

Confidence Intervals

Review

Standard error

- SE (of something), SD(of something)
Typically reserve SE for SD of a “statistic” computed from data
- “Magic formula” $SE(\text{avg of } n \text{ items}) = SD(1 \text{ item}) / \sqrt{n}$
- Less variation among averages than among individuals
- Estimating SE using n adjustment from SD of data

Using control charts

- Limits for tracking the SD of the process
- Importance of tracking both the mean and SD

Decision rules

- Decide between alternatives based on observed sample characteristic.
- Alternatives were simple, only two possible states of nature.
- Required careful analysis of opportunity costs, historical precedents.

Administrative Details

Reading

- Freedman et al. stories are great (polling, Ch 19 onward)

Assignment, Cases

- Need to do statistics in order to learn statistics.

Key Application for Today

Making statements about a process or population

- Parameter of population versus statistic from sample
- Revealing uncertainty/precision in sample statistics
- What is the process mean?
- What % will vote for candidate?

Definitions and Concepts

Confidence interval for the mean (p 95)

- Feasible range for the population mean, set of “plausible” values
- Found by “inversion” of probability statement.
Initial statement arises from: normality and knowing SE
- Chance for error and the confidence coefficient (95%)
- Effects of data variation and sample size
- Trade-off: length versus level of confidence

Role of assumptions

- Conclusions only as valid as the assumptions we use.

Features of all confidence intervals we’ll use

- Standard error: the standard deviation of our “estimator”
- Use of empirical rule is helped by the central limit theorem.
- Intervals have the form
(estimate of population value) \pm 2 SE(estimate)

Complementary idea... hypothesis testing

- Measure the number of standard errors away from some contemplated value (most often, the distance away from zero)
- CI gives “yes” or “no” answer for many values, whereas a “test” gives numerical measure for one.

Discussion

Relationship of tests to confidence intervals

- Confidence interval indicates plausible region for the population value. Plausible values are those within 2 SEs of observed statistic. Gives a yes/no answer to the question “Is the mean 50?” (e.g.)
- Testing a hypothesis
Reject all hypothesized values more than 2 SEs from the observed statistic.
- P-value enhances the testing procedure: $p < 0.05$ iff outside CI. Rather than just yes/no, the p-value quantifies how far from the null value.

Examples for Today

Interval estimates of the process mean (p 97)

- What can be said about the mean of this production process?
Might it be as small as 812 mils?
- Standard error suggests plausible range with high probability.
- “Inversion” gives a confidence interval for μ .
- Factors affecting length of confidence interval
 - process variation
 - sample size
 - level of confidence (confidence coefficient)
- Interpretation of confidence coefficient
- Review of needed assumptions (p 102)
 - independence
 - constant variance
 - normality

Purchases of consumer goods (p 104)

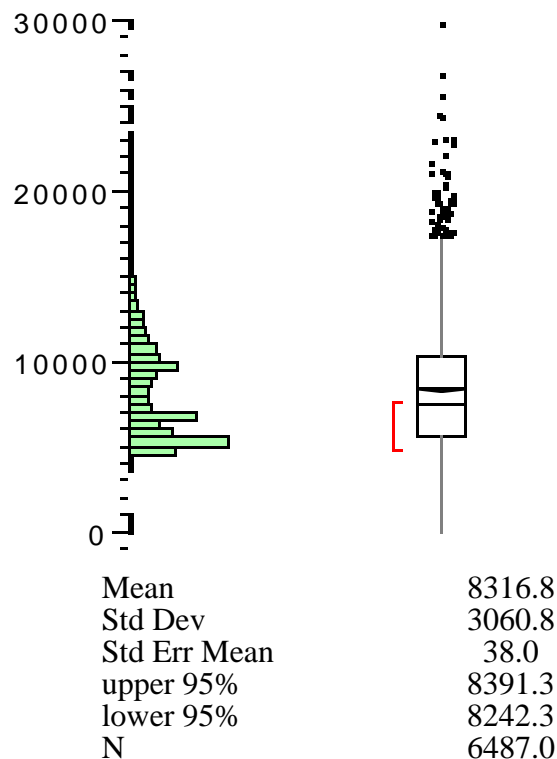
- What proportion of households will purchase a computer next year?
- Intent versus action
- Intervals for proportions
- Can get SE for proportion from JMP-IN output.
- "Dummy variable" coding of No/Yes data as zeros and ones.
- Average of 0/1 data *is* the sample proportion.

Another Example of Confidence Intervals

Credit card balances (see my web page)

- "Population" of 10,000 accounts (some have missing data)
 - 6487 observed in first month
- Finite population adjustments (see supplemental class notes)
- Data is not normal, and rather skewed instead.

"Population"



Confidence interval of a sample

- Take a sample from this “population” (say 5%)
 - Use the JMP random subset command
 - Pretend that this subset/sample is all that was observed.

Your credit department is considering purchasing a credit product from another company. You are negotiating the agreement under the assumption that the average balance is \$8,000 or more. Does the sample suggest that the average balance is this large?

- Compute the confidence interval from this subset
 - Why is the interval so long?
- Does the confidence interval cover the true population mean value?

Consequences

- What risks do we take?
 - If we conclude $\mu < 8000$ and it is in fact more.
 - If we conclude that $\mu \geq 8000$ and it is in fact less.