Statistical Methods and Data Analysis I
Lecture 10: Sampling Fundamentals

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  - Stir well (*randomize*) before tasting (*sampling*)!

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    - with P_p and P_s denoting the population and sample proportions (e.g., of republican voters in a presidential election) we can construct a *confidence interval*: $\boxed{P_p = P_s \pm \text{"sampling allowance"}}$
    - How tight is the confidence interval? Depends on how sure we want to be (e.g., *"with probability 95%"*), on the *measured* sample proportion P_s, and on the sample size.

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    - Details to follow...

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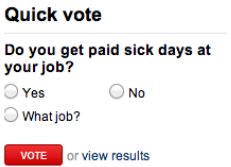
From cnn.com, Jan 14, 2012



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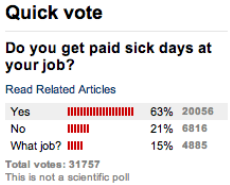

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- *Non-response bias* (also a type of *self-selection bias*):
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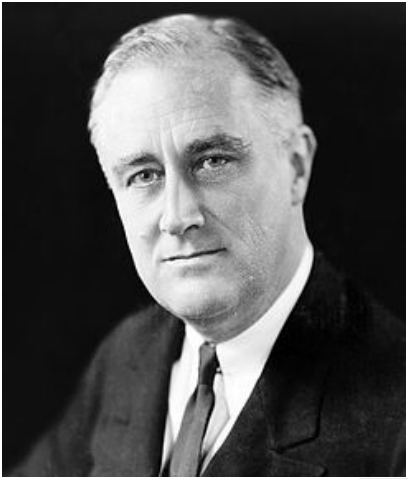
- *Some respondents may lie...*

Election prediction in the past: 1936

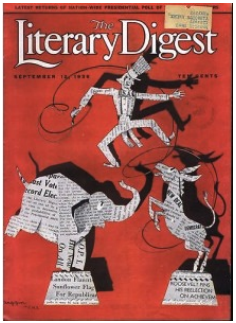
In 1936, Alfred Mossman ("Alf") Landon sought the Republican presidential nomination opposing the re-election of (the Democratic President) Franklin Delano Roosevelt.



The *Literary Digest* Poll

The Poll:

- The *Literary Digest* polled about *10 million* Americans
- About *2.4 million* responded.
- The poll showed that Landon would likely be the overwhelming winner and FDR would get only 43% of the votes.



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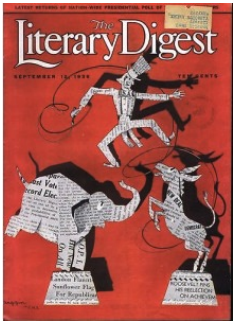

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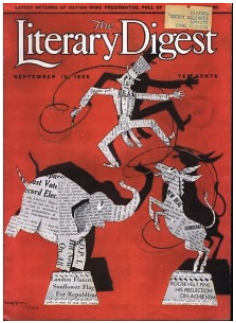

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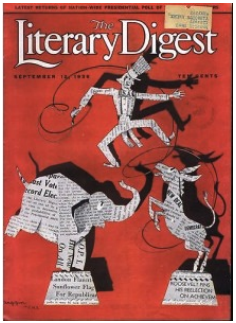

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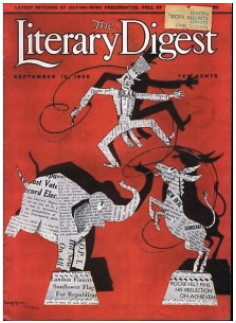

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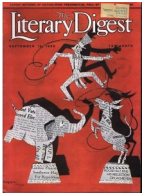
- Hardly anyone remembers Landon's name anymore...

The *Literary Digest* Poll: What Went Wrong?



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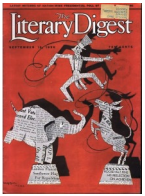

- *Convenience sampling:* the magazine had surveyed
  - its own readers,
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  - registered telephone users.
- *Non-representative sample:*
  - The participants had incomes well above the national average of the day.
  - During the Great Depression era high income individuals were far more likely to support Republicans than a truly *representative* American voter of the time.
- *Self-selection bias:*
  - The 24% who *responded* were even more biased towards the Republican party.
- But the sample was **HUGE**...
  - Doesn't help if it is biased...
  - If your soup is *not* well stirred it does not matter how large a spoon you've got, but if it *is* well stirred a small spoon will suffice.

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- Destructive experiments.
  - Suppose we want to know how durable our product is...
  - We only give a small blood sample for testing...
- A sample may be **more accurate** than a census!
  - E.g., large, but inadequately trained personnel.
  - US Census Bureau: Decennial Census (cf. West Wing S1E6 "Mr. Willis of Ohio") is **less** accurate than the monthly Current Population Survey.

Sampling Frame: Definition and Examples

Sampling frame:

A set or device from which a sample may be obtained.

- Electoral register
- Telephone directory
- Employment records
- Medical files
- Database records
- Manufacturing line
- Systematic measurements
- Events generated by a computer system

Sampling Frames: Requirements

- Must be representative
- Elements must be identifiable for both observation and analysis
- Full coverage
- No duplicates
- No foreign elements
- Must be up-to-date