

Coursework 2

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EXPERIMENTAL DATA ANALYSIS

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Introduction

In this assignment I have been tasked to look at a set of data. And discuss what I can infer from it, along with doing calculations (such as the two pair T test, which is discussed in more depth) in order to define the data in more detail, in order to help the app creators, understand their impact better. The data in question is a set of test results in a class both before and after the use of an app supposed to help said students (Data shown below).

I have also researched my methods of calculations in order to better explain and better understand them. These calculations will help in the rejection or acceptance of the hypothesis. These data set will be closely scrutinised.

Also, in this assignment I will be using standard deviation and mean in order to infer more data from the original data set. I will be discussing the outliers (if any) and investigating them further, also in my hypothesis I will be changing the alpha three different times in order to get different results and come to a conclusion to either accept or reject the hypothesis.

student	Test score before using app	Test score after using app
1	12	14
2	9	9
3	8	10
4	9	11
5	12	15
6	14	15
7	15	15
8	17	10
9	18	20
10	15	20
11	14	18
12	14	16
13	14	17
14	12	14
15	10	20
16	11	15
17	8	4
18	7	10
19	6	11
20	6	19
21	5	16
22	17	17
23	19	19
24	20	18
25	17	20
26	16	19
27	17	20
28	12	14
29	13	14
30	11	13
31	12	12
32	6	9
33	8	20
34	10	17
35	15	17
36	17	17
37	17	19
38	18	20
39	12	13
40	17	15

What data are we using?

The data set (seen below) is taken from two different tests undertaken by a group of students. The first test was undertaken in traditional ways or remembering and learning new material and the second test undertaken by the students was after use on an online app used in the aid of remembering and learning new material.

student	Test score before using app	Test score after using app
1	12	14
2	9	9
3	8	10
4	9	11
5	12	15
6	14	15
7	15	15
8	17	10
9	18	20
10	15	20
11	14	18
12	14	16
13	14	17
14	12	14
15	10	20
16	11	15
17	8	4
18	7	10
19	6	11
20	6	19
21	5	16
22	17	17
23	19	19
24	20	18
25	17	20
26	16	19
27	17	20
28	12	14
29	13	14
30	11	13
31	12	12
32	6	9
33	8	20
34	10	17
35	15	17
36	17	17
37	17	19
38	18	20
39	12	13
40	17	15

The above data set shows us two things. The first thing being that most students tend to have better test results in most cases, the other thing we can also see is that students that have lower scores before the use of the app, tend to not gain many in terms of marks. The next thing to do is to infer the data.

Inferring the data

The first thing we should do is infer to the data. This means pulling information from the data from both looking at the data set and using calculations and creating hypothesis to 'extract' more data from the set. For example, the first set of calculations I will use is Standard deviation and mean, [1] these are used to give the average score for both before and after the app being used.

What is standard deviation?

Standard deviation and mean are the same thing. They both give the average of the data sets, [2] but when we are interpreting the standard deviation there are some rules that need to be followed in order to ensure the data is inferred correctly. For example, the standard deviation cannot under any circumstances be a negative number this is because of the way it is calculated, and that the resulting data will be affected by any outliers. This is why I will be doing two different standard deviation calculations, one with and one without the outliers affecting the data.

We also need to use the same units of measurements that are in the data set. For example, if we have a group of data measured in CM, it must also be CM for the standard deviation we cannot change these or we risk the data being ruined. (See below for SD equation)

$$SD = \sqrt{\frac{\sum |x - \mu|^2}{N}}$$

Figure 1, Taken from source [1]

So, in this case we need to calculate the standard deviation of the two different tests taken, for this section I will use the data with the outliers still in the data. The data being calculated without the outliers will be discussed later on. But first I must discuss my own hypothesis.

The Hypothesis

[3] A hypothesis is a statement created by the data analysis that gives an idea to what the overserved data will give informational wise. The more data that's collected the better the hypothesis and detailed it can become.

My hypothesis' is as follows, "The data shown is between two different tests undertaken by the students. It is my understanding that the test score should be increased greatly after the students use the app", "The data change will be minimal if any" and "The increase in the data will and should be minimal and in some cases decrease the results".

Now we have our hypothesis', the next thing we need to find out is do we accept or reject the hypothesis? This is where out calculations come into play.

Our Tests

In order to test our theories/hypothesis we need to do some tests against the data. As such the first two sets of tests I do is to work out the mean/average, I did this for both the test results before and then one for after using the online app. The results can be seen below: -

SD Before app	SD After app
12.75	15.3

As you can see in the above image, the standard deviation of both the test results before and after the use of the app there is an increase in the average results by 3 points. This means that in average the results do increase after using the app, this makes one of the hypotheses I discussed true, and we can accept this one. The next tests we can do are the t test.

The T tests

[6] The T test is a mathematical equation that is used in order to determine if there is any significant change between two sets of data, in this case I will use the before and the after the online app is used to determine if there is any change worth putting our hypothesis to the test to.

In this test I will be using a two-tail t test, I will be using this because it is best suited to the data at hand and will give us the best answers to compare to our predictions. In these tests I will be changing the alpha 3 times, to 0.10, 0.05 and 0.01 and then comparing them to our hypothesis'. The results are discussed below: -

The first test I did was the alpha setting at 0.10: -

T test 0.10 alpha		
t-Test: Paired Two Sample for Means		
	12	14
Mean	12.76923077	15.33333333
Variance	17.23481781	15.64912281
Observations	39	39
Pearson Correlat	0.530390882	
Hypothesized Me	0	
df	38	
t Stat	-4.072137102	
P(T<=t) one-tail	0.000113922	
t Critical one-tail	1.304230204	
P(T<=t) two-tail	0.000227843	
t Critical two-tail	1.68595446	

As we can see the above data set works in favour to our first hypothesis, does not work in the second hypothesis and again doesn't work in the third hypothesis as it did not decrease the results between the two.

The next test I will be undertaking is the t test with a changed alpha as 0.05. But we must ask why do we need to do this? We need to do this to put our hypotheses to the test under different circumstances: -

T test 0.05 alpha		
t-Test: Paired Two Sample for Means		
	12	14
Mean	12.76923	15.33333
Variance	17.23482	15.64912
Observations	39	39
Pearson Correlat	0.530391	
Hypothesized Me	0	
df	38	
t Stat	-4.07214	
P(T<=t) one-tail	0.000114	
t Critical one-tail	1.685954	
P(T<=t) two-tail	0.000228	
t Critical two-tail	2.024394	

This test is using the 0.05 alpha settings, when putting this against our hypothesis we can see that it working in case for our first but as in the previous calculations, the other two are the null hypothesis.

The next and last test we need to do is one with the alpha changed to 0.01, as seen below: -

T test 0.01 alpha		
t-Test: Paired Two Sample for Means		
	12	14
Mean	12.76923	15.33333
Variance	17.23482	15.64912
Observations	39	39
Pearson Correlat	0.530391	
Hypothesized Me	0	
df	38	
t Stat	-4.07214	
P(T<=t) one-tail	0.000114	
t Critical one-tail	2.428568	
P(T<=t) two-tail	0.000228	
t Critical two-tail	2.711558	

The last test with the alpha changed to 0.01, but in like the past two cases the alpha doesn't change the results of our hypothesis, making the first true and the other two a null hypothesis and as such we reject them.

Outliers

An outlier in our data is anything that doesn't fit into the trend of the rest of the data, for example student 17 had a test result of 8 before using the app and then had a result of 4. This doesn't fit into the regular trend of the data. So, in order to make the data more reliable I will remove these outliers and then perform tests to see if it changes our results. The first step is with the standard deviation or mean/average. The following show the same format as the previous tests done: -

SD Before	SD After
12.86486486	15.91891892

As we can see even with the outliers removed from the situation it doesn't affect the results too greatly but instead minimally increases the results for both before and after the app being used. These outliers would normally change the results drastically but are only really seen in graphs.

In the case of the t tests, regardless of the alpha setting, it creates a minimal change in the results the same as the standard deviation. This means that the outliers in the data are small enough in number to not create a significant difference in the test results taken.

With the three t tests, even though the change was minimal and would not affect the data overall, I decided to include them in order to help with getting my point across: -

t-Test: Paired Two Sample for Means - 0.10			t-Test: Paired Two Sample for Means - 0.05			t-Test: Paired Two Sample for Means - 0.01		
	12	14		12	14		12	14
Mean	12.88888889	15.972222	Mean	12.88888889	15.97222222	Mean	12.88888889	15.97222222
Variance	17.13015873	10.94206	Variance	17.13015873	10.94206349	Variance	17.13015873	10.94206349
Observations	36	36	Observations	36	36	Observations	36	36
Pearson Correlation	0.569491832		Pearson Correlation	0.569491832		Pearson Correlation	0.569491832	
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	35		df	35		df	35	
t Stat	-5.237081033		t Stat	-5.237081033		t Stat	-5.237081033	
P(T<=t) one-tail	3.91401E-06		P(T<=t) one-tail	3.91401E-06		P(T<=t) one-tail	3.91401E-06	
t Critical one-tail	1.306211802		t Critical one-tail	1.689572458		t Critical one-tail	2.437722547	
P(T<=t) two-tail	7.82802E-06		P(T<=t) two-tail	7.82802E-06		P(T<=t) two-tail	7.82802E-06	
t Critical two-tail	1.689572458		t Critical two-tail	2.030107928		t Critical two-tail	2.723805589	

As you can see, the t test results do not differ that much when compared to the original set of tests done with the original data. This again is due to the outliers being small enough in number that it would not change the results drastically enough to change the results and potentially influence the app producers to make drastic changes.

Other Factors

There may be some other factors that play a role in the data. For example, we don't know for sure that every student used the online app and instead used the same traditional method of learning. With this I believe we can control this factor to by timing how much time a student uses the app, with this we can also set a maximum time set. This way it makes the data more reliable and will make our t test and standard deviation results more reliable to give faith into.

Another factor I'd like to discuss is the number of students. Instead of 40 students being used, I believe the number of students should be increased to 60. But why do I think this will help? I Believe this will help the results and eventually help with the companies' decisions with the app. The more students there are, I believe there would be more reliability in the data and thus making the data easier to read and easier to calculate as there would be less outliers in the data set.

Another factor I believe would help is the amount of data sets. Instead of using two data sets, one before and one after there should be 4 different data sets. One before the app use, one after 3 hours of use, 4 hours of use and one 6 hours after use. I believe this is best for the data sets as it lets us see if the amount of time spent on the app will make any significant changes.

Conclusion

In conclusion I believe the data itself is good and works well but can do with some changes to the factors such as the number of students, the data sets and time used on the app. When discussing the app itself, after looking at the data it shows a trend of a good amount but might not be the best all together. With the average before being roughly around 12 and after the use of the app being around 15, this is a good base point, but I believe it would be best if the company aimed for the app to increase an average of 7-10 instead of the average increase of 3.

One final note, the amount of interactivity the app consists of should be increased. I believe this because the amount of outliers shows that some students don't have enough interactivity as their results show little to no increase.

References

[1]

R. MCCREADY, "The Do's And Don'ts of Infographic Color Selection," *Vennage*, 06-Oct-2016. [Online]. Available: <https://venngage.com/blog/infographic-design-the-dos-and-donts-of-color-selection/>. [Accessed: 01-Dec-2021]

[2]

N. Chibana, "Infographics vs. Text: How Does Visual Content Affect Reading Comprehension?," *visme.co*, 27-May-2019. [Online]. Available: <https://visme.co/blog/infographics-vs-text/>. [Accessed: 01-Dec-2021]

[3]

A. Richards, *LW 07: Bad infographic. This graphic has way too much text and not enough attention grabbing graphics*. 2014 [Online]. Available: <https://www.pinterest.co.uk/pin/863143084804595230/>. [Accessed: 05-Dec-2021]

[4]

E. Stubblefield, "The Importance of Great Design In Infographics," *Freepik Blog*, 01-Dec-2016. [Online]. Available: <https://www.freepik.com/blog/the-importance-of-great-design-in-infographics/>. [Accessed: 18-Nov-2021]

[5]

"The Importance of Infographics," *Think! Creative*, 05-Aug-2020. [Online]. Available: <https://thinkcreative.uk.com/the-importance-of-infographics/>. [Accessed: 22-Nov-2021]

[6]

A. Hayes, "How t-tests work," *Investopedia*, 08-Oct-2021. [Online]. Available: <https://www.investopedia.com/terms/t/t-test.asp>. [Accessed: 01-Jan-2022]

Coursework 2

GRADEMARK REPORT

FINAL GRADE

68/100

GENERAL COMMENTS

Instructor

A good report you have looked at the data in detail and presented suitable explanations but why there are increases in the test results. You have demonstrated your ability to use several different techniques to analyse and referenced the data and you appropriately used the T test with different levels of significance and looked at their outcome to analyse your main hypothesis. Make sure that you always write in the third person as this is an academic document. Good conclusion though your references apart from one seemed to link to infographics which I do believe is the previous assignment just proofread your work a little bit before handing in and try to stick to the word count your total was 2000 words

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