Brief, but Complete, Summaries

BIOS 6611

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Week 1

Clear Presentation of Results

- It is important to clearly present your results so that future audiences will be able to interpret and utilize your findings
- Unfortunately there is a lot of heterogeneity in the presentation of results
- This slide deck will introduce a brief, but complete, approach to summarizing results we will use throughout the semester

What to include in a complete response?

A complete interpretation of study results includes four elements:

1. A point estimate (observed magnitude of effect)
2. An interval estimate (range of true values that are consistent with the experimental results)
3. A decision (fail to reject or reject the null hypothesis)
4. A measure of uncertainty in the decision (p-value)

Example with One-Sample t-test

Ten runners have completed 4 weeks of a new training program to improve their mile time. The researcher records the change from their baseline mile time in seconds and conducts a one-sample t-test:

```
res <- t.test( x=c(-20,-15,-13,-12,-8,-6,-3,0,5,7))
res
```

```
##
##  One Sample t-test
##
## data:  c(-20, -15, -13, -12, -8, -6, -3, 0, 5, 7)
## t = -2.3332, df = 9, p-value = 0.04451
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -12.8020918  -0.1979082
## sample estimates:
## mean of x
##      -6.5
```

One-Sample t-test: Point and Interval Estimates

From the output on the previous slide, the **point estimate** was -6.5 seconds.

Interpretation: On average, after 4 weeks of the new training program the time to complete a mile run decreased by 6.5 seconds.

For our **interval estimate** we can use the 95% confidence interval of (-12.8, -0.2) seconds.

Interpretation: We are 95% confident that the time required to complete a mile run decreases by between 0.2 and 12.8 seconds after 4 weeks of training.

One-Sample t-test: Decision

For our one-sample t-test we will use the reference value of $\mu = 0$ for our null hypothesis.

- In other words, $H_0 : \mu = 0$ versus $H_1 : \mu \neq 0$.
- From our output, we see that $t_{df=9} = -2.3332$, which corresponds to $p = 0.045$.

Interpretation: A true mean of no change is not consistent with our observed mean change since our t-statistic is more extreme than our critical value ($t_{9,0.025}$ = -2.2622). We thus **reject the null hypothesis** and conclude that the mean change after 4 weeks of training is not zero.

One-Sample t-test: Uncertainty

Related to the decision rule, the p-value in our example quantifies the uncertainty in our decision. From our one-sample t-test we observed 0.045.

Interpretation: If the null hypothesis is true and there is no change in time to complete a mile run (i.e., $\mu = 0$), then the probability of observing our change of -6.5 seconds or something more extreme is less than 0.045.

One-Sample t-test: Summary (All 4 Components Together)

Based on the four components, we can usually tie the information together in one or two short sentences:

There is a significant change **{decision}** in the time it takes to complete a mile run after four weeks of training (p=0.045) **{uncertainty}**. On average, the time required to complete a mile run decreases by 6.5 seconds **{point estimate}** (95% CI: 0.2 to 12.8 seconds) **{interval estimate}** after the training program.

When to use the complete summary?

- Whenever you can!
- Some statistical methods may not have all components as easily represented and you may either need to find substitutes (e.g., standard deviation/error in place of confidence intervals) or make note that it isn't available.