Why Should We Be Wary of Forecasts?

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What is Statistics?

It is the mark of a truly intelligent person to be moved by statistics. – George Bernard Shaw

Get your facts first, and then you can distort them as much as you please (Facts are stubborn, but statistics are more pliable.) – Mark Twain

Statisticians, like artists, have the bad habit of falling in love with their models. – George Box

What they are saying today…

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Data is king at Amazon. Clickstream and purchase data are the crown jewels at Amazon. - Ronny Kohavi, Amazon.com

I keep saying the sexy job in the next ten years will be statisticians. …The ability to take data—to be able to understand it, to process it, to extract value from it, to visualize it, to communicate it—that's going to be a hugely important skill …

- Hal Varian, Google's Chief Economist

It's more than analyzing numbers, or being a straight statistician. It's about providing insight. Today's data experts need to put numbers in context.

- Kerrie Holley, chief technology officer of IBM worldwide global services

Data-driven predictions can succeed – and they can fail. It is when we deny our role in the process that the odds of failure rise.

– Nate Silver, The Signal and the Noise, 2012, p. 9.

Learning Goals

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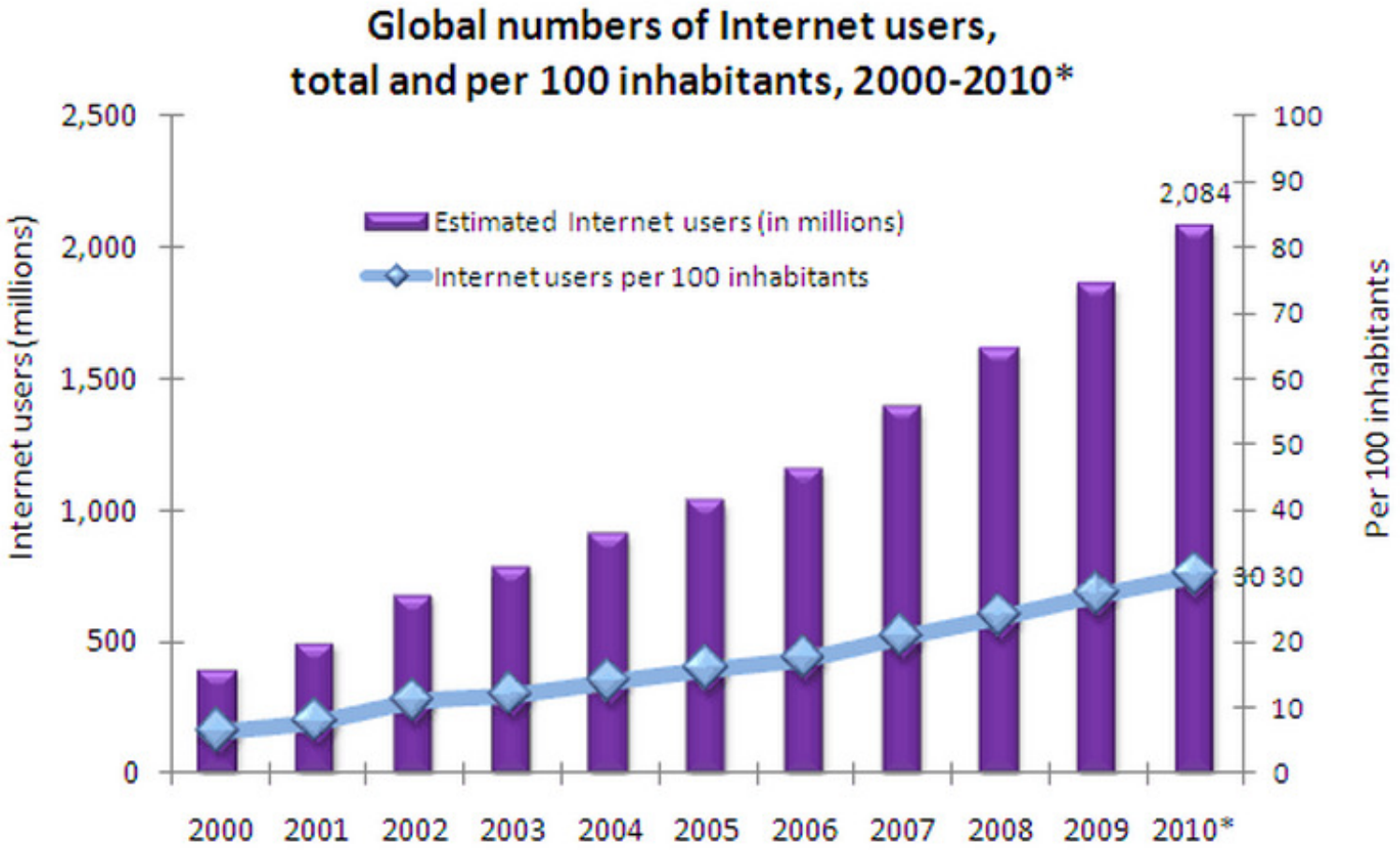
After completing this seminar, you should:

1. Know basics of **data collection**
2. Understand basics of **sampling** and identify sampling errors and biases
3. Identify a **valid survey**
4. Appreciate the **limitations of forecasts**
5. Understand **basic statistical concepts**, such as *independence vs. dependence, normal distribution* and *disaggregated vs. aggregated data, correlation vs. causation, and risk of ignoring data*

1. Data - why so much data?

- microprocessors enabled growth of high-powered, low-cost computing



Data - What are high quality data?

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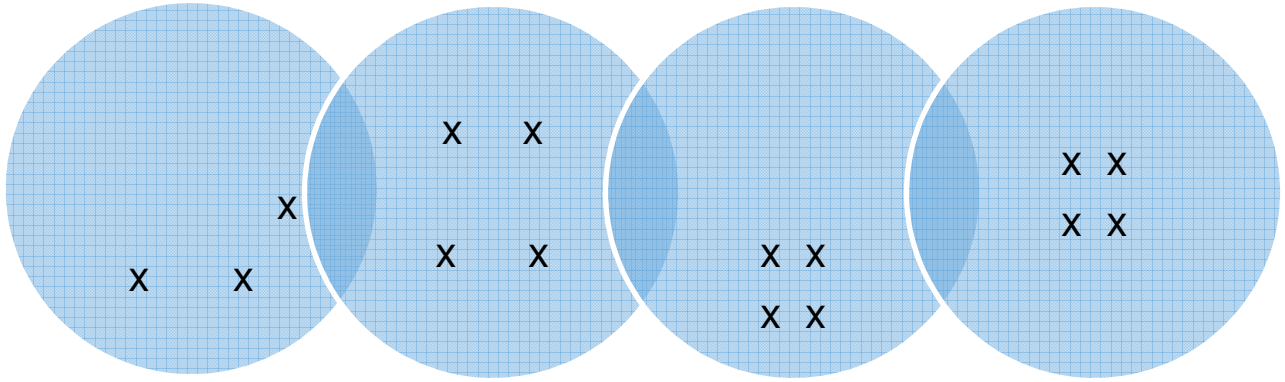
- Accurate
- Reliable/Replicable ➔ Recent Reinhart/Rogoff controversy
- Precise
- Complete
- Timely
- With Integrity
- Respectful of Confidentiality

Source: Global Fund, Monitoring and Evaluation Toolkit, 2009

Data - Precision vs Accuracy

Far better an approximate answer to the right question,…than an exact answer to the wrong question. – John W. Tukey



Data - Types and Collection

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Qualitative vs. Quantitative Data

Indirect vs. Direct Data/Assessment

e.g., student self-perceived learning vs. instructor measured learning

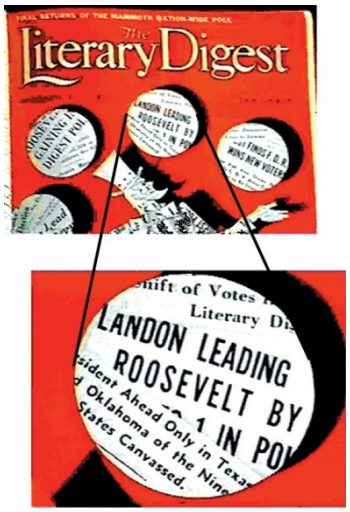
Pre- vs. Post-Data/Measurements

e.g., test results before vs. after intervention/training

Sample vs. Population Data

e.g., test results from a subset of lawyers in Egypt vs. all lawyers in Egypt

2. Sampling - Examples



In 1936, Literary Digest mailed 10 m ballots and received 2.4 m back …results showed Landon would be next president (57% to 43%).

In 1948, all pollsters made same mistake and predicted Dewey the winner.

George Gallup used a different sample of 50,000 to predict FDR the winner (56% to 44%).

Sampling - Basics

How can we avoid the *Digest's* errors? To avoid bias, we make the sample as representative as possible …

- Samples should be **representative** of population you are drawing inferences or conclusions about.
- We should select individuals for the sample *at* random.
- **Randomizing** protects us from the influences of *all* the features of our population, even ones that we may not have thought about. It does that by making sure that *on average* the sample looks like the rest of the population.
- The size of the population doesn't matter at all – in general, the larger the sample, the better.

Sampling - Types

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- Census – sample the entire population
- Simple Random Sample – sample a subset of the population, such that each individual has an equal chance of being in the sample
- Stratified Random Sample – collect random samples within the homogeneous groups (strata)
- Cluster Samples – collect clusters (subsets) at random and conduct a census within each cluster
- Systematic Samples – select individuals in sample systematically; sometimes referred to as quasi-random samples

Source: Business Statistics (2nd Ed), by Sharpe, De Veaux, and Velleman (2012)

3. What makes a Valid Survey?

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- Did they use the right sampling frame? – Have they identified the population of interest and sampled from it appropriately?
- Did they ask specific rather than general questions – Were the questions understood by the respondents? Will the answers be useful?
- Watch for biases – Is nonresponse bias present? Or voluntary response bias? ➔ leads to self-selection bias
- Did they pilot survey – Was it tested on individuals? Are all questions clear? And consistently interpreted?

Source: Business Statistics by Sharpe (2nd Ed), De Veaux, and Velleman (2012)

4. Limitation of Forecasts

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Example: Housing Bubble

Economists underestimated the impact a fall in housing prices would have on an individual's finances

- 2007 > Wall Street Journal economists predicted 38% chance of recession

  > Middle class Americans had more than 65% of their money in their homes

  > non-household wealth (savings, cash, pensions, etc) dropped by 14% for median family since 2001

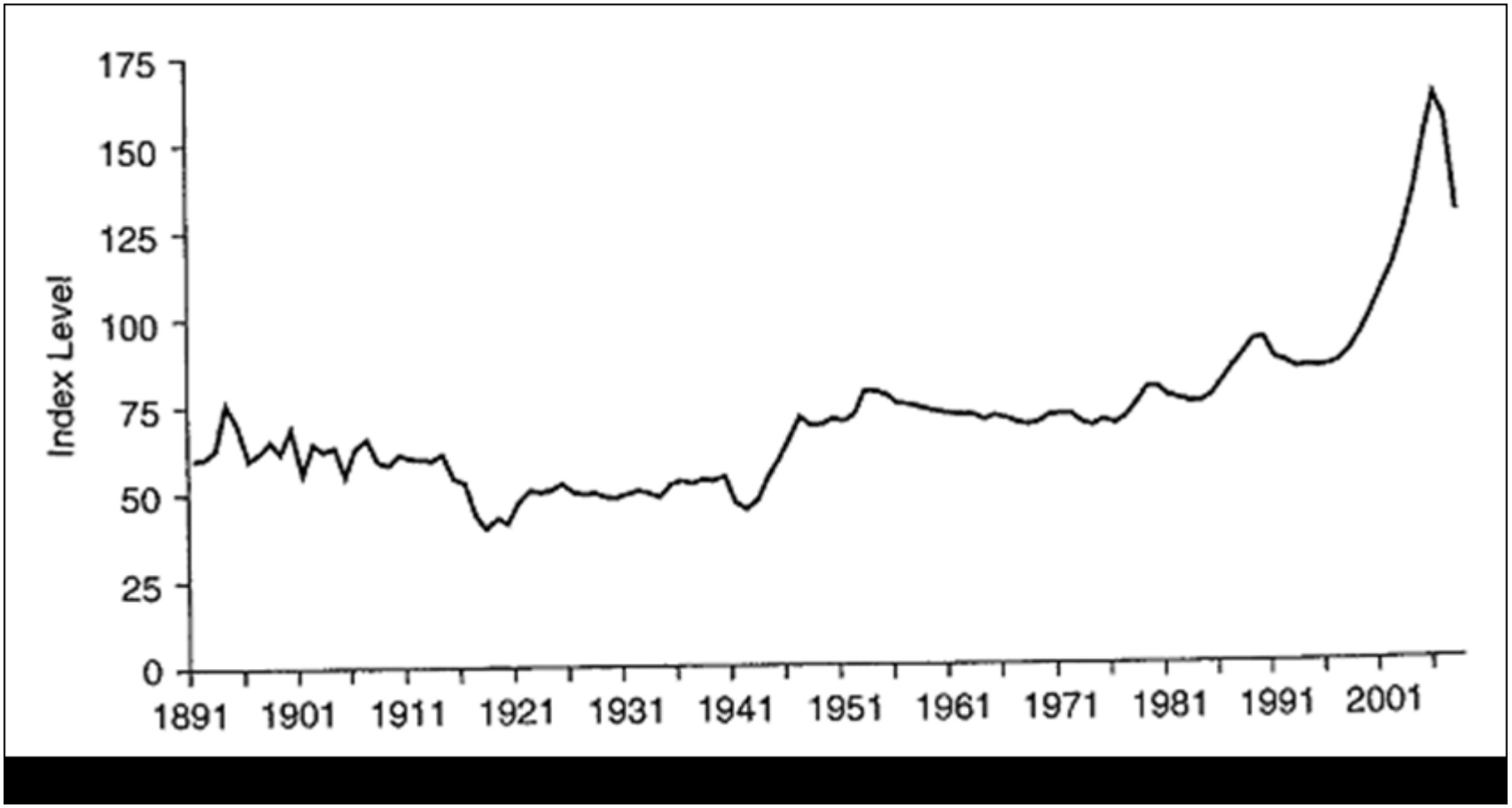
  > Americans were using their household equity as "ATMs"

  > Total volume of trades in mortgage-backed securities was about $80 trillion.

  > Ratings agencies were giving mortgage-backed securities AAA ratings

US Housing Bubble

- Between 1996 and 2006, real housing prices increased around
- 92%{more than 3 times the increase from 1890 to 1996



Source: Reinhart and Rogoff (2010)

Collapse

- Rise in housing prices, mortgage-backed securities, over-leveraged banks, positive feedback loop of home buyers..all led to the collapse
- *Risk* was not assessed accurately
- Rating agencies used data from 1980 to mid-2000s to estimate that the relationship (*Correlation*) among mortgage defaults was low
- …but home prices had steadily increased during the 80s and 90s, so when home prices declined, we had an *Out-of-sample* event
- Moody's focused on *Precision, Not Accuracy* - Moody's was trying to be precise by making detailed forecasts based on economic models – where they should have focused on accuracy…

>> Lehman went bankrupt in Sept., 2008

>> Dow crashed by 500 pts shortly thereafter

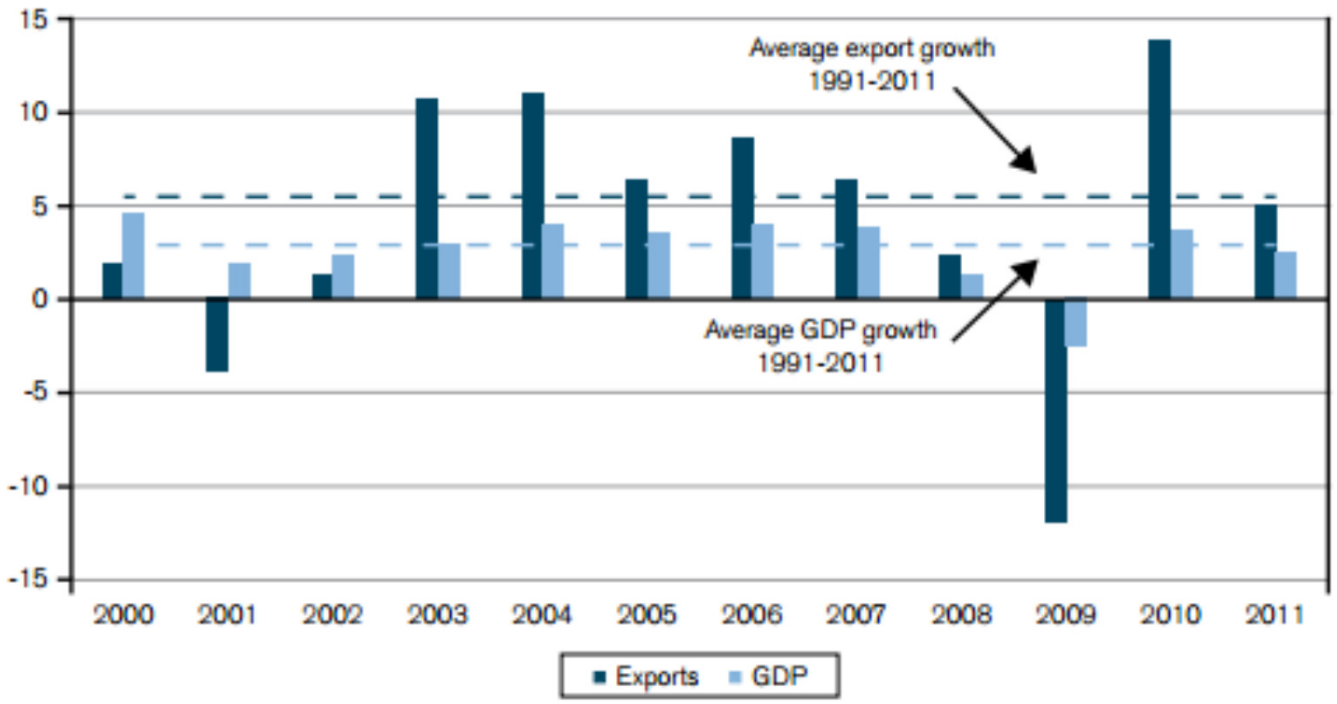
>> Federal Reserve bailed out bear Stearns and AIG

>> Crisis went global

Results of Bad Forecasts - Global Collapse

Global market not only for large firms: 90% of US firms that export employ < 100 people and firms with < 500 employees account for 97% of all US exporters

Figure 1.1: **Growth in volume of world merchandise trade and GDP, 2000-11**
(annual percentage change)



Source: WTO Secretariat.

Results of Bad Forecasts – Global GDP

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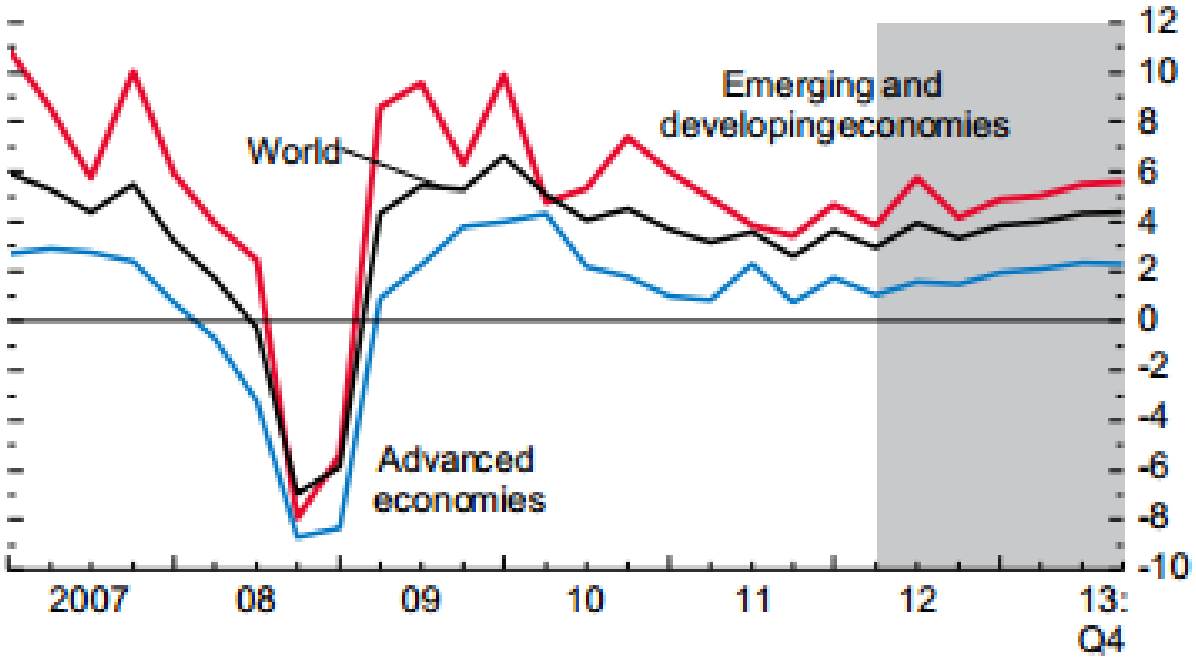
Figure 1. Global GDP Growth
(Percent; quarter over quarter, annualized)



Source: IMF staff estimates.

Political Forecasts

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McLaughlin Group Predictions Analysis*

Completely true	285	39%
Mostly true	53	7%
Partly true/false	57	8%
Mostly false	70	10%
Completely false	268	37%

*Source: The Signal and the Noise, Nate Silver (2012)

➔ Same chance of being right as being wrong

How to avoid poor forecasts?

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1. Think probabilistically – *avoid point estimates*

2. Be willing to revise your forecasts -- "*When the facts change, I change my mind" – John Maynard Keynes*

3. Look for consensus – *consider/apply multiple perspectives or variables*

4. Consider qualitative data – *rating agencies should have considered that different mortgages in the midst of a housing/credit bubble were related to each other*

Source: The Signal and the Noise, Nate Silver (2012)

5. Other Statistical Concepts…

- *Curves… normal distribution*
- *Disaggregated vs. aggregated data*
- *Correlation vs. Causation*
- *Risk of Ignoring Data*

Normal Distribution
…and danger of aggregating data

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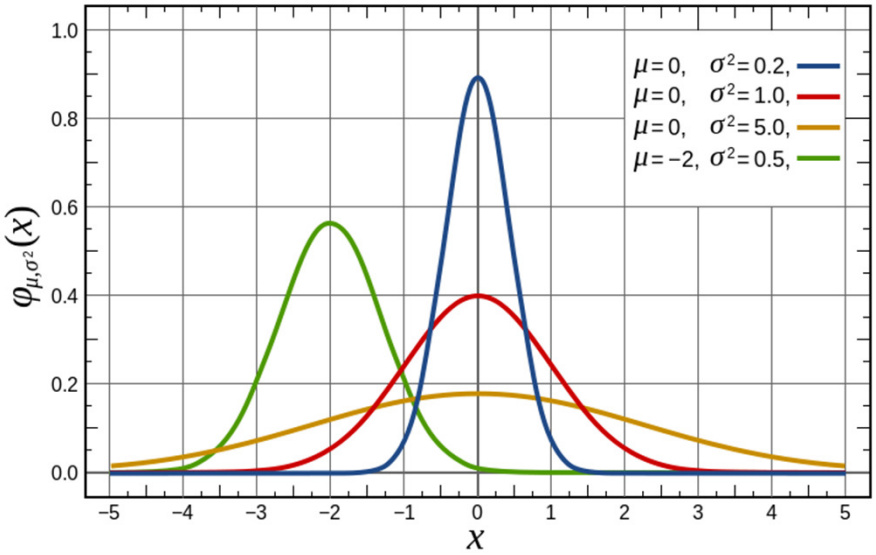
Bill James' Aging Curve for Hitters for the *average* player resembles a *normal distribution*

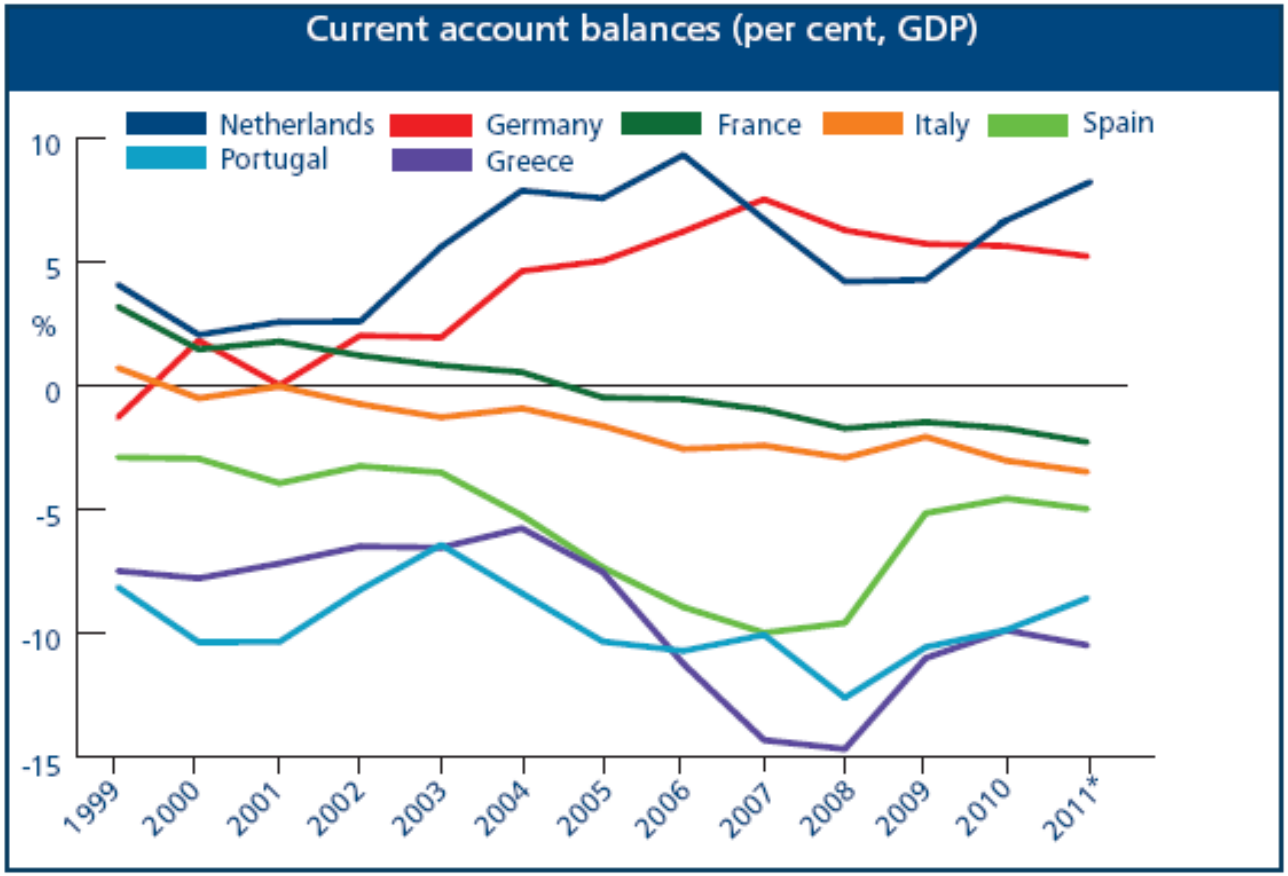


18 20 22 24 26 28 30 32 34 36
years of age

However, players at different positions with different skill sets and different stress actually have different aging curves: i.e., shortstops have different aging curves than right fielders….danger of *aggregating data*

Disaggregating data by country

Normally, exchange rate devaluation could improve competitiveness of countries with current account deficits, but common currency makes devaluation impossible



* *January-June 2011. Source: OECD*

Correlation vs. Causation - Sports Example

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- From Super Bowl I in 1967 to Super Bowl XXXI in 1997, the stock market gained an average of 14% for the year a team from the NFL won …
- …and dropped by nearly 10% when a team from the AFL won

➔During these years the indicator of win/loss had predicted the direction of the stock market in 28 of 31 years – exceeding a standard test of significance…there was only a 1 in 4,700,000 chance the relationship had emerged from random chance alone

➔…eventually, the pattern changed and the relationship has flipped since 1998

…while this apparent relationship/correlation may have been significant, there was certainly no *causal relationship*

Risk of Ignoring Data

- Economic Example:

  > In 2007 Feds predicted growth in GDP and did not predict a recession….however they used data only from the period of "Great Moderation" (1983 – 2006), during which there was little volatility, with two minor recessions….in the end ignoring data prior to 1983 proved to be costly…

- Challenger Example:

  > In 1986 NASA authorized the flight of the Challenger in dangerously cold temperatures…decision-makers ignored the years when the o-rings performed well (warm weather days) in analyzing data…a mistake that also proved to be costly…and since they had never flown in such cold weather before, this was an *out-of-sample* situation

Wrap up – Take Aways

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- It is important to have high quality data (that is replicable)!
- Both qualitative and quantitative data are useful!
- Samples must be representative of population!
- Creating a valid survey is difficult!
- Be wary of forecasts!
- Look out for dependence of variables, aggregated data, and correlations that do not imply causation!

Voluntary Reading

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Blink: The Power of Thinking without Thinking, by Malcolm Gladwell (2005)

Business Statistics, 2nd Edition, by Sharpe, De Veaux, and Velleman (2012)

Freakonomics, by Levitt and Dubner (2005)

Models Behaving Badly: Why Confusing Illusion with Reality can lead to Disaster on Wall Street and in Life, by Emanuel Derman (2011)

Moneyball, Michael Lewis (2004)

Outliers: The Story of Success, by Malcolm Gladwell (2008)

SuperFreakonomics: Global Cooling, Patriotic Prostitutes, and Why Suicide Bombers Should Buy Life Insurance, by Levitt and Dubner (2009)

The Signal and the Noise: Why so Many Predictions Fail – but some Don't, by Nate Silver, The Penguin Press, NY (2012)