Online CDS 101 *Introduction to Computational and Data Sciences*

# What are the computational and data sciences?

Data sampling

# Exploratory analysis to inference

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- If your spoonful comes only from the surface and the salt is collected at the bottom of the pot, what you tasted is probably not representative of the whole pot.
- If you first stir the soup thoroughly before you taste, your spoonful will more likely be representative of the whole pot.

# Populations and samples

**Research question**: Can people become better, more efficient runners on their own, merely by running?


PHYS ED | AUGUST 29, 2012, 12:01 AM | 21 Comments

Finding Your Ideal Running Form

By GRETCHEN REYNOLDS

David De Lossy/Getty Images

Source: http://well.blogs.nytimes.com/2012/08/29/finding-your-ideal-running-form

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*Answer: Adult women, if the data are randomly sampled*

# Anecdotal evidence and early smoking research

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- "Smoking is a complex human behavior [...] confounded by human variability."
- In time researchers were able to examine larger samples of cases (smokers), and trends showing that smoking has negative health impacts became much clearer.

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# Sampling from a population: Census

- Wouldn't it be better to just include everyone and "sample" the entire population?

Source: http://www.npr.org/templates/story/story.php?storyId=125380052

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- Taking a census may be more complex than sampling.

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# Sampling bias

- **Non-response**: If only a small fraction of the randomly sampled people choose to respond to a survey, the sample may no longer be representative of the population.
- **Voluntary response**: Occurs when the sample consists of people who volunteer to respond because they have strong opinions on the issue. Such a sample will also not be representative of the population.

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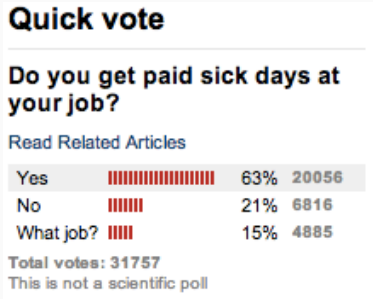


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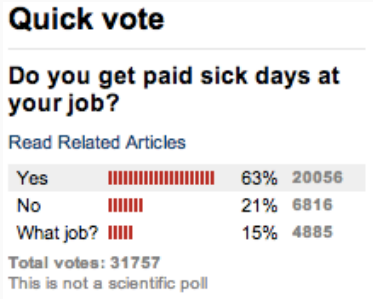


- **Convenience sample**: Individuals who are easily accessible are more likely to be included in the sample.

Source: cnn.com, Jan 14, 2012

# Sampling bias example: Landon vs. FDR

A historical example of a biased sample yielding misleading results:

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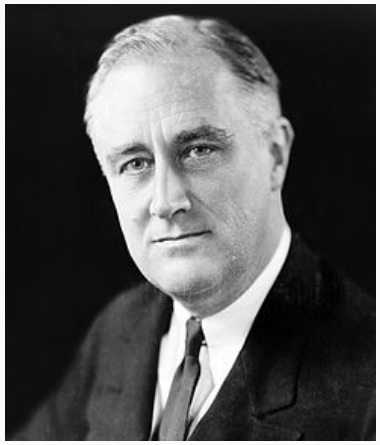

In 1936, Landon sought the Republican presidential nomination opposing the re-election of FDR.

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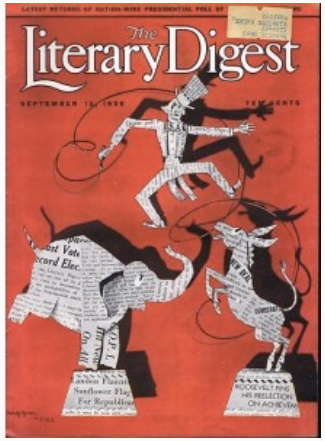


- The magazine was completely discredited because of the poll, and was soon discontinued.

# The Literary Digest Poll - what went wrong?

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These groups had incomes well above the national average of the day (remember, this is Great Depression era) which resulted in lists of voters far more likely to support Republicans than a truly **typical** voter of the time, i.e. the sample was not representative of the American population at the time.

# Large samples are preferable, but...

- The Literary Digest election poll was based on a sample size of 2.4 million, which is huge, but since the sample was **biased**, the sample did not yield an accurate prediction.

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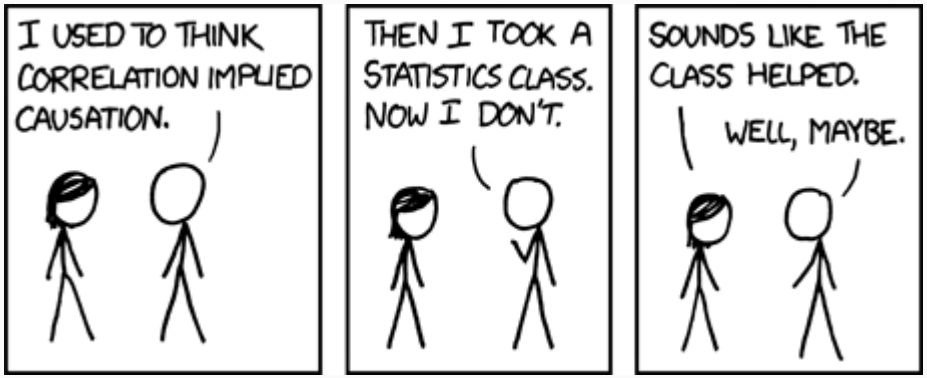
- Back to the soup analogy: If the soup is not well stirred, it doesn't matter how large a spoon you have, it will still not taste right. If the soup is well stirred, a small spoon will suffice to test the soup.

# Correlation does not imply causation




Source: http://xkcd.com/552/

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