



Statistical Dunkirk



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Statistics in Society

Major Decisions in many areas are guided by Statistics:

- Government
- Corporations
- Medicine
- Science
- Education

Rare Event Rule for Inferential Statistics [5]

If, under a given assumption, the probability of a particular observed event is extremely small, we conclude that the assumption is probably not correct.

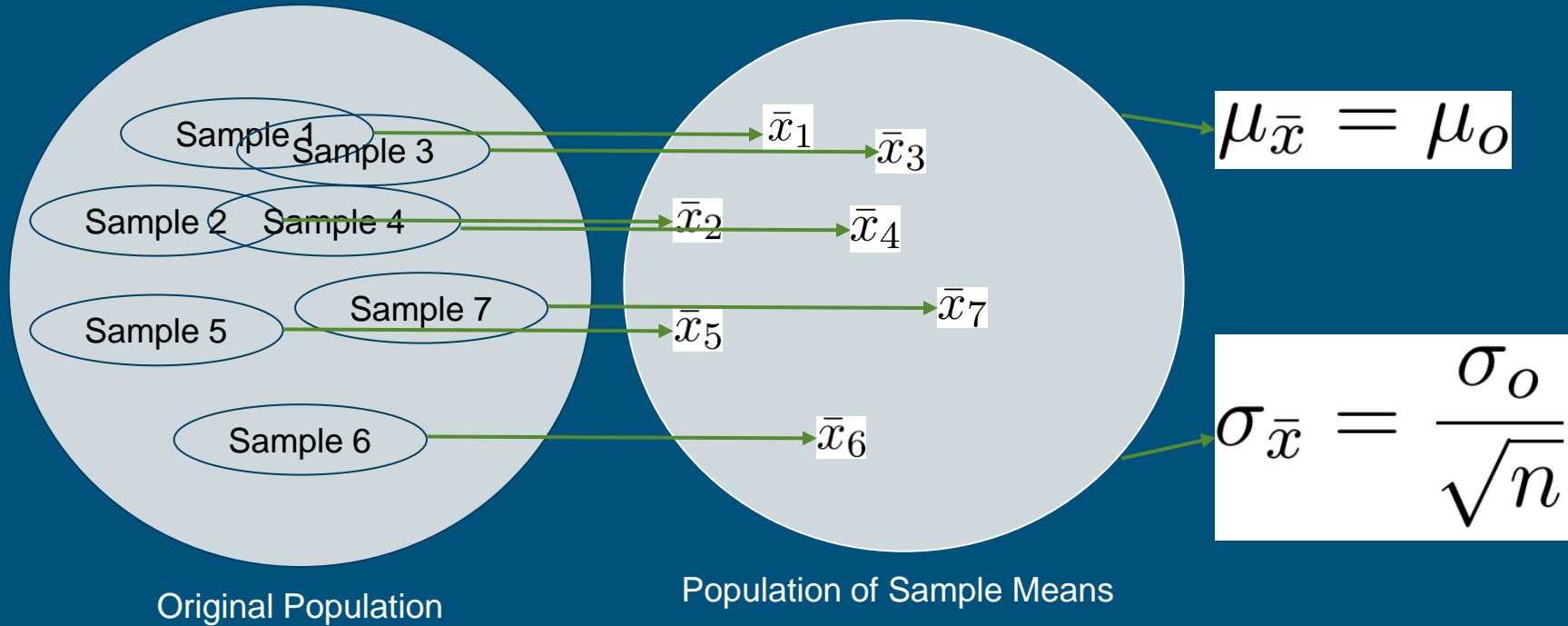
Rare Event Rule for Inferential Statistics

- Key Axiom which distinguishes Statistics from other branches of Mathematics
- Foundation for making decisions based on Statistics
- Takes into account both the outcome and the random chance it can occur
- Allows us to apply the rigour of Mathematics to a world of uncertainty

Central Limit Theorem [5]

For all samples of the same size, n , with $n > 30$, the sampling distribution of \bar{x} can be approximated by a normal distribution with mean μ and standard deviation $\frac{\sigma}{\sqrt{n}}$

Central Limit Theorem



Statistics in Medical Research [3]

- Failure to prove/report that test assumptions are not violated (For T Test)
 - *New England Journal of Medicine*: 16/31 (51.6%)
 - *Nature Medicine*: **13/22 (59.1%)**
- Failure to specify/define all applied statistical tests clearly and correctly
 - *New England Journal of Medicine*: 20/31 (64.5%)
 - *Nature Medicine*: 20/22 (90.9%)

Failure to prove/report that test assumptions are not violated

- Theorems have conditions and conclusions (often formulas)
- If all conditions are not met, then the conclusions are not guaranteed true
- In applied statistics often we can't meet all conditions perfectly, which is fine IF this deficiency is properly addressed

Women at Peak Fertility [2]

- 2013 study in *Psychological Science* by psychologists claim that women at peak fertility are 3 times more likely to wear red or pink shirts than women at other points in their menstrual cycles
- Small Sample Size
 - Self-selected sample of 24 undergraduates
- No Simple Random Sample
- Degrees of freedom on data selection and analysis

Evidence for Extrasensory Perception [2]

- 100 Students participated in a study by social psychologist Daryl Bem, where they were shown images, both non-erotic and erotic.
- Bem et al., claims “anomalous pre-cognitive arousal seconds before image was shown.”
- Attempts at replication failed to show similar results.
- Well accepted practices were employed to find any possible relationship, also known as data fishing.

Zodiac Signs and Health [1]

- A power of 0.05 was used to denote statistical significance.
- The process was repeated until two diagnoses were found for each zodiac sign.
- Increasing interest in data-fishing to find a conclusion with large data sets and no prespecified hypothesis.
- Clinically improbable, yet, significant associations were found between zodiac signs and health.
- Study created to emphasize hazards of testing multiple hypotheses without prespecification.

Need of Statisticians for Peer-Reviewing [4]

- High demand, low supply of Statisticians
- Unpaid Labour of checking
- Lack of time
- Waiving a peer-review due to “author expertise”

Statistics and Curriculum

- USC Undergraduate Program
 - Economics: Econ 317 and Econ 318
 - Econ 317 Elementary statistics for economists
 - Econ 318 Econometrics: Introduction to the application of statistical methods
- USC Masters Program
 - Economics: Econ 513
 - Econ 513 covers the practice of econometrics
- USC Graduate Program
 - Economics: Econ 609 and 611
 - Econ 609 and 611 further explore econometrics and statistics for economists.

Statistics and Curriculum

- UC Berkeley Undergraduate Program
 - Biochemistry and Molecular Biology: Math 10A and 10B
 - Math 10A and 10B covers elementary statistics at best while covering calculus and combinatorics.
 - Integrative Biology
 - Math 10A and 10B
- UC Berkeley Master's Program
 - Endocrinology
 - A course in statistics is recommended, but not required.

Statistics and Curriculum

- Princeton Undergraduate Program
 - Psychology: PSY 251
 - PSY 251 Introduces concepts in quantitative methods including common statistical tests for research to find and evaluate patterns in data.
- Princeton Graduate Program
 - Psychology: PSY 503
 - PSY 503 Quantitative Analysis in Psychological Research. Statistical reasoning and common used techniques.

Two statistics classes required to earn a Ph.D in Psychology.

Statistics and Curriculum

- UCSC Undergraduate Program
 - Sociology: SOCY 3B
 - SOCY 3B Statistical Methods. Introduces inferential and descriptive statistics. Basic understanding of probability distributions, sampling, and testing.
- UCSC Graduate Program
 - Sociology: SOCY 204 OPTIONAL
 - SOCY 204 Methods of Quantitative Data. Using statistics to answer sociological questions.

One statistics class required to earn a Ph.D in Sociology.

Bibliography

1. Peter C. Austin, Janet E. Hux, David N. Juurlink, Muhammad M. Mamdani. Testing multiple statistical hypotheses resulted in spurious associations: a study of astrological signs and health. *Journal of Clinical Epidemiology*. 59. 2006.
2. Andrew Gelman, Eric Loken. The Statistical Crisis in Science. *American Scientist*. November-December 2014.
3. Gerhard Marinell, Karl P Pfeiffer, Alexander M Strasak, Hanno Ulmer, Qamruz Zaman. The Use of Statistics in Medical Research. *The American Statistician*. 61:1, 47-55. 2007.
4. David Ozonoff. Quality and Value: Statistics in Peer Review. *Nature*. 2006.
5. Mario Triola. *Elementary Statistics*. 12th edition. 2014