

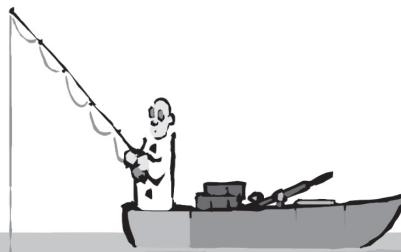
# THE CARTOON INTRODUCTION TO STATISTICS

BY GRADY KLEIN AND ALAN DABNEY, Ph.D.

THE  
**CARTOON**  
INTRODUCTION TO  
**STATISTICS**

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BY GRADY KLEIN AND ALAN DABNEY, Ph.D.



A NOVEL GRAPHIC FROM HILL AND WANG  
A DIVISION OF FARRAR, STRAUS AND GIROUX  
NEW YORK

**HILL AND WANG**  
A DIVISION OF FARRAR, STRAUS AND GIROUX  
18 WEST 18TH STREET, NEW YORK 10011

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*FOR ANNE AND LIAM AND BENJAMIN*  
—GK

*FOR ELLIOTT AND LOUISE AND NICK*  
—AD

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## INTRODUCTION

# **THEY'RE EVERYWHERE!**

MOST OF US ENCOUNTER STATISTICS **EVERY DAY...**

**AWESOME!**



STATISTICS RADIATE FROM OUR TELEVISIONS...

THIS SHOW HAS AN ESTIMATED AUDIENCE OF 4.8 MILLION!

IT MUST BE GOOD.



...EMANATE FROM OUR PHONES...

YOU SENT MORE TEXT MESSAGES THIS MONTH THAN THE ENTIRE NATION OF CHAD.



...SEEP FROM OUR RADIOS...

POLLS SHOW SENATOR NEERDORPH WITH A 40 POINT LEAD!



...AND LITTER OUR ROADS.

KILLED OR INJURED?  
Average Award \$150 million, and Beyond!  
Eaton Cake, Attorney at Law  
800 WIN CAKE



78%  
of Dentists Recommend It!  
SCOURADE!



IT'S IMPOSSIBLE TO ESCAPE THEM.

**THEY'RE *EVERYWHERE!***

**AT THE MALL**

WE'RE PLAYING THAT BACKGROUND MUSIC...

...BECAUSE STUDIES SHOW IT'LL MAKE YOU BUY 10% MORE CLOTHES!



YUP, I'M  
GRADING ON  
A CURVE!

**AT SCHOOL**



**IN THE KITCHEN**

WHY DO I HAVE TO DO THE DISHES, LIKE, 75% OF THE TIME?

BECAUSE I COOK DINNER 99% OF THE TIME.



**IN THE BEDROOM**

THIS WEBSITE WILL FIND MY PERFECT MATCH...

...IF I ENTER MY VITAL STATISTICS.



**STATISTICS ARE WITH US WHEN WE'RE BORN...**

95% OF ALL BABIES ARE DELIVERED BETWEEN WEEKS 38 AND 42...

...SO THAT'S WHEN WE'LL DELIVER YOURS.



**...AND LIKE IT OR NOT, WE WILL *BECOME STATISTICS* WHEN WE DIE.**

SO SAD.

AT LEAST HE LIVED LONGER THAN THE AVERAGE BEAGLE.



FORTUNATELY, THERE'S A **GOOD REASON** FOR ALL THIS.

**STATISTICS ARE EVERYWHERE  
BECAUSE THEY'RE SO USEFUL.**

**STATISTICS HELP PEOPLE  
PREDICT THE WEATHER...**

THERE'S A 95%  
CHANCE IT'LL BE SUNNY  
TOMORROW!

BUT ALSO A 3%  
CHANCE IT'LL  
RAIN FROGS!



**...AND ORGANIZE THE  
INTERNET...**

BASED ON YOUR BUYING  
HISTORY, I'VE GOT  
RECOMMENDATIONS  
FOR YOU.

HOW DID IT KNOW  
I WANTED A WILLIAM  
SHATNER DOLL?

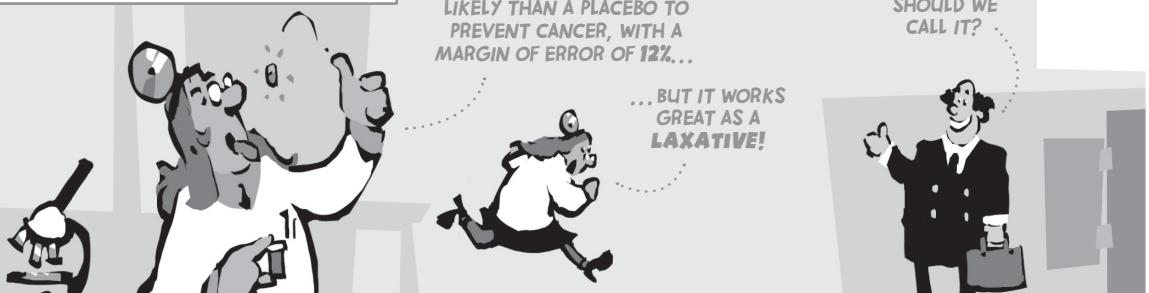


**...AND DEVELOP MEDICINES...**

OUR STUDIES SHOW THAT  
THIS PILL IS ONLY 2.5% MORE  
LIKELY THAN A PLACEBO TO  
PREVENT CANCER, WITH A  
MARGIN OF ERROR OF 12%...

...BUT IT WORKS  
GREAT AS A  
LAXATIVE!

GREAT, WHAT  
SHOULD WE  
CALL IT?



**...AND INFLUENCE FASHION.**

I USED STATISTICS TO  
DETERMINE THAT DENIM  
JACKETS ARE LIKELY TO  
COME BACK IN STYLE  
THIS YEAR...

LIKE, WOW YOU  
ARE SO 1987,  
I LOVE IT!

BUT LOSE THE  
BELL BOTTOMS.

AND THAT'S NOT ALL.



**STATISTICS ALSO HELP PEOPLE WIN ELECTIONS...**

ONLY 23% OF MY CONSTITUENTS THINK I'M AN OBSEQUIOUS JERK!



**...AND BUILD POWER PLANTS...**

WILL OUR NUCLEAR FACILITY CAUSE NEARBY RESIDENTS TO MUTATE?



**...AND MAKE MONEY...**

IF CURRENT MARKET TRENDS HOLD...

... I'LL BE BETWEEN 12% AND 15% MORE FILTHY RICH TOMORROW!



**...AND SHOW THEIR SUPERIORITY.**

HA, I HIT MORE HOME RUNS THAN YOU DID.

HA, YOU USED STEROIDS, AND HERE ARE THE STATISTICS TO BACK ME UP!



**SO WHAT MAKES STATISTICS  
SO INCREDIBLY USEFUL?**

THIS THING IS  
AMAZING!

IT'S GOT A FORK AND A  
KNIFE AND A SPOON AND  
A RAKE AND A STRAW...

...AND A DRILL AND  
FINGERNAIL CLIPPERS  
AND A PENCIL AND...



**THE SIMPLE ANSWER IS THAT STATISTICS HELP US COME TO GRIPS WITH  
LARGE NUMBERS OF IMPORTANT THINGS...**

94% OF ALL HUMANS  
WHO EVER LIVED  
ARE DEAD...

...AND 200 MILLION  
OF THEM DIED IN  
THE PLAGUE...

...AND TRAFFIC KILLS  
MILLIONS MORE  
EVERY YEAR...

...AND YOUR ODDS OF BEING  
STRUCK BY LIGHTNING ARE  
WAY HIGHER IF YOU PLAY GOLF!



**... WHICH IN TURN CAN HELP US BETTER  
UNDERSTAND OUR COMPLEX WORLD...**

**...AND MANIPULATE IT.**

STUDIES SUGGEST THAT  
78% OF ALL PEOPLE LIKE  
DOUGHNUTS.

SO IF WE GIVE  
THEM AWAY FREE  
AT OUR DEATH CULT  
MEETINGS...

...WE CAN  
ATTRACT MORE  
MEMBERS!



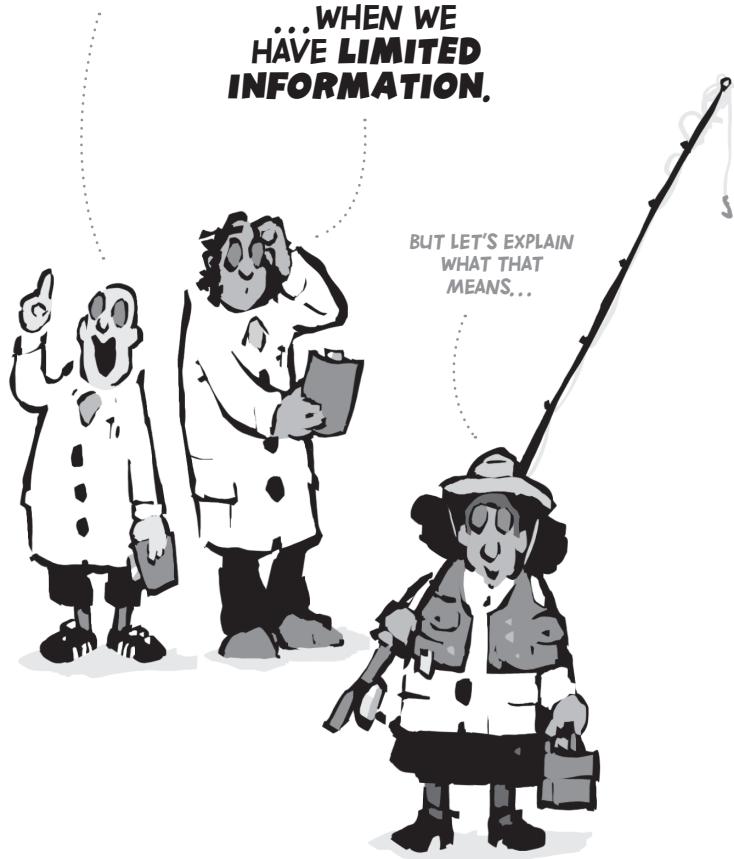
**BUT THE REAL POWER OF STATISTICS IS MORE SPECIFIC.**

HERE'S THE **REAL REASON**  
EVERYONE USES STATISTICS:

**STATISTICS HELP US  
MAKE CONFIDENT  
DECISIONS...**

**...WHEN WE  
HAVE LIMITED  
INFORMATION.**

BUT LET'S EXPLAIN  
WHAT THAT  
MEANS...



IMAGINE THAT WE WANT TO KNOW  
THE AVERAGE WEIGHT...

...OF ALL THE FISH IN A LAKE.

HERE FISHY, HERE  
FISHY, FISHY...



IF WE FIND OUT HOW  
MUCH EACH FISH WEIGHS  
ON AVERAGE....

...WE CAN FIGURE OUT  
ABOUT HOW MANY FISH  
WE NEED TO CATCH EACH  
DAY TO KEEP OUR CATS  
FROM STARVING!

IF WE DRAINED THE LAKE AND  
WEIGHED EVERY SINGLE FISH...

...WE'D HAVE ALL THE INFORMATION WE NEED TO CALCULATE THE ANSWER.



BUT FOR OBVIOUS REASONS, WE CAN'T DO THAT.

MAYBE  
THAT WASN'T SUCH  
A GOOD IDEA.



ON THE OTHER HAND, IF WE CATCH A SAMPLE OF 100 FISH AND WEIGH THEM...

THESE 100 FISH WEIGH 247 POUNDS.

SO THE AVERAGE FISH IN THIS SAMPLE WEIGHS 2.47 POUNDS!

... WE'LL HAVE ONLY **LIMITED INFORMATION** ABOUT ALL THE FISH.

SO NOW WE KNOW THE AVERAGE WEIGHT IN THIS SAMPLE PILE...

... BUT WE STILL DON'T KNOW THE AVERAGE WEIGHT OF THE REST OF THE FISH IN THE LAKE.

BUT HERE'S THE COOL THING:

WITH THE TOOLS OF STATISTICS WE CAN USE THIS **LIMITED INFORMATION**...

... TO MAKE **CONFIDENT STATEMENTS** ABOUT **ALL** THE FISH IN THE LAKE.

STATISTICS IS ABOUT USING THE FISH WE DID CATCH...

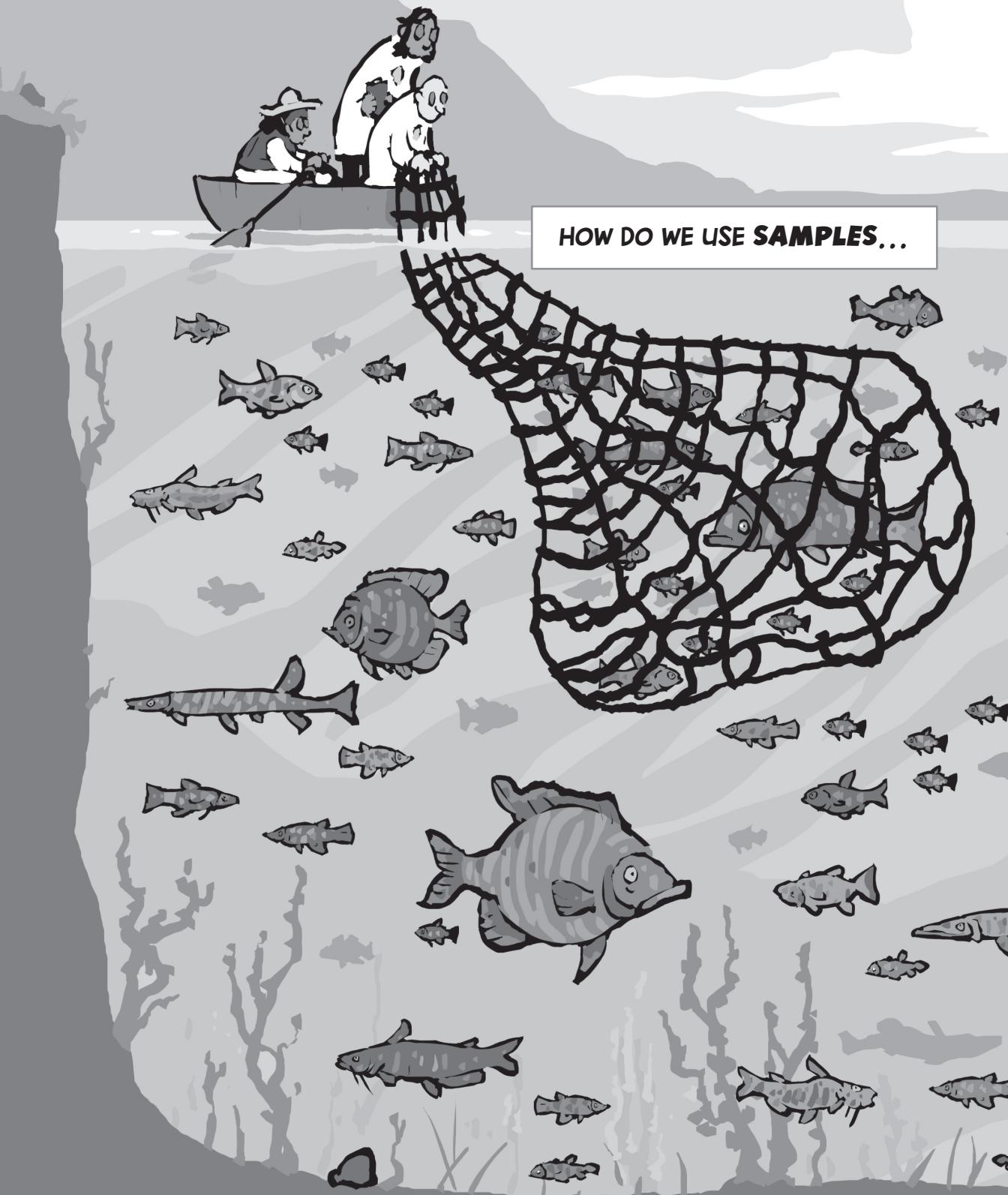
... TO SAY THINGS ABOUT THE FISH WE DIDN'T.

REALLY?  
HOW DOES THAT WORK?

THAT'S WHAT THIS BOOK IS ABOUT!

THIS BOOK IS ABOUT THE  
**FUNDAMENTAL QUESTION OF STATISTICS:**

HOW DO WE USE **SAMPLES...**



**... TO MAKE **CONFIDENT STATEMENTS**  
ABOUT **ENTIRE POPULATIONS?****

ALL STATISTICS  
PROBLEMS LOOK  
LIKE THIS!

**IN PART ONE WE'LL LEARN HOW TO  
GATHER SAMPLES...**

**...AND INVESTIGATE THEM.**

HMM, VERY FISHY.



**THEN, IN PART TWO, WE'LL LEARN HOW TO USE SAMPLES TO  
HUNT FOR QUALITIES IN POPULATIONS...**

**...USING A PROCESS CALLED STATISTICAL INFERENCE.**

WHAT CAN  
THESE FISH...

...TELL US ABOUT  
THOSE FISH.



ALONG THE WAY WE'LL  
LEARN TO SIFT THROUGH  
**BIG PILES OF DATA...**

...CALCULATE CONFIDENCE  
INTERVALS...

...AND TEST  
HYPOTHESES.

ARGH!  
WE'RE  
SKEWED!

THAT'S NOT  
NORMAL!

I'M 95% CONFIDENT  
THAT WE HATE YOU  
ABOUT THIS MUCH.

I'M 3% CONFIDENT  
THAT MY EVIL MACHINE  
ISN'T BUSTED!

AND MORE GENERALLY, WE'LL GET A SENSE OF  
THE KIND OF THINGS YOU **CAN...**

...AND **CAN'T...**

...DO WITH STATISTICS.

WE CAN USE  
STATISTICS TO  
MAKE CONFIDENT  
GUESSES...

...BUT YOU CAN NEVER  
USE THEM TO **ACHIEVE**  
**CERTAINTY.**

IF WE DON'T CATCH  
ALL THE FISH...

...WE'LL NEVER KNOW  
FOR CERTAIN WHAT'S  
DOWN THERE.



**IN THIS BOOK WE'RE GOING TO  
FOCUS ON THE BASIC CONCEPTS.**

LIKE STANDARD  
DEVIATIONS...

...AND SAMPLING  
DISTRIBUTIONS...

...AND PROBABILITIES...

...AND CONFIDENCE!

**BUT IF YOU'RE ALSO CURIOUS ABOUT  
THE TECHNICAL DETAILS...**

LIKE WHAT THE HECK DO  
THESE FORMULAS AND  
SYMBOLS MEAN?

**...YOU CAN FIND THOSE IN A SECTION AT  
THE END CALLED THE MATH CAVE.**

PART ONE

# GATHERING STATISTICS

*NO PEEKING.*

