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## INTRODUCTION

# Deceptive Math

### *True and False*

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*“The trouble with people is not that they don’t know but that they know so much that ain’t so.”*

—Josh Billings  
19<sup>th</sup> century American humorist

**T**his book has a twofold purpose: (1) to serve as a guide for making common personal financial decisions and (2) to expose common mathematical claims related to financial decision-making that are both true and deceptive.

This book is not intended to discuss outright fraud. Embezzlement, skimming, “cooking the books” are not what I consider mathematical deceptions; they are criminal acts that can land their perpetrators in jail. However, the book does give examples of mathematical cues that should alert you to fraud and profiles some fraudulent practices where these cues have appeared.

The art of making statements that are both true and misleading is a legitimate form of expression in our culture. We are bombarded with advertisements every day, and many of them fall into this category. With experience we have learned to see through many of the sales pitches. However, sales pitches framed in mathematical language are often equally creative at being both true and misleading and are much more difficult to

see through. Worse, the mathematical parlance often lends many of these claims a false aura of respectability.

Most mathematical deceptions do fall into recurring categories. These are as follows:

- *Re-labeling*: Using a different name that seems nicer than it actually is. Want to advertise an eye-catching low finance rate? Call your finance charges a transaction fee. This will also make comparison-shopping for finance rates next to impossible (unless you read the chapters in this book on loans).
- *Use of counter-intuitive results*: Math is difficult in part because results are not always what our “common sense” would lead us to expect. Presenting people with questions involving measurements, averages, statistics, and probabilities will expose widespread fallacious beliefs. As a result people make wrong and costly decisions on many issues (insurance, investments, public policies, testing practices). Believing something to be true when it is false is even worse than ignorance. You willingly act against your own interests.
- *Carefully chosen framing*: An extensive body of psychological research dating back to the 1950s demonstrates that people respond to identical choices differently depending on how the choices are presented (framed). More people, for example, will respond favorably to a “get two for the price of one” sale than “buy 2 and get 50% off.” From a financial point of view, the two propositions are identical, but the first presentation leads people to think they are getting something for free.
- *Ignorance of number size*: A million, a billion, a trillion: a common attitude is that all these numbers are equally large. Not a good attitude when considering investment decisions. Whether you are buying stock or starting your own business, you need some idea of the market size for the product or service being delivered, the cash flow it will generate, and a reasonable estimate of the growth rate. It is easy to fantasize about becoming rich on

some new business venture or stock purchase, but often a few simple estimates and calculations will tell you the most likely profit potential before you begin.

This book is divided into four parts. The first part—Daily Deceptions—examines numerical comparisons in a wide variety of contexts. Every day we engage in buying decisions where the sellers bombard us with impressive claims stated in numerical terms. You will learn that many of the numbers thrown at you every day are either deceptive or meaningless. Topics in Part I include deceptive numerical comparisons encountered when shopping, how the presentation of prices affects the outcome of automobile and real estate negotiations, and how averages are used to manipulate and deceive. The use of charts to support quantitative arguments is also examined. I will show how the exact same numerical data can be pictured differently in charts. Two opposing politicians for example, will show charts that look completely different as a way of arguing opposite sides of an issue, but the data shown on the charts will be in complete agreement.

The second part—Income—discusses earning, saving, investing, gambling, and risk-taking. The chapters that discuss earning, saving and investing contain tables and worked examples that are designed for use with the worksheets in Appendix I. The examples illustrate common financial planning scenarios such as negotiating salaries, projecting future income and expenses, planning for retirement, adjusting for inflation and choosing investments. With the aid of a calculator and the worksheets you can adapt the examples to your personal financial situation and have the ability to make informed choices.

In the chapters on gambling and risk-taking, the difference between the two activities is explained. We will learn why gambling should be avoided, but risk-taking is unavoidable because it is inherent in most financial decisions—even “safe” choices have more risk than you might think. Risk-taking exposes conflicts between psychological needs and mathematical requirements for success. Because of the psychology, people are

inherently prone to making mathematically bad choices when confronted with decisions that involve risk. Whether choosing an investment or purchasing insurance, it pays to be aware of the psychological needs within all of us—myself included—that result in poor choices and cost us money unnecessarily.

The third part—Loans—contains numerous tables that can be used to answer many common questions that relate to decisions about borrowing money. For many people, debt is unavoidable and debt management a constant struggle. This part of the book has more examples, tables and worksheets than any other part. But I believe that these resources can become a lifetime guide for anyone because the use of borrowed money is so prevalent in our society. The mathematics of debt is highly counterintuitive, and finance companies take full advantage of deceptive math in their constant bombardment of consumers with loan offers. The tables and worksheets in Part III are easy to use and will be valuable to you when making any kind of purchase that involves borrowed money.

Misunderstood math is the subject of part four. This final part of the book will take a scientific excursion. It will teach how a professional scientist, such as myself, uses and interprets numerical information. Then I will contrast the scientific understanding with how numerical data is distorted by the media and describe the misunderstandings that result. Numbers that result from a measurement have several attributes that need to be understood before making any decision based on the numerical data. The attributes of precision and accuracy (Chapter 11), size (Chapter 12) and confidence (Chapter 13) are explained. People have naïve notions of numerical precision and accuracy, number size, and how probability and statistics relate to the degree of confidence in a measurement. Whether voting, reading the newspaper, deciding on workplace policies, or making a medical decision, costly bad decisions are often the result of knowing a little about something, but not actually understanding the math. I will examine and clarify common misunderstandings and relate them to some current events.

Throughout this book, real-life examples for each subject are discussed. Many of these examples come from my own personal experiences, where I discovered that much of the marketing that uses numbers presents false choices, rigged against the consumer. Like flipping a two-headed quarter, you pay no matter which side the coin lands on because you are unaware that the coin has no tail. My goal is show how mathematical principles are used to manipulate the economic choices we make every day, whether we are aware of them or not. Of course, it pays to be aware.