



Mathematical modeling in affect

Presentation to The University of Texas at El Paso STEM seminar on 5 Oct 2018



Outline of presentation

This presentation may be a bit different than some provided. It is an overview of a book, not an article based on a formal study.

- I. Conception and example of mathematical modeling
- II. Conception and example of mathematical affect
- III. Introduction of Model-Eliciting Activities (MEA)
- IV. Resources for MEAs
- V. A bit about the book
- VI. Questions



What is mathematical modeling?

- Modeling (Am-English spelling) or modelling (Eng spelling) is a mathematical process in which mathematical problem solvers create a solution to a problem, in an attempt to make sense of mathematical phenomena (e.g., a data set, a graph, a diagram, a complex scenario such as a specific problem solving task).
- In so doing, problem solvers generally need to mathematize (turn ostensibly non-mathematical information into something that can be analyzed such as a data set), create a generalizable model, and make sense of a situation. This conception appears to be inherent in virtually any modeling activity, from about grades 5-graduate school, though students have done modeling problems as young as kindergarten.



Modeling example

- Often, an example can help elucidate things.
- Do any of you derive great joy from going to the supermarket, like I do? One source of frustration for many people is the process of checking out or paying for our goods. To understand how to check out quickly, designing a mathematical model may help.
- Prompt: Design a mathematical model to help make sense of what factors may affect your time in line at your local grocery store. Please take 2-3 minutes and think about this, then share with the larger group.
- So, we have not exactly specified a mathematical model, but you can see what may be entailed in the early stages of thinking. The next step would likely be weighing the variables. From there, we would test our mathematical model, see how it performed, and revise accordingly. We may need to undergo 1-5 rounds of revisions for a highly refined model.



Mathematical affect

- Mathematical affect is a construct in the world of mathematical psychology, comprised of attitudes and beliefs (McLeod, 1994), but later this construct grew to include feelings, emotions, and dispositions.
- Affect is one of three psychological constructs that influences cognition, which includes cognition itself, affect, and conation (DeBellis & Goldin, 2006, Goldin, 2018). Cognition is thinking/processing and you might think of conation as volition.
- Simon & Binet (1916) initially referred to affect as ‘non-intellectual factors’ and later Messick called them ‘non-cognitive factors’, though they are inherently tied to cognition, as we saw in the aforementioned claims by Goldin.
- Though there is great debate regarding specifically what sub-components comprise affect, a commonly accepted model was proposed many years ago (2000) by Anderson & Bourke. In their model, they stated that affect was comprised of the following subconstructs: Anxiety, aspiration, attitude, interest, locus of control, self-efficacy, self-esteem, and value.



Affect example

- To help learners make sense of challenging concepts, I like to use diametrically opposed examples.
- Scenario #1: Gabriella’s father is an aeronautical engineer and designs fuselages for Boeing. When he gets home from work, they often work on mathematics puzzles together. Their love for mathematics is something they share and this is their opportunity to collaborate on a project. What would you hypothesize her affect is for solving worthwhile mathematical problems?
- Scenario #2: At the parent/teacher conference, Trevor’s mother stated that she did not expect Trevor to be a capable mathematician because, “she isn’t good at mathematics either.” What would you hypothesize his affect is for solving worthwhile mathematical problems?



Introduction of Model-Eliciting Activities (MEA)

- A very popular MEA is called ‘On-Time Arrival’. After looking at 30 days of airline data from five airlines, identify the most ‘on time’ airline. Rank the airlines from 1-5 and provide a template (model) so that others can utilize your approach in future situations.
- Please feel free to peruse the problem here:
<https://engineering.purdue.edu/ENE/Research/SGMM/CASESTUDIESKIDSWEB/ontimearrival.htm> It will open as a word document. There are 4 parts to each MEA: (1) A newspaper article, (2) A set of readiness questions, (3) A data table, and (4) A problem statement.
- We can take a few minutes for you to engage in the task, but in reality, it will take 20-30 minutes for you to solve it and longer for a group of young problem solvers (e.g., 40-50 minutes).



MEA resources

Electronic

- https://engineering.purdue.edu/ENE/Research/SGMM/CASESTUDIESKIDSWEB/MEAs_html
Undergraduate engineering MEAs
- [https://engineering.purdue.edu/ENE/Research/SGMM/CASESTUDIESKIDSWEB Grades 5-9 general MEAs](https://engineering.purdue.edu/ENE/Research/SGMM/CASESTUDIESKIDSWEB/Grades%205-9/general/MEAs)
- <https://serc.carleton.edu/sp/library/MEA/examples.html> **Undergraduate statistics MEAs**

Book

- Chamberlin, S. A. (2016). Probability for Kids: Using Model-Eliciting Activities to Investigate Probability Concepts. Waco, TX: Prufrock Press.
- Chamberlin, S. A. (2013). Statistics for Kids: Model Eliciting Activities to Investigate Concepts in Statistics. Waco, TX: Prufrock Press.

<https://www.prufrock.com/Search.aspx?k=chamberlin>



A bit about the book

- Chamberlin, S. A., & Sriraman, B. (2018). *Affect in mathematical modeling (Advances in Mathematics Education Series)*. Cham, Switzerland: Springer.
- Edited book will appear here: <https://link.springer.com/search?facet-series=%228392%22&facet-content-type=%22Book%22>
- This book entails a discussion of affective considerations initially mentioned in the mid-1700s by Smith (1759). Subsequently, Pinel (n. d.), Mills (1829), and Binet and Simon (1916) mentioned the importance of affect, but it was not until mathematical psychologists, through the School Mathematics Study Group, formalized affect as a construct in the late 1960s, that it became a research focus. Affect, enjoys several conceptions, though experts typically agree that it is comprised of feelings, emotions, attitudes, and dispositions (McLeod & Adams, 1989). As with affect, mathematical modeling has existed for centuries, but was not formally conceptualized until the late 1800s (Hertz, 1894). The process of mathematical modeling occurs when problem solvers consider everyday phenomenon (e.g., data, algorithms, diagrams/figures) and create a mathematical explanation of them through mathematizing.
- The research base has grown precipitously in the last 60 years and this book is an update on some of the most recent findings and theories about affect in mathematical modeling. An objective of this book is to help readers make sense of learner affect while engaged in the development of mathematical models, utilizing an international perspective. In so doing, a vast array of authors has been utilized to provide insight on affective states while problem solvers create mathematical models.



More about the book

- The book is divided into three sections, loosely grouped around some commonalities. For each section, commentary is provided by international experts. Authors include, but are not limited to: Katrin Vorhölter (U of Hamburg), Judith Zawojewsk (Illinois Institute of Technology), Roberta Schorr (Rutgers: The State University of New Jersey), Gerald Goldin (Rutgers: The State University of New Jersey), Inés M . Gómez-Chacón (Madrid Complutense University), Jim Middleton (Arizona State University), Michael Tabach (Tel-Aviv University), Pietro Di Martino (University of Pisá), Pauline Vos (University of Agder), Peter Liljedahl (Simon Fraser University), and Bharath Sriraman (University of Montana).
- Commentators include: Jonei Cerqueira Barbosa (Universidade Federal da Bahia), Alan Schoenfeld (University of California, Berkeley), Peter Kloosterman (Indiana University), Martin Blomhøj (University of Roskilde), and Lyn English (Queensland University of Technology).



Questions

- What questions do you have?
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