K. J. SOMAIYA INSTITUTE OF MANAGEMENT STUDIES AND RESEARCH,
Vidyavihar, Mumbai- 400077
Program: *PGFinance (Batch 2016-18) Trim VI*
Subject: Quantitative Models in Finance
(End Term Examination) (In computer lab)

2nd April, 2018

Maximum Marks: 50 **Duration: 3 hours**

Instructions

- **Write all your answers in the answer sheet clearly. Your submission in answer sheet will be primarily used for evaluation, supported by the excel submission.**
- **Use Excel and solver/SolverTable as required and keep saving your work (one single file with reference of your program and roll no) as you proceed. Follow the instructions of data centre personnel and transfer your folder to an appropriate place in the server.**
- **If you assume any data not given, please provide suitable explanation of the same.**

Part A (Answer any three out of five questions. Marks – 3*11 = 33)

1. Assume that the number of units sold of a product is given by 100- 0.5 P+26 √A, where P is the price (in dollars) charged for the product and A is the amount spent on advertising (in '000 dollars). Each unit of the product costs $5 to produce.
   a. Use a data table to find the combination of price and advertising that maximizes the profit.
   b. Explain about the limitations of a data table and describe how this can be obviated.
   c. Explain the differences between data table and solver table and describe the utility of using solver table.

2. Moneyco has $100,000 to invest at time 1 (the beginning of year 1). The cash flows ((+) indicates inflows and (–) indicates outflows, associated with the five available investments are listed as below:

Investment data						
	A	B	C	D	E	
Time 1	-1.00	-1.00	-1.00			
Time 2		1.15			-1.00	
Time 3			1.28	-1.00		
Time 4	1.40			1.15	1.32	

   In addition to these investments, Moneyco can invest as much money each year as it wants in CDs, which pay 6% interest. The company wants to maximize its available cash in year 4. Assume that it can put no more than $ 50,000 in any investment.
   a. Write the formulation of an LP model which can be applied in this context.
   b. Solve the model with Solver.
   c. Do you think LP model does justice to the requirement of considering the risk associated with the instruments? What modifications and process will you suggest to take care of risk explicitly?
3. Fruit Computer produces two types of computers: Pear and Apricot. The relevant data

are given below:

Particulars	*Pear*	*Apricot*
Fixed equipment cost	*$25,000*	*$35,000*
Unit margin	*$120*	*$175*
Resource usage per computer		
	Pear	*Apricot*
Labor hours	*2.5*	*3.5*
Number of chips	*4*	*5*

The equipment cost is a fixed cost that is incurred if any of this type of computer is produced. A total of 2000 chips and 1500 labour hours are available.

a. Write the formulation of a suitable model by describing objective function, decision variables, and constraints.
b. Solve the model with Excel solver.
c. Use SolverTable to analyse the effect on the optimal solution of a change in unit margin of pear computers. Do the same for the unit margin of Apricot computers.

4. a. A firm is planning to spend $75000 on advertising. It costs $3000 per minute to advertise on television and $ 1000 per minute to advertise on radio. If the firm buys x minutes of television time and y minutes of radio time, its revenue in thousands of dollars is given by $-0.3x^2 - 0.4y^2 + 0.8xy + 5x + 10y$. How can the firm maximize its revenue?

   b. Your company is about to market a new golf club. You have convened a focus group of 100 golfers and asked them to compare your club to the clubs produced by your competitors. You have found, for example, that 30 customers in the focus group would purchase your club if you charged $120, 28 customers would purchase your club if you charged $130, and so on. How could you use this information to determine the price at which your club should be sold?

   c. Describe different possibilities/limitations with the optimization solutions obtained for non-linear problems.

5. Amanda has 30 years to save for her retirement. At the beginning of each year, she puts $ 5000 in her retirement account. At any point in time, Amanda's retirement funds are tied up in the stock market. Suppose the annual return on stocks follows a normal distribution with mean 12 % and standard deviation 25 %. Assume that if Amanda reaches her goal before 30 years, she will stop investing.
   a. Set up a simulation model in excel.
   b. Repeat the simulation with 500 trials and provide summary statistics.
   c. What is the probability that at the end of 30 years, Amanda will have reached her goal of having $ 1,000,000 for retirement?

PART B (Answer any one of the following. Marks – 1*17 = 17)

6. Data on monthly costs of overheads, machine hours, and direct material costs are provided in the annexure.

Month	Overhead Cost	Machine Hours	Direct Material Cost
1	142350	848	64912
2	168303	1059	71146
3	163142	1016	69320
4	160682	1042	70358
5	157163	913	64600
6	164361	1093	69154
7	162930	1171	75094
8	168491	1005	71165
9	149658	841	69903
10	155770	931	69065
11	157540	997	70980
12	163813	1099	70782
13	152232	958	68442
14	169976	1048	77247
15	159909	1049	70563
16	161149	1092	68361
17	172007	1095	74114
18	157789	964	68552
19	151154	832	61974
20	167576	1028	66108
21	155335	946	67391
22	154299	998	67449
23	173691	1126	76020
24	154919	991	68773
25	155813	982	70977
26	159311	989	67537
27	177196	1135	80425
28	165232	1159	75507
29	176781	1163	79252
30	153537	836	70516
31	170977	1041	70660
32	162451	893	68099
33	162623	1025	72983
34	168945	994	71937
35	160988	1043	74789
36	168795	1051	74342

a. Create a correlation matrix between the independent variables.
b. Plot two graphs – one of OHCost vs. machine hours, another of OHCost vs. direct material cost and identify the most suitable trendline to each graph.

c. If you ignore the two explanatory variables Machine hours and Direct material cost and predict each overhead cost as the mean of Overhead cost, then a typical 'error' is overhead cost minus the mean of overhead cost. Find the sum of squared errors using this form of prediction where the sum is over all the observations.
d. Run three regressions: 1. Overhead cost (OHCost) vs. machine hours, 2. OHCost vs. Direct material cost, 3. OHCost vs. both machine hours and direct material cost.
e. For the first two regressions in part c, what is the relationship between the R^2 and the corresponding correlation between the dependent and explanatory variable?

7. Mr. Carl Lipke is the marketing VP for a propane gas distributor. He would like to have a forecast of sales on a quarterly basis, and he has asked you to prepare a time-series decomposition model. The data for 1992 to 2003 are given below:

Year	Q1	Q2	Q3	Q4
1992	6.44	4.85	4.67	5.77
1993	6.22	4.25	4.14	5.34
1994	6.07	4.36	4.07	5.84
1995	6.06	4.24	4.20	5.43
1996	6.56	4.25	3.92	5.26
1997	6.65	4.42	4.09	5.51
1998	6.61	4.25	3.98	5.55
1999	6.24	4.34	4.00	5.36
2000	6.40	3.84	3.53	4.74
2001	5.37	3.57	3.32	5.09
2002	6.03	3.98	3.57	4.92
2003	6.16	3.79	3.39	4.51

a. To help Mr. Lipke to understand how propane gas sales have varied over the 12-year period, prepare a time-series plot of the raw data and the deseasonalised data (i.e. centred moving averages-CMA).
b. Prepare seasonal indices for quarters 1 through 4 based on the normalized averages of the seasonal factors. Write a short paragraph in which you explain to Carl Lipke exactly what these indices mean.
c. Estimate the long-term trend for the sales series by using a bivariate linear regression of the CMA as a function of time, where TIME = 1 for 1992Q1.
d. Plot the values of sales that would be estimated by this model alongwith original data. Does the model appear to work well for this data series?
e. Prepare a forecast for 2004Q1 through 2004Q4 from your time-series decomposition model and compare with actual data for these quarters which are 5.39, 3.56, 3.03, and 4.03 respectively. Calculate the root-mean-squared error (RMSE) for 2004 and explain the utility of this and similar measures.

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