K. J. SOMAIYA INSTITUTE OF MANAGEMENT STUDIES AND RESEARCH,
Vidyavihar, Mumbai- 400077
Program: *PGFS (Batch 2018-20) Trim III*
Subject: Operations Research
(End Term Examination) (In computer lab)

25th March, 2019

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 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.   The Sea Wharf Restaurant would like to determine the best way to allocate a monthly advertising budget of $1000 between newspaper advertising and radio advertising. Management decided that at least 25% of the budget must be spent on each type of media, and that the amount of money spent on local newspaper advertising must be at least twice the amount spent on radio advertising. A marketing consultant developed an index that measures audience exposure per dollar of advertising on a scale from 0 to 100, with higher values implying greater audience exposure. If the value of the index for local newspaper advertising is 50 and the value of the index for spot radio advertising is 80, how should the restaurant allocate its advertising budget in order to maximize the value of total audience exposure?

a.   Formulate a linear programming model that can be used to determine how the restaurant should allocate its advertising budget in order to maximize the value of total audience exposure.

b.   Solve the problem using Excel Solver.

c.   Generate sensitivity report and comment on important aspects.

2.   Blair & Rosen, Inc. (B&R), is a brokerage firm that specializes in investment portfolios designed to meet the specific risk tolerances of its clients. A client who contacted B&R this past week has a maximum of $50,000 to invest. B&R's investment advisor decides to recommend a portfolio consisting of two investment funds: an Internet fund and a Blue Chip fund. The Internet fund has a projected annual return of 12%, whereas the Blue Chip fund has a projected annual return of 9%. The investment advisor requires that at most $35,000 of the client's funds should be invested in the Internet fund. B&R services include a risk rating for each investment alternative. The Internet fund, which is the more risky of the two investment alternatives, has a risk rating of 6 per thousand dollars invested. The Blue Chip fund has a risk rating of 4 per thousand do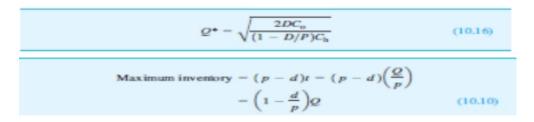llars invested. For example, if $10,000 is invested in each of the two investment funds, B&R's risk rating for the portfolio would be 6(10) + 4(10) = 100. Finally, B&R developed a questionnaire to measure each client's risk tolerance. Based on the responses, each client is classified as a conservative, moderate, or aggressive investor. Suppose that the questionnaire results classified the current client as a moderate investor. B&R recommends that a client who is a moderate investor limit his or her portfolio to a maximum risk rating of 240.

a.   Formulate a linear programming model that can be used to determine how the

investment portfolio should be structured?

b. Solve the problem using Excel Solver.

c. Generate sensitivity report and comment on important aspects

3. Wilson Publishing Company produces books for the retail market. Demand for a current book is expected to occur at a constant annual rate of 7200 copies. The cost of one copy of the book is $14.50. The holding cost is based on an 18% annual rate, and production setup costs are $150 per setup. The equipment on which the book is produced has an annual production volume of 25,000 copies. Wilson has 250 working days per year, and the lead time for a production run is 15 days. Use the production lot size model (some formulae provided) as given below:

$$Q^* = \sqrt{\frac{2DC_o}{(1 - D/P)C_h}} \qquad (10.16)$$

$$\text{Maximum inventory} = (p - d)t = (p - d)\left(\frac{Q}{P}\right)$$
$$= \left(1 - \frac{d}{p}\right)Q \qquad (10.10)$$

Compute the following:

a. Minimum cost production lot size

b. Cycle time & Length of a production run

c. Maximum inventory

d. Total annual cost

4. The management of Madeira Manufacturing Company is considering the introduction of a new product. The fixed cost to begin the production of the product is $30,000. The variable cost for the product is uniformly distributed between $16 and $24 per unit. The product will sell for $50 per unit. Demand for the product is best described by a normal probability distribution with a mean of 1200 units and a standard deviation of 300 units.

Develop a spreadsheet simulation and using 500 simulation trials to answer the following questions:

a. What is the mean profit for the simulation? Provide a summary of a few other important measures.

b. What is the probability the project will result in a loss?

c. What is your recommendation concerning the introduction of the product?

5. Giovanni Food Products produces and sells frozen pizzas to public schools throughout the eastern United States. Using a very aggressive marketing strategy they have been able to increase their annual revenue by approximately $10 million over the past 10 years. But, increased competition has slowed their growth rate in the past few years. The annual revenue, in millions of dollars, for the previous 10 years is shown below.

Year	Revenue
1	8.53
2	10.84
3	12.98
4	14.11
5	16.31

6	17.21
7	18.37
8	18.45
9	18.40
10	18.43

a.   Construct a time series plot. Comment on the appropriateness of a linear trend.
b.   Provide a regression analysis to identify the trend equation.
c.   Using the trend equation developed in part (b), forecast revenue in year 11.

PART B (Answer any one out of the two. Marks 1*17 = 17).

6.   J. D. Williams, Inc., is an investment advisory firm that manages more than $120 million in funds for its numerous clients. The company uses an asset allocation model that recommends the portion of each client's portfolio to be invested in a growth stock fund, an income fund, and a money market fund. To maintain diversity in each client's portfolio, the firm places limits on the percentage of each portfolio that may be invested in each of the three funds. General guidelines indicate that the amount invested in the growth fund must be between 20% and 40% of the total portfolio value. Similar percentages for the other two funds stipulate that between 20% and 50% of the total portfolio value must be in the income fund, and at least 30% of the total portfolio value must be in the money market fund.
In addition, the company attempts to assess the risk tolerance of each client and adjust the portfolio to meet the needs of the individual investor. For example, Williams just contracted with a new client who has $800,000 to invest. Based on an evaluation of the client's risk tolerance, Williams assigned a maximum risk index of 0.05 for the client. The firm's risk indicators show the risk of the growth fund at 0.10, the income fund at 0.07, and the money market fund at 0.01. An overall portfolio risk index is computed as a weighted average of the risk rating for the three funds where the weights are the fraction of the client's portfolio invested in each of the funds.
Additionally, Williams is currently forecasting annual yields of 18% for the growth fund, 12.5% for the income fund, and 7.5% for the money market fund. Based on the information provided, how should the new client be advised to allocate the $800,000 among the growth, income, and money market funds? Develop a linear programming model that will provide the maximum yield for the portfolio. Use your model to develop a managerial report.
Managerial Report
   a) Recommend how much of the $800,000 should be invested in each of the three funds. What is the annual yield you anticipate for the investment recommendation?
   b) Assume that the client's risk index could be increased to 0.055. How much would the yield increase and how would the investment recommendation change?
   c) Refer again to the original situation where the client's risk index was assessed to be 0.05. How would your investment recommendation change if the annual yield for the growth fund were revised downward to 16% or even to 14%?
   d) Assume that the client expressed some concern about having too much money in the growth fund. How would the original recommendation change if the amount invested in the growth fund is not allowed to exceed the amount invested in the income fund?
   e) The asset allocation model you developed may be useful in modifying the portfolios for all of the firm's clients whenever the anticipated yields for the three funds are periodically revised. What is your recommendation as to whether use of this model is

possible?

7.   What will your portfolio be worth in 10 years? In 20 years? When you stop working? The Human Resources Department at Tri-State Corporation was asked to develop a financial planning model that would help employees address these questions. Tom Gifford was asked to lead this effort and decided to begin by developing a financial plan for himself.

Tom has a degree in business and, at the age of 25, is making $34,000 per year. After two years of contributions to his company's retirement program and the receipt of a small inheritance, Tom has accumulated a portfolio valued at $14,500. Tom plans to work 30 more years and hopes to accumulate a portfolio valued at $1 million. Can he do it?

Tom began with a few assumptions about his future salary, his new investment contributions, and his portfolio growth rate. He assumed 5% annual salary growth rate as reasonable and wanted to make new investment contributions at 4% of his salary. After some research on historical stock market performance, Tom decided that a 10% annual portfolio growth rate was reasonable. Using these assumptions, Tom developed the Excel worksheet shown in Figure below:

	A	B	C	D	E	F	G	H
1	Financial Analysis - Portfolio Projection							
2								
3	Age			25				
4	Current Salary			$34,000				
5	Current Portfolio			$14,500				
6	Annual Salary Growth Rate			5%				
7	Annual Investment Rate			4%				
8	Annual Portfolio Growth Rate			10%				
9								
10			Beginning		New	Portfolio	Ending	
11	Year	Age	Portfolio	Salary	Investment	Earnings	Portfolio	
12	1	25	14,500	34,000	1,360	1,518	17,378	
13	2	26	17,378	35,700	1,428	1,809	20,615	
14	3	27	20,615	37,485	1,499	2,136	24,251	
15	4	28	24,251	39,359	1,574	2,504	28,329	
16	5	29	28,329	41,327	1,653	2,916	32,898	

Tom's specific situation and his assumptions are in the top portion of the worksheet (cells D3:D8). The worksheet provides a financial plan for the next five years. In computing the portfolio earnings for a given year, Tom assumed that his new investment contribution would occur evenly throughout the year and thus half of the new investment could be included in the computation of the portfolio earnings for the year. Using Figure 12.18, we see that at age 29, Tom is projected to have a portfolio valued at $32,898.

Tom's plan was to use this worksheet as a template to develop financial plans for the company's employees. The assumptions in cells D3:D8 would be different for each employee, and rows would be added to the worksheet to reflect the number of years appropriate for each employee. After adding another 25 rows to the worksheet, Tom found that he could expect to have a portfolio of $627,937 after 30 years. Tom then took his results to show his boss, Kate Riegle. Although Kate was pleased with Tom's progress, she voiced several criticisms. One of the criticisms was the assumption of a constant annual salary growth rate. She noted that most employees experience some variation in the annual salary growth rate from year to year. In addition, she pointed out that the constant annual portfolio growth rate was unrealistic and that the actual growth rate would vary considerably from year to year. She further suggested that a simulation model for the portfolio projection might allow Tom to account for the random variability in the salary growth rate and the portfolio growth rate.

After some research, Tom and Kate decided to assume that the annual salary growth rate would vary from 0% to 10% and that a uniform probability distribution would provide a

realistic approximation. Tri-State's accounting firm suggested that the annual portfolio growth rate could be approximated by a normal probability distribution with a mean of 10% and a standard deviation of 5%. With this information, Tom set off to develop a simulation model that could be used by the company's employees for financial planning.

Managerial Report
Play the role of Tom Gifford and develop a simulation model for financial planning. Write a report for Tom's boss and, at a minimum, include the following:

a) Without considering the random variability in growth rates, extend the worksheet in Figure 12.18 to 30 years. Confirm that by using the constant annual salary growth rate and the constant annual portfolio growth rate, Tom can expect to have a 30-year portfolio of $627,937. What would Tom's annual investment rate have to increase to in order for his portfolio to reach a 30-year, $1 million goal?

b) Incorporate the random variability of the annual salary growth rate and the annual portfolio growth rate into a simulation model. Assume that Tom is willing to use the annual investment rate that predicted a 30-year, $1 million portfolio in part 1. Show how to simulate Tom's 30-year financial plan. Use results from the simulation model to comment on the uncertainty associated with Tom reaching the 30-year, $1 million goal. Discuss the advantages of repeating the simulation numerous times.

c) What recommendations do you have for employees with a current profile similar to Tom's after seeing the impact of the uncertainty in the annual salary growth rate and the annual portfolio growth rate?

d) Assume that Tom is willing to consider working 35 years instead of 30 years. What is your assessment of this strategy if Tom's goal is to have a portfolio worth $1 million?

e) Discuss how the financial planning model developed for Tom Gifford can be used as a template to develop a financial plan for any of the company's employees.

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