

# Midterm 2 (L10-L18) Review

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- This week's office hours: 3-5pm Wednesday at R1475 MSC.
- Midterm 2 will **NOT** cover bootstrap, power calculation, but you need understand the concept of power.

- When using  $\bar{X}$  to estimate  $\mu$ , if the  $X_i$  are normal and  $\sigma$  is known, or  $n$  is large enough for the CLT to work, then a  $100(1 - \alpha)\%$  CI for  $\mu$  is given by:

$$\bar{X} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}.$$

- When using  $\bar{X}$  to estimate  $\mu$ , if the  $X_i$  are normal,  $\sigma$  is unknown, and the sample size is small, then a  $100(1 - \alpha)\%$  CI for  $\mu$  is given by:

$$\bar{X} \pm t_{(n-1, \alpha/2)} \frac{S}{\sqrt{n}}.$$

- If  $n\pi > 5$  and  $n(1 - \pi) > 5$ , an approximate  $100(1 - \alpha)\%$  CI for  $\pi$  would be of the form:

$$P \pm z_{\alpha/2} \sqrt{\frac{P(1-P)}{n}}.$$

When the data is drawn from a population that has a normal distribution and  $\sigma$  is unknown, use a t-test. To test:

$$H_0 : \mu = \mu_0$$

$$H_A : \mu \neq \mu_0$$

at the significance level  $\alpha$ , based on a sample of size  $n$ , use one of the following methods:

- Using the rejection region method, determine the value  $t_{(n-1, \alpha/2)}$ , then compute  $t_{obs} = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}}$ . Reject the null if  $t_{obs} < -t_{(n-1, \alpha/2)}$  or  $t_{obs} > t_{(n-1, \alpha/2)}$ .
- Using the p-value method, compute

$$p\text{-value} = P(t_{(n-1)} < -|t_{obs}|) + P(t_{(n-1)} > |t_{obs}|).$$

Reject if  $p\text{-value} < \alpha$ .

When the data is not normal and  $n$  is too small to use the CLT, use sign test to test the population median.

If  $M$  is the population median, test:

$$H_0 : M = M_0$$

$$H_A : M > M_0$$

by computing  $b$  = the number of observations strictly larger than  $M_0$ . If any observations are equal to  $M_0$ , remove them. The p-value is then  $P(B \geq b)$ , where  $B \sim \text{Bin}(n, 0.5)$ .

When making a test about population proportion  $\pi$  based on a sample of size  $n$ , if  $n(\pi_0) > 5$  and  $n(1 - \pi_0) > 5$ , then test:

$$H_0 : \pi = \pi_0$$

$$H_A : \pi \neq \pi_0.$$

by computing the sample proportion  $p$ , and then finding:

$$Z_{obs} = \frac{(p - \pi_0)}{\sqrt{\frac{\pi_0(1 - \pi_0)}{n}}}.$$

Then the p-value is  $P(Z < -|z_{obs}|) + P(Z > |z_{obs}|)$ . Reject if p-value  $< \alpha$ .



See problems from the Midterm 2 practice.