

# **Making Sense of Statistics**

PHL 328

Critical Thinking  
Distance Delivery

**Critical Thinking**

## **Statistics**

1. *(Used with a singular verb)* The branch of mathematics that deals with the collection, organization, analysis, and interpretation of numerical data. Statistics is especially useful in drawing general conclusions about a set of data from a sample of the data.
2. *(Used with a plural verb)* Numerical data.

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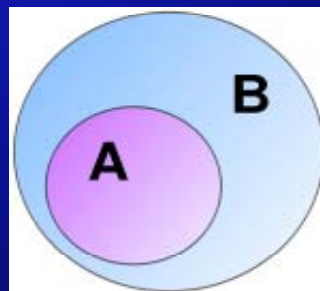
## What Numbers Can Tell Us

- Eastern Oregon University – Fall 08
- Total students – 3,666
- Male – 1,322
- Female – 2,344
- Some questions
  - Why so many more women?
  - Same pattern elsewhere?

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## Samples & Populations

- Populations
  - Groups
  - Sets
  - People
  - Other things
- Samples
  - Part of a group
  - Subsets



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## Samples as Evidence

- Curious about the population
- Population is too big to survey
- The sample has property  $P$
- Why does it have  $P$ ?
- Because the population has  $P$

$e_1$ . Sample has  $P$

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$t_0$ . Population has  $P$

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## Rival Explanations

- Why does the sample have  $P$ ?
- $t_1$ . Fluke: it's just a coincidence that the sample has  $P$
- $t_2$ . Bias: the sample has  $P$  because of the way the sample was chosen
- $t_3$ . The sample has  $P$  for some other reason, but not because the population has  $P$

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## Statistical Significance

- Making the fluke hypothesis unlikely
- Probability theory
- Statistical tests
- Sample size
- Giere's rule of thumb
  - 100 =  $\pm 10\%$
  - 500 =  $\pm 5\%$
  - 2000 =  $\pm 2\%$
  - 10000 =  $\pm 1\%$
- Important footnote

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## D H I L 1 0 1

## Sampling Techniques

- Technical randomness
- Practical randomness
- Polls
  - Phone surveys
  - *Literary Digest* poll
  - 2008 election
- Try to make the population explanation more plausible than the bias rival explanation

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## Naomi Oreskes' Study

- *An Inconvenient Truth*
- "Beyond the Ivory Tower: The Scientific Consensus on Climate Change"
- *Science* 3 December 2004
- The "consensus" opinion
- Institute for Scientific Information (ISI) data base
- 928 papers surveyed
- Keywords: "climate change"
- 10% of the total
- Some articles thrown out

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## Naomi Oreskes' Study

- Six categories
  - explicit endorsement of the consensus position
  - evaluation of impacts
  - mitigation proposals
  - methods
  - paleoclimate analysis
  - rejection of the consensus position
- 75% explicit or implicit endorsement of consensus view (1<sup>st</sup> three categories)
- 25% take no position (next two categories)
- 0% reject consensus position

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## The Evidence

**e<sub>1</sub>.** In a sample of 928 peer reviewed papers addressing “climate change,” not one rejected the consensus view that “most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations”

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**t<sub>0</sub>.** Most, if not all, scientists working on climate change agree with the consensus view.

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## Rival Explanations

**D**

**H**

**I**

**L**

**2**

**0**

**3**

**t<sub>1</sub>.** It’s just a statistical fluke that the articles from the sample showed such unanimity .

**t<sub>2</sub>.** It’s just a statistical fluke that the articles listed in the ICI data base showed such unanimity .

**t<sub>3</sub>.** The ICI data base is biased and only lists “green” articles.

**t<sub>4</sub>.** Oreskey, because of her biases, misinterpreted many of the articles as favorable, or neutral, when in fact the authors were arguing against the consensus view.

**t<sub>5</sub>.** Respectable scientists arguing against the consensus view cannot get their articles published in peer reviewed journals.

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## The Best Explanation?

- Some of the rivals are possible
- The prestige of *Science*
- Oreskey's reputation
- Articles rejecting Oreskey's thesis?
- Giere's rule of thumb
- Censorship in science?
- Simplest, most plausible, explanation of the sample?

Self, World, & God

## A Different Sample

$e_1$ . In a sample of 18% of the articles published in major newspapers on global warming in the past 14 years, over one half gave equal weight to the contentious view, and the rejection of the consensus view.

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$t_0$ . Journalists see the consensus view very controversial.

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