Types of Statistical Inference

Single categorical variable

One-proportion z-interval and test (Chapters 19-21)

Single quantitative variable

One sample t-interval and test (Chapter 23)

Two quantitative variables

Regression inference (Chapter 27)

Two categorical variables

Two categories each:
Two proportion z-interval and test (Chapter 22)

More than two categories each:
Chi-square tests (Chapter 26)

One categorical, one quantitative variable

Two categories:
2-sample t-interval and test (Chapter 24)
Paired t-interval and test (Chapter 25)

More than two categories:
ANOVA test (Chapter 28)

Confidence intervals (2 sample t-intervals)

observed value $\pm$ (critical value)(standard error)

$$(\bar{y}_1 - \bar{y}_2) \pm t^* SE(\bar{y}_1 - \bar{y}_2) \quad \text{or} \quad (\bar{y}_1 - \bar{y}_2) \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

The critical value t^* depends on the level of confidence (e.g. 95%) and the degrees of freedom df.

Degrees of freedom

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1 - 1}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2 - 1}\left(\frac{s_2^2}{n_2}\right)^2}$$

or underestimate $df = (smaller\ sample\ size) - 1$

The standard error formula again comes from the formula for the standard deviation of a difference between two random variables

$$\sqrt{SD(X)^2 + SD(Y)^2}$$

Hypothesis tests (two-sample t-tests)

$$t = \frac{\text{observed} - \text{expected}}{\text{standard error}}$$

1. State the null and alternative hypotheses.
   The null hypothesis is always $H_0: \mu_1 = \mu_2$ i.e. $\mu_1 - \mu_2 = 0$.
   The alternative is $H_A: \mu_1 \neq \mu_2$ or $H_A: \mu_1 < \mu_2$ or $H_A: \mu_1 > \mu_2$. (Pick one.)
2. Find the t-score of the sample using the null hypothesis.
3. Convert the t-score to a P–value.
4. Compare the P-value to α=.05.
5. Retain the null if the P-value is greater than α, and reject the null hypothesis if the P-value is less than α. Report the P-value of the test.

$$t = \frac{(\bar{y}_1 - \bar{y}_2) - 0}{SE(\mu_1 - \mu_2)}$$

$$t = \frac{(\bar{y}_1 - \bar{y}_2) - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$