Research for Marketing Decisions

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Week - 08

Lecture - 38

Analysis using SPSS: Hypothesis Testing for Differences in Means Paired Sample T test, One way ANOVA

Now the next one is fifth one, do a t-test to determine if the respondent differ in their attitude towards internet and attitude toward technology, now here we will use the paired sample t-test now paired sample t-test when you have to use when you want to see whether for the same respondents they differ in the two variables. In their score on two variables. This is mostly also used when you are conducting experiment. Pre-intervention, Post-intervention.

You do paired t-test. Because same respondents. Pre-intervention. You give intervention. Pre

you know Patients 30 patients come, You note down their fever, give injections,

post Paired t-test. Right? So, we will do a pair t test for attitude towards internet, attitude towards technology. So, there is null hypothesis.

What null hypothesis we say? There is no difference between the two pair of variables for the these respondents. It is mainly used in experiments. Right? This when you have to use the pre and post intervention

you have to go to analyze, compare means Paired sample t-test. Analyze, compare means paired sample t-test. What is the pair?

Attitude towards internet and attitude towards technology. So you have variable 1, variable 2 in the same row for pair number one you want only that, so attitude towards technology attitude towards internet and if you click ok so you are getting a significant

value less than 0.05 so what is the null hypothesis at the background that there is no difference for the respondents on the two variables and in the population you are inferring about for the population using this sample, you are getting null hypothesis rejected, which means there is some difference, mean difference between the two variables for the respondents, which means their attitude toward technology and internet is significantly different. Now not this one I am saying if you will have to use the experiments you can use the same test let's say, pre-intervention you take readings on a particular variable, which is your dependent variable, give the intervention post take the readings and see whether there is a difference whether the intervention is effective. Now there is a so for independent details we are

taking only one variable, we are checking the response across different say demographic groups. But for paired sample t-test, we are taking two different variables. We are paired sample t-test, we are taking two different variables and seeing whether for the same respondents, whether they differ in the two variables. Mean of the two variables in the population is different. Generally, this test is used for experiment when you have

observation before intervention, observation after intervention for the same respondents, you do the t-test to see whether the intervention has worked. Medical experiments and all these things. Sorry? Medical experiments. Medical experiments, right.

With the rats, one could do. Okay, the sixth one is do a Wilcoxon signed rank test. So, Wilcoxon signed rank test is a non-parametric alternative to paired sample t-test, paired t-test. So, which means there are some assumptions for the paired t-test. The assumption is

that differences between the pair of variables are normally distributed if they are norm differences between the two pair of variables are normally distributed in the population, then we will have to use the parametric if that assumption is not met we have to use the non-parametric right?. So there is some assumption behind this test the assumption is the differences between the two variables between the pair of variables if it is normally distributed in the population then you use the parametric version otherwise if the assumptions are not met or if you do not want to check the assumptions use the non-parametric one wilcoxon signed ranked test which is an all non-parametric alternative to the pad t-test, where you have to go analyze non-parametric related samples, click on these the screen will come just run cancel and let me do it again analyze non-parametric related samples when it comes click run and now what is the variable attitude towards attitude towards internet, attitude towards technology, once second, just once second....

analyze, so it is giving point zero zero zero..... sorry once more.... analyze, so when you go to magic show magic show or any performance, do you tell them to repeat? okay I'm just.. okay analyze

non-parametric test, related sample, let me reset it, attitude towards internet, attitude towards technology, and click run, you will get this. Seventh one, we have already done compare, means of internet usage against the gender using a bar chart. This is we need not do we have already done box plot. So now, the next one, before we move to the next one, just think about some of the questions that you can answer using one sample t-test, independent sample t-test and paired sample t-test. Think about some questions and write them down so that we can proceed to the next part. Please do that. Some of the questions let's say in the real business situation that you could use these tests for.

And after you think that, do the last 10th one also test the hypothesis that the mean internet users of the population is 5, 10, 15. These two things quickly do it. Have you written? After you write, now start doing the assignment question number 10. Test the hypothesis that the mean internet usage population is 5, 10, 15.

Do that test. What test you will use? One sample T- test. So, can I tell what I have written for this? Yeah.

Tell me. For one sample test, T- test I have written. People have high preference for X biscuit flavor. Assuming in a 7 point Likert scale, high preference is high. Okay.

Okay. Good. For the independent sample, T-test I have written. Customers from Shiliguri have same preference for X biscuit flavor as like customers from Burdwan. Right.

Why biscuit? You like biscuit so much? I also like biscuit. Okay. Third one,

pair sample T- test Customers from Shiliguri have same preference for X biscuit, X flavor biscuit as they have for Y flavor biscuit. Very good. Thank you. And so for these Man-Whiteny tests, I have taken that there are two families of toothpaste, like Colgate family which has many flavors, and Pepsodent family which has many flavors.

Customers are given toothpaste from both the families. Customers have ranked them. We are getting the mean rank for each of the toothpaste. And then we are testing that whether the Colgate family has the is a equal valent rank to the pepsodent family or not, so which means let's say, with colgate you have about 10 toothpaste, for pepsodent also 10

toothpaste, for a particular family you ask them their preference for all of them right? and this is

for a particular household you have done this you are doing this 30 more right and you are taking an average of their, but for the same family yes for the same family, you are looking at their preference for the colgate, on 10 toothpaste you took their preference out of let's say, 10 point scale, you took an average preference for a score, for another pepsodent average preference now this you have 30. Now, Wilcoxon signed rank, right? Or you, Mann-Whitney you are saying? Mann-Whitney, independent sample. Independent sample, so you cannot do that.

Because you have only, it is not, you have only, you are talking about Pepsodent and Colgate as two family of toothpaste who would have, you know, 10-10 brands, let's say. You are not inferring it to any population. Yeah, Mann-Whitney is the non-parametric of independent sample t-test. Mann-Whitney is non-parametric version of independent sample t-test, where there are two groups and on a metric variable you want to see whether two different groups their means are different, significantly different. So, when you say Colgate and Pepsodent

there are two groups colgate family pepsodent family right?. Now for two so there are two different groups and you have uh you might ask people, now it it cannot be done because the groups here they have a very limited number of brands. Generally, when you are doing independent sample t-test, you would have independent groups. Their sample you take and infer it to the population of the independent groups. Now here, the groups have limit discrete number of brands.

You cannot infer to the population of these two groups because they are groups, but they are very limited. 10-10 brands are there. So, you need not do this test for them. Can we do correlation then? So, what you can simply do is you have 10 brands in Colgate, 10 brands in Pepsodent, you from the now see every brand would have a different target customer also.

So, let us say you go for a general toothpaste consuming population right? and take the random sample thousand, now for thousand, you note down the preference for 10 colgate brands, 10 pepsodent brands, for each thousand you take the average and do the paired sample that is one possibility they will it will tell you whether in the population of the respondents there is difference in the let's say, preference mean difference of the preference across two brands is significantly different or not, the means of the preference

regarding the two brands are different or not, because see thousand respondents from each respondent you have taken preference for colgate and now, in paired t-test, what happens? You have the same respondents, but two different variables.

Same respondent, two different preferences. Preference for Colgate, preference for Tepsodent family. The average and then when you want to compare, you use paired sample t-test. So, now do the exercise point number 10th.

Once it is done, please let me know quickly. Now, if you have done that we will do now point number 8, do a one-way ANOVA. Now for ANOVA there is a sheet that I sent you the during the before the last class where there was a sheet about normalized sales and in-store promotion. Can you download that sheet? Now independent sample t-test we use when we have two groups and we want to compare them on a metric variable.

ANOVA we use when we have more than two groups and we want to see whether they differ on the metric variable. So, we are using ANOVA here because this problem is such that there are more than two groups. So, if you look at the exercise do a one way ANOVA comparing normalized shales. So, let us say sales are given which are converted to normalized across various in-store promotion levels, so what is given is, if you look at the data the store number is the variable number one, in-store promotion there are three types of promotion, which means let's say gender and internet usage male female whether their internet usage differs independent sample t-test now, in this case let's say, for gender male female, and the third gender let's say, the internet usage would have been there then you cannot use independent sample t-test

you would have to use then ANOVA. Similar in this case, you have three types of in-store promotion. First type of in-store promotion is the least amount of discount. Second is medium amount of discount. Third is high amount of discounts.

Now it is they are seeing whether it leads to whether there is a difference in the sales achieved through these three different types of insert promotion. So you have metric variable as the sales, and grouping variable as the insert promotion. So for three different types of promotions you want to see whether the sales differ this is very common you would have to use it let's say, somebody is into sales and distribution and they want to see whether running different types of discount offers. What should be the appropriate level of discount? In-store promotion, let's say.

It would be very, very useful. For three different types of in-store promotion, now we have to see whether there is a difference in the metric variable sales that they help the store achieve. How to do that? We have to go to analyze, compare means and one way ANOVA.

Normalized sales is the dependent variable. In-store promotion is the factor. It means the three grouping variables. Click on contrast, don't do anything. Click on post hoc and select the Cheffe test.

I'll tell you later what it is. You can select either Tukki or Cheffe. Continue and if you click OK, then you will get something like this. This is the output of the ANOVA test. Now, how do you read this?

First one, ANOVA table, normalized stage, one way. What is the hypothesis testing going on? ANOVA table is there, first. As you see, the first table, normalized sales, between groups, within groups, ANOVA. 0.000. Whenever p-value is there, there is some hypothesis testing.

Now, first table, there is 0.000. Which means there is null hypothesis. What is null hypothesis? that across

these three different groups there is no difference in the variance for sales

across these three in-store promotions the sales, the variance in these sales, that they help achieve,

don't vary, do not do not differ. Now if it is. Greater than 0.05, which means there is no difference. You use whatever type of promotion, the sales would not differ much.

But there is 0.000, which means at least two of the in-store promotions, if not three, at least two of the promotions differ in the kind of sales that they are generating. Because their variants are different. Then you come to post hoc test to see which of the groups differ and which one is giving more sales, which one is giving less sales. So, post hoc is like independent sample t-test. The first table, ANOVA table is saying there is a null hypothesis that across the three groups there is no difference in the variance for the normalized sales.

If null hypothesis is true, you need not look further. If null hypothesis is rejected, which means at least two of the groups differ in their variance for normalized sales, which

means in-store promotion would have some impact. Then look at the post hoc. In post hoc, we are looking, you see three rows, high, medium and low. How to read this?

For high in-store promotion, high and mid so it is doing independent sample t-test now. Between high and medium. High insular promotion is 3. Which is coded as 3.

And medium is coded as 2. Between high and medium. The mean difference is 2.11. Significance is 0.037. This is independent empathy test.

If you look at this particular high medium. Two groups. Between high and medium type of insular promotion. There is a mean difference. Positive 2.1.

and significance 0.037. Which means what? You tell me there is a difference. There is a difference for high, for the in-store promotion coded as 3 and coded as 2.

There is a difference in the mean. There is a difference in the means of the normalized sales because p-value is 0.037. And if you look at mean difference is positive also, which means high minus medium. The high generates more sales than medium. Then if you look at this high and low.

Now this one is comparing high and low. The difference is 4.6 and again significance is 0.000, again there is a difference. In the mean normalized sales for high and low.

Insert promotion 3 and 1 and if you look at the mean difference, it is highly positive, 4.6, which means the high in-store promotion generate also lot more sales than the low in-store promotion. Right? Now, identify some questions, business, real business scenario question that you could answer using ANOVA. The last table you need not look at homogeneous subsets table that you need not look at.

So when you are looking at high let us say you are looking at this particular row high and medium. So you are looking at difference between high and medium. You are conducting independent sample test between these two groups high and medium. If you are looking at low then you are conducting a test between high and low this row is between high and low, high and low, this is the first row, this this this first is the one where one group is high only, and first time it is between high and medium, another time it is between high and low tell me some of the business questions

that you could answer using ANOVA. Sir, for higher medium difference is 2.1. That is significant that I can see from... Yes, 2.1. Mean difference 2.1 and significant 0.037 level. The mean of the installed promotion between high and low.

So, high installed promotion would have certain... There are 30 sample, 10 sample are for high. Mean... 10 sample R for medium. Mean, the mean difference 2.6. Now, how big is the difference to the test is going on p value?

That. Since significant result, there is difference. Sorry? Since significant result, there is difference. There is a difference in the mean of the normalized sales between high and medium store promotion.

So, which means if you are running two or three, type three or four types of promotional offers and you want to know whether they have an impact, you would have to do a similar type of test. If there are more than two groups and you want to see whether they differ on some metric variable, metric means interval or ratio variable, you will have to use this test one way or another. And there will be hundreds of situations. Some of you might have to use it every day. And some of you would be using it.

Data science, it is like bread and butter. They will have to use day in, day out. You have to tell me example. I have already, this example was a real example only in-store promotion.

We are comparing the sales of the men's booth per lakh population across many cities and we are checking whether they are the same or different. Yes. Across many cities, so your groups are cities and you want to see whether there is a significant mean difference. Yes, you can do that.

For normalizing, I am taking per 1000 boxes. See, you have different cities. So, between two different cities, you are seeing how much sales is there for a particular brand in two different cities, right? The problem is to what you are generalizing it to. Each city is a nominal sort of variable, right?

It is not categorical variable. We take here in the groups are nominal and categorical. When you are saying city, they are nominal but not categorical. If you say tier 1, tier 2, so their groups have to be nominal and categorical

they should not, they cannot be only nominal. Thank you everybody.