SRM VALLIAMMAI
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

SRM Nagar, Kattankulathur - 603 203,

Approved by AICTE, Affiliated to Anna University,
Accredited by NBA 'A' Grade Accreditation by NAAC,
ISO 9001: 2015 Certified

DEPARTMENT OF MANAGEMENT STUDIES

REGULATION 2023

LAB MANUAL

BA3241 – DATA ANALYSIS AND BUSINESS MODELING LABORATORY

FIRST YEAR - SECOND SEMESTER

CODE	COURSE TITLE	L	T	P	C
BA 3241	DATA ANALYSIS AND BUSINESS MODELLING LABORATORY	0	0	4	2

Exp. No	Title of the Experiment	Duration
1	Descriptive Statistics	4
2	Hypothesis Testing – Parametric Test	4
3	Hypothesis Testing – Non-Parametric Test	4
4	Correlation & Regression	4
5	Forecasting	4
6	Forecasting: Extended experiment – 1	4
7	Portfolio Selection	4
8	Risk Analysis & Sensitivity Analysis	4
9	Revenue Management	4
10	Revenue Management: Extended experiment – 2	4
11	Transportation & Assignment	4
12	Networking Models	4
13	Queuing Theory	4
14	Inventory Models	4
15	Inventory Models: Extended experiments – 3	4
	TOTAL HOURS:	**60**

- Spreadsheet Software and
- Data Analysis Tools

TOTAL: 60 PERIODS

REQUIREMENTS for a batch of 30 students

1. Personal Computers – 30 Numbers
2. Any licensed Spreadsheet and Analysis software like Microsoft Excel, SPSS etc. – 30 users Licenses

TEXT BOOKS

1. David M. Levine et al, “Statistics for Managers using MS Excel’ (6th Edition) Pearson, 2010
2. David R. Anderson, et al, ‘An Introduction to Management Sciences: Quantitative approaches to Decision Making, (13th edition) South-Western College Pub, 2011.
3. Hansa Lysander Manohar, “Data Analysis and Business Modelling using MS Excel, PHI Learning private Ltd, 2017
4. William J. Stevenson, Ceyhun Ozgur, ‘Introduction to Management Science with Spreadsheet’, Tata McGraw Hill, 2009.
5. Wayne L. Winston, Microsoft Excel 2010: Data Analysis & Business Modeling, 3rd edition, Microsoft Press, 2011.
6. Vikas Gupta, Comdex Business Accounting with Ms Excel, 2010 and Tally ERP 9.0 Course Kit, Wiley India, 2012
7. Kiran Pandya and Smriti Bulsari, SPSS in simple steps, Dreamtech, 2011

EXPERIMENT NO: 1 – DESCRIPTIVE STATISTICS

Question:

Create demographic factors for the employees of an organisation (say EmpId, EmpName, Gender, Income, Marital status) and find the level of dispersion and distribution using SPSS.

Aim: To display dispersion and distribution of the provided data using descriptive statistics in SPSS

Procedure:

1. Open a new SPSS file with type in data option
2. Type the provided data in a single column in data view
3. Go to descriptive statistics option in Analyse menu and choose descriptive in it
4. Check out the needed options in the dialog box that appears after shifting the data into variables box
5. Note down the output available in SPSS output screen

Input (In Variable view)

Name	Type	Width	Decimal	Values
EmpName	String	14	0	None
EmpId	Numeric	8	2	None
Gender	Numeric	8	2	{1,Male 2,Female}
Age	Numeric	8	2	None
Income	Numeric	8	2	None
Marital	Numeric	8	2	{1 – Unmarried, 2 – Married, 3 - Divorced}

Input (In Data view)

EmpName	EmpId	Gender	Age	Income	Marital
A	1	MALE	30	15000	UNMARRIED
B	2	MALE	32	13000	MARRIED
C	3	MALE	35	16000	MARRIED
D	4	FEMALE	45	25000	MARRIED
E	5	FEMALE	23	13000	UNMARRIED
F	6	FEMALE	21	12000	UNMARRIED
G	7	MALE	24	15000	UNMARRIED
H	8	FEMALE	35	30000	MARRIED
I	9	MALE	22	14000	UNMARRIED
J	10	MALE	28	29000	DIVORCED

Output:

Descriptive Statistics							
	N	**Range**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Variance**
	Statistic	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**	**Statistic**
EMPID	10	9	1	10	5.5	3.02765	9.166667
GENDER	10	1	1	2	1.4	0.516398	0.266667
AGE	10	24	21	45	29.5	7.531416	56.72222
INCOME	10	18000	12000	30000	18200	6972.964	48622222
MARITAL	10	2	1	3	1.6	0.699206	0.488889
Valid N (list wise)	10						

Result:

Thus dispersion and distribution of the provided data is done through descriptive statistics in SPSS software.

EXPERIMENT NO: 2 HYPOTHESIS TESTING

PARAMETRIC TEST – 1: ANOVA

ANOVA 1 & 2

Question:

A Study compared the effects of four 1-month point–of-purchase promotion on sales. The unit sales for five stores using all four promotions in different month follow.

		Store				
		I	**II**	**III**	**IV**	**V**
Sales Promotion Types	**Free sample**	78	87	81	89	85
	One pack gift	94	91	87	90	88
	Cents off	73	78	69	83	76
	Refund by mail	79	83	78	69	81

a) Use one way ANOVA to determine whether different promotions produce different effects on sales? Significance level 0.05
b) Use two way ANOVA to determine effects of sales due to sales promotion and various store

Hypothesis:

One way ANOVA

H0: Different promotions do not produce different effects on sales

Two way ANOVA

Rows : H_0 : Different promotions do not produce different effects on sales

Columns : H_0 : Different stores do not produce different effects on sales

Algorithm

One-way Anova:

1. Input the data in DATA VIEW after defining the variables in VARIABLE VIEW
2. Click on ANALYZE at the SPSS menu bar
3. Click on COMPARE MEANS
4. Click on ONE-WAY ANOVA
5. Select the appropriate variable as the dependent variable and take it to the right hand side box called DEPENDENT LIST, then select another appropriate variable as a factor(independent variable) that appears from the list of the variables on the left hand side of the box and click it towards the arrow directing to the FACTOR box
6. Then click OPTION followed by DESCRIPTIVES.Click CONTINUE to return to the main dialog box
7. Click OK to get the output for one-way ANOVA

Two way Anova:

1. Input the data in DATA VIEW after defining the variables in VARIABLE VIEW
2. Click on ANALYZE at the SPSS menu bar
3. Click on GENERAL LINEAR MODEL followed by UNIVARIATE
4. Take the appropriate variable as the dependent variable box,then select another appropriate two variable as FIXED FACTORS. The independent variable is the first factor and the block variable is second factor
5. Then click MODEL followed by CUSTOM
6. Take both the factors one by one to the right hand side box called MODEL
7. Click CONTINUE to return to the main dialog box
8. Click OK to get the output for two-way ANOVA

Outputs:

ONE WAY ANOVA

Frequency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	49412.346	3	16470.782	1028.087	.000
Within Groups	26194.027	1635	16.021		
Total	75606.373	1638			

H0 is rejected p value is less than significance level

TWO WAY ANOVA

Tests of Between-Subjects Effects

Dependent Variable: frequency

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	55714.349(a)	7	7959.193	652.595	.000
Intercept	10994805.843	1	10994805.843	901493.387	.000
Store	6302.003	4	1575.501	129.179	.000
Sales promotion	49705.472	3	16568.491	1358.495	.000
Error	19892.024	1631	12.196		
Total	11238889.000	1639			
Corrected Total	75606.373	1638			

a R Squared = .737 (Adjusted R Squared = .736)

H0 is rejected p value is less than significance level for both column and rows.

PARAMETRIC TEST-2: T - Test

Question:

1. Is there a difference between health service and educational service workers in the amount of compensation employers pay them per hour? Use a t- test to determine whether these population are different in employee compensation (Significance level of 0.05)
   Independent Sample test

Health service Worker	Educational service Worker
20.10	26.19
19.80	23.88
22.36	25.50
18.75	21.64
21.90	24.85
22.96	25.30
20.75	24.12

2. A company selects 8 salesmen at random and their sales figure for previous month is recorded. They then undergo a training course and their sales figure for the following month is compared as shown in table. Has the training course caused any improvement?

Previous Month	75	90	94	95	100	90	70	64
Following Month	77	101	93	92	105	88	76	68

Aim:

To solve the question and test the hypothesis in SPSS

Procedure

Type in the data for the problem. Data should be in numerical

T-test (independent sample)

Null Hypothesis (H_0) : There is no difference between health service and educational service workers in the amount of compensation employers pay them per hour

1. Click on ANALYZE at the SPSS menu bar
2. Click on COMPARE MEANS followed by 'Independent sample t-test'
3. Select the test variable for which this test is to be done by clicking on the arrow after highlighting the appropriate variable to transfer it from left to right
4. Select the GROUPING VARIABLE in the same way and transfer it to right side box.
5. Then define the codes for the two groups by clicking on DEFINE GROUPS just below the GROUPING VARIABLE and typing the codes
6. Click OK to get the output for an independent sample t-test

Paired sample t-test

Null Hypothesis (H_0) : There is no difference in sales figure before & after training course

1. Click on COMPARE MEANS followed by 'paired sample t-test'
2. Select two variables from the variable list appearing on the left side. These should be transferred to the box on the right by clicking on the arrow
3. Click OK to get desired output

Result: Thus the provided questions were solved and hypothesis were tested.

Output:

Independent Sample test

	Levene's Test		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Diff	Std. Error Difference	95% Confidence Interval of the Difference	
COMPENSATION								Upper	Lower
Equal variances assumed	0.12	0.73	-4.41	12	0.001	-3.55	0.804	-5.304	-1.799
Equal variances not assumed			-4.41	11.99	0.001	-3.55	0.804	-5.304	-1.799

Paired Sample

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		Mean	Std. Dev	Std. Error Mean
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Previous month Following month	-2.75	4.713203	1.666	-6.69	1.19	-1.65	7	0.142

EXPERIMENT NO: 3 HYPOTHESIS TESTING

NON-PARAMETRIC TEST - 1

1. Use Chi-square to test the relationship between source of information of a Product A and experience of the respondent in his work life using the product. Give your inference

	Source				
Experience	**Friends**	**Agent**	**Advt.**	**Expo**	**Total**
Up to five years	8	4	23	9	44
6-10 years	18	4	12	12	46
11-15 years	3	3	24	12	42
16-20 years	2	3	6	4	15
21-25 years	8	3	6	14	31
Above 25 years	1	1	6	14	22
Total	**40**	**18**	**77**	**65**	**200**

2. Use Kolmogorov -smirnov test to study the relationship between rank and factors influencing the purchase of machinery among the respondents.

Rank ⇨ Factor Influencing ⇩ Purchase	1	2	3	4	5	6	Total score	Weighted Average
Price	252	190	72	126	44	38	722	3.61
Quality	228	100	160	96	70	35	689	3.45
Brand Name	168	160	170	90	82	25	701	3.51
Warranty	192	195	112	132	64	25	720	3.60

Aim: To find the relationship between the variables with Chi-Square, Kolmogorov smirnov in SPSS.

Hypothesis: H0: There is no difference in using a product based on source or information and experience of respondents in his/her work-life

Algorithm for Chi-Square:

1. Input the data in DATA VIEW after defining the variables in VARIABLE VIEW
2. Click on the DATA option in the MENU BAR and select WEIGHT CASES option
3. Click on WEIGHT CASES BY and include DATA as the FREQUENCY VARIABLE and Click OK.
4. Click on ANALYZE at the SPSS menu bar
5. Click on DESCRIPTIVE STATISTICS followed by CROSS TABS
6. Select the row variable for a cross tabulation by highlighting it in the variable list on the left side and clicking on the arrow leading to the row variable. Similarly, select the variable you wish to be the column variable in cross-tabulation
7. Click on STATISTICS in the main dialog box. Then click on ‘Chi-square’.
8. Click OK to get the output

Hypothesis: H0: There is no significant difference in ranking and factors to influence the purchase of the machinery

Algorithm for Kolmogorov smirnov:

1. Open a new SPSS page
2. Define the variables in the variable view of SPSS application screen along with the coding assigned for each variable.
3. Input the data for the variables in the data view
4. Testing of chi-square(Analyze→Nonparametric→1-Sample K-S→Move all variables into test variable column→Go to Options→Chose Descriptive→continue→Ok)

Outputs:

Chi-Square test:

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	40.604(a)	15	.000
Likelihood Ratio	39.723	15	.000
Linear-by-Linear Association	7.663	1	.006
N of Valid Cases	200		

a 9 cells (37.5%) have expected count less than 5. The minimum expected count is 1.35.

Ho is rejected.

Kolmogrov smirnov test:

One-Sample Kolmogorov-Smirnov Test

		Frequency	Factor Rank	Purchase Influence
N		2826	2826	2826
Normal Parameters(a,b)	Mean	153.83	2.65	2.50
	Std. Deviation	60.219	1.487	1.127
Most Extreme Differences	Absolute	.148	.194	.172
	Positive	.077	.194	.171
	Negative	-.148	-.134	-.172
Kolmogorov-Smirnov Z		7.851	10.324	9.144
Asymp. Sig. (2-tailed)		.000	.000	.000

a Test distribution is Normal. b Calculated from data.

H0 is rejected.

Result: Thus the relationship between variables were analysed through modules of SPSS

NON-PARAMETRIC TEST - 2

1. Is there a difference between health service and educational service workers in the amount of compensation employers pay them per hour? Use a Mann-Whitney U test to determine whether these population are different in employee compensation(Significance level of 0.05)

Health service Worker	Educational service Worker
20.10	26.19
19.80	23.88
22.36	25.50
18.75	21.64
21.90	24.85
22.96	25.30
20.75	24.12
	23.45

2. A Study compared the effects of four 1-month point–of-purchase promotion on sales. The unit sales for five stores using all four promotions in different month follow.

		Store				
		I	II	III	IV	V
Sales Promotion Types	Free sample	78	87	81	89	85
	One pack gift	94	91	87	90	88
	Cents off	73	78	69	83	76
	Refund by mail	79	83	78	69	81

Use the Kruskal-Wallis test to determine whether all five stores data are different populations. Significance level 0.05

Aim: To find the relationship between the variables using SPSS

Hypothesis: There is difference between health service and educational service workers in the amount of compensation employers pay them per hour

Algorithm for Mann-Whitney U test

1. Input the data in DATA VIEW after defining the variables in VARIABLE VIEW
2. Click on ANALYZE at the SPSS menu bar
3. Click on NON-PARAMETRIC STATISTICS followed by TWO INDEPENDENT SAMPLES
4. Take a test variable on the right hand box and the coded grouping variable in bot labeled GROUPING VARIABLES followed by define groups, which should be the coded values entered in variable view
5. Click MANN-WHITNEY U TEST
6. Click OK

KRUSKAL WALLIS TEST:

Hypothesis:

H0: All five stores data are from same population

Algorithm:

1. Input the data in DATA VIEW after defining the variables in VARIABLE VIEW
2. Click on ANALYZE at the SPSS menu bar
3. Click on NON-PARAMETRIC STATISTICS followed by K INDEPENDENT SAMPLE
4. Take the test variable to the right hand side box and below that click the box of DEFINE GROUPS and give the coded value from minimum to maximum
5. Click KRUSKAL WALLIS TEST
6. Click OK

Output:

Mann-Whitney U test:

Test Statistics(b)

	Compensation
Mann-Whitney U	3.000
Wilcoxon W	31.000
Z	-2.893
Asymp. Sig. (2-tailed)	.004
Exact Sig. [2*(1-tailed Sig.)]	.002(a)

a Not corrected for ties.
b Grouping Variable: workerjob

H0 is rejected.

KRUSKAL WALLIS

Test Statistics(a,b)

	store
Chi-Square	1358.994
Df	13
Asymp. Sig.	.000

a Kruskal Wallis Test
b Grouping Variable: frequency

H0 is rejected p value is less than significance level

Result: Thus the relationship between the variables is tested in SPSS

EXPERIMENT NO: 4 CORRELATION AND REGRESSION

Question:

Consider the data on the quantity demanded and the price of a commodity over a ten year period as given in the following table. Estimate the correlation coefficient find a 95 percent approx prediction interval for demand when price equals 8.

Year	Demand	Price
1996	100	5
1997	75	7
1998	80	6
1999	70	6
2000	50	8
2001	65	7
2002	90	5
2003	100	4
2004	110	3
2005	60	9

Aim: To find correlation coefficient and the regression output for the provided problem using SPSS

Procedure:

Correlation

1. Type the data along with variable labels and value labels in SPSS file
2. Click on ANALYZE at the SPSS menu bar
3. Click on CORRELATE followed by BIVARIATE
4. On the dialog box which appears select all the variables for which the correlation are required by clicking on the right arrow to transfer them from the variable list on the left. Then select person under the heading correlation coefficients and select 2-tailed under the test of significance.
5. Click OK to get the matrix of the pair wise Pearson correlations among all the variables selected, along with the two tailed significance of each pair wise correlation.

Regression

1. Type the data along with variable labels and value labels in SPSS file
2. Click on ANALYZE at the SPSS menu bar
3. Click on REGRESSION followed by LINEAR
4. In the dialog box which appears select a dependent variable by clicking on the arrow leading to the dependent box after highlighting the appropriate variable from the list of the variables on the left side
5. Select from the independent variables to be included in the regression model in the same way transferring them from left side to right side box by clicking on the arrow leading to the box called independent variable or independents
6. In the same dialog box select the METHOD
7. Select OPTIONS if you want additional output options, select the ones you want and click CONTINUE
8. Click OK from the main dialog box to get the REGRESSION output

Result: Thus correlation coefficient and regression was solved using SPSS

Output:

Correlations

		Demand	price
Demand	Pearson Correlation	1	-.933(**)
	Sig. (2-tailed)		.000
	N	10	10
Price	Pearson Correlation	-.933(**)	1
	Sig. (2-tailed)	.000	
	N	10	10

** Correlation is significant at the 0.01 level (2-tailed).

Regression:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.933(a)	.870	.853	7.500

a Predictors: (Constant), price

ANOVA (b)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3000.000	1	3000.000	53.333	.000(a)
	Residual	450.000	8	56.250		
	Total	3450.000	9			

a Predictors: (Constant), price
b Dependent Variable: demand

Coefficients (a)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta	B	Std. Error
1	(Constant)	140.000	8.551		16.372	.000
	Price	-10.000	1.369	-.933	-7.303	.000

a Dependent Variable: demand

EXPERIMENT NO: 5 - FORECASTING

Question: From the provided data for 6 weeks forecast demand for 7th week. Display the result using moving average, naïve method and weighted moving average with period of 2.

Week	Sales
Jan 3	100
Jan 10	120
Jan 17	110
Jan 24	105
Jan 31	110
Feb 7	120

Aim: To forecast sales for next period with moving average, weighted moving and naïve methods using POM-QM software

Procedure:

1. Select the module from the menu bar(In our case its Forecasting)
2. Open a new sheet with Time series analysis
3. Provide title for the problem and Number of past periods(In our case its 6)
4. Enter Period name and Demand that is provided in question and choose the method as moving average and click solve
5. Note the output of moving average
6. Go for edit data, choose the method as weighted moving average and provide weight for the period(say,0.65 for 1 period ago and 0.35 for 2 period ago) and click solve
7. Note the output of weighted moving average
8. Go for edit data, choose the method as Naïve method and click solve
9. Note the output of Naïve method

Output:

Moving average method:

MOVING AVERAGE						
	Demand(y)	Forecast	Error	|Error|	Error^2	|Pct Error|
Jan-03	100					
Jan-10	120					
Jan-17	110	110	0	0	0	0
Jan-24	105	115	-10	10	100	0.1
Jan-31	110	107.5	2.5	2.5	6.25	0.02
Feb-07	120	107.5	12.5	12.5	156.25	0.1
TOTALS	665		5	25	262.5	0.22
AVERAGE	110.83		1.25	6.25	65.63	0.06
Next period forecast		115	(Bias)	(MAD)	(MSE)	(MAPE)
				Std err	11.46	

Weighted Moving Average:

WEIGHTED MOVING AVERAGE						
	Demand(y)	Forecast	Error	|Error|	Error^2	|Pct Error|
Jan-03	100					
Jan-10	120					
Jan-17	110	113	-3	3	9	0.03
Jan-24	105	113.5	-8.5	8.5	72.25	0.08
Jan-31	110	106.75	3.25	3.25	10.56	0.03
Feb-07	120	108.25	11.75	11.75	138.06	0.1
TOTALS	665		3.5	26.5	229.88	0.24
AVERAGE	110.83		0.88	6.63	57.47	0.06
Next period forecast		116.5	(Bias)	(MAD)	(MSE)	(MAPE)
				Std err	10.72	

Naïve method:

NAIVE						
	Demand(y)	Forecast	Error	|Error|	Error^2	|Pct Error|
Jan-03	100					
Jan-10	120	100	20	20	400	0.17
Jan-17	110	120	-10	10	100	0.09
Jan-24	105	110	-5	5	25	0.05
Jan-31	110	105	5	5	25	0.05
Feb-07	120	110	10	10	100	0.08
TOTALS	665		20	50	650	0.43
AVERAGE	110.83		4	10	130	0.09
Next period forecast		120	(Bias)	(MAD)	(MSE)	(MAPE)
				Std err	14.72	

Result: Thus forecasting for next period is done through the models through three methods

EXPERIMENT NO: 6 – FORECASTING (EXTENDED EXPERIMENT – 1)

Question:

From the provided data for 6 weeks forecast demand for 7th week. Display the result using exponential smoothing and exponential smoothing with trend.

Week	Sales
Jan 3	100
Jan 10	120
Jan 17	110
Jan 24	105
Jan 31	110
Feb 7	120

Aim: To forecast sales for next period through exponential smoothing and trend analysis

Procedure:

1. Select the module from the menu bar(In our case its Forecasting)
2. Open a new sheet with Time series analysis
3. Provide title for the problem and Number of past periods(In our case its 6)
4. Enter Period name and Demand that is provided in question and choose the method as exponential smoothing and enter the Alpha Value as 0.50 and then click on solve.
5. Note the output of exponential smoothing
6. Go for edit data, choose the method as Exponential Smoothing with Trend now enter the Alpha Value as 0.50 and Beta Value as 0.50 and then click on Solve
7. Note the output of Exponential Smoothing with Trend.

Result: Thus forecast sales for next period with exponential smoothing and Exponential Smoothing with Trend done using POM-QM software

Output:

Exponential Smoothing

(untitled) Solution						
	Demand(y)	Forecast	Error	|Error|	Error^2	|Pct Error|
Past period 1	100					
Past period 2	120	100	20	20	400	.17
Past period 3	110	110	0	0	0	0
Past period 4	105	110	-5	5	25	.05
Past period 5	110	107.5	2.5	2.5	6.25	.02
Past period 6	120	108.75	11.25	11.25	126.56	.09
TOTALS	665		28.75	38.75	557.81	.33
AVERAGE	110.83		5.75	7.75	111.56	.07
Next period forecast		114.38	(Bias)	(MAD)	(MSE)	(MAPE)
				Std err	13.64	

Trend Analysis

(untitled) Solution

	Demand(y)	Unadjusted forecast	Trend	Adjusted forecast	Error	|Error|	Error^2	|Pct Error|
January	100							
February	120	100	0	100	20	20	400	16.667%
March	110	110	5	115	-5	5	25	4.545%
April	105	110	2.5	112.5	-7.5	7.5	56.25	7.143%
May	110	107.5	0	107.5	2.5	2.5	6.25	2.273%
June	120	108.75	.625	109.375	10.625	10.625	112.891	8.854%
TOTALS	665				20.625	45.625	600.391	39.482%
AVERAGE	110.833				4.125	9.125	120.078	7.896%
Next perio...				117.5	(Bias)	(MAD)	(MSE)	(MAPE)
						Std err	14.147	

EXPERIMENT NO: 7 PORTFOLIO SELECTION

(MARKOWITZ MODEL)

Question: With the available portfolio select a best portfolio combination.

Month	Small Cap	LT Treasuries
1	0.1126	-0.0324
2	0.0452	0.0051
3	-0.0249	-0.0094
4	-0.0403	0.0016
5	-0.0014	0.0243
6	-0.0519	0.0200
7	0.0370	0.0398
8	-0.0228	0.0067
9	0.0131	0.0185
10	0.0259	0.0198
11	0.0885	0.0010
12	0.0441	0.0246

Aim: To select a best portfolio using Markowitz model

Procedure

1. Open an excel sheet.
2. Enter the expected returns of both the securities with corresponding month in separate columns
3. Calculate Mean return of both the securities using average function. Ex.(=Average(B8:B19))
4. Calculate correlation between the two securities using correlation function. Ex(=CORREL(B8:B19,C8:C19))
5. Enter various combination of the securities. Ex (100%Smallcap, 90%SmallCap10%LT Treasuries…)
6. Calculate risk for each combinations using Markowitz risk formula. Ex(=SQRT(E8^2*B22^2+F8^2*C22^2+2*B24*E8*F8*B22*C22)

   Risk=Sqrt((PropOfx^2*StdevOfX^2)+(PropOfY^2*StdevOfY^2)+(2*CorrXY*StdevOfX*StdevOfY*PropOfX*PropOfY))

7. Calculate Portfolio return by multiplying the prop of each security combination along with its corresponding Mean return

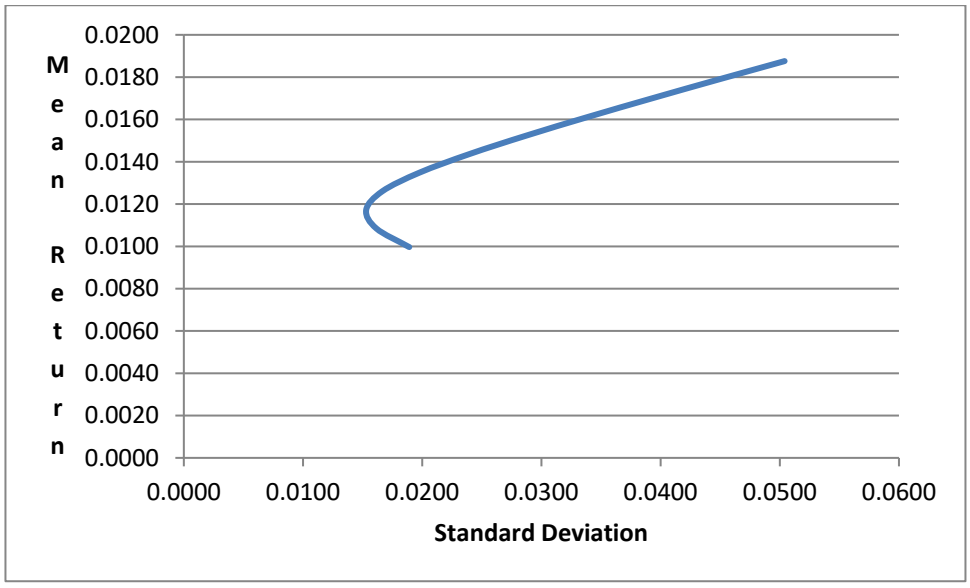
   Return=Prop of X * Mean Return of X + Prop of Y * Mean Return of Y

8. Compare risk and return of various combinations and select a better combination of portfolio

Result: Thus a better portfolio combination was selected with Markowitz model using Excel.

Output		
Mean	0.0188	0.0100
St. Dev.	0.0504	0.0189
Corr.	-0.3162	-0.3162

w1	1-w1	St. Dev	Mean
1.0	0.0	0.0504	0.0188
0.9	0.1	0.0448	0.0179
0.8	0.2	0.0393	0.0170
0.7	0.3	0.0339	0.0161
0.6	0.4	0.0288	0.0152
0.5	0.5	0.0240	0.0144
0.4	0.6	0.0198	0.0135
0.3	0.7	0.0167	0.0126
0.2	0.8	0.0153	0.0117
0.1	0.9	0.0162	0.0108
0.0	1.0	0.0189	0.0100



EXPERIMENT NO: 8 – RISK ANALYSIS AND SENSITIVITY ANALYSIS

(SCENARIO ANALYSIS THROUGH DATA TABLE)

Question

I am going to build a new house. The amount of money I need to borrow (with a 15-year repayment period) depends on the price for which I sell my current house. I'm also unsure about the annual interest rate I'll receive when I close. Can I determine how my monthly payments will depend on the amount borrowed and the annual interest rate? *using data table command

Aim: To determine how spreadsheet output vary with change in response to inputs with sensitivity analysis.

Procedure

1.Open a new excel sheet
2.Add Four columns that satisfies the requirement of the question(Amount borrowed, No of months, Annual Int. rate & Monthly payment)

3.Two rows later enter various combination of the amount intended to borrow

4.In columns enter the various possible interest rates
5.Select range of data inputs starting from least borrowing amount(first cell in data) to the highest rate & maximum borrowing(ending cell)

6.Click What-if-Analysis on the DATA tab and then click Data Table

7.Define column input cell(Annual Int. rate) and row input cell(Amount borrowed)
8.Resulting table displays monthly payment for various combinations of amount borrowed for various Annual Int. rates

Result: Thus provided problem was solved for various scenarios on how sensitive the outputs are for changing inputs using Data Table in Excel

Output:

Amount borrowed	2300000
No of months	240
Annual Int. rate	12%
Monthly Payment	Rs. 25,324.98

Rs. 25,324.98	8%	9%	10%	11%	12%
2350000	19656.34162	21143.56	22678.01	24256.42722	25875.52
2320000	19405.4096	20873.64	22388.5	23946.7707	25545.2
2300000	19238.12159	20693.7	22195.5	23740.33302	25324.98
2280000	19070.83357	20513.75	22002.49	23533.89535	25104.76
2270000	18987.18957	20423.78	21905.99	23430.67651	24994.66
2260000	18903.54556	20333.81	21809.49	23327.45767	24884.55
2250000	18819.90155	20243.83	21712.99	23224.23883	24774.44

SENSITIVITY ANALYSIS THROUGH SCENARIO MANAGER

Ques: Create best, worst, and most-likely scenarios for the sales of an automobile by varying the values of Year 1 sales, annual sales growth, and Year 1 sales price.

	Year1 sales	Annual sales growth	Year1 sales price
Best case	20000	20%	10
most likely case	10000	10%	7.5
worst case	5000	2%	5

For each scenario, you want to look at the firm's NPV and each year's after-tax profit.

Aim: To solve the provided problem of various scenarios using scenario manager in Excel

Procedure

1.Open a new excel file

2.Enter the input description in subsequent columns(taxrate,year1sales,salesgrowth,year1price,year1cost,intrate,costgrowth,pricegrowth)

3.Enter 5 years data

a. Unit sales basic data should be year1sales

b. Unit price basic data should be year1price

c. Unit cost basic data should be year1cost

d. For all the above inputs use growth rates available in input description corresponding column

e. Calculate after tax profits and NPV in a separate cell with formula(=NPV(Int. rate, After Tax Profit Range))

4.To begin defining the best case scenario, display the Data Tab and then click Scenario Manager on the What-if-Analysis menu in DATA Tools group, Then click the add button and fill in the Add scenario dialog box

5.Enter a name for the scenario and select input cells(year1sales,salesgrowth,year1price)

6.By clicking Add in scenario manager dialog box enter the data for most likely and worst case

7.In scenario manager click summary and in the result cells define range of after tax profits and NPV cell number separated by a comma

8.Result displayed as scenario summary report

Result: Thus provided problem was solved for various scenarios using scenario manager in Excel

Input & output:

INPUT		
	tax rate	0.4
	year1sales	20000
	sales growth	0.2
	year1price	10
	year1cost	6
	intrate	0.15
	costgrowth	0.05
	pricegrowth	0.03

year	1	2	3	4	5
Unit sales	20000	21000	22050	23152.5	24310.13
Unit price	7.5	7.725	7.95675	8.195453	8.441316
unit cost	6	6.3	6.615	6.94575	7.293038
revenues	150000	162225	175446.3	189745.2	205209.4
cost	120000	132300	145860.8	160811.5	177294.7
before tax profits	30000	29925	29585.59	28933.74	27914.8
tax	12000	11970	11834.24	11573.49	11165.92
After Tax profits	18000	17955	17751.35	17360.24	16748.88

npv	Rs. 59,153.46

Output:

Scenario Summary	Current Values:	Best	mostlikely	Worst
Changing Cells:				
C2	12000	20000	10000	5000
C3	0.05	0.2	0.1	0.02
C4	7.5	10	7.5	5
Result Cells:				
B17	10800	18000	9000	4500
C17	10773	17955	8977.5	4488.75
D17	10650.8115	17751.3525	8875.67625	4437.838125
E17	10416.14537	17360.24228	8680.121139	4340.06057
F17	10049.32645	16748.87742	8374.438708	4187.219354
B19	Rs. 35,492.08	Rs. 59,153.46	Rs. 29,576.73	Rs. 14,788.37

EXPERIMENT NO: 9 - REVENUE MANAGEMENT

INDUSTRY	SALES DATE	SALES UNITS	SALES PRICE (Rs.)
Agriculture	08-07-2012	5647	73.5
Manufacturing	09-07-2012	2537	130.84
Services	10-07-2012	846	21.99
Manufacturing	11-07-2012	455	137.39
Agriculture	12-07-2012	2467	7.85
Construction	13-07-2012	9345	280.69
Services	14-07-2012	3446	104.09
Agriculture	15-07-2012	8946	269.09
Manufacturing	16-07-2012	7346	221.41
Construction	17-07-2012	2744	83.29
Agriculture	18-07-2012	6957	208.69
Services	19-07-2012	2475	4.24
Manufacturing	20-07-2012	5455	17.03
Construction	21-07-2012	9244	277.54
Agriculture	22-07-2012	1057	28.41
Construction	23-07-2012	7757	233.33
Services	24-07-2012	2257	68.07
Manufacturing	25-07-2012	2055	62.37
Construction	26-07-2012	5657	168.87
Services	27-07-2012	1157	34.42

AIM: To manage the revenue of the set of provided data in Excel.

ALGORITHM:

1. Type the data in a fresh excel sheet
2. Calculate revenue in a separate column by multiplying sales unit and sales price
3. Sort the data on basis of industry
4. Use subtotal option and calculate subtotal of each industry

RESULT: Thus revenue of various sectors was managed through excel functions

OUTPUT:

INDUSTRY	SALES DATE	SALES UNITS	SALES PRICE (Rs.)	REVENUE (Rs.)
Agriculture	08-07-2012	5647	73.5	415054.5
Agriculture	12-07-2012	2467	7.85	19365.95
Agriculture	15-07-2012	8946	269.09	2407279.14
Agriculture	18-07-2012	6957	208.69	1451856.33
Agriculture	22-07-2012	1057	28.41	30029.37
Agriculture Total		**25074**		**4323585.29**
Construction	13-07-2012	9345	280.69	2623048.05
Construction	17-07-2012	2744	83.29	228547.76
Construction	21-07-2012	9244	277.54	2565579.76
Construction	23-07-2012	7757	233.33	1809940.81
Construction	26-07-2012	5657	168.87	955297.59
Construction Total		**34747**		**8182413.97**
Manufacturing	09-07-2012	2537	130.84	331941.08
Manufacturing	11-07-2012	455	137.39	62512.45
Manufacturing	16-07-2012	7346	221.41	1626477.86
Manufacturing	20-07-2012	5455	17.03	92898.65
Manufacturing	25-07-2012	2055	62.37	128170.35
Manufacturing Total		**17848**		**2242000.39**
Services	10-07-2012	846	21.99	18603.54
Services	14-07-2012	3446	104.09	358694.14
Services	19-07-2012	2475	4.24	10494
Services	24-07-2012	2257	68.07	153633.99
Services	27-07-2012	1157	34.42	39823.94
Services Total		**10181**		**581249.61**
Grand Total		**87850**		**15329249.3**

EXPERIMENT NO: 10 – REVENUE MANAGEMENT

EXTENDED EXPERIMENT – 2

Question:

Given sales data for products manufactured and marketed by ABC private limited calculate the profitability.

Product	Price / Unit	Markup %	Quantity Sold	Qty. Returned	Shipping Cost	Actual Shipping Cost
Product 1	₹ 125	10%	35	0	₹ 50	₹ 25
Product 2	₹ 85	25%	52	1	₹ 50	₹ 25
Product 3	₹ 100	30%	28	0	₹ 50	₹ 25
Product 4	₹ 250	30%	55	0	₹ 50	₹ 25
Product 5	₹ 135	40%	40	0	₹ 50	₹ 25
Product 6	₹ 145	25%	60	0	₹ 50	₹ 25
Product 7	₹ 120	30%	37	2	₹ 50	₹ 25
Product 8	₹ 110	50%	44	0	₹ 50	₹ 25

Aim:

To determine the product wise profitability for the given data.

Procedure:

1. Open a new excel sheet and type the given data.
2. Calculate the Total revenue for the first product using the formula. (Total Revenue = Price per Unit * Qty.Sold). SYNTAX: =IFERROR(((D2*B2))*(1+(C2)),0)
3. Copy the formula and calculate the same for all the products.
4. The next step is to calculate the Profit per Unit. Calculate using the formula. SYNTAX: =IFERROR((B2*C2)+(F2-G2),0).
5. Copy the formula and calculate the same for all the products.
6. The next step is to calculate the Net Income. Calculate using the formula. SYNTAX = IFERROR(((D2-I2)*H2)+(I2*G2),0)
7. Copy the formula and calculate the same for all the products.
8. Now calculate the total revenue. Total Revenue SYNTAX= SUM(E2:E9)
9. Now calculate the profitability of Product 1. SYNTAX=E2/E10.
10. Copy the formula and calculate the same for all the products.

OUTPUT:

Product	Price / Unit	Markup %	Quantity Sold	Total Revenue	Shipping Cost	Actual Shipping Cost	Profit / Unit	Qty Returned	Net Income	Profitablity
Product 1	₹ 125	10%	35	₹ 4,813	₹ 50	₹ 25	₹ 38	0	₹ 1,313	8%
Product 2	₹ 85	25%	52	₹ 5,525	₹ 50	₹ 25	₹ 46	1	₹ 2,384	9%
Product 3	₹ 100	30%	28	₹ 3,640	₹ 50	₹ 25	₹ 55	0	₹ 1,540	6%
Product 4	₹ 250	30%	55	₹ 17,875	₹ 50	₹ 25	₹ 100	0	₹ 5,500	28%
Product 5	₹ 135	40%	40	₹ 7,560	₹ 50	₹ 25	₹ 79	0	₹ 3,160	12%
Product 6	₹ 145	25%	60	₹ 10,875	₹ 50	₹ 25	₹ 61	0	₹ 3,675	17%
Product 7	₹ 120	30%	37	₹ 5,772	₹ 50	₹ 25	₹ 61	2	₹ 2,185	9%
Product 8	₹ 110	50%	44	₹ 7,260	₹ 50	₹ 25	₹ 80	0	₹ 3,520	11%
			Total Revenue	₹ 63,320						

EXPERIMENT NO: 11 - TRANSPORTATION AND ASSIGNMENT

AIM: To solve a linear programming problem and transportation problem

ALGORITHM:

Solve the following Transportation problem using TORA

Source/Destination	D1	D2	D3	D4	Supply
S1	5	2	4	3	22
S2	4	8	1	6	15
S3	4	6	7	5	8
Demand	7	12	17	9	

Question: Three workmen P, Q, R must be assigned to three jobs X, Y, Z. The cost involved for each pair of a worker and a job are given in the table below. Determine the optimal solution.

Workers	Jobs		
	X	Y	Z
P	Rs 8	Rs 6	Rs 5
Q	Rs 8	Rs 6	Rs 2
R	Rs 6	Rs 6	Rs 3

Transportation Problem:

1. Select TORA form the desktop and click tora.exe
2. Press ALT+Enter to maximize the screen
3. Select the **transportation model** in main menu
4. In the DATA ENTRY choose type a new problem.
5. Provide problem title, number of nodes, and number of destinations and give NO to use a defined variable.
6. Enter demand, supply and units that has to be assigned from each source to the destination, press F8 for done and save the file.
7. Solve the problem using AUTOMATED PROCEDURE and view the solution.
8. Save the file.

ASSIGNMENT PROBLEM

Procedure:

1. Select POM form the desktop or from the programs
2. Choose the module of program to work (In our case it is **Assignment**)
3. Provide the problem title and How many objects to be assigned
4. Enter the object and destination
5. On completion click SOLVE
6. Note the output

Result:

The given transportation and assignment problem were solved successfully.

Output:

Assignment Problem Solution

	Dest1	Dest2	Dest3
Object1	0	1	0
Object2	0	0	1
Object3	1	0	0

Total cost or profit is $ 14

TRANSPORTATION

Title: transportation
Size:(3 x 4)
Final Iteration No: 1
Total cost = 104.0000

Output:

	D1	D2	D3	D4	SUPPLY	Ui
	5	2	4	3	3.00	
S1	12	2	8		22	
	-3.00	0.00	0.00	0.00		
	4	8	1	6	0.00	
S2			15		15	
	-5.00	-9.00	0.00	-6.00		
	4	6	7	5	5.00	
S3	7			1	8	
	0.00	-2.00	-1.00	0.00		
Vj	-1.00	-1.00	1.00	V4=0.00		
DEMAND	7	12	17	9		

EXPERIMENT NO: 12 NETWORK MODELS-CPM

Question:

For the provide data identify the critical path.

Activity	Preceding Activity	Normal time(Days)
1 to 2	-	20
1 to 3	-	25
2 to 3	1 -2	10
2 to 4	1 - 2	12
3 to 4	1-3 , 2-3	5
4 to 5	2-3 , 3-4	10

Aim: To find the critical path using TORA module

Procedure:

1. Choose PERT/CPM model in TORA
2. Give the number of nodes
3. Provide the duration for each node
4. Compute the solution
5. Note down the critical path

Result: Thus critical path for the provided problem is found using TORA

Output:

		Earliest		**Latest**			
Activity	**Duration**	**Start**	**Complete**	**Start**	**Complete**	**Total Float**	**Free Float**
C 1-2	20	0	20	0	20	0	0
1-3	25	0	25	5	30	5	5
C 2-3	10	20	30	20	30	0	0
2-4	12	20	32	23	35	3	3
C 3-4	5	30	35	30	35	0	0
C 4-5	10	35	45	35	45	0	0

EXPERIMENT NO: 13 QUEUING THEORY

Question:

Customer arrives at a rate of 26 per hour according to Poisson arrival process. There is one server who serves customers in an average time of 2 minutes according to exponential distribution.

Aim: To solve the provided problem under waiting lines models of queuing theory

Procedure:

1. Open POM-QM software
2. Select waiting line from the module
3. There are several models available like M/M/1,M/D/1,M/G/1.. select the models one by one and execute by following the proceeding steps
4. Select M/M/1 and provide the inputs like arrival rate, service rate and number of servers. All the data in same time interval
5. Click SOLVE and note down the results
6. Repeat the experiment for other models and note down the results

Result:

Thus the provided problem was solved under various models of waiting line

Output:

M/M/1 CONSTANT SERVICE						
Parameter	Value		Parameter	Value	Minutes	Seconds
M/M/1 (exponential service times)			Average server utilization	0.87		
Arrival rate(lambda)	26		Average number in the queue(Lq)	5.63		
Service rate(mu)	30		Average number in the system(Ls)	6.5		
Number of servers	1		Average time in the queue(Wq)	0.22	13	780
			Average time in the system(Ws)	0.25	15	900

M/M/1 with a Finite System Size						
Parameter	Value		Parameter	Value	Minutes	Seconds
M/M/1 with a Finite System Size			Average server utilization	0.62		
Arrival rate(lambda)	26		Average number in the queue(Lq)	0.29		
Service rate(mu)	30		Average number in the system(Ls)	0.9		
Number of servers	1		Average time in the queue(Wq)	0.02	0.93	55.71
Maximum system size	2		Average time in the system(Ws)	0.05	2.93	175.71
			Effective Arrival Rate	18.54		
			Probability that system is full	0.29		

EXPERIMENT NO: 14 INVENTORY MODELS

Calculate EOQ using the following data demand is 10000 units, setup cost is 10, and holding cost is 20

Aim: To calculate Economic order quantity using TORA Module

Algorithm:

1. Open TORA and choose Inventory models from Main menu
2. Select General EOQ and choose new problem
3. Provide problem title, data if provided for discount quantity and buffer stock
4. Provide Demand, Setup cost and Holding cost
5. Run the problem
6. Note down the Economic lot size and cost/unit time

Result: Thus EOQ for the provided data is calculated using TORA

EXPERIMENT NO: 15 INVENTORY MODELS

EXTENDED EXPERIMENT - 3

Calculate EOQ using the following data demand is 50000 units, setup cost is 25, and holding cost is 30

Aim: To calculate Economic order quantity using TORA Module

Algorithm:

1. Open TORA and choose Inventory models from Main menu
2. Select General EOQ and choose new problem
3. Provide problem title, data if provided for discount quantity and buffer stock
4. Provide Demand, Setup cost and Holding cost
5. Run the problem
6. Note down the Economic lot size and cost/unit time

Result: Thus EOQ for the provided data is calculated using TORA