntington-Hill) and asks students to compute apportionments based on these methods. Unfortunately, there appears to be no discussion of well-known apportionment paradoxes: the Alabama Paradox (increase in total representatives leads to a loss of a representative for a state), the Population Paradox (increase in population leads to a loss of a representative), the New State Paradox (introduction of a new state causes the gain of a representative), and the Quota Paradox (states do not receive their upper or lower quotas). While attempting to present a deductive proof that all quota methods suffer the first three paradoxes and that all divisor methods suffer the fourth paradox would not be appropriate, a discussion of the result would provide a good segue into the discussion of what the mathematical proof means: notably, that it is not the case that we just haven't been clever enough to figure out an unfailingly fair method; it is impossible to devise a method that doesn't lead to at least one of these problems. This realization, then, would provide good background for a discussion of which paradoxes are more important to avoid as well as the limits of mathematics (i.e., it can tell us the consequences of a choice, but cannot make the choice for us).

Topic 17: Standard Deviation, z-Scores, and Normal Distributions

This topic begins with some examples that describe how to compute the standard deviation and show how the distribution of the data affects this number. There is no discussion of why the standard deviation might be a better statistic than the quartiles and no explanation of why the formula divides by one less than the sample size (other than referring to more advanced mathematics). Both of these explanations would require a discussion of sampling distributions, something that is only briefly discussed in Topic 20. In the Instructor's Manual, the authors do mention sampling distributions, but only to indicate that they decided to not treat the topic. Following this, a significant time is spent discussing the appearance of

the Bell Curve; however, no discussion takes place describing the relationship between the probability that a score lies in a particular interval and the area under the curve above that interval. Without this connection, the curve simply becomes an icon to represent the normal distribution. The topic ends by presenting the idea of using z -scores to standardize values.

Parting Comments

As with all textbooks, choices needed to be made when this book was written. The authors of *Quantitative Reasoning* have done a very good job, in my opinion, of choosing topics that are important in our daily lives. Unlike quantitative reasoning texts that present many topics that are background material for more advanced mathematics, this text really does focus on ideas and concepts that every individual in our society should understand, and it attempts to do so as stand-alone material.

The trade-off is that the authors may not have provided enough material to make the text really stand alone. Admittedly, adding the “missing” content to the topics I presented above would also significantly lengthen the discussion of those topics, which in turn would have required a loss of other topics.

Weighing the example-driven nature of the text against the in places shallow coverage, I would prefer to use this text rather than a deeper, but more traditional, text. Supplementing the activities and explorations with some of my own explanations would allow me to cover the topics at the depth I felt was appropriate while still allowing a more engaging experience for the students in the course.

It is also worth noting that this is the first edition of this text. I expect that as future editions are produced, underdeveloped sections will be improved or culled out, while the text will retain its most positive feature: its conversational tone and example-driven format.

Acknowledgments

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