Lecture 9

1. You are the marketing analyst for a local restaurant. Download the file named *ch8_P1restaurant.xlsx*. The file contains 18,095 transactions over the last two years. Each record includes the transaction number, the date of visit, the amount of bill, and the member's passport number. You are given $13,000 to conduct the next marketing campaign directed specifically to passport members. Based on the past experiences, it is estimated the average cot to provide incentives to members included in the campaign is $5.75. The following cutoff points can be used:

Recency Cutoffs		Frequency Cutoffs		Monetary Value Cutoffs	
9/1/2012	1	1	1	$0	1
5/1/2013	2	10	2	$10	2
9/1/2013	3	20	3	$40	3

You want to include multiple dimensions in the optimization model.

a. Formulate and solve a 0-1 LP model that uses both recency and frequency data as input. The goal of the model is to identify those member segments that maximize the expected revenue under budget limitations. These segments are defined as a combination of recency and frequency values

b. Adjust the LP model so it identifies the percentage of customers from recency and frequency segments who should be included in the campaign.

c. Focus the analysis on the recency and monetary value of visits by members. Formulate and solve a 0-1 LP model to identify the recency and monetary value segments of members who should be included in the campaign. Adjust the model to identify the percentage of customers from each segment (recency and monetary value) to maximize the expected revenues under the same budget constraints.

d. Consider frequency and monetary value as the basis of your analysis. Formulate and solve a 0-1 LP model to identify the frequency and monetary value segments of members who should be included in the campaign to maximize the expected revenues under the same budget constraints.

e. Adjust the model to identify the percentage of customers in each of the two segments.

f. Compare the results from the three two-dimensional binary LP models. Generate insights and recommendations for the restaurant management regarding the future of marketing campaigns and segments of customers who should be reached to maximize the expected revenues.

Answer: see *ch9_P1_P2restaurant_solution.xlsx*

2. Continue the analysis of the restaurant from problem 1. You have the same budget constraints, but now you want to combine all three dimensions of the RFM analysis into a single optimization model.

   a. Formulate and solve a 0-1 LP model that incorporates recency, frequency, and monetary value data as inputs. The goal of the model is to identify those combinations of segments that maximize the expected revenue under budget limitations. These segments are defined as a combination of recency, frequency, and monetary spending of members who should be included in the campaign.

   b. Formulate and solve a GP model considering the following priorities:
   - Recency: Priority 1 (P1 = 1,000)
   - Frequency: Priority 2 (P2 = 500)
   - Monetary Value: Priority 2 (P2 = 500)
   - Do Not Exceed Budget: Priority 3 (P3 = 100)

   c. Provide recommendations regarding the RFM segments that should be reached in the next marketing campaign. What is the expected revenue of your recommendation?

   d. Analyze the approaches and results between LP and GP models and discuss advantages and disadvantages of each approach.

   e. Change priorities listed in step b and observe the impact in the final solution. Overall, which of the three dimensions is most relevant to the marketing analysis in the restaurant?

   Answer: see *ch9_P1_P2restaurant_solution.xlsx*

3. The Marketing and Sales departments of a shoe store have decided to perform an RFM analysis to determine whether and how to invest in their direct marketing customers. Use the ch8_ P3shoes.xlsx. Assume that the next campaign for the company has a total budget of $2,000 and the cost to reach a customer of $9.00.

   a. Formulate and solve a 0-1 LP model that uses both recency and frequency data as input. The goal of the model is to identify those combinations of recency and frequency values of customers who should be included in the campaign to maximize the expected revenue.

   b. Formulate and solve a continuous LP model so it identifies the percentage of customers from recency and frequency segments who should be included in the campaign to maximize the expected revenue under the same budget limitations.

   c. Focus the analysis on the recency and monetary value of purchases by customers. Formulate and solve a 0-1 LP model to identify the recency and monetary value segments of customers who should be included in the campaign.

   d. Adjust the model to identify the percentage of customers from each segment (recency and monetary value) to maximize the expected revenue under the same budget limitations.

   e. Now consider frequency and monetary value as the basis of your analysis. Formulate and solve a 0-1 LP model to identify the frequency and monetary value segments of customers who should be included in the campaign to maximize the expected revenues under the same budget constraints.

   f. Adjust the model to identify the percentage of customers in each of the two segments.

   g. Compare the results from the three two-dimensional binary LP models. Generate insights and recommendations for the shoe store management team regarding the future of marketing campaigns and segments of customers who should be reached to maximize the expected revenues within a limited budget.

Answer: see *ch9_P3_P4shoes_solution.xlsx*

4. Expand the analysis of the shoe store from problem 3. You have the same budget constraints, but now you want to combine all three dimensions of the RFM analysis into a single optimization model.

   a. Formulate and solve a 0-1 LP model that incorporates recency, frequency, and monetary value data as inputs. The goal of the model is to identify those combinations of segments that maximize the expected revenue under budget limitations. These segments are defined as a combination of recency, frequency, and monetary spending of customers who should be included in the campaign.

   b. Formulate and solve a GP model considering the following priorities:
   • Monetary Value: Priority 1 (P1 = 10)
   • Frequency: Priority 2 (P2 = 5)
   • Recency: Priority 3 (P3 = 2)
   Provide recommendations regarding the RFM segments that should be reached in the next marketing campaign. What is the expected revenue of your recommendation?

   c. Formulate and solve the same GP model with new priorities:
   • Budget Constraints: Priority 1 (P1 = 100)
   • Monetary Value: Priority 2 (P2 = 10)
   • Frequency and Recency: Priority 3 (P3 = 5)
   Will your recommendations regarding the REM segments that should be reached in the next marketing campaign change? Why or why not?

   d. Overall, which of the above three dimensions is most relevant to the marketing analysis of the data from the shoe store?

   Answer: see *ch9_P3_P4shoes_solution.xlsx*

5. All different RFM variations of linear programming models have an objective function that seeks to minimize the expected cost to reach potential customers.
    a. True
    b. *False

6. The decision variables for frequency and monetary value are defined as 1 if customers in a given frequency and given monetary value group should be reached. Otherwise, they are 0.
    a. *True
    b. False

7. The decision maker may use the IFERROR function when trying to avoid a division by zero error.
    a. *True
    b. False

8. The decision maker may enforce the continuous value for decision variables in order to calculate the percentage of customers to be reached in a given RFM group.
    a. *True
    b. False

9. A goal programming model for RFM analysis is used when the analyst wants to assign priorities to each of the dimensions.
    a. *True
    b. False

10. The objective function of the goal programming model for RFM analysis seeks to maximize the expected revenue.
    a. True
    b. *False

11. Goal programming models can be formulated for RFM analysis with three dimensions only.
    a. True
    b. *False

12. RFM-based mathematical programming models can help the decision maker to identify RFM segments that are not worthy of pursuing because they are not profitable.
    a. True
    b. *False

13. RFM-based mathematical programming models can help the decision maker to identify RFM segments that are not worthy of pursuing due to marketing budget constraints.
    a. *True
    b. False

14. An RFM mathematical model that combines all three dimensions of an RFM model is always:
    a. A goal programming model.
    b. *A linear programming model.
    c. A non-linear programming model.
    d. None of the above can be used to formulate an RFM model.

15. An RFM model that combines any two dimensions, including recency-frequency value, recency-monetary value, or frequency-monetary value, is always:
    a. A goal programming model.
    b. *A linear programming model.
    c. A non-linear programming model.
    d. None of the above can be used to formulate such a model.

16. All different RFM variations of linear programming models have the following objective function and constraints:
    a. *To maximize the expected revenues from potential customers while not exceeding budget constraints
    b. To minimize the expected cost to reach potential customers while not exceeding budget constraints
    c. Minimize the expected cost to reach potential customers while not ensuring profit levels
    d. Any of the above can be a construct for the recency and frequency case.

17. Which of the following serves as a definition for decision variables for recency and frequency?
    a. 1 if customers in a given recency should not be reached; 0 otherwise
    b. *1 if customers in a given recency and frequency should be reached; 0 otherwise
    c. 1 if customers in a given recency or frequency should not be reached; 0 otherwise
    d. 1 if customers in a given recency or frequency should be reached; 0 otherwise

18. Why may the decision maker encapsulate an IFERROR function in the AVERAGEIFS function when building the Microsoft Excel template for RFM models with dual dimensions?
    a. To avoid any potential input error
    b. *To avoid a division by zero error
    c. To avoid errors when calculating the expected revenue
    d. To avoid errors when calculating the utilized budget

19. The decision maker may change the binary constraints of the decision variables in the Solver Parameters box to be continuous decision variables. This change will:
    a. Limit the decision variables to a number between 0 and 1.
    b. Indicate that the decision variables represent the percentage of customers to be reached in a given group.
    c. Most likely increase the amount of budget used.
    d. *All of the above will occur

20. The linear programming model with single dimensions of the RFM framework and five groups in this dimension has the following number of decision variables.
    a. *5
    b. 25
    c. 50
    d. 75
    e. 125

21. The linear programming model with three dimensions of the RFM framework and five groups in each of these dimensions has the following number of decision variables.
    a. 3
    b. 15
    c. 25
    d. 75
    e. *125

22. Critics of the RFM approach claim that this methodology is:
    a. Less likely to be used successfully in predictive and prescriptive analytics.
    b. Fails to indicate anything about the propensity of a prospect to respond to marketing stimuli.
    c. It simply shows who purchased from the company in the past.
    d. *All of the above