Study Guide for Exam 2 (Chs. 6-9)

1. Be able to interpret a probability distribution (e.g., the X axis corresponds to values of the variable; Y axis corresponds to how likely each value is).

2. Calculate the percentage of cases above and/or below a particular Z score in a normal distribution.

3. Calculate the percentage of cases above and/or below a particular raw score in a normal distribution.

4. Calculate a particular Z score in a normal distribution given the percentage of cases above and/or below it.

5. Calculate a particular raw score in a normal distribution given the percentage of cases above and/or below it.

For the computational components related to power, the following example is provided:

You want to know whether employees of a company who take vitamins every day take, on average, less sick days than employees at the company in general. The population mean (μ) for sick days per year taken at the company is 4 with a population standard deviation (σ) of 1. Suppose that the mean number of sick days for vitamin-takers, in actuality, is 3. In order to test your hypothesis, you found the number of sick days taken by 10 vitamin-takers and used an alpha level of $p < .01$.

6. In terms of H_0, H_1, μ_1, and μ_2, write out the research hypothesis and null hypothesis for this example. Assume that μ_1 refers to the population mean for vitamin takers and μ_2 refers to the population mean for employees in general.

7. What would your power equal in this example?

8. What would Beta equal in this example?

9. What is the effect size (Cohen's d) for this example?

According to Cohen's effect size convention, this effect size is _____.

(Power answers and formula found below)

MAKE SURE TO FULLY UNDERSTAND TYPE-I and TYPE-II error for this exam. That content is introduced in Chapter 7 but it comes back for Chapter 9 on statistical power.

Note that for the content related to hypothesis testing, the following guidance is provided:

1. Translate a hypothesis into H_0, H_1, μ_1, and μ_2.

2. Completely understand the difference between a one and two tailed test.

3. Complete all steps in the hypothesis testing if N = 1.

A. Translate the hypothesis into H_0, H_1, μ_1, and μ_2.

B. Determine the comparison distribution.

C. Determine $Z_{critical}$ based on the alpha level and number of tails.

D. Calculate a Z score.

E. Explain your conclusion.

4. Complete all steps in the hypothesis testing if N > 1.

A. Translate the hypothesis into H_0, H_1, μ_1, and μ_2.

B. Determine the comparison distribution.

a. Calculate μ_m and σ.

b. understand the relationship between the magnitude of N and the variance of a distribution of means.

C. Determine $Z_{critical}$ based on the alpha level and number of tails.

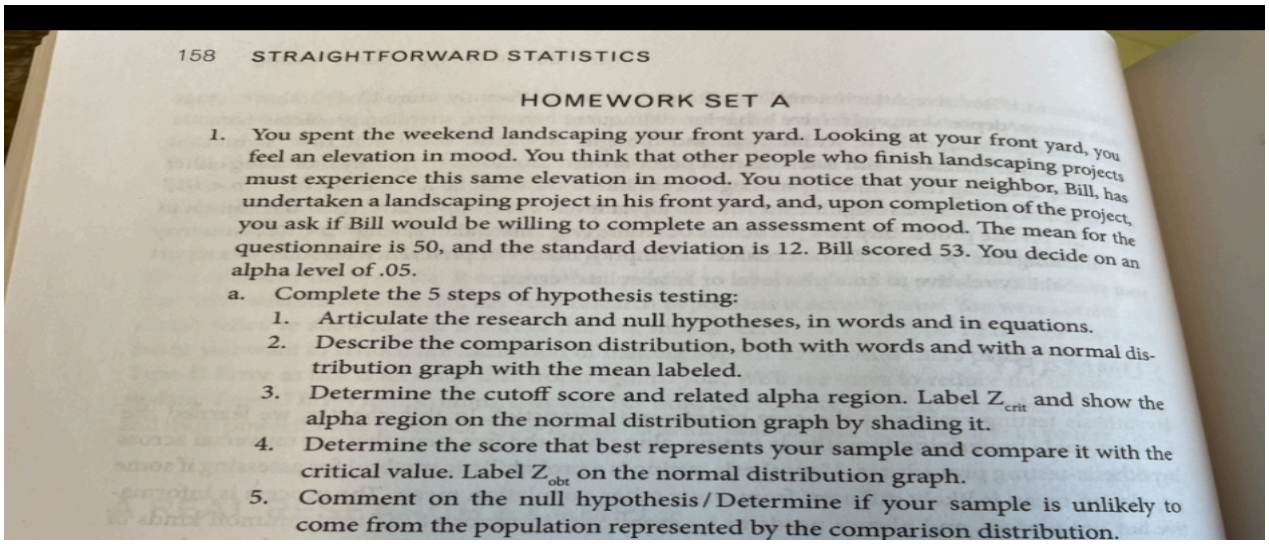
D. Calculate a Z score.

E. Explain your conclusion.

EXAMPLE ITEMS FOR BOTH (a) Hypothesis testing if N = 1 (Ch. 7) and (b) Hypothesis testing if N > 1) (Ch. 8) are following. They are based on exemplary problems from the hFor the computational components related to power, the following examples are provided:

HYPOTHESIS TESTING EXAMPLE (with answers) IF N = 1 (vis a vis Chapter 7)

(NOTE THAT THIS EXAMPLE IS FROM THE HOMEWORKS THAT WERE ASSIGNED–it is a great exemplar of the kind of item that will be on the test)



HOMEWORK SET A

1. You spent the weekend landscaping your front yard. Looking at your front yard, you feel an elevation in mood. You think that other people who finish landscaping projects must experience this same elevation in mood. You notice that your neighbor, Bill, has undertaken a landscaping project in his front yard, and, upon completion of the project, you ask if Bill would be willing to complete an assessment of mood. The mean for the questionnaire is 50, and the standard deviation is 12. Bill scored 53. You decide on an alpha level of .05.
   a. Complete the 5 steps of hypothesis testing:
      1. Articulate the research and null hypotheses, in words and in equations.
      2. Describe the comparison distribution, both with words and with a normal distribution graph with the mean labeled.
      3. Determine the cutoff score and related alpha region. Label Z_{crit} and show the alpha region on the normal distribution graph by shading it.
      4. Determine the score that best represents your sample and compare it with the critical value. Label Z_{obt} on the normal distribution graph.
      5. Comment on the null hypothesis / Determine if your sample is unlikely to come from the population represented by the comparison distribution.

ANSWERS:

1. a. 1. Research hypothesis: People who have finished landscaping projects will score higher on an assessment of mood than people in general.

$H_1 = \mu_1 > \mu_2$

Null hypothesis: People who have finished landscaping projects will score lower than, or equal to, the general population on an assessment of mood.

$H_0 = \mu_1 \leq \mu_2$

2. The comparison distribution is the population of individual scores on the mood assessment that represents the general population, with a mean of 50 and a standard deviation of 12.

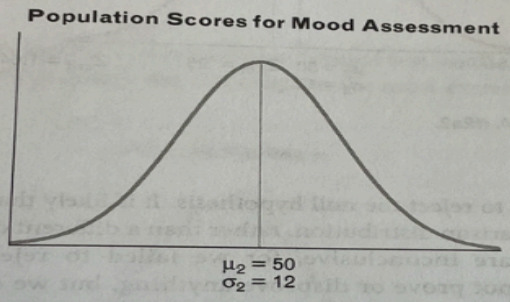
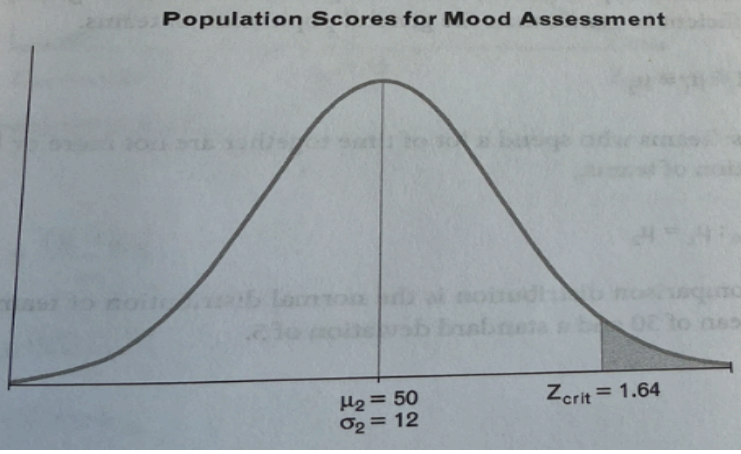


FIGURE 7.8: Homework Set A #1a3.

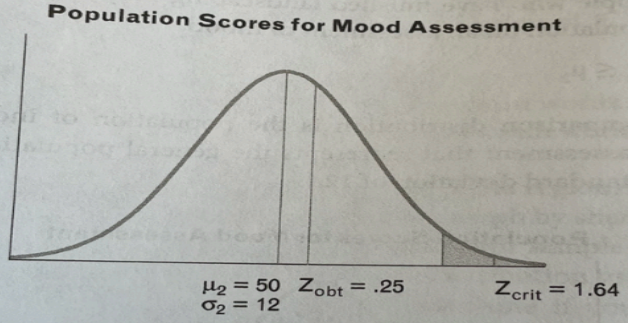
3. Alpha level is .05. Cutoff score (from % Mean-to-Z table) is 1.64.



4. $Z = \frac{(X - \mu_2)}{\sigma_2}$

$Z = \frac{(53 - 50)}{12}$

$Z = .25 = Z_{obt}$



RE 7.10: Homework Set A #2a2.

5. We failed to reject the null hypothesis. It is likely that the sample comes from the comparison distribution, rather than a different distribution.

a. Our results are inconclusive, for we failed to reject the null hypothesis. Statistics do not prove or disprove anything, but we did not find support for the hypothesis that completing landscaping projects elevates mood.

b. Type II Error, failing to reject H_0 when H_1 is actually true.

HYPOTHESIS TESTING EXAMPLE (with answers) IF N > 1 (vis a vis Chapter 8)

1. You have a friend who thinks that people who take tons of pictures do so because they don't have very good memories, so they use pictures of an event less to document the event and more to help them remember it. You decide to collect data from 10 people you know who are always taking pictures, and you compare their mean score of 32 on the Memory Assessment Test to the population mean of 30 and standard deviation of 3. You use an alpha of .05.
   a. Articulate the research and null hypotheses.
   b. Determine the characteristics of the comparison distribution.
   c. Determine critical value.
   d. Compare Z_{obt} based on sample with $Z_{crit.}$
   e. Comment on the null hypothesis.

ANSWERS:

1. a. $H_1: \mu_1 < \mu_2$

   $H_0: \mu_1 \geq \mu_2$

   b. $\sigma = 3$

   $\sigma^2 = 9$

   $\sigma^2_M = \frac{\sigma^2}{N} = \frac{9}{10} = .9$

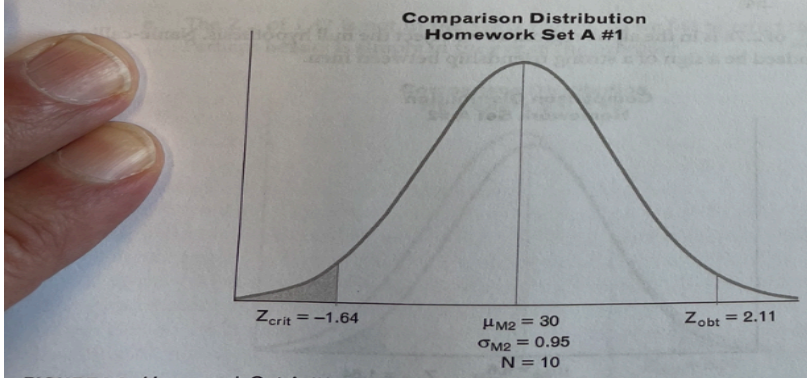
   $\sigma_M = \sqrt{\sigma^2_M} = \sqrt{.9} = .95$

   c. $Z_{crit} = -1.64$ (Alpha level of .05, negative because the mean of the special population is predicted to be less than the mean for the general population.)

   d. $Z_{obt} = \frac{M - \mu_{M2}}{\sigma_{M2}}$

   $Z_{obt} = \frac{32 - 30}{.95} = 2.11$

   e. The Z_{obt} of 2.11 is not in the alpha region, so we fail to reject the null hypothesis. It appears that people who take a lot of photographs do not have worse memories than people in general.



ANSWER KEY AND FORMULAS regarding power-related questions:

---

6. H_1: $\mu_1 < \mu_2$

H_0: $\mu_1 >= \mu_2$

7. $Z_{critical} = -2.33$

$\sigma^2_M = \sigma^2/N = 1^2/10 = .1$; σ_M = Square Root of (.1) = .32

$M_{critical} = -2.33(.32) + 4 = 3.25$

$Z_{upper} = (3.25-3)/.32 = .78$

Power = 78.23%

8. Beta = 100%-power = 21.77%

9. Cohen's $d = | (M - \mu_2)/ \sigma | = (3-4)/1 = 1$ ... it's large

FORMULAS FOR HYPOTHESIS TESTING:

Formulas for comparing a single score to a distribution:

$Z = (X - \mu_2)/\sigma_2$

$X = Z(\sigma_2) + \mu_2$

Formulas for comparing a sample mean to a distribution of means:

$\mu_{M2} = \mu_2$

$\sigma^2_{M2} = \sigma^2_2/N$

$\sigma_{M2} = \sqrt{\sigma^2_{M2}}$

$Z = (M - \mu_{M2})/ \sigma_{M2}$

Formulas for Computing Power