***PRACTICALS***

***MINITAB***



***SUBMITTED TO***

***Mr.Muhammad Farooq***

***SUBMITTED BY***

***NAME:***

***ROLL NO:***

***CLASS: MSc (Previous)***

***DEPARTMENT OF STATISTICS***

***UNIVERSITY Of PESHAWAR***

***Q NO (1): -***

**Given the data below, test the hypothesis that the means of three populations are equal? Perform One Way ANOVA.**

|  |  |  |
| --- | --- | --- |
| **Sample 1** | **Sample 2** | **Sample 3** |
| **40** | **70** | **45** |
| **50** | **65** | **38** |
| **60** | **66** | **60** |
| **65** | **50** | **42** |

***SOLUTION:-***

* First we will label “C1” as “Sample1”,”C2” as “Sample2” and “C3” as “Sample3” in “Worksheet Window”.
* Enter the data in the corresponding samples in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “ANOVA” and then click on “One Way”.
* A dialogue box will appear, select the “response data are in separate columns for each factor”, then shift all three samples one by one in “Responses” box, and click “OK”.
* The result will appear on “Session Window”

*OUTPUT RESULT:-*

**————— 6/29/2015 8:24:19 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**One-way ANOVA: Sample 1, Sample 2, Sample 3**

Method

Null hypothesis All means are equal

Alternative hypothesis At least one mean is different

Significance level α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor Levels Values

Factor 3 Sample 1, Sample 2, Sample 3

Analysis of Variance

Source DF Adj SS Adj MS F-Value P-Value

Factor 2 546.0 273.00 2.80 0.113

Error 9 876.2 97.36

Total 11 1422.3

Model Summary

S R-sq R-sq(adj) R-sq(pred)

9.86717 38.39% 24.70% 0.00%

Means

Factor N Mean StDev 95% CI

Sample 1 4 53.75 11.09 (42.59, 64.91)

Sample 2 4 62.75 8.77 (51.59, 73.91)

Sample 3 4 46.25 9.60 (35.09, 57.41)

Pooled StDev = 9.8671

# *Q NO (2): -*

**The following data represent the marks obtained by five students in three subjects: Perform “Two Way ANOVA”?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Student** | **Subjects** | | |
|  | **English** | **Statistics** | **Economics** |
| **1** | **47** | **73** | **61** |
| **2** | **80** | **88** | **86** |
| **3** | **71** | **77** | **59** |
| **4** | **62** | **60** | **66** |
| **5** | **56** | **95** | **87** |

***SOLUTION:-***

* First we will label “C1” as “Data”, “C2” as “Subjects” and “C3” as “Students” in “Worksheet Window”.
* Enter the data in the corresponding columns in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “ANOVA”, select “General Linear Model” and click on “Fit General Linear Model”.
* A dialogue box will appear, then shift the “Data” in “Responses” box, and shift “Subjects” and “Student” into “Factors” box.
* Then click on “OK”.
* The result will appear on “Session Window”.

*OUTPUT RESULT:-*

**————— 6/29/2015 9:14:12 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**General Linear Model: Data versus Subjects, Students**

Factor Information

Factor Type Levels Values

Subjects Fixed 3 Economics, English, Statistics

Students Fixed 5 1, 2, 3, 4, 5

Analysis of Variance

Source DF Adj SS Adj MS F-Value P-Value

Subjects 2 595.6 297.8 2.93 0.111

Students 4 1329.7 332.4 3.27 0.072

Error 8 813.1 101.6

Total 14 2738.4

Model Summary

S R-sq R-sq(adj) R-sq(pred)

10.0813 70.31% 48.04% 0.00%

Coefficients

Term Coef SE Coef T-Value P-Value VIF

Constant 71.20 2.60 27.35 0.000

Subjects

Economics 0.60 3.68 0.16 0.875 1.33

English -8.00 3.68 -2.17 0.062 1.33

Students

1 -10.87 5.21 -2.09 0.070 1.60

2 13.47 5.21 2.59 0.032 1.60

3 -2.20 5.21 -0.42 0.684 1.60

4 -8.53 5.21 -1.64 0.140 1.60

Regression Equation

Data = 71.20 + 0.60 Subjects\_Economics - 8.00 Subjects\_English + 7.40 Subjects\_Statistics

- 10.87 Students\_1 + 13.47 Students\_2 - 2.20 Students\_3 - 8.53 Students\_4

+ 8.13 Students\_5

Fits and Diagnostics for Unusual Observations

Obs Data Fit Resid Std Resid

5 56.00 71.33 -15.33 -2.08 R

R Large residual

# *Q NO (3):-*

**Apply one sample Z-test to the following data:**

**16, 18, 23, 26, 19, 24, 25, 23, 21, 22:** **Assume** **μ=20 and σ=3.20**

***SOLUTION:-***

* First we will label “C1” as “x” in “Worksheet Window”.
* Enter the data in “x” column in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “Basic Statistics” and click on “1-Sample Z”.
* A dialogue box will appear, shift the “x” in the test variable box, and input the value of standard deviation in “Known Standard Deviation” box and population mean in “Hypothesized Mean” box.
* Then click on “Ok”.
* The result will appear on “Session window”.

***OUTPUT RESULT:-***

**————— 6/30/2015 8:26:35 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**One-Sample Z: x**

Test of μ = 20 vs ≠ 20

The assumed standard deviation = 3.2

Variable N Mean StDev SE Mean 95% CI Z P

x 10 21.70 3.20 1.01 (19.72, 23.68) 1.68 0.093

*Q NO (4):-*

**Apply one sample t-test to the following data:**

**1472, 1486, 1401, 1350, 1610, 1590: Assume μ = 1500?**

***SOLUTION:-***

* First we will label “C1” as “x” in “Worksheet Window”.
* Enter the data in “x” column in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “Basic Statistics” and click on “1-Sample t”.
* A dialogue box will appear, shift the “x” in the test variable box, and input the value of population mean in “Hypothesized Mean” box.
* Then click on “Ok”.
* The result will appear on “Session window”.\

***OUTPUT RESULT:-***

**————— 01-Jul-15 10:15:15 AM ————————————————————**

Welcome to Minitab, press F1 for help.

**One-Sample T: x**

Test of μ = 1500 vs ≠ 1500

Variable N Mean StDev SE Mean 95% CI T P

x 6 1484.8 102.1 41.7 (1377.7, 1592.0) -0.36 0.731

*Q NO (5):-*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Males** | **1293** | **1380** | **1614** | **1497** | **1340** | **1643** | **1466** | **1627** | **1383** | **1711** |
| **Females** | **1061** | **1065** | **1092** | **1017** | **1021** | **1138** | **1143** | **1094** | **1270** | **1028** |

**Apply two sample t-test to the following data: μ1 - μ2=350**

***SOLUTION:-***

* First we will label “C1” as “Males” and “C2” as “Females” in “Worksheet Window”.
* Enter the data in corresponding columns in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “Basic Statistics” and click on “2-Sample t”.
* A dialogue box will appear, select “Each sample in its own column” and shift “Males” in “Sample1” and “Females” in “Sample2” box
* Click on “Option” another dialogue box will appear, input the populations mean difference in “Hypothesized difference” and choose “Alternative Hypothesis” then click “OK
* Click on “OK”
* The result will appear on “Session Window”.

***OUTPUT RESULT:-***

**————— 01-Jul-15 11:10:00 AM ————————————————————**

Welcome to Minitab, press F1 for help.

**Two-Sample T-Test and CI: Males, Females**

Two-sample T for Males vs Females

SE

N Mean StDev Mean

Males 10 1495 146 46

Females 10 1092.9 76.6 24

Difference = μ (Males) - μ (Females)

Estimate for difference: 402.5

95% lower bound for difference: 310.2

T-Test of difference = 350 (vs >): T-Value = 1.01 P-Value = 0.166 DF = 13

# *Q NO (6):-*

**Apply paired t-test to the following data:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Pollinated** | **0.78** | **0.76** | **0.43** | **0.92** | **0.86** | **0.59** | **0.68** |
| **Non-pollinated** | **0.21** | **0.12** | **0.32** | **0.29** | **0.30** | **0.20** | **0.14** |

***SOLUTION:-***

* First we will label “C1” as “Pollinated” and “C2” as “Non-pollinated” in “Worksheet Window”.
* Enter the data in the corresponding column in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “Basic Statistics” and click on “Paired t”.
* A dialogue box will appear, and then shift “Pollinated” in “Sample1” and “Non-pollinated” in “Sample2” box.
* Click on “OK”.
* The result will appear on the “Session Window”.

# *OUTPUT RESULT:-*

**————— 02-Jul-15 9:49:06 AM ————————————————————**

Welcome to Minitab, press F1 for help.

**Paired T-Test and CI: Pollinated, Non-pollinated**

Paired T for Pollinated - Non-pollinated

N Mean StDev SE Mean

Pollinated 7 0.7171 0.1670 0.0631

Non-pollinated 7 0.2257 0.0796 0.0301

Difference 7 0.4914 0.1872 0.0708

95% CI for mean difference: (0.3183, 0.6646)

T-Test of mean difference = 0 (vs ≠ 0): T-Value = 6.95 P-Value = 0.000

*Q NO (7):-*

**Find the estimated regression line of the following data:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Fertilizer** | **0.3** | **0.6** | **0.9** | **1.2** | **1.5** | **1.8** | **2.1** | **2.4** |
| **Corn Yield** | **10** | **15** | **30** | **35** | **25** | **30** | **50** | **45** |

***SOLUTION:-***

* First we will label “C1” as “Fertilizer” and “C2” as “Corn Yield” in “Worksheet Window”.
* Enter the data in the corresponding column in “Worksheet Window”.
* Then go to “Tool Bar” clicks on “Stat”, select “Regression” and click on “Fitted Line Plot”.
* A dialogue box will appear, shift “Corn Yield” in “response (Y)” and “Fertilizer” in “Predictor (X)” box, and then click on “Graphs”.
* Another dialogue box will appear, select the required graph and click “OK”.
* Then click “OK”.
* The result will appear on the “Session Window”.

***OUTPUT RESULT:-***

**————— 02-Jul-15 10:26:11 AM ————————————————————**

Welcome to Minitab, press F1 for help.

**Regression Analysis: Corn Yield versus Fertilizer**

The regression equation is

Corn Yield = 8.036 + 16.27 Fertilizer

S = 7.06405 R-Sq = 77.0% R-Sq(adj) = 73.1%

Analysis of Variance

Source DF SS MS F P

Regression 1 1000.60 1000.60 20.05 0.004

Error 6 299.40 49.90

Total 7 1300.00

******

# *Q NO (8):-*

**Use one sample “Sign-test” to the following data:**

**2.55, 4.62, 2.93, 2.46, 1.95, 4.55, 3.11, 0.90: Median=2**

***SOLUTION:-***

* First enter the data in column “C1” in “Worksheet Window”.
* Go to “Tool Bar” clicks on “Stat” select “Non-Parametric” and click on “1-Sample Sign”.
* A dialogue box will appear, shift “C1” in “Variables” box and input the median value in “Test median” box.
* Click “OK”.
* The result will appear on the “Session Window”.

***OUTPUT RESULT:-***

**————— 02-Jul-15 10:59:47 AM ————————————————————**

Welcome to Minitab, press F1 for help.

**Sign Test for Median: C1**

Sign test of median = 2.000 versus ≠ 2.000

N Below Equal Above P Median

C1 8 2 0 6 0.2891 2.740

***Q NO (9):-***

**Perform the “Mann-Whitney U” test on the following data:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group 1** | **31** | **28** | **42** | **36** | **29** | **51** | **34** | **25** | **44** | **33** | **49** |
| **Group 2** | **27** | **45** | **30** | **53** | **41** | **39** | **48** | **43** | **26** | **37** |  |

***SOLUTION:-***

* First we will label “C1” as “Group 1” and “C2” as “Group 2” in “Worksheet Window”.
* Enter the data in the corresponding column in “Worksheet Window”.
* Go to “Tool Bar” clicks on “Stat”, select “Non-Parametric” and click on “Mann-Whitney”.
* A dialogue box will appear, then shift “Group 1” in “First Sample and Group 2” in “Second Sample” box.
* Click on “OK”.
* The result will appear on the “Session Window”.

***OUTPUT RESULT:-***

**————— 03-Jul-15 12:01:31 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**Mann-Whitney Test and CI: Group 1, Group 2**

N Median

Group 1 11 34.00

Group 2 10 40.00

Point estimate for η1 - η2 is -2.50

95.5 Percent CI for η1 - η2 is (-12.01,6.00)

W = 113.0

Test of η1 = η2 vs η1 ≠ η2 is significant at 0.5974

# *Q NO (10):-*

**Apply “Kruskal-Wallis H” test on the following data:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group A** | **80** | **88** | **87** | **86** | **90** | **88** | **85** |  |  |  |
| **Group B** | **99** | **91** | **98** | **98** | **99** | **96** | **92** | **98** |  |  |
| **Group C** | **89** | **82** | **81** | **80** | **86** | **86** | **86** | **84** |  |  |
| **Group D** | **76** | **77** | **75** | **78** | **76** | **73** | **71** | **80** | **75** | **80** |

***SOLUTION:-***

* First we will label “C1” as “Data” and “C2” as “Groups” in “Worksheet Window”.
* Enter the data in the “Data” column and enter the corresponding group number in the “Groups” column “Worksheet Window”.
* Go to “Tool Bar” clicks on “Stat”, select “Non-Parametric” and click on “Kruskal-Wallis”.
* A dialogue box will appear, and then shift “Data” in the “Response” and “Groups” in the “Factor” box.
* Click on “OK”.
* The result will appear on the “Session Window”.

***OUTPUT RESULT:-***

**————— 03-Jul-15 12:50:31 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**Kruskal-Wallis Test: Data versus Groups**

Kruskal-Wallis Test on Data

Groups N Median Ave Rank Z

A 7 87.00 19.4 0.75

B 8 98.00 29.5 4.20

C 8 85.00 16.5 -0.17

D 10 76.00 5.7 -4.43

Overall 33 17.0

H = 27.49 DF = 3 P = 0.000

H = 27.62 DF = 3 P = 0.000 (adjusted for ties)

***Q NO (11):-***

**Apply “Runs-test” to the following data:**

**13.0, 12.8, 12.9, 13.0, 13.1, 12.9, 12.6, 12.6, 12.7, 12.9, 13.1, 13.1, 13.2, 13.3, 13.2, 13.1, 12.9, 13.2, 13.3, 13.2?**

***SOLUTION:-***

* Enter the data in “C1” column in “Worksheet Window”.
* Go to “Tool Bar” clicks on “Stat”, select “Non-parametric” and click on “Runs test”.
* A dialogue box will appear, shift “C1” in “Variables”.
* Click “Ok”.
* The result will appear on the “Session Window”.

***OUTPUT RESULT:-***

**————— 04-Jul-15 9:45:50 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**Runs Test: C1**

Runs test for C1

Runs above and below K = 13.005

The observed number of runs = 6

The expected number of runs = 11

10 observations above K, 10 below

\* N is small, so the following approximation may be invalid.

P-value = 0.022

*Q NO (12):-*

**Apply “Median test” to the following data:**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample1** | **38** | **49** | **45** | **29** | **31** | **35** |  |  |  |
| **Sample2** | **31** | **42** | **22** | **26** | **43** | **37** | **25** | **30** | **47** |

***SOLUTION:-***

* First we will label “C1” as “Data” and “C2” as “Sample. No” in “Worksheet Window”.
* Enter the data in “Data” column and enter the sample number in “Sample. No” column corresponding to the sample in “Worksheet Window”.
* Go to “Tool Bar” clicks on “Stat”, select “Non-parametric” and click on “Mood’s Median Test”.
* A dialogue box will appear, shift “Data” in “Response” box and shift “Sample. No” to “Factor” box.
* Click on “OK”.
* The result will appear on the “Session Window.

***OUTPUT RESULT:-***

**————— 04-Jul-15 9:45:50 PM ————————————————————**

Welcome to Minitab, press F1 for help.

**Mood Median Test: Data versus Sample. No**

Mood median test for Data

Chi-Square = 0.04 DF = 1 P = 0.833

Sample. Individual 95.0% CIs

No N≤ N> Median Q3-Q1 ----+---------+---------+---------+--

1 3 3 36.5 15.5 (---------\*---------------)

2 5 4 31.0 17.0 (-------\*----------------)

----+---------+---------+---------+--

28.0 35.0 42.0 49.0

Overall median = 35.0

A 95.0% CI for median(1) - median(2): (-11.3,19.6)

*Q NO (13):-*

**Apply “Chi-Square test” to the following data:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Categories** | **Math’s** | **Chemistry** | **Physics** |
| **Music** | **24** | **83** | **17** |
| **Craftwork** | **11** | **62** | **28** |
| **Drama** | **32** | **121** | **34** |
| **Reading** | **10** | **26** | **44** |

***SOLUTION:-***

* First we will label “C1” as “Data”, “C2” as “Subjects” and “C3” as “Interest” in “Worksheet Window”.
* Enter the data in “Data” column and enter the corresponding subjects and interest in the “Subjects” and “Interest” column in “Worksheet Window”.
* Go to the “Tool Bar” clicks on “Stat”, select “Tables” and Click on “Chi-Square Test for Association”.
* A dialogue box will appear, shift “Interest” in “Rows” box and shift “Subjects” in “Columns” box.
* Click “OK”.
* The result will appear on “Session Window”.

***OUTPUT RESULT:-***

**————— 08-Jul-15 8:34:11 AM ————————————————————**

Welcome to Minitab, press F1 for help.

**Chi-Square Test for Association: Interests, Subjects**

Rows: Interests Columns: Subjects

Chemistry Math’s Physics All

Craftwork 2 1 0 3

1 1 1

1 0 -1

Drama 0 0 3 3

1 1 1

-1 -1 2

Music 0 3 0 3

1 1 1

-1 2 -1

Reading 2 0 1 3

1 1 1

1 -1 0

All 4 4 4 12

Cell Contents: Count

Expected count

Residual

Pearson Chi-Square = 16.000, DF = 6, P-Value = 0.014

Likelihood Ratio Chi-Square = 18.729, DF = 6, P-Value = 0.005

\* NOTE \* 12 cells with expected counts less than 5

# *Q NO (14):-*

**Find the inverse of the following matrix:**

**A= 1 2 3**

**2 3 1**

**3 1 2**

***SOLUTION:-***

* First go to the “Tool Bar” Clicks on the “Editor” and then click “Enable Command” a cursor will appear in “Session Window”.
* Then go to the “Tool Bar” Clicks on the “Calc” select “Matrices” and click on “Read”.
* A dialogue box will appear, Input number of rows and columns in the required boxes and input the name of a matrix in “Read into matrix” box then click “OK”.
* The cursor again appears in “Session Window”, and then input the first row elements by giving space and press “Enter” for the input of the second row elements and so forth.
* Go to the “Tool Bar” clicks on “Data” and click on “Display data”, a dialogue box will appear, shift “A” in the box and click “OK”; matrix “A” will appear in “Session Window”.
* Then go to the “Tool Bar” Clicks on the “Calc” select “Matrices” and click on “Invert”.
* A dialogue box will appear, Shift “A” in “Invert from” box and input name of inversed matrix in “Store result in” box, and then click “OK”.
* Go to the “Tool Bar” clicks on “Data” and click on “Display data”, a dialogue box will appear, shift “B” in the box and click “OK”.
* The matrix “B” will appear in “Session Window”.

***OUTPUT RESULT:-***

**————— 20-Jul-15 4:25:25 AM ————————————————————**

Welcome to Minitab, press F1 for help.

MTB > Name m1 "A"

MTB > Read 3 3 'A'.

DATA> 1 2 3

DATA> 2 3 1

DATA> 3 1 2

3 rows read.

MTB > Print 'A'.

**Data Display**

Matrix A

1 2 3

2 3 1

3 1 2

MTB > Name m2 "B"

MTB > Invert 'A' 'B'.

MTB > Print 'A'.

**Data Display**

Matrix A

1 2 3

2 3 1

3 1 2

MTB > Print 'B'.

**Data Display**

Matrix B

-0.277778 0.055556 0.388889

0.055556 0.388889 -0.277778

0.388889 -0.277778 0.055556

# *Q NO (15):-*

**Find the Eigen values of the following matrix:**

**A= 1 2 3**

**2 3 1**

**3 1 2**

***SOLUTION:-***

* First go to the “Tool Bar” Clicks on the “Editor” and then click “Enable Command” a cursor will appear in “Session Window”.
* Then go to the “Tool Bar” Clicks on the “Calc” select “Matrices” and click on “Read”.
* A dialogue box will appear, Input number of rows and columns in the required boxes and input the name of a matrix in “Read into matrix” box then click “OK”.
* The cursor again appears in “Session Window”, and then input the first row elements by giving space and press “Enter” for the input of the second row elements and so forth.
* Go to the “Tool Bar” clicks on “Data” and click on “Display data”, a dialogue box will appear, shift “A” in the box and click “OK”; matrix “A” will appear in “Session Window”.
* Then go to the “Tool Bar” Clicks on the “Calc” select “Matrices” and click on “Eigen Analysis”.
* A dialogue box will appear, shift “A” in “Analyze matrix” box and input the column number in “Storage column of Eigen values” and the name of Eigen vectors in “Matrix of eigenvectors” box, and then click on “OK”.
* The matrix Eigen vectors will appear in “Session Window” and Eigen values will appear in “Worksheet Window”.

***OUTPUT RESULT:-***

**————— 20-Jul-15 4:37:04 AM ————————————————————**

Welcome to Minitab, press F1 for help.

MTB > Name m1 "A"

MTB > Read 3 3 'A'.

DATA> 1 2 3

DATA> 2 3 1

DATA> 3 1 2

3 rows read.

MTB > Print 'A'.

**Data Display**

Matrix A

1 2 3

2 3 1

3 1 2

MTB > Name m2 "B"

MTB > Eigen 'A' C10 'B'.

MTB > Print 'B'.

**Data Display**

Matrix B

-0.577350 0.211325 0.788675

-0.577350 -0.788675 -0.211325

-0.577350 0.577350 -0.577350

MTB >

# Eigen Values

6.00000

1.73205

-1.73205