

NATS 1500

Commented [GM1]:
v4: Added "Why stop there" to LE ~ Smoking

Statistics and Reasoning in Modern Society

Web page:

<http://wiki.math.yorku.ca/index.php/NATS1500>

or go to Moodle page

There are three kinds of lies:

lies, damned lies and statistics

There are three kinds of lies:

lies, damned lies and statistics

– Benjamin Disraeli

There are three kinds of lies:

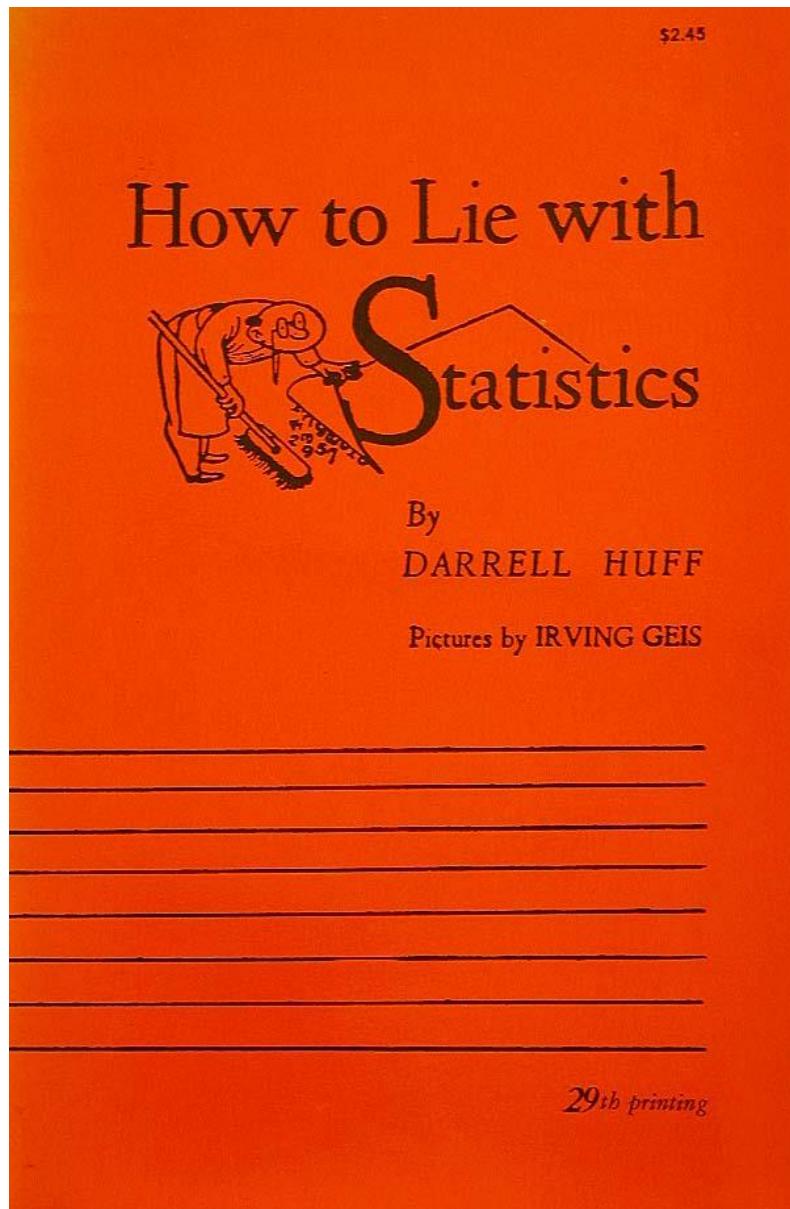
lies, damned lies and statistics

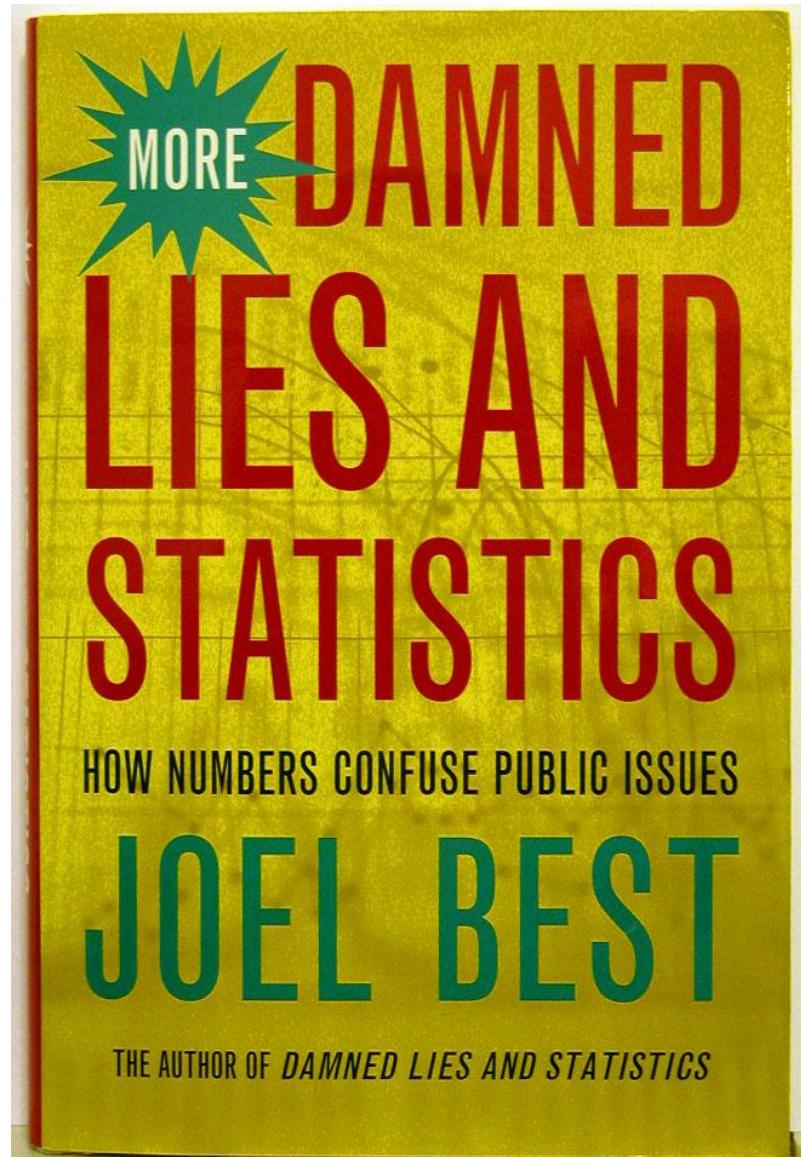
– *Benjamin Disraeli*

Prime Minister of Great Britain (1868, 1874-1880)



Best selling stats
book of all times







Statistical thinking will one day
be as necessary
for efficient citizenship
as the ability
to read and write.

– H. G. Wells

Commented [GM2]: Who would believe a SCIFI writer?

Who is right?

Disraeli or Wells?

Misunderstand statistics?

Splitting hairs?

Does it really matter?

Misunderstand statistics?

Splitting hairs?

Does it really matter?

A few consequences?

- The global economic meltdown
- Wrongful murder convictions
- Delayed response to health effects of tobacco
- Poor health policies and treatment decisions

Meet the man whose big idea felled Wall Street

Math whiz proposed applying this statistical formula to credit risk, and financial meltdown ensued

Mar 18, 2009 04:30 AM

Comments on this story □
(102)

CATHAL KELLY
STAFF REPORTER

Note: This article has been edited to correct a previously published version.

Former University of Waterloo statistician David X. Li didn't burn down the American economy. He just supplied the matches.



$$P_Y[\tau_a < 1, \tau_b < 1] = \Phi_a(\Phi^{-1}(F_a(1)), \Phi^{-1}(F_b(1)), \gamma)$$

University of Waterloo statistician David Li is shown in this handout photo, along with his statistical formula for modeling the behaviour of several correlated risks at once.

Commented [GM3]: THEY USED THE FORMULA BUT DIDN'T UNDERSTAND IT

As economists and market watchers cast about for people to blame for the U.S. market meltdown, Li has surfaced as a scapegoat. Recently, *Wired* magazine ran an article on Li's work subtitled, "The Formula That Killed Wall Street."

The formula in question is the so-called Gaussian copula function. On the most basic level, the formula allows statisticians to model the behaviour of several correlated risks at once.

In a scholarly paper published in 2000, Li proposed the theorem be applied to credit risks, encompassing everything from bonds to mortgages. This particular copula was not new, but the financial application Li proposed for it was.

Disastrously, it was just simple enough for untrained financial analysts to use, but too complex for them to properly understand. It appeared to allow them to definitively determine risk, effectively eliminating it. The result was an orgy of misspending that sent the U.S. banking system over a cliff.

"To say David brought down the market is like blaming Einstein for Hiroshima," says Prof. Harry Panjer, Li's mentor at the University of Waterloo. "He wasn't in charge of the financial world. He just wrote an article."

It is easy to lie with statistics.
It is hard to tell the truth without it.

– *Andrejs Dunkels*

Not just global issues.

Also everyday decisions:

Does using cellphones cause brain cancer?

Plastic bottles? Are they poisonous?

Controversy over Bisphenol-A bottles

New drugs: are they safe?

Will taking more Vitamin D help to prevent
cancer?

Pot use before 18 lowers IQ by 8 points

THERESA BOYLE
HEALTH REPORTER

Persistent, dependent use of marijuana before age 18 has been shown to cause lasting harm to a person's intelligence, attention and memory, according to a study in *The Proceedings of the National Academy of Sciences of the U.S.*

Among a long-range study cohort of more than 1,000 New Zealanders, individuals who started using cannabis in adolescence and used it for years afterward showed an average decline in IQ of eight points when their IQs were compared at ages 13 and 38. Quitting pot did not appear to reverse the loss either, said lead re-

Commented [g4]: this might be useful for your students but it's probably too late for you

Pot use before 18 lowers IQ by 8 points

THERESA BOYLE
HEALTH REPORTER

Persistent, dependent use of marijuana before age 18 has been shown to cause lasting harm to a person's intelligence, attention and memory, according to a study in The Proceedings of the National Academy of Sciences of the U.S.

Among a long-range study cohort of more than 1,000 New Zealanders, individuals who started using cannabis in adolescence and used it for years afterward showed an average decline in IQ of eight points when their IQs were compared at ages 13 and 38. Quitting pot did not appear to reverse the loss either, said lead re-

Don't forget to brush your teeth

Good oral health could lower risk of dementia

NATASJA SHERIFF
REUTERS

People who keep their teeth and gums healthy with regular brushing may have a lower risk of developing dementia later in life, according to a new study.

Researchers, who followed close to 5,500 elderly people over an 18-year period, found those who reported brushing their teeth less than once a day were up to 65 per cent more likely to develop dementia than those who brushed daily.

Commented [g5]: In this audience it might be too late to do anything about pot but here's a useful piece of advice for your

Most of these issues boil down to asking:

Will X cause Y?

Why can't the experts agree?

How do I make a wise decision for myself?

Freakonomics

The Hidden Side of Everything



February 26, 2010, 10:54 AM

Freakonomics Radio, Fat Edition: Is the Obesity Epidemic for Real?

By STEPHEN J. DUBNER

Perhaps the biggest star of the podcast, however, is someone you'd never think would have something useful to say about obesity: a political scientist. He's [Eric Oliver](#) of the University of Chicago. He is the author of a book called [*Fat Politics: The Real Story Behind America's Obesity Epidemic*](#), and nearly all his research runs counter to the prevailing wisdom. In a nutshell, he argues that the "epidemic" is an overwrought product of moralism, shady statistics, and perversely misaligned incentives. His most controversial argument is that the causal relationship between weight and maladies like heart disease, cancer, and even diabetes has not been firmly established.



Eric Oliver, a University of Chicago political scientist and author of [*Fat Politics*](#). He thinks the "obesity epidemic" is gravely overstated.

World Business

Canada Takes Steps to Ban Most Plastic Baby Bottles

By IAN AUSTEN
Published: April 19, 2008

OTTAWA — The Canadian government moved Friday to ban polycarbonate infant bottles, the most popular variety on the market, after it officially declared one of their chemical ingredients toxic.



David McNew/Getty Images

Nalgene brand water bottles had used bisphenol-a, which some studies in animals linked to hormonal changes.

The action, by the departments of health and environment, is the first taken by any government against bisphenol-a, or BPA, a widely used chemical that mimics a human hormone. It has induced long-term changes in animals exposed to it through tests.

Also on Friday, Senator Charles E. Schumer, Democrat of New York, said he intended to introduce on Monday a bill that would ban many uses of BPA-related plastics. It would prohibit them in all children's products, including nonfood items they may put in their mouths, as well as in any product used to contain food or beverages.

The toxic designation will allow Canada eventually to ban the manufacture, import or sale of baby bottles made with polycarbonate. Polycarbonate, which dominates the North American baby bottle market, mimics glass but is lighter and shatter-resistant.

- [!\[\]\(393884bcaeb81fb92d40944aa75474c4_img.jpg\) E-MAIL](#)
- [!\[\]\(7a2a02a01f938eb179a2fd96d747ac5b_img.jpg\) PRINT](#)
- [!\[\]\(9639bd316596abd9db73050c1baa5b96_img.jpg\) REPRINTS](#)
- [!\[\]\(40d235849e55d5796de5ed6fb6052ce4_img.jpg\) SAVE](#)
- [!\[\]\(ee4d36a2fb829417e2198f87e1043d33_img.jpg\) SHARE](#)

ARTICLE TOOLS
SPONSORED BY
slumdog millionaire
4 GOLDEN GLOBE NOMS

<http://www.bisphenol-a.org/whatsNew/20080205.html>

N Courses Research R READ Topics Res Lib C Tech Down Ent Hlth > Other bookmark

BisphenolA

Home | Contact Us | Search | Register | Help



What's New

**Are the Myths About Polycarbonate Bottles True?
New Information Supports the Safe Use of Polycarbonate Bottles**

February 5, 2008

Summary

For decades, polycarbonate plastic has been safely used to make baby bottles, reusable water bottles, and sippy cups. The safety of these products has been supported by numerous science-based safety evaluations of bisphenol A that have been conducted by independent government and scientific bodies worldwide. For example, recent evaluations by the European Food Safety Authority and NSF International both provide strong support for the safety of polycarbonate bottles. In spite of this strong scientific support, numerous myths, misinformation and scare stories about polycarbonate bottles continue to circulate. Several new studies have carefully examined these myths and provide additional strong support for the safe use of polycarbonate bottles.

What Do We Know About the Safety of Polycarbonate Bottles?

Polycarbonate plastic has been the material of choice for baby bottles, reusable water bottles and sippy cups for decades because it is lightweight, highly shatter-resistant, and transparent. During that time, many studies have been conducted to assess the potential for trace levels of bisphenol A to migrate from polycarbonate bottles into foods or beverages. The conclusions from those studies and comprehensive safety evaluations by government bodies worldwide are that polycarbonate bottles are safe for use.

Gender bias seen in ICUs, study finds

Women 50 and older less likely to be admitted

NOOR JAVED

STAFF REPORTER

Women 50 and older in need of critical care are less likely than men to be admitted to the intensive care unit or receive crucial life-supporting treatments in hospitals across the province, according to the find-



Commented [GM6]: Toronto Star Nov. 15, 2007, page A3

Commented [GM7]: STATISTICS PLAY A HUGE ROLE IN ALMOST ALL PUBLIC CONTROVERSIES.

HOW SHOULD WE INTERPRET THE DATA?



TORONTO STAR

MOSTLY CLEAR, WINDY, HIGH 8C ★ FRIDAY, NOVEMBER 11, 2005 ★ thestar.com

Canada faces climate crisis

We're dangerously unprepared to deal with impact of changes, report warns

PETER CALAMAI
SCIENCE REPORTER

OTTAWA—Canada is more vulnerable to climate change than any other industrialized nation but is dangerously unprepared to deal with the "unavoidable"

impacts, warns a study specially commissioned by Prime Minister Paul Martin.

The unpublished report lists damage to forestry, fishing and agriculture caused by higher temperatures and less reliable

precipitation. Large swaths of Ontario's boreal forest are likely to die over the next century.

The danger to the country from climate change is "perhaps unmatched in times of peace," says the draft of a blunt report

from the National Round Table on the Environment and the Economy. Created by the federal government in 1994, the round table is a blue-ribbon advisory body of business and labour leaders, academics, envi-

ronmentalists and civic activists. The 24 members are appointed directly by the Prime Minister, giving the group an inside track in Ottawa policy discussions.

Although the report also sug-

gests cozying up to the United States to get a North American approach on adapting to climate change, the overriding emphasis is on handling the issue here

► Please see Climate, A12

MEET THE GENERAL: David Fraser is Canada's new warrior chieftain



NEWS

POWER HEROES

Hydro One line crews are heroes in Florida as they restore power to neighbourhoods ravaged by Hurricane Wilma. **A17**

PASSING JUDGMENT

Justice Richard Schneider comes to the defence of mentally ill patients charged with crimes. **A17**

POLITICS OF PAY

Health

D SECTION ▶ TORONTO STAR ▶ FRIDAY, NOVEMBER 11, 2005 ★ thestar.com

Diaper Daze:
Duncan milks his
mom and hits the
bottle. D4



LUCAS OLMOS/TORONTO STAR

Marika Bandera, who suffers from blurred vision and shaking hands, moved away from these power lines only to discover her new apartment was next to a cellphone tower.

Distress signals

It started with nausea and vomiting in the morning, followed by insomnia and the annoying sound of static electricity.

Marika Bandera, sitting in her east-end Toronto apartment, begins to cry as she recalls how her symptoms gradually got worse over the course of a year. These included tingling sensations

Some people are certain that cellphones and power lines are making them sick. U.K. acknowledges their belief in electrical sensitivity, *Tyler Hamilton* writes

"They would not listen, they are not hearing their patients," she says.

It wasn't until a trip to Europe

appliances that use electricity. Little is known about the phenomenon of ES or how many people think they have it, but

need to consider ES in terms other than its etiology (causes), as this position alone is failing to meet the needs of those who

This hasn't stopped Sweden, with an estimated 250,000 sufferers, from accepting ES as a physical impairment. Dr. Ola

he

B
f
g
o

Tr
Ca
th

The following is a list of some of the most common symptoms associated with electrical sensitivity:

Tr
Ca
th

Teacher had felt 'cheated' over race

LOUISE BROWN
EDUCATION REPORTER

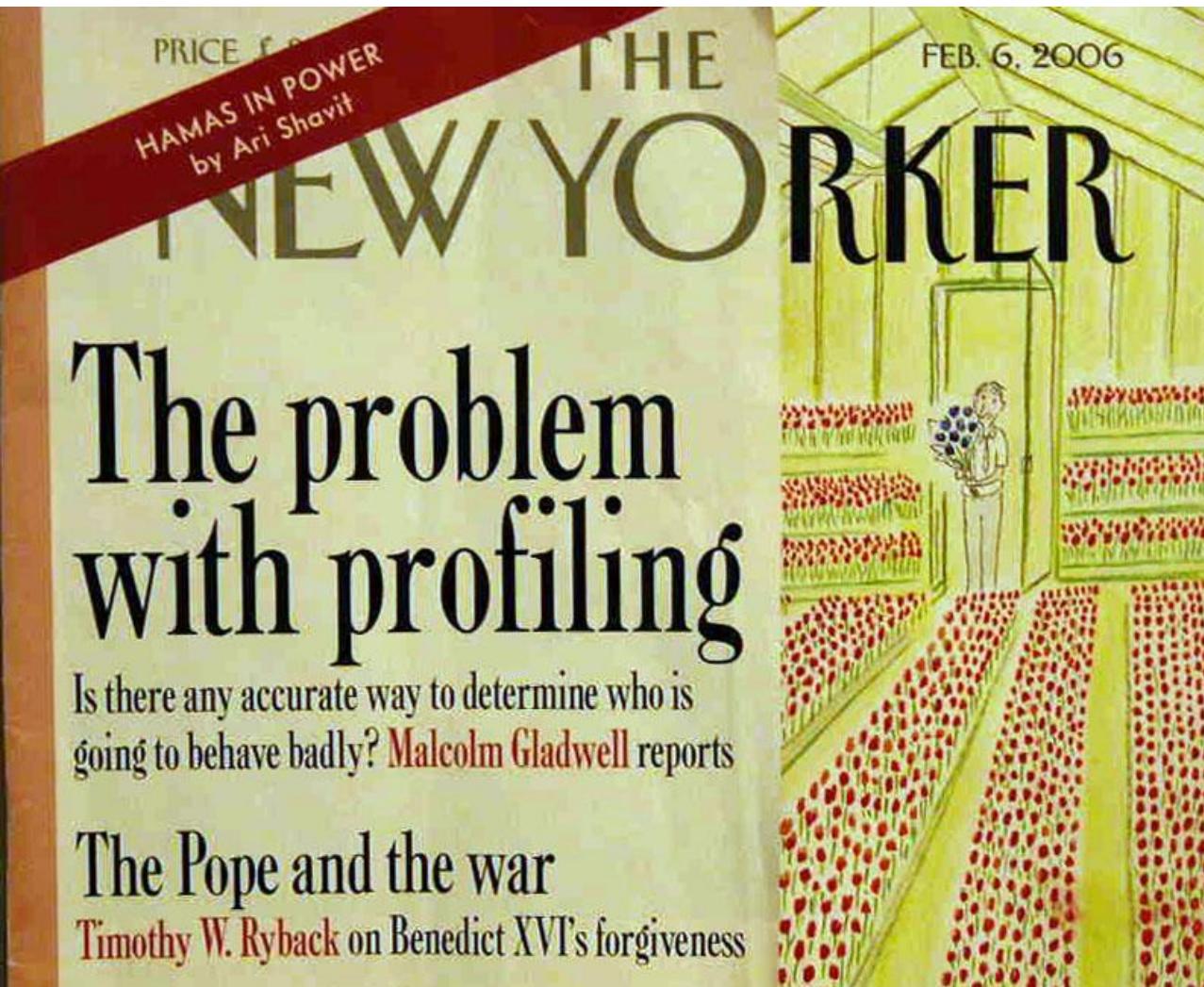
The first time Francis Omoruyi-Odin lost out on a promotion, he knew something was wrong.

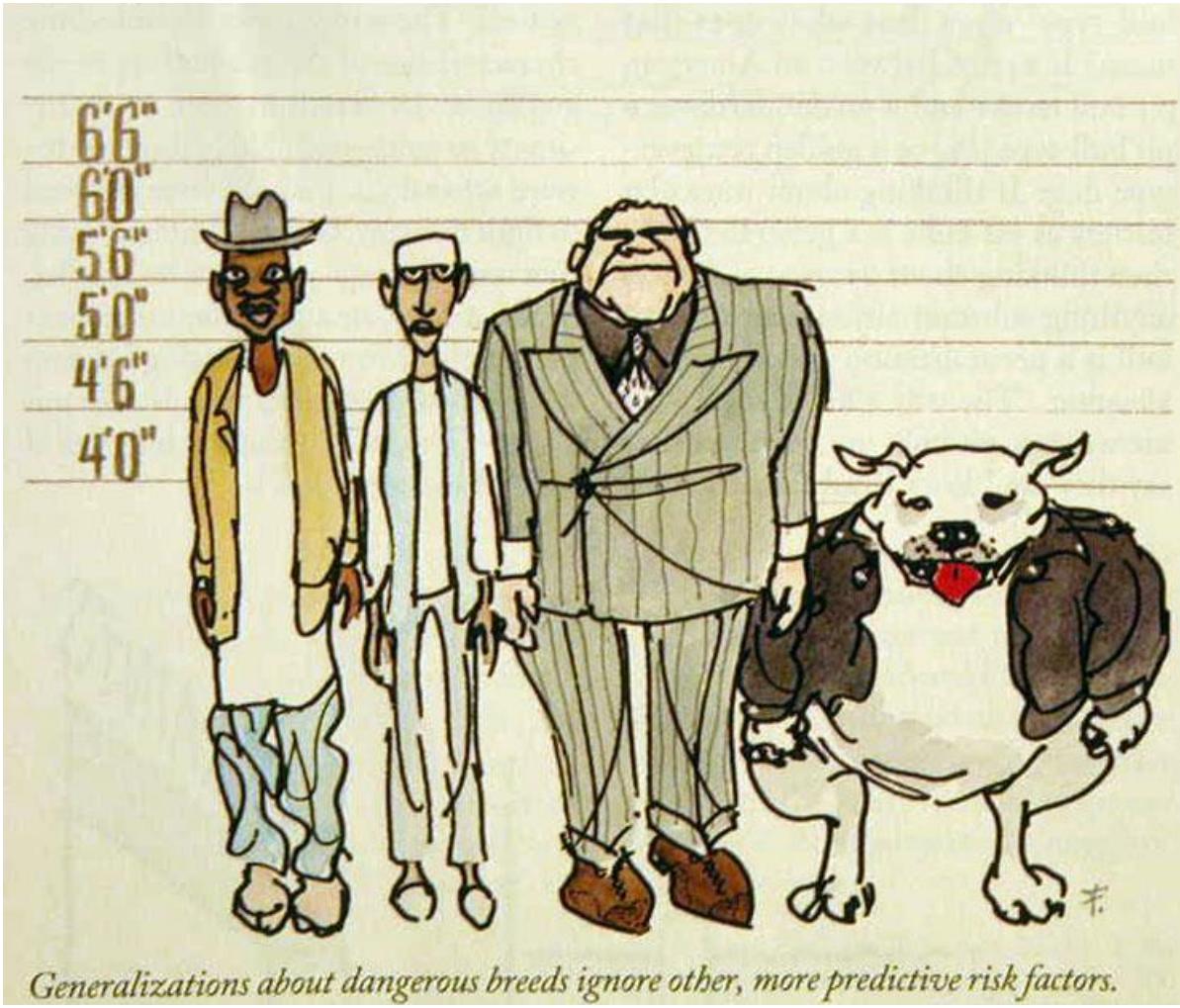
He suspected it was his black skin. It seems he was right.

Since moving to Canada from Nigeria 20 years before as an automotive engineer, Omoruyi-Odin had embraced teaching, leaving the auto shop behind to teach hundreds of Scarborough high school students in such subjects as business, math, machine shop and English.

He had been drawn to this country since the time he ran an auto shop in Nigeria where Canadian diplomats would bring their cars and rave about home.

By 1002, with 15 years of exp...





Generalizations about dangerous breeds ignore other, more predictive risk factors.

HUFF POST PITBULLS

Edition: U.S. ▾



Like 234k



Follow



Newsletters



Huffington Post Search

FRONT PAGE

POLITICS

BUSINESS

MEDIA

WORLDPOST

SCIENCE

TECH

HEALTHY LIVING

TASTE

IMPACT

HUFFPOST LIVE

ALL SECTIONS

[Green](#) • [Energy](#) • [Climate Change](#) • [Earth Day](#) • [Animals](#) • [Saving Strays](#) • [Girls In STEM](#) • [Keystone XL Pipeline](#) • [Fracking](#) • [Generation Change](#)



Giant Invasive Crab Caught Walking Down The Street In Hawaii



The 10 Best Animal Photos From The Department Of The Interior's Instagram Account



The 10 Best Photos From The Dept. Of The Interior's Instagram

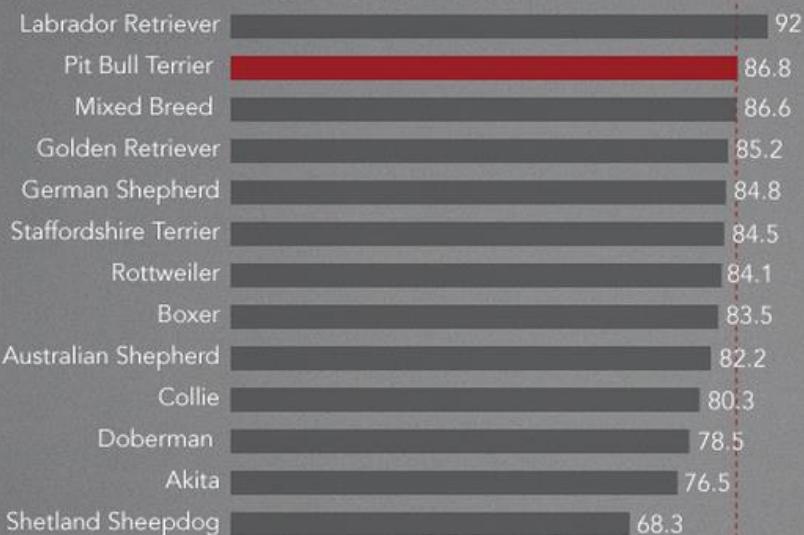
Why It's Ridiculous People Still Think Pit Bulls Are Inherently Mean (INFOGRAPHIC)

Posted: 10/24/2013 10:46 am EDT | Updated: 11/11/2013 3:34 pm EST

Pit Bulls Are Just About The Nicest Dogs There Are

They're among the most tolerant dogs tested by the American Temperament Test Society.

Percent passing (low aggression, panic and avoidance)



Note: To reduce sample size bias, only breeds where 400 or more dogs were tested are shown here.



Note: To reduce sample size bias, only breeds where 400 or more dogs were tested are shown here.

The breed isn't the problem, the owner is.

80%

of the hundreds of pit bulls seized and killed every year by animal control in Prince George's County, MD, because of a breed-specific ban are "nice, family dogs."

84%

of dogs involved in fatal attacks were neglected or abused.

86%

of fatal dog attacks involve unneutered male dogs.



Sources: American Temperament Test Society, Inc., American Humane Association, ASPCA

THE HUFFINGTON POST



Commented [GM10]: LIES THAT SOMEONE IN GRADE SCHOOL COULD CATCH YET FEW DID.

ing Tour through the Twists and Turns of Math Abuse and Innumeracy).

Consider how the Harris government in Ontario in the mid-1990s was able temporarily to bamboozle most of the media and the public with claims of a crime wave among the province's youth by using carefully massaged statistics as justification for setting up special boot camps.

The absolute number of th

camps.

The absolute number of crimes committed by those age 12 to 17 had, indeed, been rising. But the number of young people in the province was rising even faster, which meant that the youth crime rate — the number of crimes committed per 1,000 young people — had actually been dropping since 1991.

Solicitor General Bob Runciman sidestepped this inconve-

How?

of crimes ↑

of youths ↑

of crimes
of youths

Ask: 1) absolute # OR rate?

2) Is the denominator correct?

How can numbers lie?

"How to Lie with Statistics" mentions relatively obvious ways

We will see some more subtle but perhaps more important ways

When Statistics Seem to Lie:

*They're Usually Answering a
Different Question*

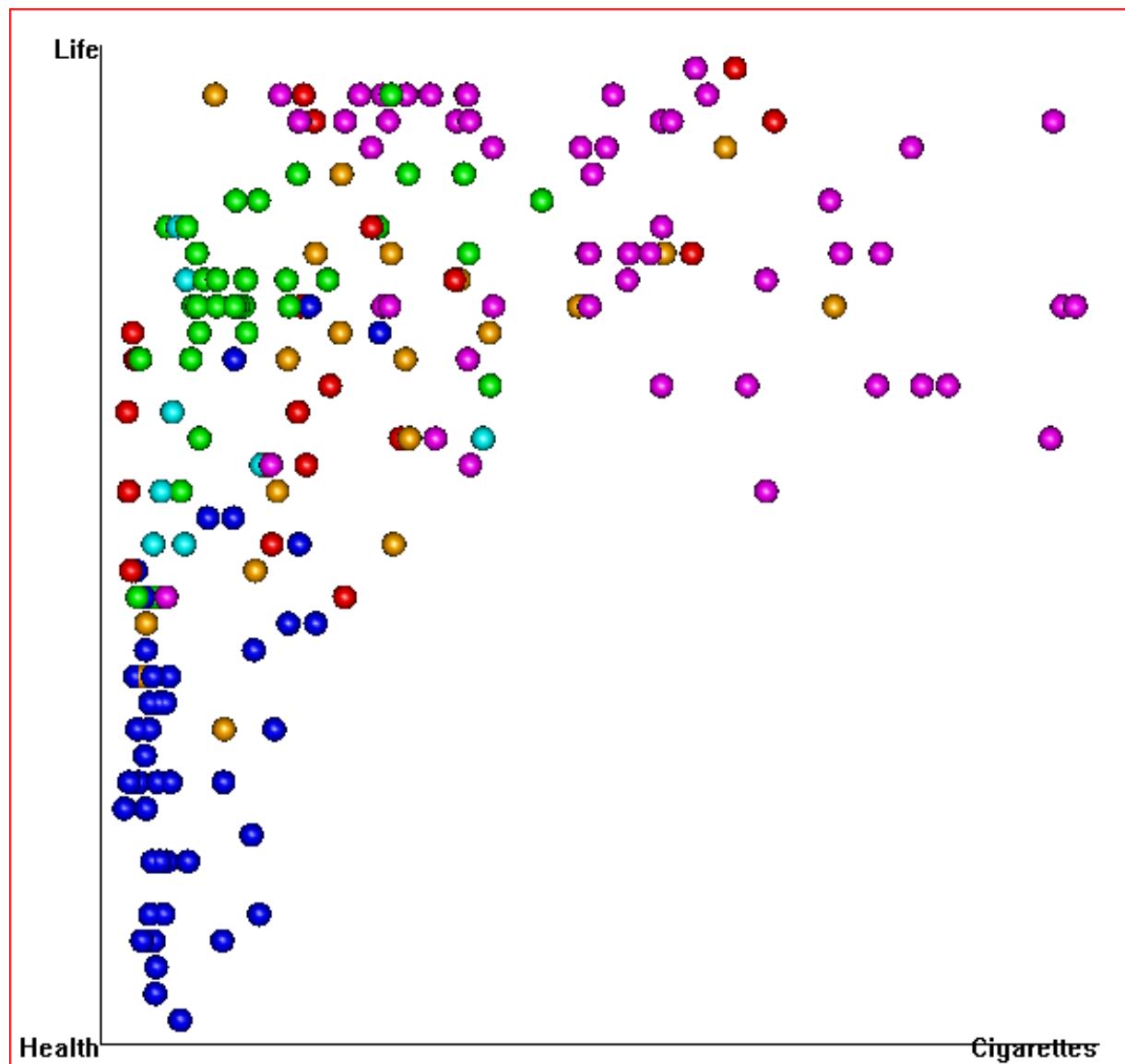
Answering an important question:

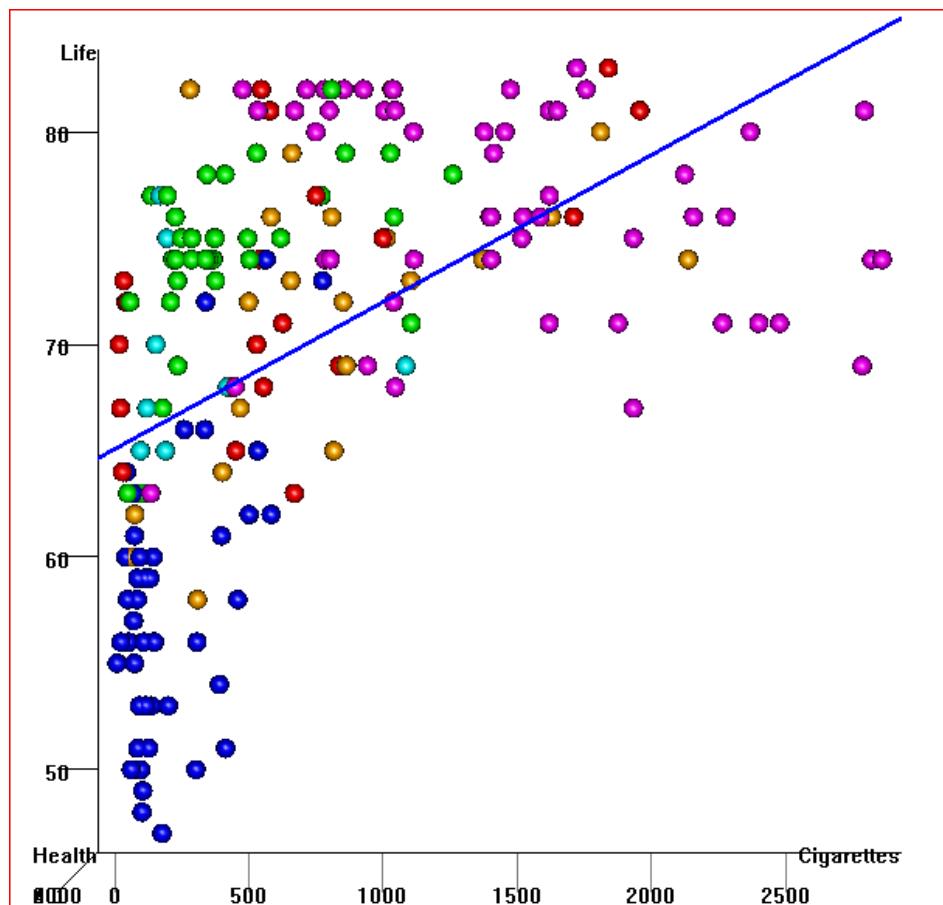
Just how harmful is smoking anyways?

Use data for an ‘evidence-based’ answer:

We can go to the web (e.g. Gapminder.org) to get data on
Smoking and on **Life Expectancy**
from most countries in the world

We’ll see just how much smoking is bad for your health by looking at
the **relationship** between **Smoking** and **Life Expectancy**





Coefficients	Estimate	Std. Error	DF	t-value	p-value
(Intercept)	65.075840	0.855974	183	76.025515	<.00001
Cigarettes	0.006915	0.000855	183	8.090493	<.00001

Commented [g11]: some of you might say that we should really fit a quadratic here and you're right it would be better and you'd come up with a much better conclusion.
You'd find that it's not true that 4 cigarettes a day adds 10 years to your life. You would find that 4 cigarettes a day is optimal. But you shouldn't go higher than that.

Coefficients	Estimate	Std. Error	DF	t-value	p-value
(Intercept)	65.075840	0.855974	183	76.025515	<.00001
Cigarettes	0.006915	0.000855	183	8.090493	<.00001

What does this actually mean?

Commented [g12]:

Coefficients	Estimate	Std. Error	DF	t-value	p-value
(Intercept)	65.075840	0.855974	183	76.025515	<.00001
Cigarettes	0.006915	0.000855	183	8.090493	<.00001

What does this actually mean?

One extra **cigarette per year** adds

0.006915 years to your life,

Commented [g13]:

Coefficients	Estimate	Std. Error	DF	t-value	p-value
(Intercept)	65.075840	0.855974	183	76.025515	<.00001
Cigarettes	0.006915	0.000855	183	8.090493	<.00001

What does this actually mean?

Commented [g14]:

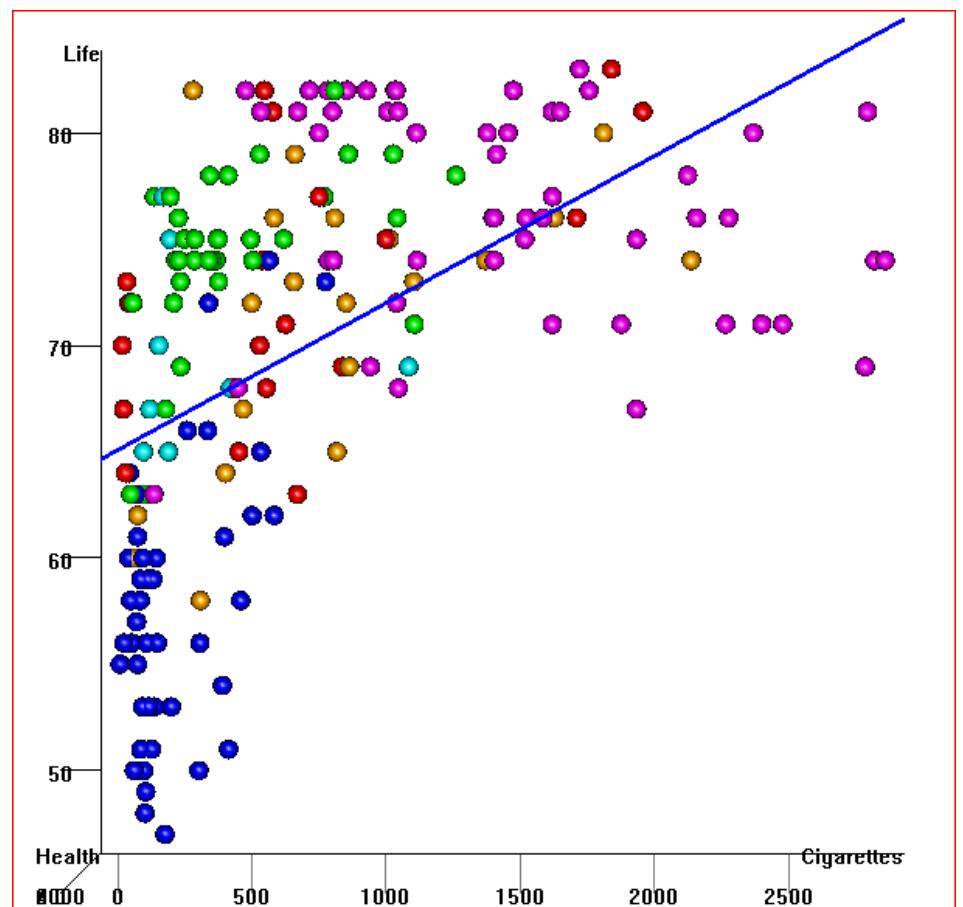
One extra **cigarette per year** adds

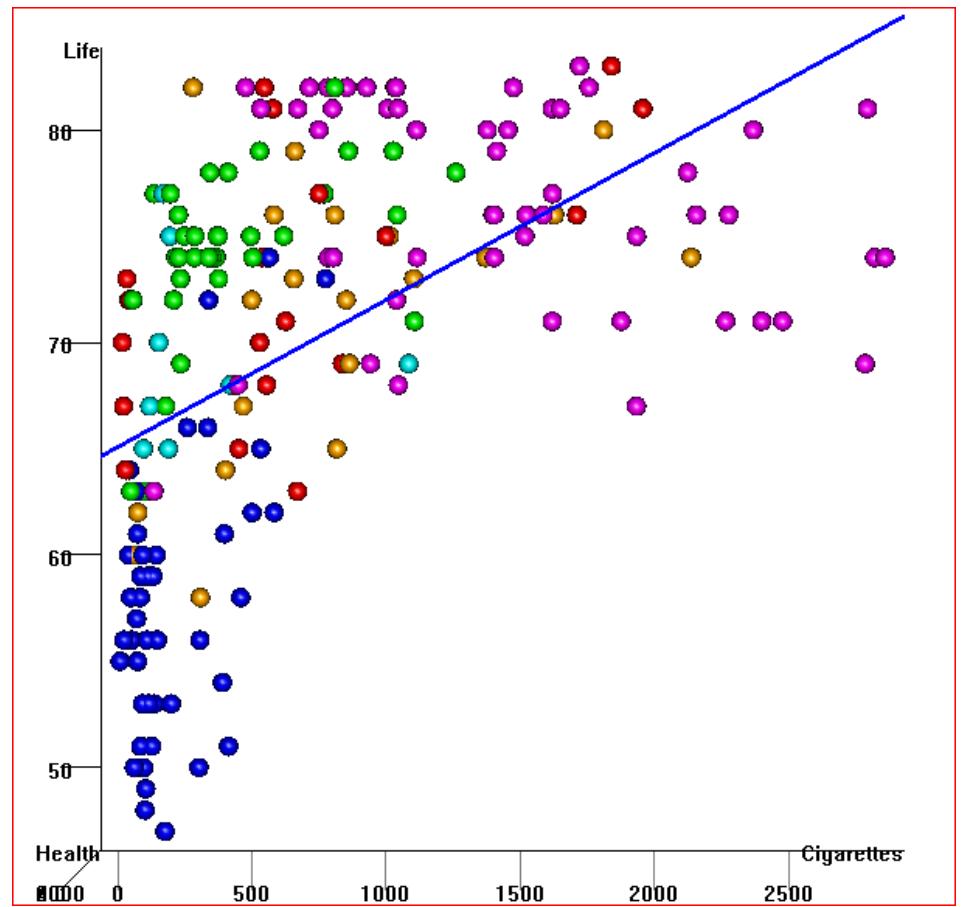
0.006915 years to your life,

Not very impressive but in better units:

**All it takes is 4 cigarettes a day
to add 10 years to your life**

Commented [g15]: but if 4 add ten wheynt 40 or 4000: Why stop there??

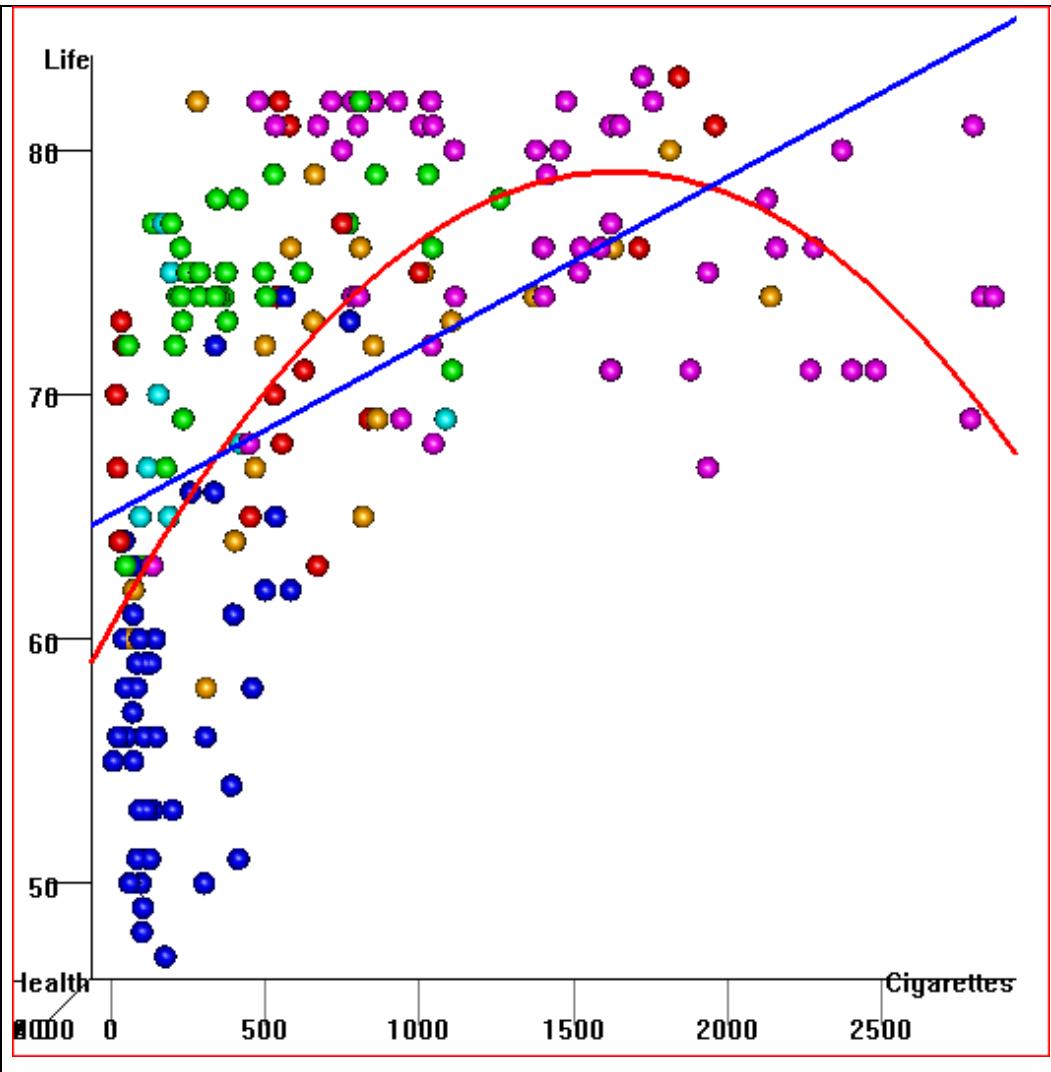




But why stop there?

A good statistician would tell you
that this is ridiculous.

There's obvious curvature in the relationship



Fitting a quadratic
model and maximizing
the quadratic shows
that

4.495 cigarettes/day

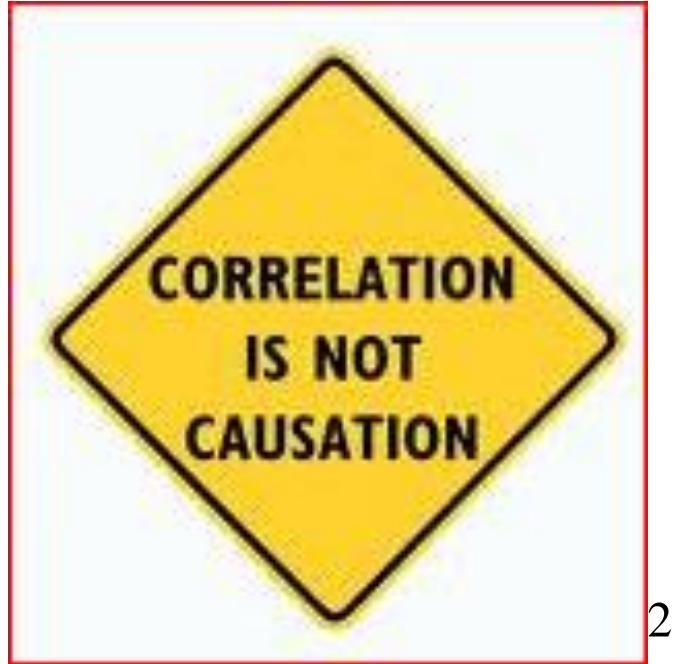
is actually optimal

What's the problem?

Maybe it isn't smoking that's responsible for higher life expectancies.

Maybe it's something else –
a **CONFOUNDING VARIABLE**¹ that causes
BOTH
higher life expectancies
and higher rates of smoking.

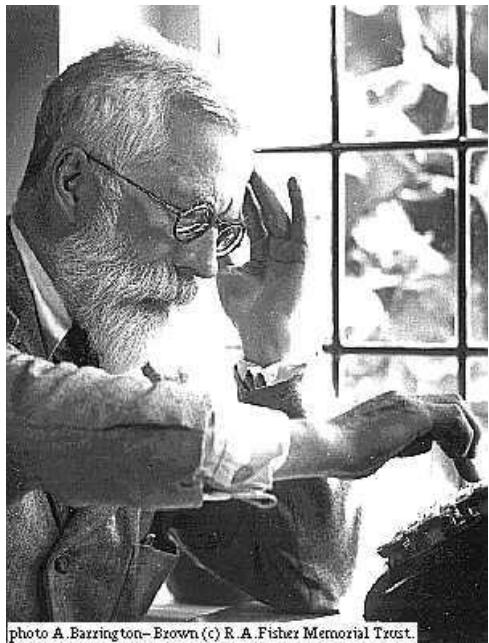
¹ Also called a “lurking variable” or a “lurking factor”



2

² Adapted from a sign by Edward Tufte

R. A. Fisher's brilliant solution (~1920):



Randomized Experiment
using **Random Assignment** to treatments (levels
of the X variable)

To avoid the possibility that some factor other than smoking is
responsible for the difference in health:

Toss a coin to choose who gets to smoke and who doesn't

Observe for many years and then compare smokers and non-smokers

If there's a difference between the two groups either smoking that's responsible **OR** it's due
to something else **BY CHANCE – which we can measure**

What can it mean when a variable X (Smoking) is correlated
(associated) with another variable
Y (Life Expectancy) in a sample of data



If we compare a group of **smokers** with a group of **non-smokers** the two groups **could be different** in all sorts of ways other than the mere fact that one group smokes and the other doesn't. And these other differences could be responsible for differences in health.

Fisher's idea:

- Make sure the two groups are similar *except for chance*.
- How? Take one group of willing subjects and **RANDOMLY ASSIGN**³ subject to the two ‘treatments’: one randomly selected group smokes for 20 years and the other does not.

³ There are many ways of doing this but the idea is that a RANDOM mechanism, e.g coin flip or random number generator, must be used somewhere.

At the end of 20 years, if the group assigned to smoke is less healthy than the group assigned to not smoke then either:

- being assigned to smoke causes poorer health
- or**
- it could be due to other initial differences in the two groups
BUT the differences occur only BY CHANCE – and we can calculate the chance that those initial differences would result in health differences at the end of the study.

Data obtained through an experiment with **random assignment** to *conditions* (also referred to as *treatments*, *treatment and control*, *groups*, *experimental factor*) is called

Experimental Data

In pharmaceutical studies, the process of testing drugs with randomized experiments is called ***clinical trials*** – the resulting data is experimental data.

Note: There are other important issues for experiments to work well: blinding of subject, blinding of assessor, double blind, use of placebo.

The *ideal* experiment is often called a:
Randomized Controlled Double Blind Experiment

Correlation is not necessarily causation
unless you are analyzing an experiment

Sir Ronald A. Fisher laid the foundations of Experimental Design
ca 1925 to 1940

Fisher insisted that only an experiment can determine whether X causes Y.

He went so far as to defend tobacco companies in the 50s because there was no experimental evidence that tobacco was harmful, only "observational data".

With observational data, X is not controlled by the experimenter. It is just observed as it happens to have been determined naturally. For example, by personal choice to smoke or not smoke.

Should we only use experimental data to determine whether X causes Y?

Problems with experimental data:

- too costly
- too risky
- too long
- subjects who are willing and available may not be typical of target population
- observational data already on hand so let's use it
- won't give an answer until it's too late
- experimental situation not realistic
- we can only tell whether **assignment to treatment groups** makes a difference. What if subjects don't comply?

For example: clinical trials are used to assess the **effectiveness** of drugs but not useful to discover possible rare side-effects. These need to be monitored with observational data when the drug is being used.

"Second best" method for causal inference:

Use observational data with care

How?

Use *observational data* and try to control for the possible effects of a confounding factor(s) by measuring it and

1) Analyzing each *stratum* with similar values for the confounding factor(s). This is called *stratification*.

OR

2) Building a statistical model in that includes the confounding factor(s) and using *multiple regression*.

OR

3) Use new advanced methods: propensity score matching, discontinuity models, etc.

This are no perfect solutions and they all require judgment to assess studies based on these methods:

Problems:

- 1) The confounding factor may be known but may be measured with error so that it is not fully controlled.
- 2) Some important confounding factors might not be known.

Note that these are NOT problems for randomized experiments.

Why does choosing treatments at random work?

Fisher was adamant – nothing short of a true randomized experiment could be used to infer causality.

Commented [GM21]: Fisher knew he had a brilliant idea BUT he became convinced that this was the ONLY idea – the ONLY way to do it

Fisher's reaction to the mounting evidence of an association between smoking and lung cancer in the 1950s:

AUG. 3, 1957

CORRESPONDENCE

BRITISH
MEDICAL JOURNAL 297

Dangers of Cigarette-smoking

SIR,—In the *Journal* of July 20 (p. 158) Dr. Robert N. C. McCurdy writes, “Fisher’s criticism (*Journal*, July 6, p. 43) . . . would not be so unfair if he had specified what alternative explanations of the facts still await exclusion.” I had hoped to be brief. A few days later the B.B.C. gave me the opportunity of putting forward examples of the two classes of alternative theories which any statistical association, observed without the precautions of a definite experiment, always allows—namely, (1) that the supposed effect is really the cause, or in this case that incipient cancer, or

a pre-cancerous condition with chronic inflammation, is a factor in inducing the smoking of cigarettes, or (2) that cigarette-smoking and lung cancer, though not mutually causative, are both influenced by a common cause, in this case the individual genotype.

Commented [g22]: fisher went on an international lecture tour to defend tobacco and to make fun of the claims that it might be leading to an increase in Lung cancer. Fisher was a tobacco denier

Understanding the problem:

*The fundamental
2 x 2 table of statistics*

Questions		

Commented [GM23]: You might think that the positive association between smoking and LE is an error – that it really should be negative.
I will try to convince you that there isn't ONE correct sign. The correct sign DEPENDS on the question.
This is the solution to the enigma: to realize that different relationships between variables answer different questions about them.

Understanding the problem:

*The fundamental
2 x 2 table of statistics*

Questions	Causal		
	what would happen if ...?		
	Predictive		
	passive guessing		

Commented [g25]: most of the really big question: Climate change, taking a drug, etc.smoking pot, brushing your teeth.

Commented [g24]: two types of questions – I used to apologize for oversimplifying heretut I've stopped. Instead I ask for counter exemplars. anyways definitely two 'archetypes of data'.

Commented [g26]: This is actually important: e.g. insurance companies, credit risk,investments that are too small to affect the market, point of sale credit card fraud detections.

Understanding the problem:

*The fundamental
2 x 2 table of statistics*

Questions	Data	
	Experimental random assignment to treatments (X)	Observational X is not controlled
Causal what would happen if ...?		
Predictive passive guessing		

Commented [g27]: there are poor experiments i.e. with bad reandomization but that generally makes them useless as experiments and they become observational

Commented [GM28]: Not random selection that's critical here BUT ransom assignment to levels of X

Understanding the problem:

*The fundamental
2 x 2 table of statistics*

		Data	
Questions	Causal what would happen if ...?	Experimental random assignment to treatments (X)	Observational X is not controlled
	Predictive passive guessing	Ideal where Fisher wants to be	Ideal for prediction under the same conditions as those observed

Understanding the problem:

*The fundamental
2 x 2 table of statistics*

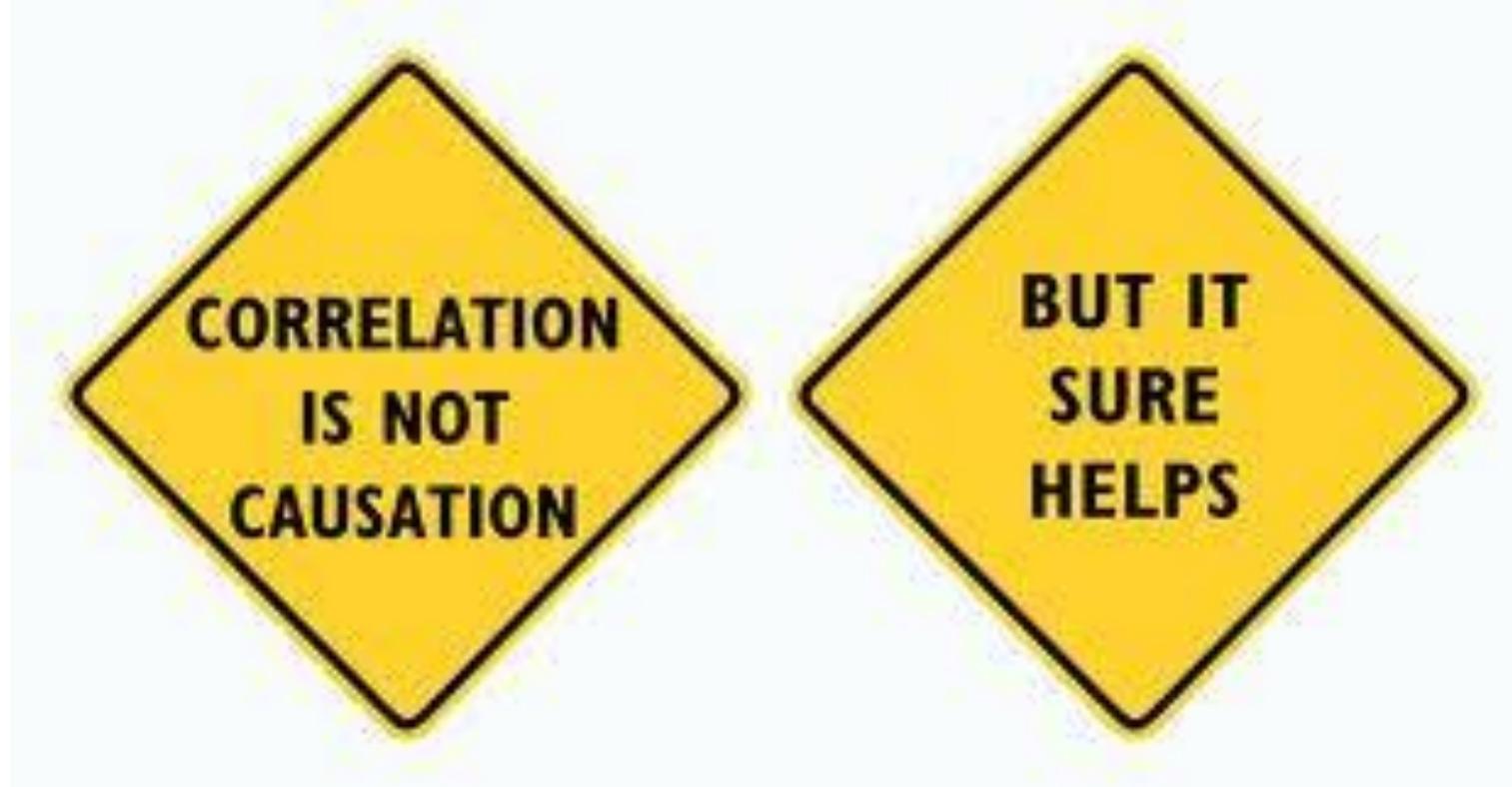
Questions	Data		
	Experimental random assignment to treatments (X)	Observational X is not controlled	Where most of the difficult questions are
Causal what would happen if ...?	Ideal where Fisher wants to be		
Predictive passive guessing	Hardly ever	Ideal for prediction under the same conditions as those observed	

Commented [g29]: you could say that they are difficult because they are here

Commented [g30]: note that statisticains rarely thing of things this way. If your theoretical you might not worry about the interpretations Causal or predictive of your model, that's for the user. Many applied people work in only one of these boxes and they might not even be aware of the other boxes.. In fact in the same company, Phase III drug research in in ... and Phase IV in UR and LR. Because they are so different come compnies build vitual firewalls to isolate them from each other.

Hints of causal effects based on correlations (observational data) are everywhere:

Commented [g31]: when they say correlations, the really critical issue is that they are based on observational data. Correlations with experimental data WOULD be causation.



How should we react to them?

(how would we like our students to react to them)

Commented [g32]: to turn this into a topic for this conference!

How can we do better than Fisher?

Should we even try?

Recent example in the news:

People who use sunscreen lotion have a higher risk of skin cancer than people who don't

Should I stop using SSL?

How can we make wise decisions when faced with this kind of information?

The solution to the problem involves asking questions more than finding answers!

What question do we want to ask?
Is the question causal or predictive?

What kind of data do we have?

How were people assigned randomly
to use more or less SSL?

If the answer is yes, then we go on to ask more
questions: Were the subjects like me? Did they
comply with the random assignment?

If the answer is ‘not randomly’ then we need to think of possible confounding factors.

Understanding these issues is important for simple everyday questions.

But also for very large questions

Conjectures::

1. Most scientific and social controversies subsist on conflicting interpretations of evidence
2. Most conflicting interpretations of evidence are rooted in difficulties inferring causality from observational data

Caution:

Taking a hard line “**correlation is not causation**”
may be as problematic as seeing causation in every correlation.

Caution:

Taking a hard line “**correlation is not causation**” may be as problematic as seeing causation in every correlation.

For many important issues, we only have observational data.

This is a major challenge for modern Statistics and for the interpretation of scientific evidence.

We need to find a balance between extreme skepticism and extreme gullibility.

EXAMPLES

Public policy:

Fighting crime:

Does capital punishment work.

8 inside Syria
WORLD — AA1

World Tour? Our pick is . . .
LIVING — L1

PHILLIES CRUSHED
Phillies on verge of winning Series
SPORTS — S1

Shock, sadness spread over senseless shooting

'Extremely dangerous' man, right, sought in murder of innocent bystander

Kyle Weese

Bailey Zaveda outside Duke of York tavern

CAROLA VYHNAK AND HENRY STANCU STAFF REPORTERS

An "extremely dangerous" Toronto resident is the subject of a Canada-wide police manhunt following the weekend shooting death of a young woman innocently taking a smoke break outside a Queen St. E. tavern.

Toronto police say they'll do whatever it takes to track down Kyle Weese, 25, described by Det. Sgt. Gary Giroux of the homicide squad yesterday as an "extremely violent man with an extremely violent history."

Weese is "extremely" well-known to both detectives and uniform officers in 55 Division, Giroux said yesterday as he announced the arrest warrant.

Bailey Zaveda, 23, died of gunshot

ALBERT AJI ASSOCIATED PRESS

DAMASCUS—U.S. militaries yesterday attacked Syria close to Iraq, killing eight people. The Syrian government as "serious aggressors."

A U.S. military of by special forces eign fighter net through Syria ir where the Am unable to shut was out of the "We are tak own hands," Associated J anonymity.

A Syrian carried by News Ager attacked th the town o metres in



JUSTICE REFORM Reports virtually ignored, critics say

Despite hype, experts' recommendations produce few changes

TRACEY TYLER LEGAL AFFAIRS REPORTER

Just last week, at virtually the same time a 15-year-old was charged with murdering Brampton teenager Rajiv Dharamdial, government printing presses were gearing up to publish a major new report on preventing youth crime.

Commissioned last year by Premier Dalton McGuinty after 14-year-old Jordan Manners was shot dead in a Toronto school, the report examines the "root causes" of youth criminal behaviour. It represents months of work by Roy McMurtry, Ontario's former chief justice, and former Liberal cabinet minister Alvin Curling.

"I'm sure the premier . . . is going to take the report seriously," McMurtry said in an interview. "But there will certainly be other people in government who might be quite happy to see it buried."

While McMurtry doesn't doubt the sincerity of McGuinty or his cabinet in wanting to do something about youth crime, a lowering of expectations might be prudent.

In recent years, the province has

“You try to move on but you can’t. It brings everything back,” she said. “(Violence) is happening more and the justice system is at fault for protecting young offenders.”

New York Times
November 18,
2007

Does Death Penalty Save Lives? A New Debate



Joe Raedle/Getty Images

The Supreme Court is considering how to assess the constitutionality of lethal injections. Above, the Texas death chamber.

By ADAM LIPTAK

Published: November 18, 2007

For the first time in a generation, the question of whether the death penalty deters murders has captured the attention of scholars in law and economics, setting off an intense new debate about one of the central justifications for capital punishment.

According to roughly a dozen

- [E-MAIL](#)
- [PRINT](#)
- [SINGLE PAGE](#)
- [REPRINTS](#)
- [SAVE](#)
- [SHARE](#)

ARTICLE TOOLS
SPONSORED BY

USES AND ABUSES OF EMPIRICAL EVIDENCE IN THE DEATH PENALTY DEBATE

John J. Donohue* and Justin Wolfers**

INTRODUCTION.....	791
I. THEORY: WHAT ARE THE IMPLICATIONS OF THE DEATH PENALTY FOR HOMICIDE RATES?	795
II. A CENTURY OF MURDERS AND EXECUTIONS	796
III. THE IMPORTANCE OF COMPARISON GROUPS	798
A. <i>Canada Versus the United States</i>	798
B. <i>Non-Death Penalty States Versus Other States in the United States</i>	800
IV. PANEL DATA METHODS	804
A. <i>Katz, Levitt, and Shustorovich</i>	811
B. <i>Dezhbakhsh and Shepherd</i>	813
C. <i>Mocan and Gittings</i>	816
D. <i>Other Studies</i>	818
V. INSTRUMENTAL VARIABLES ESTIMATES.....	821
A. <i>Problems with Invalid Instruments</i>	827
B. <i>Problems with Statistical Significance</i>	833
VI. A PARTIAL RECONCILIATION: LACK OF STATISTICAL POWER AND REPORTING BIAS	836

Figure 1. Homicides and Execution in the United States

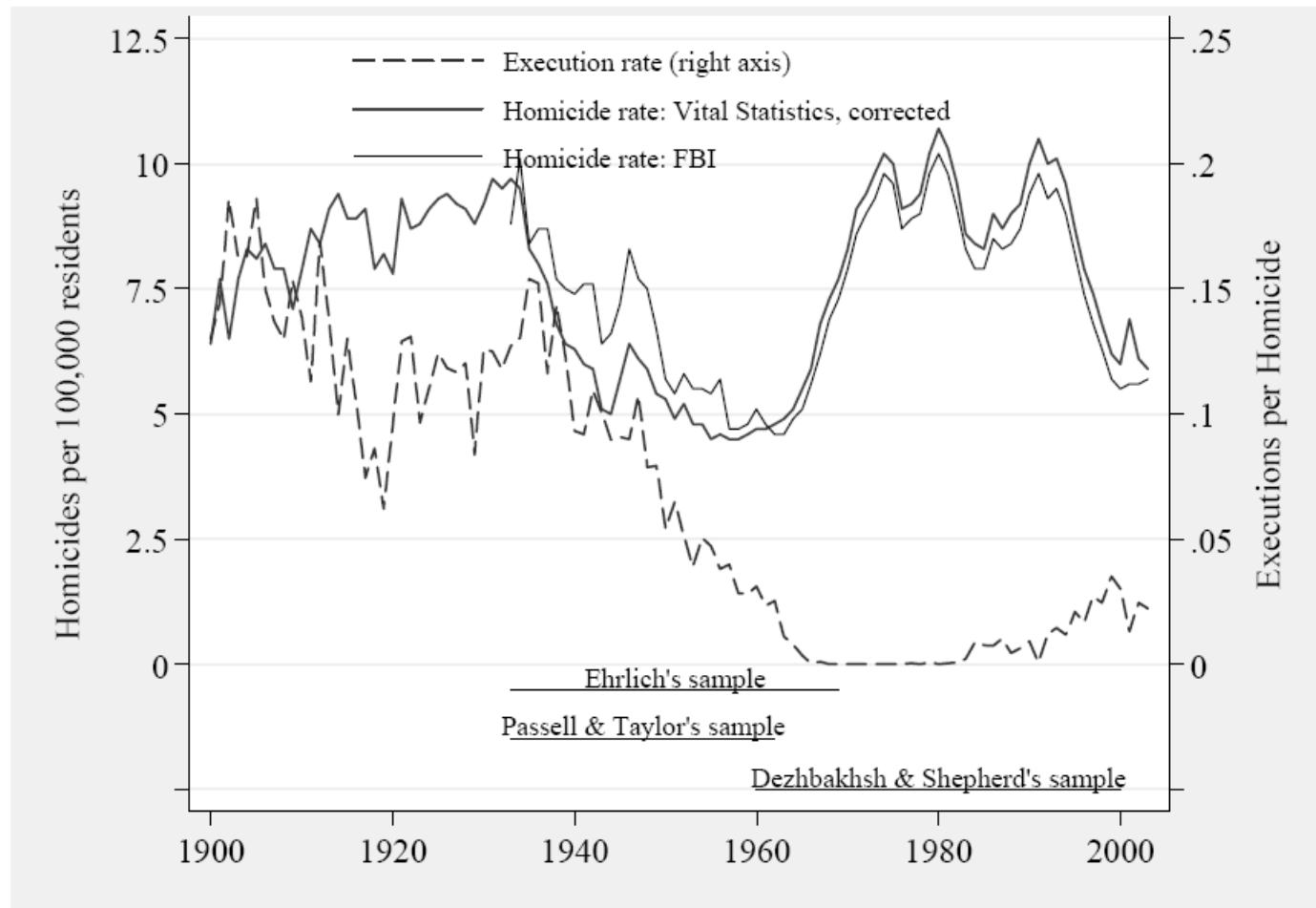
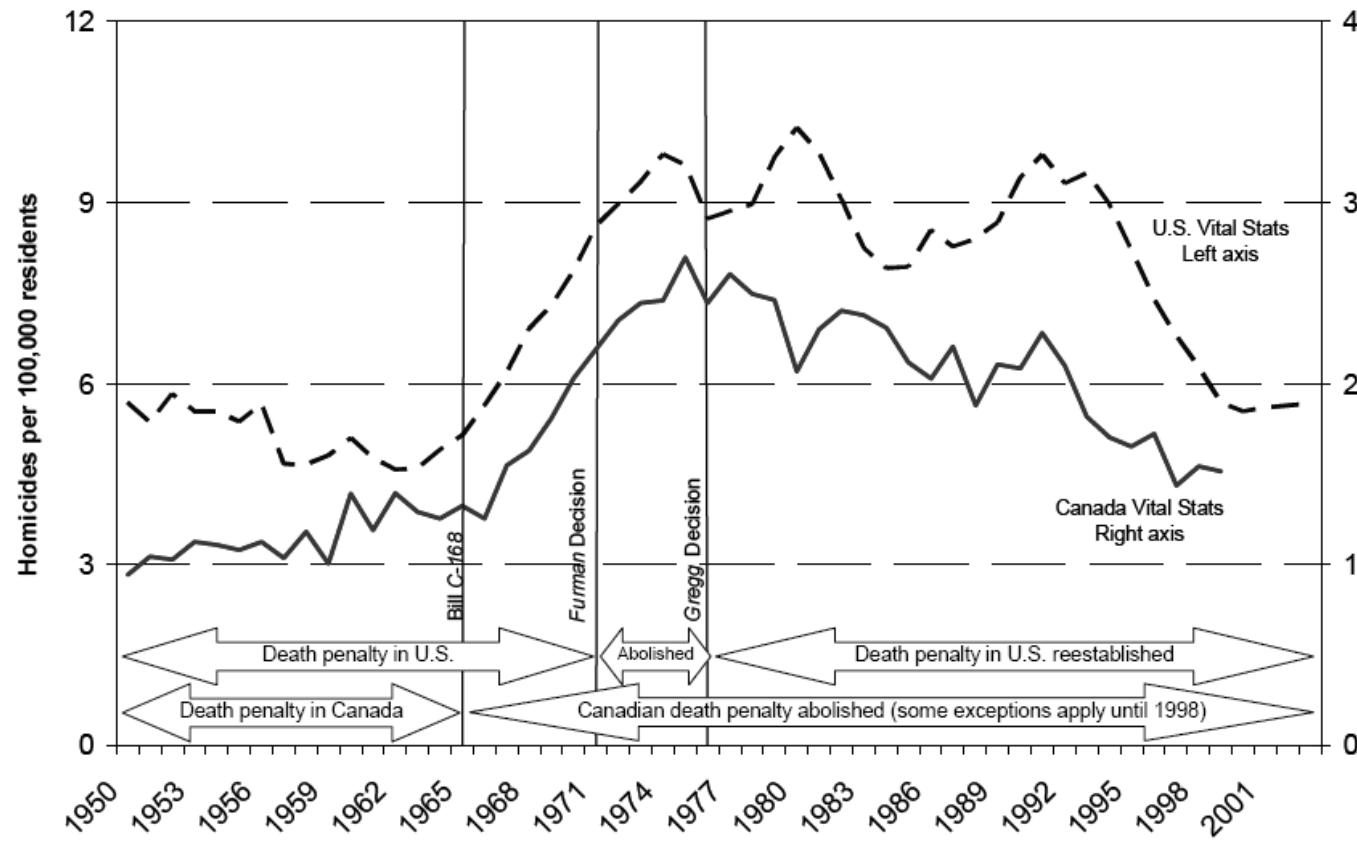
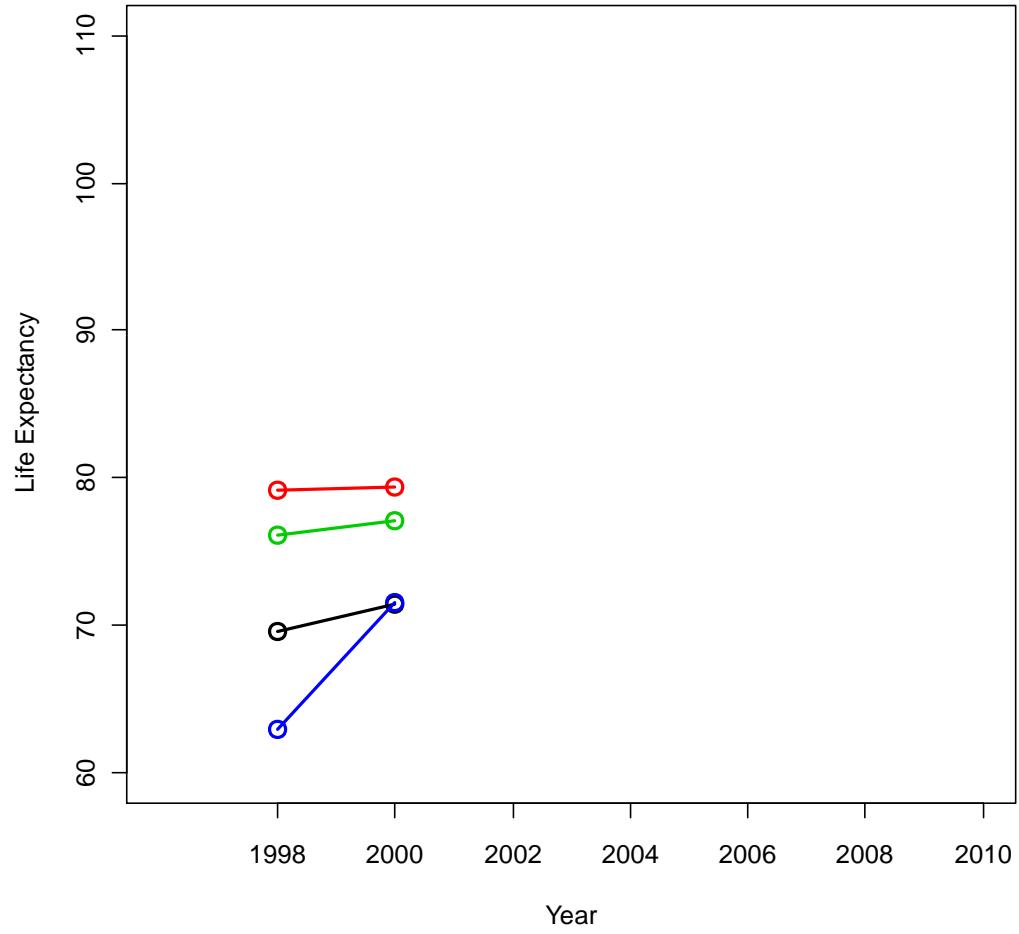
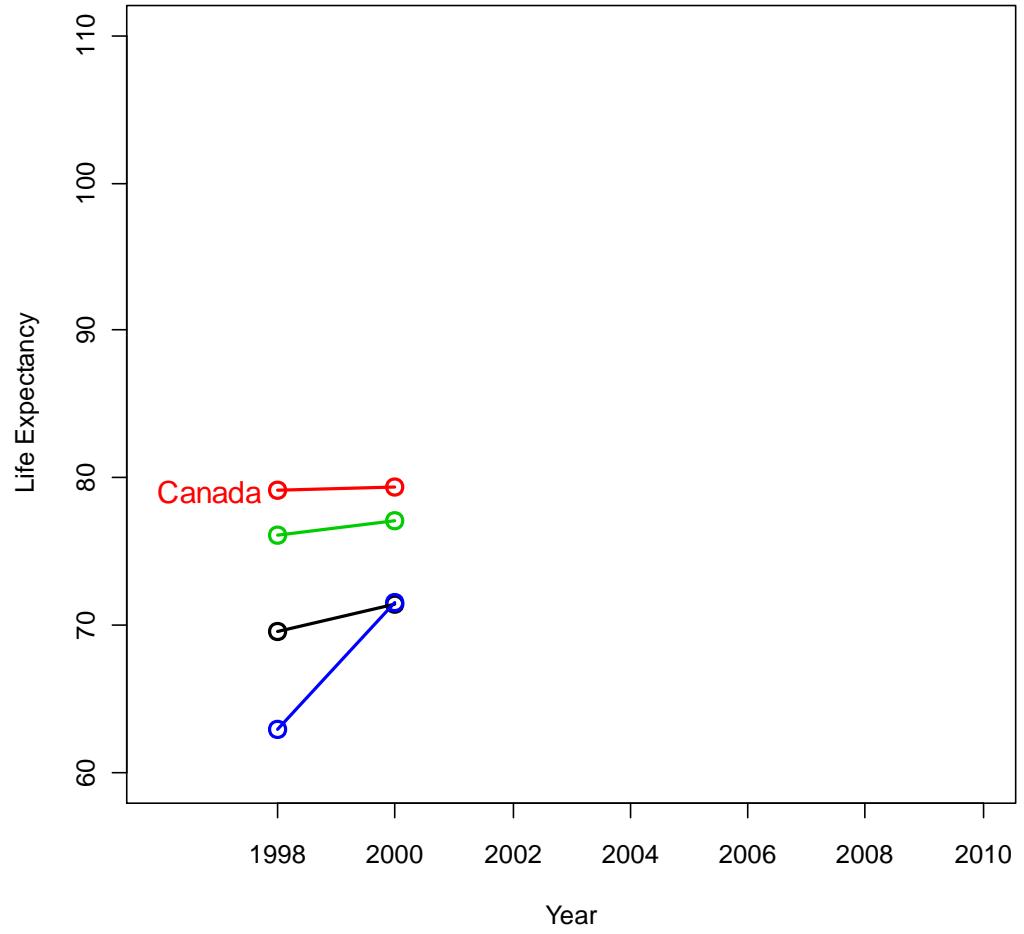


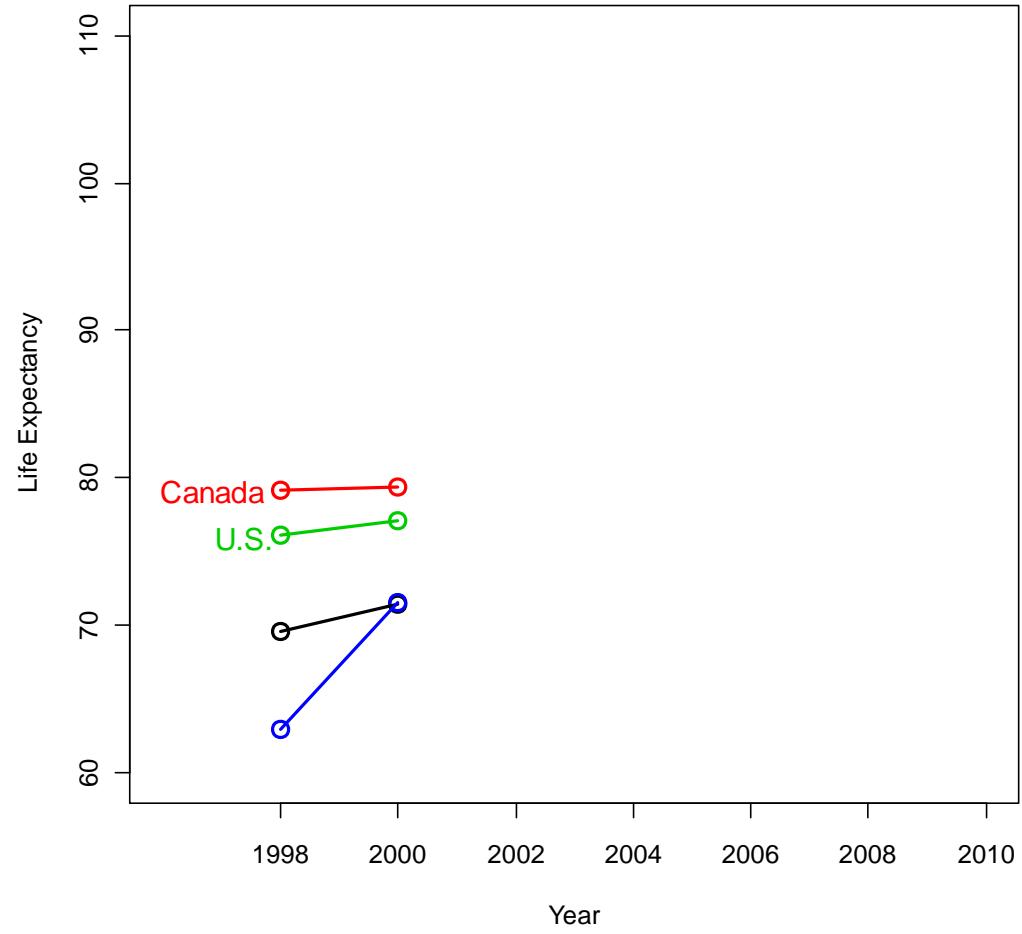
Figure 2. Homicide Rates and the Death Penalty in the United States and Canada

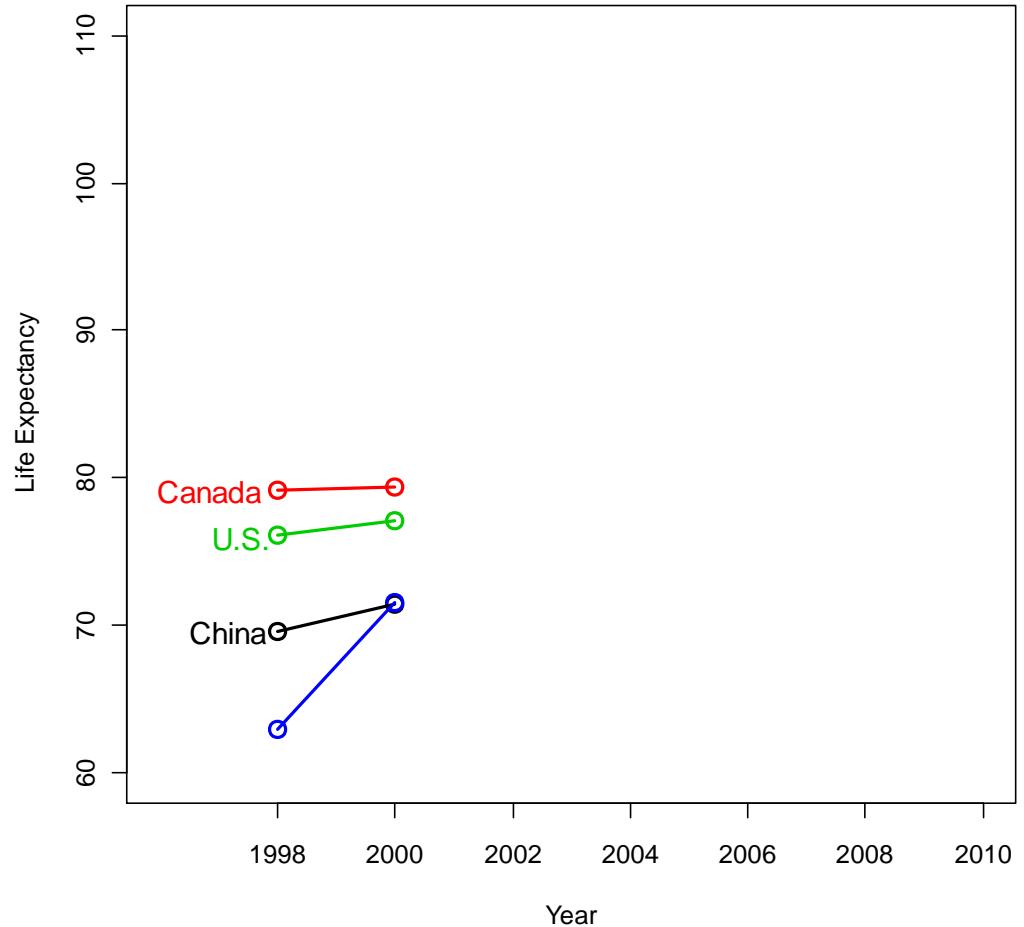


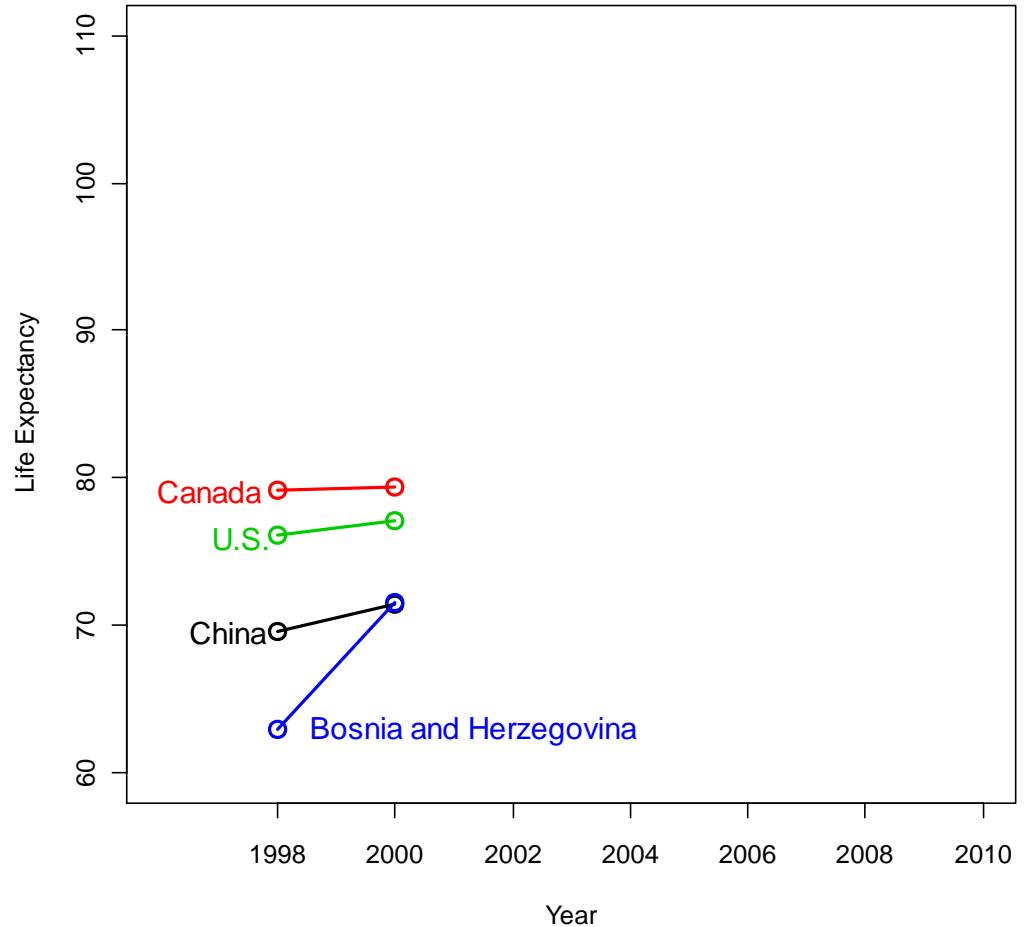
Another common way of thinking
that can mislead: extrapolation

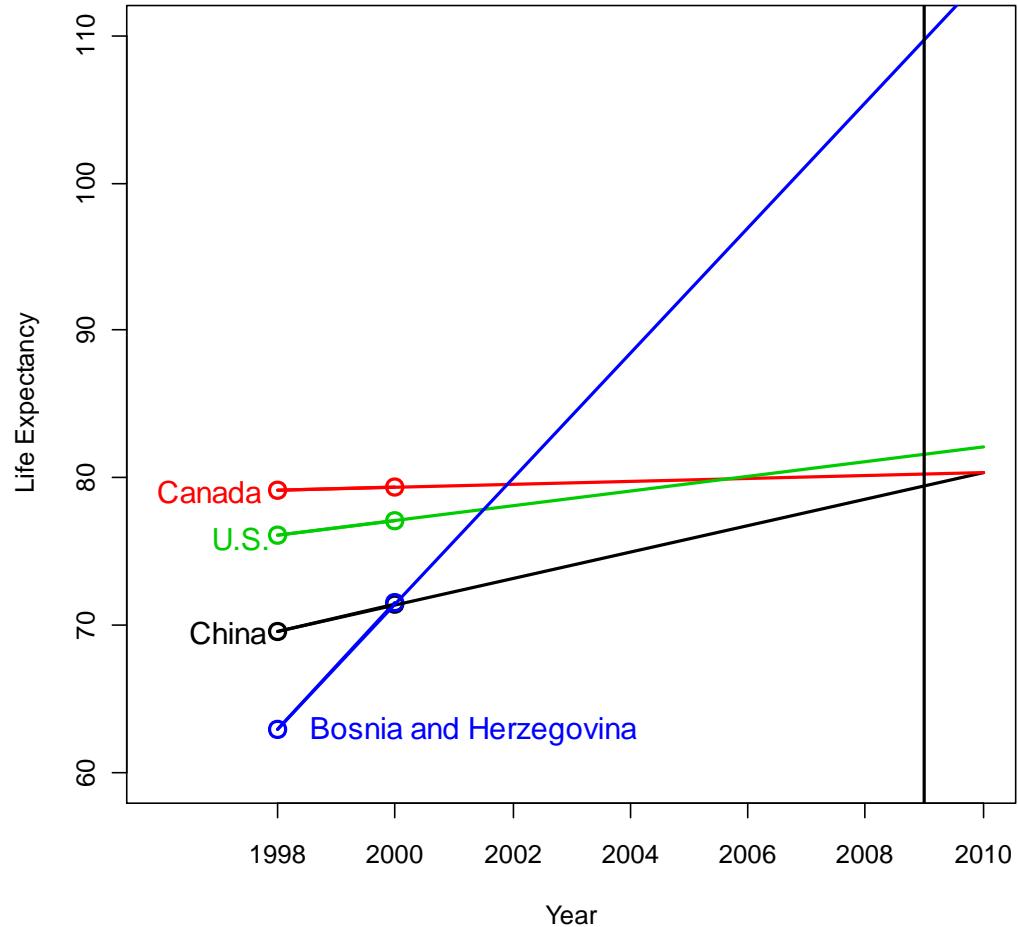








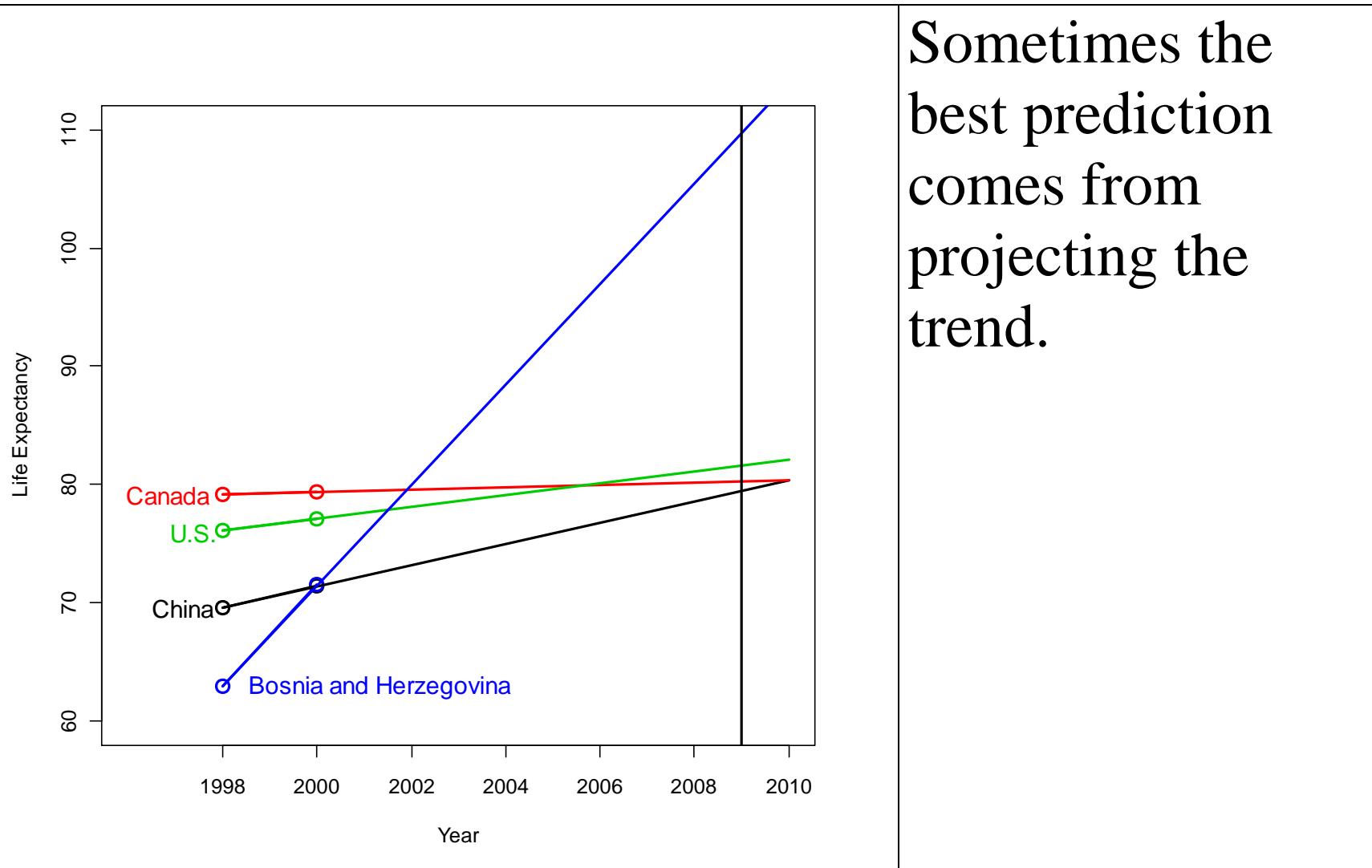




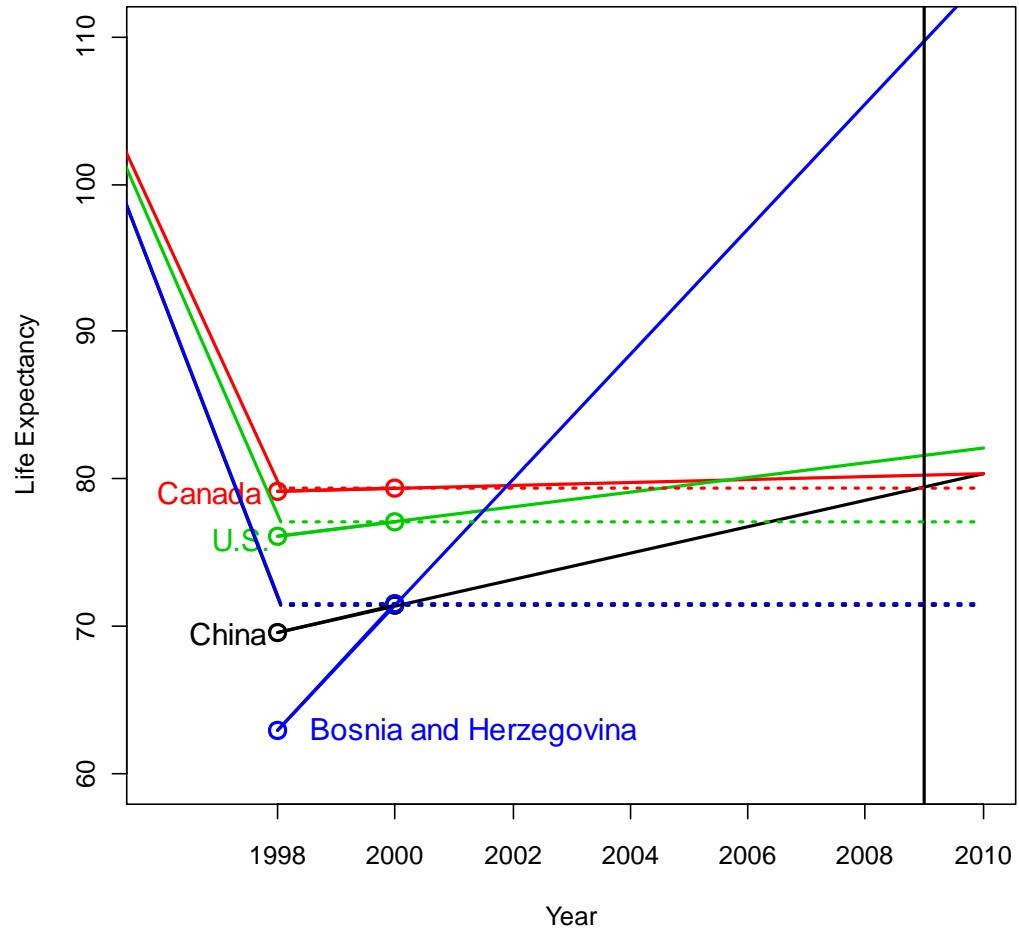
So:

To have a very long life,

move to Bosnia-Herzegovina |



Sometimes the best prediction comes from projecting the trend.



Sometimes the best prediction comes from projecting the trend.

Sometimes you should use the last value.

Usually:
something in between.

Do statistics lie?

OR is it misuse of statistics that lies?

Statistics \neq calculations

Statistics = calculations + statistical reasoning

If you take away reasoning, you're not doing statistics

Statistics is about how NOT TO LIE with data

What do you need to know about Statistics?

How can we help students develop the judgment to assess the information they see every day?

What do you need to know about Statistics?

How can we help students develop the judgment to assess the information they see every day?

What Educated Citizens Should Know About Statistics and Probability



Jessica Utts

American Statistician, 2003

2. SEVEN IMPORTANT TOPICS

There are of course many important topics that need to be discussed in an elementary statistics course. For this article, I have selected seven topics that I have found to be commonly misunderstood by citizens, including the journalists who present statistical studies to the public. In fact researchers themselves, who present their results in journals and at the scientific meetings from which the journalists cull their stories, misunderstand many of these topics. If all students of introductory statistics understood them, there would be much less confusion and misinterpretation related to statistics and probability and findings based on them. In fact the public is often cynical about statistical studies, because these misunderstandings lead to the appearance of a stream of studies with conflicting results. This is particularly

1. When it can be concluded that a relationship is one of cause and effect, and when it cannot, including the difference between randomized experiments and observational studies.
2. The difference between statistical significance and practical importance, especially when using large sample sizes.
3. The difference between finding “no effect” or “no difference” and finding no statistically significant effect or difference, especially when using small sample sizes.
4. Common sources of bias in surveys and experiments, such as poor wording of questions, volunteer response, and socially desirable answers.
5. The idea that coincidences and seemingly very improbable events are not uncommon because there are so many possibilities.

6. “Confusion of the inverse” in which a conditional probability in one direction is confused with the conditional probability in the other direction.

7. Understanding that variability is natural, and that “normal” is not the same as “average.”

Why I like being a statistician:

Why I like being a statistician:



John W. Tukey:

“The best thing about being a statistician is that you get to play in everyone's backyard.”

Some practical advice from a statistician

- A few things I've learned recently

Gambling is good

STRUCK BY LIGHTNING

THE CURIOUS WORLD OF PROBABILITIES

JEFFREY S.
ROSENTHAL

"Highly entertaining."

— Michael Adams, author of *Fire and Ice*



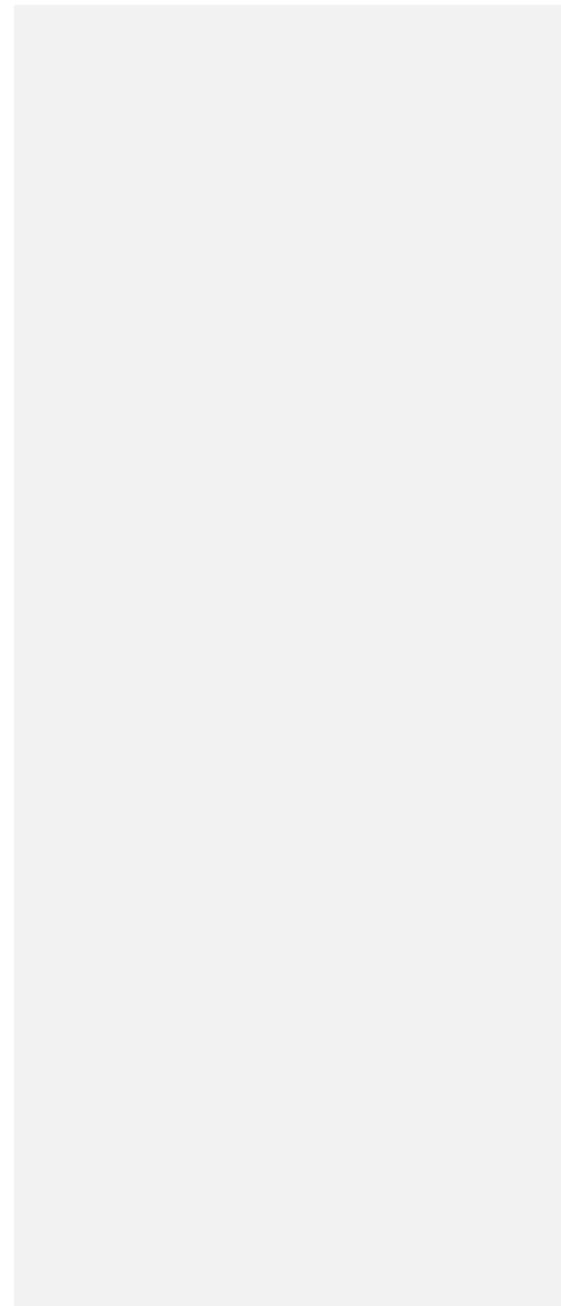
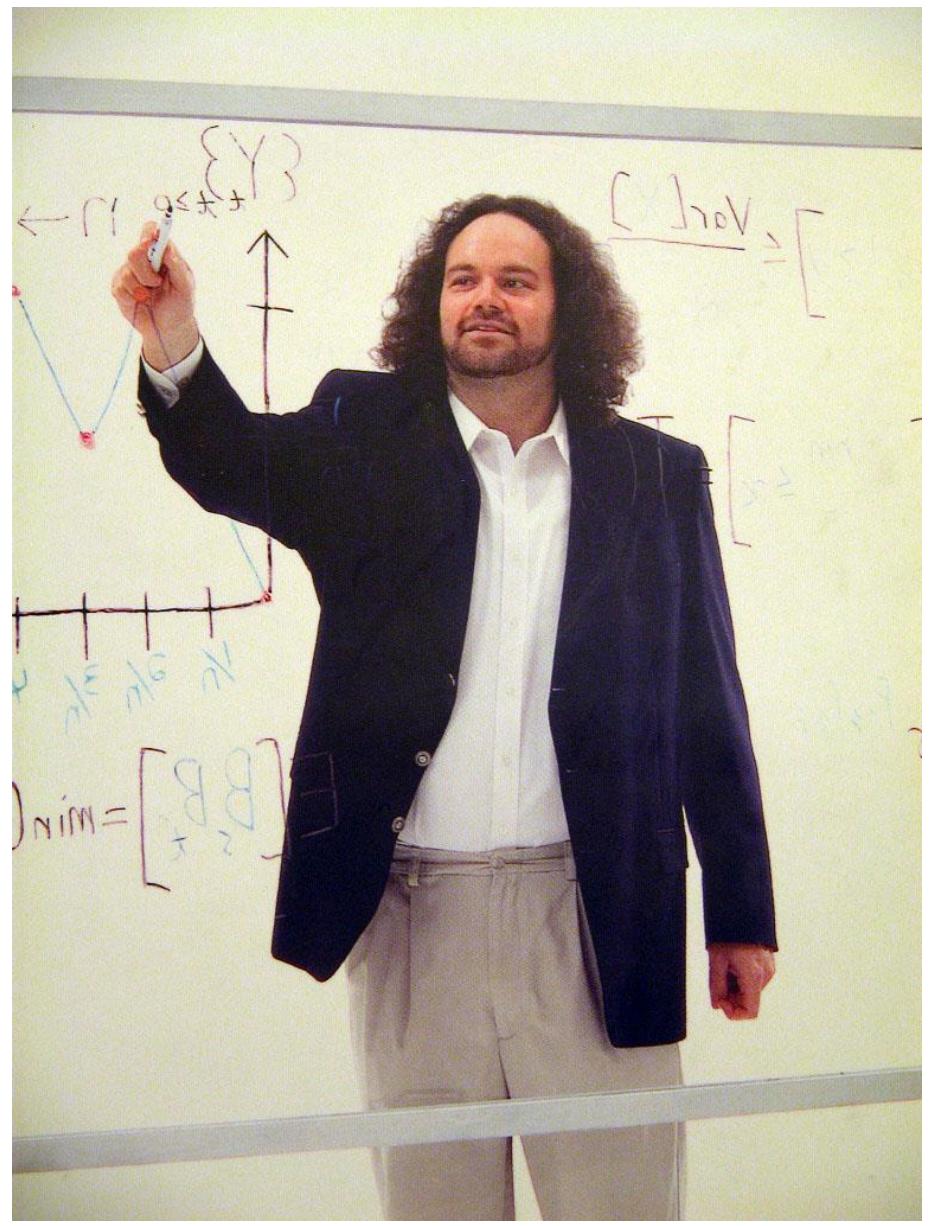


Table 3.5 Average Loss When Betting \$10 at Various Casino Games

Game	Average Loss
Roulette	\$0.526
Keno*	\$2.51
Slot Machines	\$0.50 to \$1.20
Craps	\$0.141
Don't Pass Line	\$0.137

* Specifically, the version of keno described above; others may vary.

Table 3.5 Average Loss When Betting \$10 at Various Casino Games

Game	Average Loss
Roulette	\$0.526
Keno*	\$2.51
Slot Machines	\$0.50 to \$1.20
Craps	\$0.141
Don't Pass Line	\$0.137

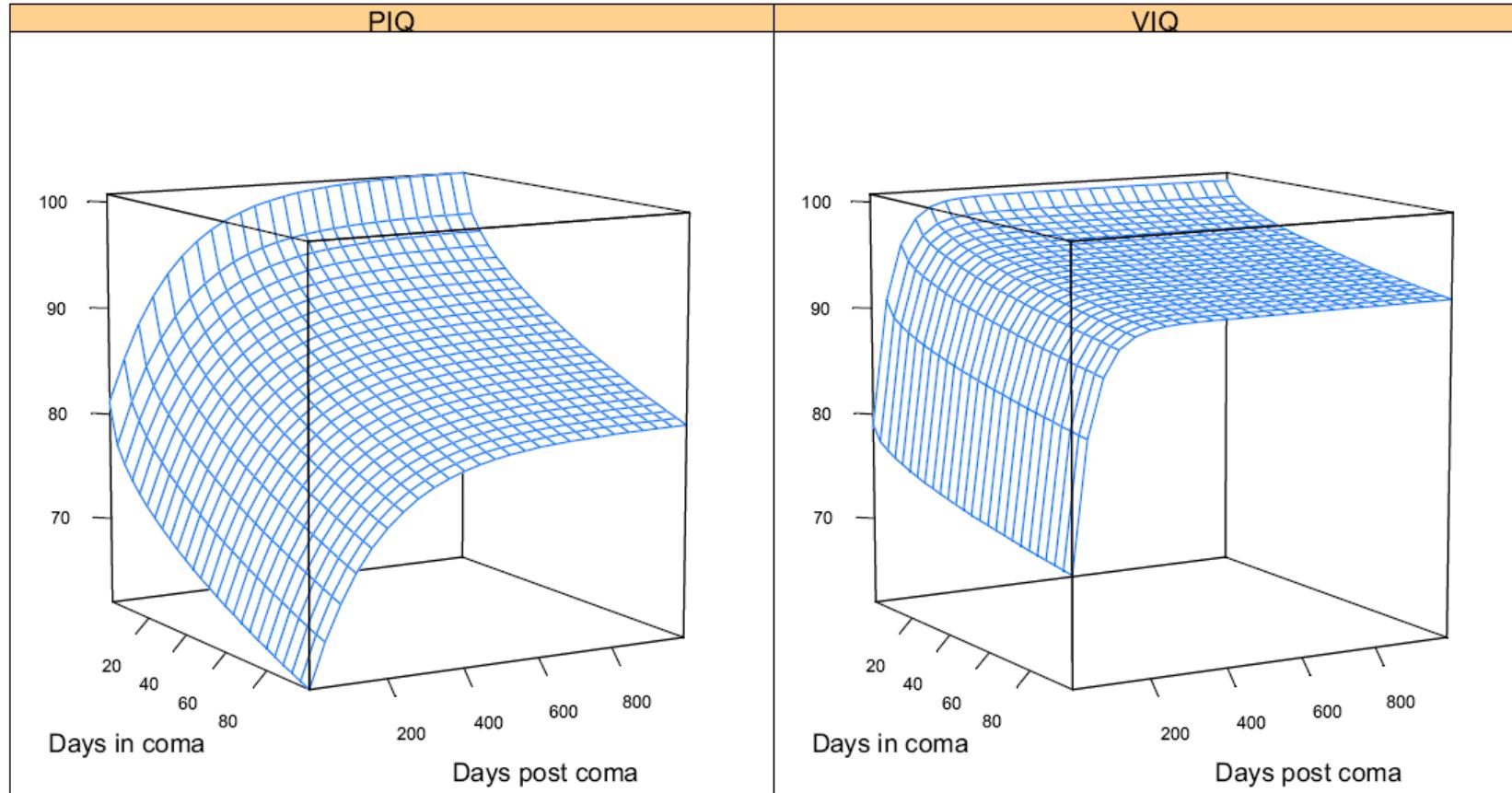
*Specifically, the version of keno described above; others may vary.

Gambling is good
if you own the casino

If you are a mathematician
don't drive a motorcycle.

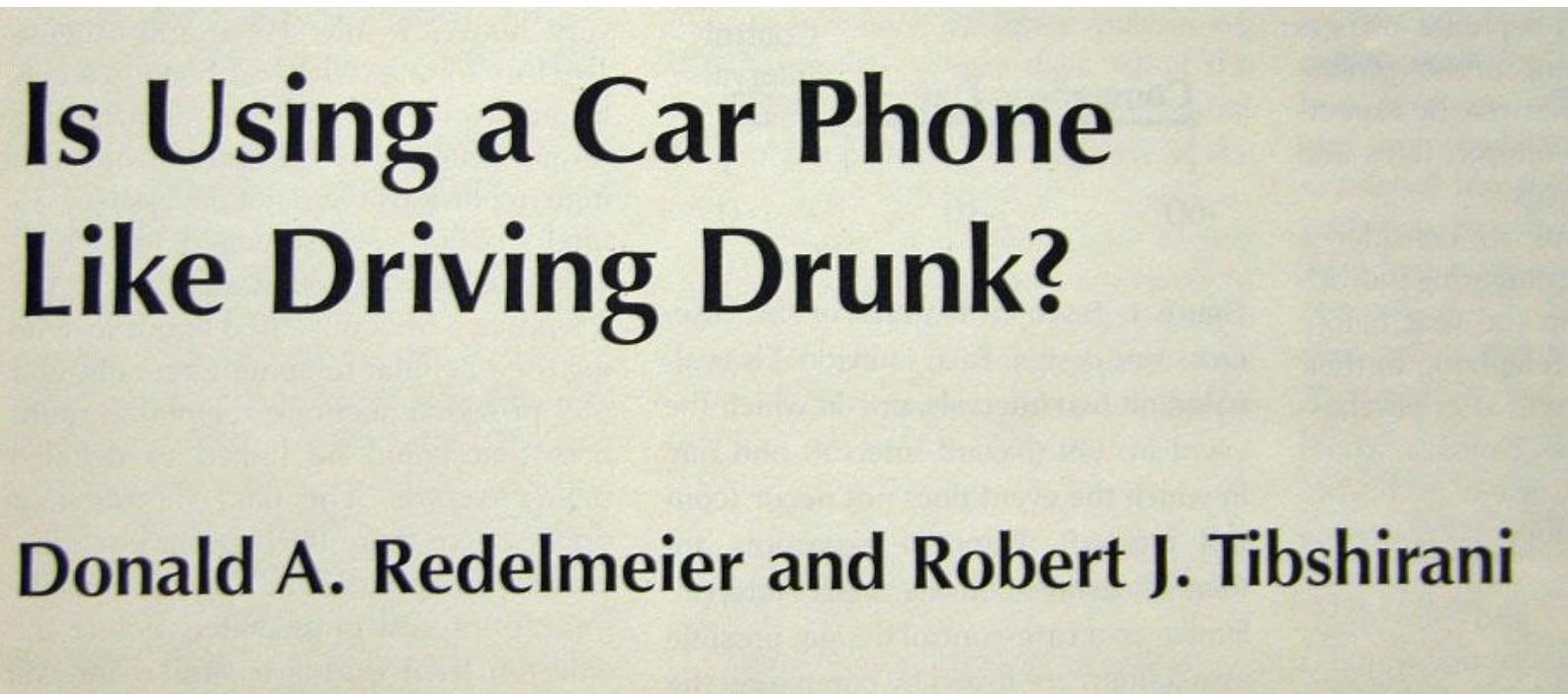
If you are a mathematician
don't drive a motorcycle.

But if you're an english major
it might not be as bad.



Don't use a cell phone
while you drive

Observational data with a very clever analysis:



Is Using a Car Phone Like Driving Drunk?

Donald A. Redelmeier and Robert J. Tibshirani

venues of \$25 million for the Microsoft Corporation) (Value Line Investment Survey 1997; Cellular Telecommunication Industry Association 1996).

We decided to go forward, and our first inclination was to conduct a case-control study. To do so, we planned to survey drivers who had car telephones and drivers who did not and compare the number of collisions each person experienced during a one-year interval. A brief look at the literature, however, revealed that such a study had already been completed in 1978 evaluating an early generation of mobile telephone



(Smith 1978). This survey of 498 individuals found that the overall frequency

of traffic collisions was marginally lower among mobile telephone subscribers than among members of the general public (11% vs. 12%). The difficulty in interpreting these data was the possibility of biases in favor of mobile telephone owners. In particular, prior to the 1990s most mobile telephone owners were young, intelligent urban professionals who would otherwise be expected to have very low collision rates and very safe driving patterns.

Redelmeier and Tibshirani found a clever solution to this problem:

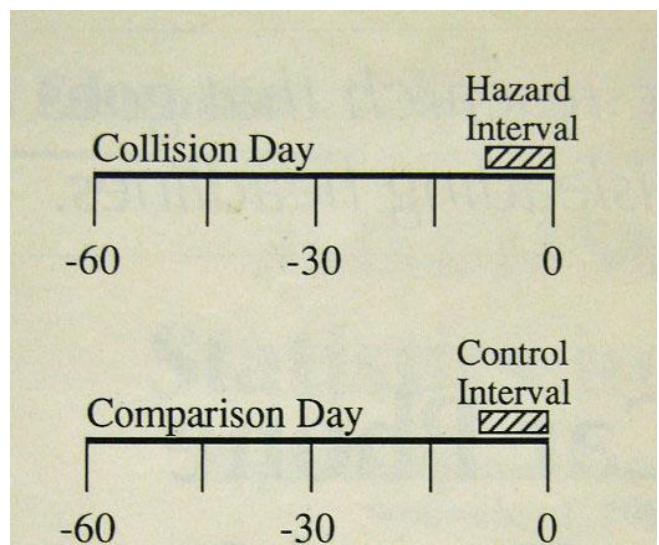


Figure 1. Essential features of the case-crossover design. Each individual is evaluated on two intervals, one in which the event occurs (hazard interval) and one in which the event does not occur (control interval). Potential exposures are then measured during each interval. Similar to a case-control design, possible associations are tested by comparing the exposures in the hazard interval to the exposures in the control interval.

individuals had been the time of the collision. We selected a risk of encouraging, concerns and might be for driving reck.

ch we con an individ- cutive days conditional e have only vehicle at a cutive days alone, we any cellular l interval as therefore, a t a relative lysis would e could not probability ducted our ed in a col- lular tele- ed an esti- of driving

We next considered biases arising from not knowing the precise moment of every collision. We reasoned that individuals might use their cellular telephone immediately after a collision to make an emergency call. It would be a

**The data showed that
drivers were more
likely to have made a
cellular telephone
call during the 10-
minute interval
immediately before
the collision than
during a similar
interval on the day
before the collision...**

blunder to mislabel these calls made

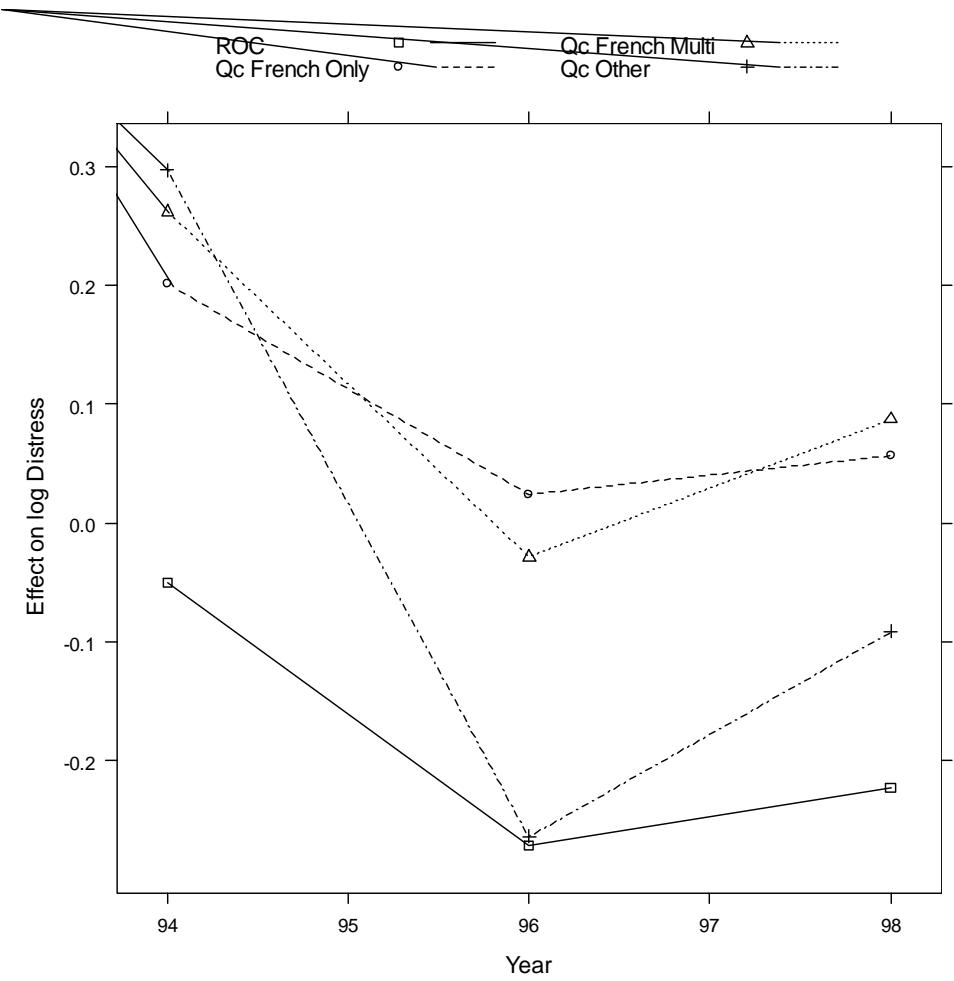
than five tive risk association inexperienced performance who use phone ar This sug telephon advantag factor in tions in a ty. A false could als eral attitu telephon selves to hand-hel

The a implicate their bra with their hearing, voice-act ly availab ated in o safety ac data base telephone relative r

Phoning vs drinking:

Driving with a blood alcohol level at the legal limit is associated with a relative risk of 4 (Simpson 1985), which is about the same as what we found for using a cellular telephone. Driving with a blood alcohol level 50% above the legal limit, however, is associated with a factor of 10 (Simpson 1985). And greater degrees of intoxication must surely be associated with even higher relative risks.

Politics may be
good for your health



Politics may also be bad for your health
depending on where you live, what languages you
speak
and on the outcome of the next referendum

Best and Worst Jobs Overall

The listings below shows the 10 best and worst jobs overall, according to *The 2002 Jobs Rated Almanac*, by Les Krantz (St. Martin's Griffin, 2002)

Low Stress, Autonomy, High Demand Boost Job Ratings, Author Says

"Biologist" is rated the nation's single best job in terms of low stress, high compensation, lots of autonomy, and tremendous hiring demand. Lumberjack was rated the worst job, according to The 2002 Jobs Rated Almanac by Les Krantz.

Biologist displaces financial planner, which was ranked as the nation's best-rated job in 2001, but still makes a strong showing in the No. 3 spot this year. Actuaries, who work autonomously and with little stress helping insurance providers and others determine risk, rose to No. 2. Computer systems analysts and accountants round out the top five.

Although the Monty Python comedy

BEST JOBS
Biologist
Actuary
Financial planner
Computer-systems analyst
Accountant
Software engineer
Meteorologist
Paralegal assistant
Statistician
Astronomer

Doing the Math to Find the Good Jobs

Mathematicians Land Top Spot in New Ranking of Best and Worst Occupations in the U.S.

THE WALL STREET JOURNAL. | CAREERS

By SARAH E. NEEDLEMAN

Nineteen years ago, Jennifer Courier set out on a career path that has since provided her with a steady stream of lucrative, low-stress jobs. Now, her occupation -- mathematician -- has landed at the top spot on a new study ranking the best and worst jobs in the U.S.



"It's a lot more than just some boring subject that everybody has to take in school," says Ms. Courier, a research mathematician at mental images Inc., a maker of 3D-visualization software in San Francisco. "It's the science of problem-solving."

The study, released Tuesday from CareerCast.com, a new job site, evaluates 200 professions to determine the best and worst according to five criteria inherent to every job: environment, income, employment outlook, physical demands and stress. (CareerCast.com is published by Adicio Inc., in which Wall Street Journal owner News Corp. holds a minority stake.)

The findings were compiled by Les Krantz, author of "Jobs Rated Almanac," and are based on data from the U.S. Bureau of Labor Statistics and the Census Bureau, as well as studies from trade associations and Mr. Krantz's own expertise.

Scott Brundage

According to the study, mathematicians fared best in part because they typically work in favorable conditions -- indoors and in places free of toxic fumes or noise -- unlike those toward the bottom of the list like sewage-plant operator, painter and bricklayer. They also aren't expected to do any heavy lifting, crawling or crouching -- attributes associated with occupations such as firefighter, auto mechanic and plumber.

The study also considers pay, which was determined by measuring each job's median income and growth potential. Mathematicians' annual income was pegged at \$94,160, but Ms. Counter, 38, says her salary exceeds that amount.

The Best and Worst Jobs

Of 200 Jobs studied, these came out on top -- and at the bottom:

The Best	The Worst
1. Mathematician	200. Lumberjack
2. Actuary	199. Dairy Farmer
3. Statistician	198. Taxi Driver
4. Biologist	197. Seaman
5. Software Engineer	196. EMT
6. Computer Systems Analyst	195. Roofer
7. Historian	194. Garbage Collector
8. Sociologist	193. Welder
9. Industrial Designer	192. Roustabout
10. Accountant	191. Ironworker
11. Economist	190. Construction Worker
12. Philosopher	189. Mail Carrier
13. Physicist	188. Sheet Metal Worker
14. Parole Officer	187. Auto Mechanic
15. Meteorologist	186. Butcher
16. Medical Laboratory Technician	185. Nuclear Decontamination Tech
17. Paralegal Assistant	184. Nurse (LN)
18. Computer Programmer	183. Painter
19. Motion Picture Editor	182. Child Care Worker
20. Astronomer	181. Firefighter

More on the Methodology

- For methodology info and detailed job descriptions, go to http://careercast.com/jobs/content/JobsRated_Methodology
- See the complete list of job rankings
- Read about the last study of the best and worst jobs.

Her job entails working as part of a virtual team that designs mathematically based computer programs, some of which have been used to make films such as "The Matrix" and "Speed Racer." She telecommutes from her home and rarely works overtime or feels stressed out. "Problem-solving involves a lot of thinking," says Ms. Counter. "I find that calming."

Other jobs at the top of the study's list include actuary, statistician, biologist, software engineer and computer-systems analyst, historian and sociologist.

Update in 2014: <http://blogs.wsj.com/atwork/tag/best-jobs/>

THE WALL STREET JOURNAL. ≡ MANAGEMENT S

At Work 

HIRING B-SCHOOLS OFFICE LIFE MANAGEMENT

HOT TOPICS: WORKING FROM HOME B-SCHOOLS ROBOTS

All posts tagged Best Jobs

1 - 3 of 3

6:00 AM ET
Apr 15, 2014

EMPLOYMENT

The 10 Best Jobs of 2014

By Adam Auriemma

HUMAN RESOURCES

Another day, another reason to get better at math.

BEST JOBS

It's no secret that quantitative skills are in high demand on the job market—one analytics recruiter recently told The Journal that workers who can't crunch numbers may ultimately face a "permanent pink slip."



Lumberjack ranks as 2014's worst job. — Getty Images

CAREERCAST

LUMBERJACK

MATH

SORRY ENGLISH MAJORS-- AGAIN

SE

Below are the best and worst jobs of 2014, according to CareerCast.com. Click [here](#) for the full rankings and [here](#) for details on the methodology.

Best Jobs of 2014 / Midlevel Income

1. Mathematician / \$101,360
2. Tenured University Professor / \$68,970
3. Statistician / \$75,560
4. Actuary / \$93,680
5. Audiologist / \$69,720
6. Dental Hygienist / \$70,210
7. Software Engineer / \$93,350
8. Computer Systems Analyst / \$79,680
9. Occupational Therapist / \$75,400
10. Speech Pathologist / \$69,870

Worst Jobs of 2014 / Midlevel Income

200. Lumberjack / \$24,340
199. Newspaper Reporter / \$37,090
198. Enlisted Military Personnel / \$28,840
197. Taxi Driver / \$22,820
196. Broadcaster / \$55,380
195. Head Cook / \$42,480
194. Flight Attendant / \$37,240
193. Garbage Collector / \$22,970
192. Firefighter / \$45,250
191. Corrections Officer / \$38,970

What Statisticians do:

- Health and Medicine
- Finance, Banking, Insurance
- Business and Industry
- Education
- Government

Health and Medicine

Biostatistics

Clinical Trials

Drug Monitoring

Epidemiology

Genetics

Pharmaceutical research

Public Health

Business and Industry

Actuaries for Insurance and Pensions

Agriculture

Banking: e.g. methods to assess risk

Chemistry

Computer Science

Economics

Finance

Manufacturing

Market Research

Quality Improvement and Reliability

Government:
Statistics Canada
Environment
Forestry
Government Regulation
Law
National Defense
Population Research
Risk Assessment

Notes:

R. A. Fisher and Tobacco:

R. A. Fisher and the Role of a Statistical Consultant

J. H. Bennett

Journal of the Royal Statistical Society. Series A (Statistics in Society), Vol. 154, No. 3 (1991), pp. 443-445
doi:10.2307/2983153

Extracts from R. A. Fisher's letters referring to the responsibilities of statistical consultants are considered along with his view of his own role as a scientific consultant to the Tobacco Manufacturers' Standing Committee in the late 1950s. Contrary to a recent suggestion that Fisher may have been `misrepresenting data on

lung cancer while acting as an adviser to the tobacco industry', his letters show that he was very deeply concerned about the possible misrepresentation to consumers of an alleged statistical result. Further, Fisher believed that it is `only by giving students the opportunity of making fine distinctions in the logic of the subject that they can learn to recognize the difference between honest and dishonest work in statistical practice'.

American Journal of Epidemiology Vol. 133, No. 5: 416-425
Copyright © 1991 by [The Johns Hopkins University School of Hygiene and Public Health](#)

When Genius Errs: R. A. Fisher and the Lung Cancer Controversy

Paul D. Stolley

Clinical Epidemiology Unit, University Pennsylvania School of Medicine 220-L Nursing Education Building, Philadelphia, PA 19104-6095

R. A. Fisher's work on lung cancer and smoking is critically reviewed. The controversy is placed in the context of his career and personality. Although Fisher made invaluable contributions to the field of statistics, his analysis of the causal association between lung cancer and smoking was flawed by an unwillingness to examine the entire body of data available and prematurely drawn conclusions. His views may also have been influenced by personal and professional conflicts, by his work as a consultant to the tobacco industry, and by the fact that he was himself a smoker.

[Text](#)