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Abstract

In *Numbers Don’t Lie: 71 Stories to Help Us Understand the Modern World* (2020), Vaclav Smil draws on his interdisciplinary background in science, public policy, and history to provide readers with 71 short essays that help us better understand aspects of the world—including its people, environment, energy consumption, and present crises (among other things). In most of his essays, Smil utilizes both data and reasoning with data to shed light on diverse topics, with issues ranging from happiness rankings and vaccine payoffs to chicken production and diesel engines. Though the book arguably has some flaws, its easy-to-digest essays—many of which use tools we often teach in quantitative reasoning courses—provide excellent case studies for instructors to use in the classroom.

Keywords

quantitative literacy, quantitative reasoning, civilization, environment

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Cover Page Footnote

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Introduction

One of the well-known challenges of teaching a quantitative reasoning (QR) course is the need to continually update source material to keep it timely and interesting for both students and instructors (Dingman and Madison 2010). For example, students may have found the Great Recession intriguing in 2013 as a lens for discussing mortgages, but by 2023, most will have little interest in (or memory of) the topic. With this dilemma in mind, as a QR course instructor, I am always on the lookout for articles, books, and videos—media accessible to a general audience—that use (or misuse) quantitative information in making sense of the world. One can imagine my delight, then, in coming across Czech-Canadian scientist and policy analyst Vaclav Smil’s 2020 book, *Numbers Don’t Lie: 71 Stories to Help Us Understand the Modern World*, in a recent visit to a local library. The premise of Smil’s text is that quantitative information, when used appropriately, can help us better understand contexts of importance, such as climate change, population shifts, and alternative energy sources. Whereas mass media and our own biases (among other things) may lead us to think about the world (e.g., electric vehicles) one way, data and quantitative reasoning with data can paint an entirely different picture (hence the idea that “numbers don’t lie”). While this notion is certainly not new (see, for example, Rosling et al. [2018] *Factfulness: Ten Reasons We’re Wrong About the World—and Why Things Are Better Than You Think*), Smil’s approach is refreshing, especially for those looking for bite-sized analyses of timely topics that utilize quantitative information.

Following an introduction where he sets the stage for the book to come, Smil presents 71 brief, self-contained chapters, in which he introduces a current idea or topic, describes or analyzes it using data (in most cases), and offers his perspective on the matter. While the latter characteristic of his chapters may be off-putting to some readers (indeed, his sardonic end-of-chapter quips frustrated me at times), I liked that each of them had the potential to promote conversation or debate. What *Numeracy* readers will likely find most exciting about Smil’s text is that he weaves hallmark characteristics of quantitative reasoning into his analyses. For example, Smil attends to units, qualifies precision, balances absolute and relative quantities, and provides visualization when appropriate. He also ensures that his data come from reliable sources, going so far as to discuss his choice of sources at the beginning of the text. This marriage of quantitative reasoning with brevity in exposition makes for excellent case studies one can utilize in or out of the classroom. Before discussing ways to do so, I briefly summarize Smil’s book and highlight two of my favorite chapters. I then end with a gentle commentary on the name itself.
Overview of Numbers Don’t Lie

As noted before, the premise of Smil’s text is that quantitative information can provide us with insights that help us better understand a topic, and that in some cases, such insights might run counter to what we might believe or have been told. Per the author, his “hope is that this book will help readers understand the true state of our world,” and his “goal is to demonstrate not only that numbers do not lie, but to discover which truth they convey” (xvi). While the task he lays out may sound quite daunting, bear in mind that his book is aimed at a general audience and is not intended to provide an all-encompassing account of the current state of the world. Instead, Smil sets out to give an “eclectic” sweep of many major issues that affect all of us (xi). Below is a verbatim list of the book’s sections:

- People: The Inhabitants of Our World
- Countries: Nations in the Age of Globalization
- Machines, Designs, Devices: Inventions that Made Our Modern World
- Fuel and Electricity: Energizing Our Societies
- Transport: How We Get Around
- Food: Energizing Ourselves
- Environment: Damaging and Protecting Our World

Smil provides roughly ten topic-specific chapters for each section. While all of the chapters in each section relate to some overarching theme, they do not (for the most part) connect directly to each other. The context itself drives each chapter, rather than the specific use of any quantitative technique. Smil begins with reader-friendly exposition—for example, the issue of passenger safety in flying (212)—prior to bringing up any data on the topic. After laying out the context, he presents data, visualizations, and in some cases new analysis of data to show how quantitative information helps us to understand the topic. Towards the end of most chapters, he ends by directly sharing his own opinion on the topic (though one can likely deduce it well before that). One thing I did find a bit odd (given the title of the book) is that, in some cases, chapters do not include quantitative information at all. For example, the second section’s first chapter, “The First World War’s extended tragedies” (53), contains a brief discussion of the long-term consequences of the First World War, focusing on the development of synthetic ammonia (which is discussed in detail in a later chapter). While chapters like this felt (to me) somewhat out of place in the text given its goal, most give discrete discussions aligned with what Smil sets out to do from the beginning.

In light of the diversity of the chapters across the sections, there is something of interest here for every reader. My two favorite chapters are ones that genuinely surprised me, as they contain convincing quantitative analyses of topics I had not thought about in any great depth before. The first, “How many people did it take to build the Great Pyramid?” (31), reads as a brilliant Fermi estimation essay—
answering a question similar to that which you might find in Weinstein and Adam’s (2008) *Guessimation: Solving the World’s Problems on the Back of a Cocktail Napkin*. In it, Smil first describes what he calls inaccurate estimates of the worker count (e.g., Herodotus reported 100,000 workers), then homes in on the physics of its construction: he calculates the Great Pyramid’s potential energy in joules, then uses an estimate of workers’ energy requirement and expenditure—along with a bound for the time the pyramid was built—to make a conservative estimate of no more than 10,000 workers designing and building the Great Pyramid. What I appreciate about the analysis is that all of Smil’s steps are traceable, and one need not have a strong physics background to find the argument convincing. These facts make the book ripe for one to bring into the classroom.

The second chapter that I most enjoyed, “Modern cars have a terrible weight-to-payload ratio” (197), exemplifies the idea that one’s metric choices in analyzing an issue can influence the conclusions one draws. Smil uses the metric of vehicle-to-passenger weight ratios (what he calls a weight-to-payload ratio) to argue that many modern cars “may be, by some definition, smart—but they are not wise” (200). Smil notes that, although car engines have significantly increased in power in the last century (specifically comparing current vehicles to Ford’s Model T), their weight-to-payload ratios have also increased. More specifically, the average vehicle weight has increased while the weights of drivers and passengers have hardly changed. Smil notes that this ratio hinders a vehicle’s energy efficiency, implying that electric and hybrid vehicles are not as innovative as we think. What jumps out to me in this chapter is not just what Smil shares, but the questions his analysis invites. The chapter is a starting point for conversation, rather than a comprehensive analysis. For example, he does not define energy efficiency, and in relation, does not discuss the connection between weight-to-payload ratios and energy efficiency. That is not a fault, but instead an opportunity for the reader to ask: How did Smil’s metric choice influence his analysis? Is the weight-to-payload ratio the only ratio we should care about? How do we define energy efficiency, and how has that changed for the typical vehicle over time? There are many more questions one might ask, depending on one’s goals. I ask these questions here not to discount any of Smil’s analysis, but to instead note that I believe his work will provoke Numeracy readers to think in ways that we often ask our students to.

**Potential Uses in the QR Classroom**

In my view, a strength of *Numbers Don’t Lie* is that, while each chapter connects to one of the book’s seven themes, the chapters are all self-contained, save for the occasional references to other parts of the book. This characteristic makes the text not only easy for a general reader to pick up and put down, but also ideal for an instructor who wants their class to read a portion of the text as a case study. As a
QR instructor, I see three related ways one might use this in the classroom: (1) as a QR content-specific reference for manifestations of that content in real-world contexts, (2) as a collection of artifacts for students to individually read and respond to, and (3) as a book for students to review and analyze. I imagine Numeracy readers could generate additional ideas. Below, I expand on what I mean by each of the three ideas above.

With respect to (1), note that quantitative reasoning skills and practices are evident throughout the book. Accordingly, once a topic has been discussed in class, one could consider assigning one or more of the chapters related to that topic for students to reflect on or answer questions about. Table 1 below provides an example (non-exhaustive) list of QR skills, along with the title of an example chapter wherein that skill is used.

<table>
<thead>
<tr>
<th>Example QR Content</th>
<th>Example Chapter</th>
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<tbody>
<tr>
<td>Estimations</td>
<td>“How many people did it take to build the Great Pyramid” (31)</td>
</tr>
<tr>
<td>Unit conversions</td>
<td>“Why electric container ships are a hard sail” (166)</td>
</tr>
<tr>
<td>Unit choice</td>
<td>“Why it’s bad to predict how bad a pandemic will be while it is happening” (15)</td>
</tr>
<tr>
<td>Absolute and relative quantities</td>
<td>“India vs. China” (77)</td>
</tr>
<tr>
<td>Proportional reasoning</td>
<td>“How big can a wind turbine be?” (151)</td>
</tr>
<tr>
<td>Ratios</td>
<td>“Modern cars have a terrible weight-to-payload ratio” (197)</td>
</tr>
<tr>
<td>Logarithmic scales</td>
<td>“Moore’s curse: Why technical progress takes longer than you think” (125)</td>
</tr>
<tr>
<td>Precision</td>
<td>“What makes people happy?” (39)</td>
</tr>
<tr>
<td>Effective visualization</td>
<td>“Why chickens rule” (243)</td>
</tr>
</tbody>
</table>

At a basic level, one could have students verify some of the arithmetic Smil completes in each chapter. To make things more interesting, one could draft questions that require students to utilize both the information in that chapter and the specific skill.

With respect to idea (2) mentioned above, an instructor need not connect every chapter to a specific skill. One could, for example, have students pick a chapter on a topic they believe is of interest and/or debatable, and then ask students to analyze strengths and weaknesses in Smil’s argument. Or, in relation, one might have students write a response to Smil’s argument using either his data or similar data. For example, in “Why electric cars aren’t as great as we think (yet)” (201), Smil argues that the case for electric vehicle (EV) adoption has been undermined by important factors such as unrealistic production forecasts and the environmental impact of EV production. I can readily imagine a student critiquing the way that Smil presents his argument, then providing additional data that spin the pursuit of EVs in a positive light.

With respect to idea (3) mentioned above, there are multiple ways in which one might have students read the entire text and respond. One effective assignment I have seen in another context asks students to identify the author’s main argument, then analyze the extent to which the author supports that argument. Here, Smil’s argument is laid out in the introduction, so the task would not be all that difficult.
While it would require much of students in a short time, it could be an assignment that students work on throughout the semester. Again, with your own reading of the book, I imagine that you might think of additional ways you could leverage this in the classroom.

**Parting Thoughts**

A priori, I imagine that many *Numeracy* readers will be wary of the title of Smil’s book. In a world where companies, politicians, and relatives palter or misuse quantitative information regularly, the notion that numbers do not lie, while true in many respects, feels like the wrong message to send to the general public. (In my view, it is akin to leading a news story about COVID-19 vaccines with a discussion of their side effects.) The good news here is that Smil focuses not on the misuse of quantitative information, but instead on the insights one can gain when applying quantitative reasoning to understand a context or topic. To his credit, Smil recognizes that statistics do not exist in isolation, noting: “True comprehension of many numbers (individually or part of complex statistics) requires a combination of basic scientific literacy and numeracy” (xiii). One can infer from this quote that he places trust in his readers to bring those literacies to the fore when reading his text. With that idea in mind, I believe the target audience for the text is a proper subset of the general public. Readers of *Numeracy* will find themselves at home in reading the text, and—assuming you still have things to learn about the state of the world—appreciate the insights Smil has to share about the progress we have made, where we are, and where we might be heading next. While Smil is more cynical than Rosling et al. (2018) in *Factfulness*, and his text may have flaws to some readers (e.g., unconnected stories, incomplete arguments), I still believe that if you have the time, you should read some or all of Smil’s “stories.”

**References**

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