

STAT324 Midterm 2 (L8-L18) Review

<https://dzwang91.github.io/stat324/>



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- This week's office hours: 2-4pm Wednesday at R1475 MSC.
- This week's discussion: TAs will go through the practice problems
- 6 big problems:
 - Problem 1-3: several MC. Either circle the **BEST** answer or circle **ALL** correct answers.
 - Problem 4-6: Show all your work.



- What is t distribution? What is the shape of t distribution?
- How can we characterize a specific t distribution? Which parameter do we use?
- How can we use t table?
- What is the distribution of $\frac{\bar{X}-\mu}{S/\sqrt{n}}$ where $\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$, $X_i \sim N(\mu, \sigma^2)$ i.i.d. and S is the sample standard deviation.



- How can we interpret a 95% confidence interval?
- How can we build a confidence interval for μ when σ is known and σ is unknown?
- How can we determine the required sample size to achieve certain confidence level?
- What is the approximate distribution of sample proportion?
- How can we make a confidence interval for population proportion?
What is the assumption we need to check?
- What is the idea of using Bootstrap method to build confidence interval?



- What is null hypothesis? What is alternative hypothesis?
- What is type I error?
- What is type II error?
- What is the relationship between type I error and type II error for fixed sample size?
- How can we reduce type I error or type II error?
- What is power?
- How can we increase power?
- What is p-value?
- What are two methods to make a conclusion in hypothesis testing?



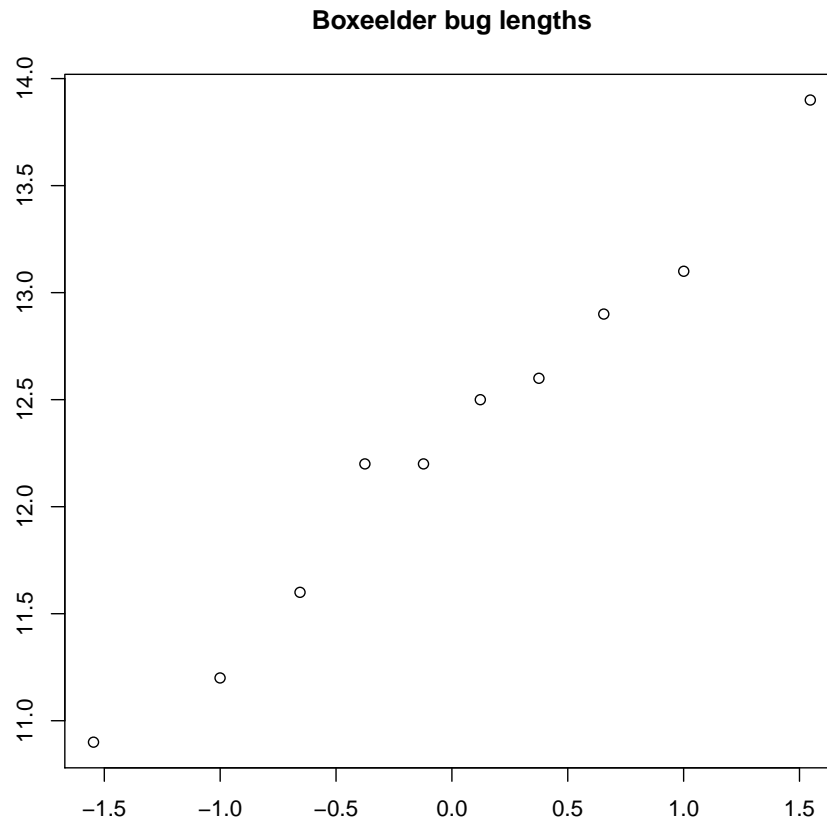
For following tests, what are the setup to use them? What are assumptions? How can we check those assumptions? How can we calculate p-value? How can we make the rejection region given certain significance level? How can we calculate the power? How can we calculate the required sample size?

- Sample mean test
- Z test
- T test
- Sign test
- Z test for population proportion
- Two sample t test
- Welch t test
- Permutation test
- Z test for comparing two independent population proportions

1. A researcher is investigating the weights of lizard eggs of a certain species to see if they have decreased in radius during a drought. She wishes to test her hypothesis that the population's radius is below a certain value, μ_0 . She decides she will use a t-test to address her hypothesis. Answer the following questions:

- (a) Explain, **in the context of this problem**, what a **type I error** would be.

2. The sunny south wall of a house was covered with boxelder bugs. A researcher enclosed the wall in plastic to capture all the bugs. The lengths of a simple random sample of 10 bugs were measured in mm: 10.9, 11.2, 11.6, 12.2, 12.2, 12.5, 12.6, 12.9, 13.1, 13.9. Here $\bar{x} \approx 12.31$ and $s \approx 0.90$. Here is a QQ plot of the 10 lengths:



- (a) Is it plausible that the population of lengths is normally distributed? Why or why not?

(b) Suppose the population of lengths is normal. Find a 95% confidence interval for the unknown population mean length. **Keep two digits after decimal.**

(c) Suppose the population of lengths is normal. **Find the test statistic and p-value** for a test to decide whether the population mean length **is different than** 12.5. **Draw a conclusion** using significance level 0.05.

(d) **Find the test statistic and p-value** for a test of $H_0 : M = 11$ vs. $H_A : M > 11$, where M is the population median length. **Draw a conclusion** using significance level 0.05.

3. The Wisconsin State Patrol are worried their fleet of vehicles—which includes 500 police cruisers, motorcycles, SUVs, and so forth—is aging. They are interested in the proportion of their vehicles which have traveled over 100,000 miles. Call this proportion π . The State patrol hires you, a statistician, to make inferences about π .
- (a) Suppose you collect a simple random sample of size $n = 35$ Wisconsin State Patrol vehicles. In the sample, 10 vehicles have traveled more than 100,000 miles. Calculate the **point estimate** of π and its **estimated standard error**. **Keep three digits after decimal.**
- (b) Calculate a 90% confidence interval for π . **Interpret the interval in context.** **Keep three digits after decimal.**

4. For a certain experiment, a neuroscientist has gathered a sample of 80 *Drosophila Melanogaster*(fruitflies) and found that 55 of the flies reacted when prodded with a needle heated at $41^{\circ}C$. He knows that if **over** 62% of flies react, he will need to recalibrate his heated stimulus.

(a) What are the hypotheses?

H_0 :

H_A :

(b) Choose an appropriate test by **checking assumptions**, calculate the test statistic and solve for the associated p-value. **Keep two digits after decimal.**

(c) Given $\alpha = 0.05$, make a reject or not reject decision **in the context of the problem.**