Madan Bhandari Memorial College

Testing of Hypothesis

Lab: 2

PROJECT 2.1: CONFIDENCE INTERVAL FOR POPULATION MEAN μ, (σ UNKNOWN AND LARGE n)

OBJECT:

THE FOLLOWING VALUES ARE THE LENGTHS OF 40 STEEL RODS SELECTED FOR LAB TEST FROM A FACTORY

LENGTH: 125, 120, 121, 123, 122, 130, 124, 122, 120, 122, 118, 119, 123, 124, 122, 124, 121, 122, 138, 149, 123, 128, 122. 130. 120, 122, 124, 134, 137, 128, 122, 121, 125, 120, 132, 130, 128, 130, 122, 124

TEST WHETHER THIS SAMPLE OF SIZE 40 HAS COME FROM A POPULATION WHOSE MEAN LENGTH IS 125 CM.

WORKING EXPRESSIONS:

To perform parametric test of hypothesis, we follow basic 5 steps. They are:

Step 1: Null hypothesis (H_0)

In a null hypothesis, we assume that there is no significant difference in relationship between variables or groups being compared.

Step 2: Alternative hypothesis (H_1)

In a null hypothesis, we assume that there is significant difference in relationship between variables or groups being compared.

Step 3: Test statistic: We perform the various expressions based on the type of question in test statistics.

Parametric test of hypothesis are of two types. They are:

a) Z – Test (when n>30)
   i. Test of significance of Single Mean

   Formula: $Z_{cal} = \frac{\bar{x} - \mu}{\frac{s.d.}{\sqrt{n}}}$

   ii. Test of significance of Double Mean

   Formula: $Z_{cal} = \frac{\bar{x}1 - \bar{x}2}{\frac{s.d.}{\sqrt{n}}}$

iii. Test of significance of Single Proportion

Formula: $Z_{cal} = \frac{p-P}{\sqrt{\frac{PQ}{n}}}$

iv. Test of significance of Double Proportion

Formula: $Z_{cal} = \frac{P1-P2}{\sqrt{\frac{P1Q1}{n1}+\frac{P2Q2}{n2}}}$

b) T - Test (when n<30)

Step 4: Tabulated value: In this step, we use tabulated values to determine the critical value or p-value for making decision regarding the null hypothesis.

Step 5: Conclusion and decision

In conclusion and decision, we assess the statistical significance of the results and determine what her there is sufficient evidence to accept or reject the null hypothesis.

PROCESS:

Solution: We wish to test the hypothesis that the samples differs significantly from a hypothesized population mean height of 125 cm. So we have

(H_0) :$\mu = 125$ Versus **(**H_1) : $\mu \neq 125$

1. Enter the data in the data editor.
2. Select Analyze ⟹ Compare Means ⟹ One sample T test. Type in Test Value Box.
3. Click Options ⟹ Type 95 in confidence interval percentage box.
4. Click on Continue and then Ok.
5.

CALCULATION:

Step 1: **Null Hypothesis (H_0),** $\mu = 125$

i.e. The sample of size 40 has come from a population whose mean length is 125 cm.

Step 2: **Alternative Hypothesis (H_1),** $\mu \neq 125$

i.e. There is significant difference in sample of size 40 has come from a population whose mean length is 125 cm.

Step 3: **Test Statistics:**

From SPSS,

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Length	40	125.28	6.148	.972

One-Sample Test

	Test Value = 125					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Length	.283	39	.779	.275	-1.69	2.24

Here, from the table,

$|Z_{cal}| = 0.283$

P-value (sig. (2-tailed)) = 0.779

At 95% confidence level, i.e. level of significance (α) = 0.05

Step 5: Decision and Conclusion

Since, $P > \alpha$

Decision: We accept H_o region and reject H_1 region

Conclusion: The sample of size 40 has come from a population whose mean length is 125 cm.

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PROJECT 2.2: HYPOTHESIS TESTING BETWEEN TWO POPULATION MEANNS FOR MATCHES PAIRED SAMPLES

OBJECT:

THE SALES OF A PRODUCT OF A COMPANY AFTER AND BEFORE ADVERTISEMENT ARE AS FOLLOW:

IS ADVERTISEMENT EFFECTIVE AT 5%?

Month	1	2	3	4	5	6
Before X	120	140	160	140	180	190
After Y	200	210	150	200	220	240

WORKING EXPRESSIONS:

To perform parametric test of hypothesis, we follow basic 5 steps. They are:

Step 1: Null hypothesis (H_o)

In a null hypothesis, we assume that there is no significant difference in relationship between variables or groups being compared.

Step 2: Alternative hypothesis (H_1)

In a null hypothesis, we assume that there is significant difference in relationship between variables or groups being compared.

Step 3: Test statistic: We perform the various expressions based on the type of question in test statistics.

Parametric test of hypothesis are of two types. They are:

a) Z – Test (when n>30)

i. Test of significance of Single Mean

Formula: $Z_{cal} = \frac{\bar{x} - \mu}{\frac{s.d.}{\sqrt{n}}}$

ii. Test of significance of Double Mean

Formula: $Z_{cal} = \frac{\bar{x}1 - \bar{x}2}{\frac{s.d.}{\sqrt{n}}}$

iii. Test of significance of Single Proportion

Formula: $Z_{cal} = \frac{p-P}{\sqrt{\frac{PQ}{n}}}$

iv. Test of significance of Double Proportion

Formula: $Z_{cal} = \frac{P1-P2}{\sqrt{\frac{P1Q1}{n1}+\frac{P2Q2}{n2}}}$

b) T - Test (when n<30)

Step 4: Critical value: In this step, we use tabulated values to determine the critical value or p-value for making decision regarding the null hypothesis.

Step 5: Conclusion and decision

In conclusion and decision, we assess the statistical significance of the results and determine whether there is sufficient evidence to accept or reject the null hypothesis.

PROCESS:

$H_0 : \mu_x = \mu_y$ versus $H_1 : \mu_x < \mu_y$

1. Enter the data into Data editor
2. Select Analyze ⟹ Compare Mean ⟹ Paired - samples T Test
3. Move value into Test variable(s) and type into grouping variable
4. Click options ⟹ Continue ⟹ OK.

CALCULATION:

Step 1: **Null Hypothesis (H_0),** $\mu_x = \mu_y$

i.e. The sales of a product of a company after advertisement is not effective at 5% significance level

Step 2: **Alternative Hypothesis (H_1),** $\mu_x < \mu_y$

i.e. The sales of a product of a company after advertisement is effective at 5% significance level

Step 3: **Test Statistics:**

From SPSS,

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Before_X - Before_Y	-48.333	31.885	13.017	-81.795	-14.872	-3.713	5	.014

P-value = sig. (2-tailed) = 0.014

$|T_{cal}|$= -3.713

$\alpha = 0.05$

Step 5: Decision and Conclusion

Since, $p < \alpha$

Decision: We accept H_1 region and reject H_0 region

Conclusion: After testing of hypothesis, we can conclude that the sales of a product of a company was effective after advertisement at 5% significance level.

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PROJECT 2.3: HYPOTHESIS TESTING WHEN RAW DATA FOR INDEPENDENT SAMPLES IS GIVEN

OBJECTS: THE MONTHLY ADVERTISING COST OF A COMPANY FOR TWO PRODUCTS X AND Y WERE AS FOLLOWS DURING 6 MONTH PERIOD

IS THERE SUFFICIENT EVIDENCE TO CONCLUDE THAT AVERAGE COST ON ADVERTISING ON PRODUCT Y IS MORE THAN ON PRODUCT X.

Month	1	2	3	4	5	6	7
Cost I (X)	220	240	160	240	280	290	-
Cost II (Y)	100	110	150	100	120	140	145

WORKING EXPRESSIONS:

To perform parametric test of hypothesis, we follow basic 5 steps. They are:

Step 1: Null hypothesis (H_o)

In a null hypothesis, we assume that there is no significant difference in relationship between variables or groups being compared.

Step 2: Alternative hypothesis (H_1)

In a null hypothesis, we assume that there is no significant difference in relationship between variables or groups being compared.

Step 3: Test statistic: We perform the various expressions based on the type of question in test statistics.

Parametric test of hypothesis are of two types. They are:

A) Z – Test (when n>30)

i. Test of significance of Single Mean

Formula: $Z_{cal} = \frac{\bar{x} - \mu}{\frac{s.d.}{\sqrt{n}}}$

ii. Test of significance of Double Mean

Formula: $Z_{cal} = \frac{\bar{x}1 - \bar{x}2}{\frac{s.d.}{\sqrt{n}}}$

iii. Test of significance of Single Proportion

Formula: $Z_{cal} = \frac{p-P}{\sqrt{\frac{PQ}{n}}}$

iv. Test of significance of Double Proportion

Formula: $Z_{cal} = \frac{P1-P2}{\sqrt{\frac{P1Q1}{n1}+\frac{P2Q2}{n2}}}$

B) T – Test (when n<30)

Step 4: Critical value: In this step, we use tabulated values to determine the critical value or p-value for making decision regarding the null hypothesis.

Step 5: Conclusion and decision

In conclusion and decision, we assess the statistical significance of the results and determine whether there is sufficient evidence to accept or reject the null hypothesis.

PROCESS:

Solution:

$H_0 : \mu_1 = \mu_2$ VS $H_1 : \mu_1 < \mu_2$

5. Enter the data into Data editor
6. Select Analyze ⟹ Compare Mean ⟹ Independent samples T Test
7. Move value into Test variable(s) and type into grouping variable
8. Click Define groups nd type 1 and 2 into group 2
9. Click options ⟹ Continue ⟹ OK.

CALCULATION:

Step 1: **Null Hypothesis (H_0),** $\mu_1 = \mu_2$

i.e. There is no sufficient evidence to conclude that average cost on advertising on product y in more than on product x.

Step 2: **Alternative Hypothesis (H_1),** $\mu_1 < \mu_2$

i.e. There is sufficient evidence to conclude that average cost on advertising on product y in more than on product x.

Step 3: **Test Statistics:**

From SPSS,

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cost	Equal variances assumed	1.357	.269	5.862	11	.000	114.762	19.576	71.675	157.848
	Equal variances not assumed			5.548	6.775	.001	114.762	20.686	65.515	164.008

From the table,

P-value = 0.269

$\alpha = 0.05$

Step 5: Decision and Conclusion

Since, P-value > α

Decision: We accept H_o region and reject H_1 region.

Conclusion: There is no sufficient evidence to conclude that average cost on advertising on product y in more than on product x as average cost of both product X and Y are equal.