

1a. Dr. Lou Swate runs a behavioral weight loss clinic, in which people are given a behavior modification regimen for losing weight. Below you have data from a sample of 11 overweight people who have enrolled in his program. The data represent pounds of weight lost after a week on the program. For these data, estimate the weight loss one would find in the population from which the sample was drawn in terms of both central tendency (mean) and variability (variance). [10 pts]

Weight Loss
2
4
3
6
2
4
3
2
5
3
7

$$M = \bar{X} = \hat{\mu} = \frac{\sum X}{n} = \frac{41}{11} = 3.73$$

$$SS = \sum X^2 - \frac{(\sum X)^2}{n} = 181 - \frac{41^2}{11} = 28.18$$

$$s^2 = \hat{\sigma}^2 = \frac{SS}{df} = \frac{28.18}{10} = 2.82$$

1b. Test the null hypothesis that these data were drawn from a population experiencing weight loss of 5 pounds, which is what Dr. Swate claims people should lose in one week. [10 pts]

$$H_0: \mu = 5$$

$$H_1: \mu \neq 5$$

With $\alpha = .05$ and a two-tailed test, $t_{\text{Crit}}(10) = 2.228$

Decision Rule: If $|t_{\text{Obt}}| \geq 2.228$, reject H_0 .

$$t = \frac{M - \mu}{s_M} = \frac{3.73 - 5.0}{.506} = -2.51$$

$$s_M = \sqrt{s^2/n} = \sqrt{2.82/11} = .506$$

Reject H_0 , because $|-2.51| \geq 2.228$. Thus, it appears that people lose significantly less weight than the five pounds claimed.

1c. What is the size of the effect found in the prior analysis? [3 pts]

$$d = \frac{M - \mu}{s} = \frac{1.27}{1.68} = .76$$

OR

$$r^2 = \frac{t^2}{t^2 + df} = \frac{6.3}{6.3 + 10} = .39$$

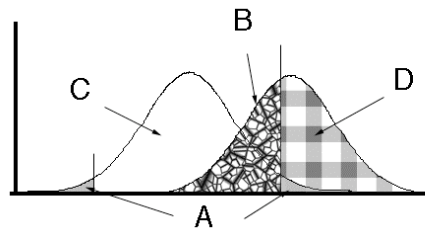
1d. What kind of error might you be making in your decision? [1 pt]

In rejecting H_0 , you could be making a Type I error.

1e. If the effect size were larger, what would be the likely effect on your decision? Why? [1 pt]

With a larger effect size, the t would be even larger, which would lead to the same decision (reject H_0).

2. Label the graph below appropriately:



The distribution on the left represents H_0 True. The distribution on the right represents H_0 not true. So, in terms of hypothesis testing, what do A, B, C, and D represent? [2 pts]

Letter	Label	Letter	Label
A	Type I Error (α)	C	Correct retention of H_0
B	Type II Error (β)	D	Power ($1 - \beta$), correct rejection

3. You should recognize a few similarities between the curves in hypothesis testing (as above) and the curves in a signal detection paradigm. Indicate three similarities below: [3 pts]

In Hypothesis Testing Terms	In Signal Detection Terms
Effect Size	d'
Power	Hits
Type II Error	Misses
Type I Error	False Alarms
critical value of statistic	Criterion

4. As you know, IQ is normally distributed with $\mu = 100$ and $\sigma = 15$. Use that information to answer the following questions. [10 pts]

a. What is the probability of having an IQ between 115 and 125?

$$\frac{115 - 100}{15} = 1.0$$
$$\frac{125 - 100}{15} = 1.67$$

Proportion for 1.67 = .4525 (from mean to z)

Proportion for 1.00 = .3413 (from mean to z)
.1112

b. What is the probability of drawing a sample of $n = 25$ people and finding a mean IQ equal to or greater than 110?

Because this distribution is the sampling distribution of the mean, the standard error is the correct measure of the standard deviation of the distribution.

$$\frac{15}{\sqrt{25}} = 3 = s_M$$

$$\frac{110 - 100}{3} = 3.33$$

Thus, the probability is very small (less than .0005).

c. What two IQ values determine the middle 80% of IQ scores in the population?

z-scores of -1.28 and +1.28 cut off the lower and upper 10% of the distribution.

$$\frac{X - 100}{15} = -1.28$$

$$X = 80.8$$

$$\frac{X - 100}{15} = +1.28$$

$$X = 119.2$$

d. For samples of $n = 100$, what sample means would determine the middle 80% of IQ scores?

Same z-scores as above in c, but you'd be dealing with the sampling distribution of the mean, so you'd need an estimate of standard error ($15/10 = 1.5$). Thus,...

$$\frac{X - 100}{1.5} = -1.28$$

$$X = 98.08$$

$$\frac{X - 100}{1.5} = +1.28$$

$$X = 101.92$$

e. What is true about the sampling distribution of the mean as your sample size increases? [Need to talk about several points.]

As the sample size increases, the sampling distribution of the mean approaches normal. Moreover, as the sample size increases, the variability of the sampling distribution of the mean decreases (standard error gets smaller). The mean of the sampling distribution of the mean will be the mean of the parent population.

5. Miscellaneous questions [10 pts]

a. If you are looking for a small effect (low d), what would you need in order to be able to reject H_0 ?

Lots of power!

b. What is the definition of the median?

Half the scores are above the median and half are below.

c. If you were to add a constant to all the scores in a sample, what would happen to the sample variance?

The variance would stay the same.

d. Why is the SS not a good measure of variability?

Because it will typically increase as sample size increases.

e. In a positively skewed population, with $\mu = 85$ and $\sigma = 10$, what percentage of scores would be above 85?

Either you can't say precisely (because you can't use the Unit Normal Table), or you would say that the answer would be less than 50%.

f. Michael Jackson is currently on trial. If you think of a court decision in Hypothesis Testing terms, H_0 would be that Michael Jackson is not guilty.

In terms of court decisions, what is a Type I Error?

Saying that he's guilty when he is not guilty.

In terms of court decisions, what is a Type II Error?

Saying that he's not guilty when he is guilty.

Which does our judicial system see as the more serious error? Why?

Type I Error is typically thought of as more serious in the judicial system. Jurists would supposedly prefer to let many guilty people go free than to convict an innocent person.

g. Suppose that you are computing a t -test with $t_{\text{crit}} = 1.96$. What can you tell me about that t -distribution?

The sample size must be very large, because the t distribution is normal.

h. If your t statistic came out as 1.94, what would you decide and what would you do next?

You would retain H_0 and you would try to figure out how you could attain more power.