Contents

Preface x v
Acknowledgments xix

Introduction Connecting the Seat of the Intellect to the Seat of the Pants 1

You cannot learn to ride a bicycle from a book, and I claim the same is true for coping with uncertainty. Paradoxically, this book attempts to do what it claims is impossible.

FOUNDATIONS

Part 1 The Big Picture 9

Chapter 1 The Flaw of Averages 11
In planning for the future, uncertain outcomes are often replaced with single, so-called average numbers. This leads to a class of systematic errors that I call the Flaw of Averages, which explains among other things why forecasts are always wrong.

Chapter 2 The Fall of the Algebraic Curtain and Rise of the Flaw of Averages 22
The electronic spreadsheet brought the power of business modeling to tens of millions. In so doing, it also paved the way for an epidemic of the Flaw of Averages.
Chapter 3  Mitigating the Flaw of Averages  

New technologies are illuminating uncertainty much as the lightbulb illuminates darkness. Probability Management is a scientific approach to harnessing these developments to cure the Flaw of Averages.

Chapter 4  The Wright Brothers Versus the Wrong Brothers  
The success of the Wright Brothers’ airplane was the result of carefully constructed models that they tested in their wind tunnel. Analogous models can help us manage uncertainty and risk, but as we saw in the financial crash of 2008, models can also be used to obfuscate.

Chapter 5  The Most Important Instrument in the Cockpit  
The proper use of models, like the instruments in an airplane, is not obvious.

Part 2  Five Basic MINDles for Uncertainty

Chapter 6  MINDles Are to MINDs What HANDles Are to HANDs  

Just as industrial designers develop handles to help us grasp the power of physics with our hands, informational designers develop MINDles (first syllable rhymes with “mind”) to help us grasp the power of information with our minds. Section 2 will provide some important MINDles for grasping uncertainty.

Chapter 7  Mindle 1: Uncertainty Versus Risk  

These two concepts are often used interchangeably but they shouldn’t be. Uncertainty is an objective feature of the universe, whereas risk is in the eye of the beholder.
Chapter 8  Mindle 2: An Uncertain Number Is a Shape  55
Even graduates of statistics courses have a hard time visualizing uncertainty. A shape in the form of a simple bar graph, called the histogram, does the trick. Try running a simulation in your head or better yet, on your web browser at FlawOfAverages.com.

Chapter 9  Mindle 3: Combinations of Uncertain Numbers  67
When uncertain numbers are added or averaged, the chance of extreme events goes down. I cover a case study in the film industry.

Chapter 10  I Come to Bury SIGMA, Not to Praise it  78
Just as the height and weight of a criminal suspect have been superseded by surveillance videos and DNA samples, sigma is pushing obsolescence.

Chapter 11  Mindle 4: Terri Dial and the Drunk in the Road  83
A banking executive discovers the Strong Form of the Flaw of Averages: Average inputs don’t always result in average outputs. Designing an incentive plan around your average employee is systematically erroneous.

Chapter 12  Who Was Jensen and Why Wasn’t He Equal?  91
The Nuts and Bolts of the Strong Form of the Flaw of Averages
This chapter shows how to identify the Flaw of Averages before it occurs by understanding your options and restrictions.

Chapter 13  Mindle 5: Interrelated Uncertainties  98
Interrelated uncertainties are at the heart of modern portfolio theory. They are best understood in terms of scatter plots.
Part 3  Decisions and Information  

Chapter 14  Decision Trees  
Decision trees are a powerful Mindle for thinking through decisions in the face of uncertainty.

Chapter 15  The Value of Information  
Because There Isn’t Anything Else  
The flip side of decision trees. Information is the complement of uncertainty. What is it worth to find things out?

Part 4  The Seven Deadly Sins of Averaging  

Chapter 16  The Seven Deadly Sins of Averaging  
So here are the Seven Deadly Sins, all eleven of them. And the twelfth deadly sin is believing we won’t discover even more tomorrow.

Chapter 17  The Flaw of Extremes  
Viewing uncertainties solely in terms of nonaverage outcomes also leads to devastatingly wrong answers and policy decisions.

Chapter 18  Simpson’s Paradox  
Imagine a weight loss treatment that makes people lose weight on average, unless they are either male or female, in which case it makes them gain weight on average.

Chapter 19  The Scholtes Revenue Fallacy  
Suppose you have various product lines with different unit sales. The average unit sales times the average profit per unit might be positive while your average profit might be negative.

Chapter 20  Taking Credit for Chance Occurrences  
If you execute a marketing campaign and make a bunch of sales, how do you know the increase wasn’t just by chance?
APPLICATIONS

Part 5  The Flaw of Averages in Finance  155

Chapter 21  Your Retirement Portfolio  157
If your retirement fund will last you 20 years given average returns, then you are as likely as not to suffer financial ruin before you get there.

Chapter 22  The Birth of Portfolio Theory: The Age of Covariance  163
Harry Markowitz started a revolution in finance in the early 1950s by explicitly recognizing risk/return trade-offs.

Chapter 23  When Harry Met Bill(y)  169
Bill Sharpe extended the work of Markowitz and brought it into widespread practice.

Chapter 24  Mindles for the Financial Planning Client  175
How the pros explain this stuff to their clients.

Chapter 25  Options: Profiting from Uncertainty  181
Options allow us to exploit uncertainty through an understanding of the Strong Form of the Flaw of Averages.

Chapter 26  When Fischer and Myron Met Bob: Option Theory  192
The theory of three economists led to the trillion-dollar derivatives industry.

Chapter 27  Prices, Probabilities, and Predictions  200
The new phenomenon of prediction markets is changing the way we perceive and report uncertain events, such as political races.
When people invest in portfolios of oil exploration sites, they often use the hole-istic approach. That is, they rank the places to drill hole by hole, then start at the top and go down the list until they run out of money. This ignores the holistic effects of portfolios.

For several years, Shell has been using Probability Management to manage its portfolios of petroleum exploration sites in a more holistic manner.

An example of a real option is a gas well in which you have the choice of whether or not to pump depending on the price of gas.

You can’t rely on accountants to detect risks because generally accepted accounting principles are built on the Flaw of Averages.

The inventory problem introduced in Chapter 1 is at the heart of all supply chains.

When stocking out is not an option.

A manager at Olin creates a simulation to get two divisions of his organization to work as a team and discovers a general principle in the process.
Part 8  The Flaw of Averages and Some Hot Button Issues  263

Chapter 35  The Statistical Research Group of World War II  265

The exciting environment in which my father became a statistician.

Chapter 36  Probability and the War on Terror  272

Two inescapable statistical trademarks of the war on terror are the problem of false positives and implications of Markov chains.

Chapter 37  The Flaw of Averages and Climate Change  289

The earth’s average temperature may actually be going down, not up, but you won’t be happy when you find out why. The Flaw of Averages permeates this issue.

Chapter 38  The Flaw of Averages in Health Care  299

Treating the average patient is not healthy.

Chapter 39  Sex and the Central Limit Theorem  307

Women have a diversified portfolio of two X chromosomes, whereas men have only one. Apparently it makes a difference.

PROBABILITY MANAGEMENT

Part 9  Toward a Cure for the Flaw of Averages  317

Chapter 40  The End of Statistics as You Were Taught It  319

The nineteenth-century statisticians confirmed their theories by simulating uncertainty with dice, cards, and numbered balls. Today, computerized dice, cards, and balls are bypassing the very theories they were trying to confirm.
Chapter 41 Visualization
Visual statistics provides a window into
distributions. You need to see it to appreciate it.

Chapter 42 Interactive Simulation: A New Lightbulb
Imagine simulating 100,000 rolls of a die before
your finger leaves the Enter key. A new technology
does for probability distributions what the
spreadsheet did for numbers.

Chapter 43 Scenario Libraries: The Power Grid
New data structures allow the results of simulations
to be added together like numbers, providing a more
practical approach to enterprisewide risk models.

Chapter 44 The Fundamental Identity
of SLURP Algebra
This looks like math. Feel free to skip it.

Chapter 45 Putting It into Practice
The technology surrounding Probability
Management is improving fast, and recent
breakthroughs promises to make it more accessible
than ever.

Chapter 46 The CPO: Managing
Probability Management
The CPO must strike the correct balance between
transparency of presentation, data collection, and
statistical rigor.

Chapter 47 A Posthumous Visit by My Father
Some comments from the hereafter.

Red Word Glossary

Notes

About the Author

Index