Assignment 1

# Eating disorder study.

Data from a psychology experiment was reported and analyzed in American Statistician (May 2001). Two samples of female students participated in the experiment. One sample consisted of 11 students known to suffer from the eating disorder bulimia; the other sample consisted of 14 students with normal eating habits. Each student completed a questionnaire from which a “fear of negative evaluation” (FNE) score was produced. (The higher the score, the greater the fear of negative evaluation.)

1. Does the data support that bulimics tend to have a greater fear of negative evaluation? Explain.
2. Use appropriate graph(s) to check the data conditions first. Comment on the graphs.
3. Perform a complete hypothesis testing even if the conditions are not valid (for the sake of practice.)

## Analysis

This analysis is about Inferences About the Difference Between Two Population Means. More specifically about Small-Sample Confidence Interval for (μ1 − μ2) with Independent Samples.

### Assumptions:

#### The samples are randomly and independently selected from the populations.

If the students participating in the study were not related to each other, we can consider this as true.

#### Both populations have a Normal distribution or n1 ≥ 30 and n2 ≥ 300

We do not have access to the population, and the samples are smaller than 30. However, we can try to see if the samples are Normally distributed. The graphs below **do not** show that the FNE scores are Normally distributed.

Chart, histogram

Description automatically generated

#### Equal variances between the two samples σ1 = σ2

To answer this, we conduct an F-test:

H0: σ1 == σ2  
Ha: σ1 != σ2

Variances:



Text

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Decision: Since p-value= 0.8305 > α = 0.05, our test statistics does not fall in the rejection region, and we fail to reject H0.

Conclusion: At 5% level of significance, there is insufficient evidence to conclude that the population variances of the FNE results are not equal.

### t-test

Ignoring that the samples are not distributing Normally, and because we failed to prove that the variances in both samples are not equal, we conduct a t-test with *var.equal = TRUE* to see if the mean of the FNE scores from the bulimic group is greater than that of the ‘normal’ group:

H0: μ1 <= μ2

Ha: μ1 > μ2

Text

Description automatically generated

Decision: Since p-value= 0.044 < α = 0.05, our test statistics falls in the rejection region, and we are able to reject H0.

Conclusion: At 5% level of significance, there is sufficient evidence to say that the mean of the FNE scores from the bulimic group is greater than the one from the ‘normal’ group.

# Jelly Belly Candy Machines

Jelly Belly Candy Company is testing two machines that use different technologies to fill three-pound bags of jellybeans. The file Bags contains a sample of data on the weights of bags (in pounds) filled by each machine.

1. Does the data support that the mean bag weights for the two machines are different?
2. Construct a 95% confidence interval for the difference between the mean bag weights for the two machines.
3. Interpret the interval in the context of the question.

## Analysis

This exercise is again about Inferences About the Difference Between Two Population Means. Specifically, about Small-Sample Confidence Interval for (μ1 − μ2) with Independent Samples. The difference between exercise 1 and 2 is that in the first one we wanted to see if μ1 > μ2 and here we want to see if μ1 != μ2.

### Assumptions:

#### The samples are randomly and independently selected from the populations.

Since the samples were taken from different machines, we can consider this as true.

#### Both populations have a Normal distribution or n1 ≥ 30 and n2 ≥ 300

We do not have access to the population, and the samples are smaller than 30. However, we can try to see if the samples are Normally distributed. The graphs below show that the results for machine 1 seem to be normally distributed. For machine 2, it is not very clear that that is the case. It looks like there is an outlier and it is skewed to the left. However, for the sake of practice we will continue with the experiment as if it was normally distributed.

Chart, histogram

Description automatically generated

#### Equal variances between the two samples σ1 = σ2

To answer this, we conduct an F-test:

H0: σ1 == σ2  
Ha: σ1 != σ2

A picture containing diagram

Description automatically generated

Text

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Decision: Since p-value= 0.000007 < α = 0.05, our test statistics falls in the rejection region, and we H0.

Conclusion: At 5% level of significance, there is sufficient evidence to conclude that the variances in all (population) results for each machine are not equal.

### t-test

Assuming that the samples distribute Normally and considering that the variance between the populations are different, we conduct a t-test with *var.equal = FALSE,* to see if the mean bag weights for the two machines are different*.*

H0: μ1 = μ2

Ha: μ1 != μ2

Text

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Decision: Since p-value= 0.2953 > α = 0.05, our test statistics does not fall in the rejection region, and we fail to reject H0.

Conclusion: At 5% level of significance, there is insufficient statistical evidence to say that the mean bag weights for the two machines are different.

# SAT scores

The College Board SAT college entrance exam consists of three parts: math, writing, and critical reading. TestScores data file contains the math and writing scores for a sample of 12 students who took the SAT exam.

1. What is the point estimate of the difference between the mean scores for the two tests?
2. What are the estimates of the population mean scores for the two tests?
3. Which test reports the higher mean score?

Use a α = 0.05 level of significance and test for a difference between the population mean for the math scores and the population mean for the writing scores.

## Analysis

This would be a Paired Difference Experiment because the samples are NOT independent from each other. The point estimate would be the difference between the math and writing score for each student.

For this kind of experiment the assumptions are the following:

* The population of differences in test scores is approximately normally distributed.
* The sample differences are randomly selected from the population differences.
* We do NOT need to assume that the variances between the populations are equal.

To calculate the population’s mean scores for each test we use the One Sample t-test to see if the arithmetic mean for each test can be considered for the whole population:

### Math scores:

Estimated mean is 514.

H0: μ-math == 514  
Ha: μ-math != 514

Text, letter

Description automatically generated

With p-value = 1 > α = 0.05, there is no sufficient to reject H0. We cannot consider that the mean in the population for the math scores is different than 514.

### Writing scores:

Estimated mean is 489.

H0: μ-writing == 489  
Ha: μ-writing != 489

Text, letter

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With p-value = 1 > α = 0.05, there is no sufficient to reject H0. We cannot consider that the mean in the population for the writing scores is different than 489.

### Paired t-test

With the estimated means of 514 for the math tests and 489 for the writing tests, we now want to know which grades are higher in the population. In other words, calculate if the difference between these means is different to 0 in the population.

We conduct a paired t-test:

H0: μ-math - μ-writing == 0  
Ha: μ-math - μ-writing != 0

Text, letter

Description automatically generated

With p-value = 0.03935 < α = 0.05, there is sufficient to reject H0. We can consider that the mean of the math scores is greater than the mean of the writing scores in the population.