Course Number: MMA 2025S
Course Name: MMA 861: Analytical Decision Making

Assignment Name: Assignment 1 Individual
Due Date: June 22, 2024 9am

Team Name: Team Gordon

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Order of files:

Filename	Pages	Comments and/or Instructions
MMA861Assignment Individual	6	

Additional Comments:

Question 3

We are looking to minimize cost to $504,000.00 by optimizing 3 sales representatives assigned to each district to make quota of calls. Each of the four districts this cost includes the fixed cost of $88,000 per district where there is at least one sales representative and then additional $80,000 per sales representative. As well, each sales representative is only allowed to have at most 160 hours allocated to them. We are looking to find the best way to assign sales representatives to each of the districts to minimize cost.

1. Each Sales Representative has a cost associated with it $88,000 per district if there is at-least one representative and additional $80,000 per representative.
2. Each representative takes a certain amount of time to make each call and is only allowed to work at most 160 hours.
3. Each district has a quota for the number of calls District 1: 50 calls, district 2: 80 calls, district 3: 100 calls and district :4 60 calls.

Using Simple Linear Programming in excel, we will minimize cost by assigning sales representatives to certain districts: Considering the minimum number of calls to make in each district and the amount of time it takes a representative to make a call.

Technical Analysis

1. **Decisions:**
   - Variables
     - X_{ij} – number of representatives
       - i = district
       - j = sales representatives
     - Y_i – Binary, number of representatives being assigned to a district
2. **Objective:**

   Minimize total cost while making sure each district has at least district has at least one sales representative.

3. **Objective Function:**

   Cost:
   - Fixed cost if there are 1 or more employees in a district

     $$\sum_{i=1}^{4} 88000 y_i$$

   - Cost of each representative

     $$\sum_{ij-1}^{4} 80000 x_{ij}$$

4. **Constraints:**

   1. **Allocated hours per representative**

      1 sales representative = 160

   2. **Each district to make quota of calls**

      District 1 = $X_{11} + X_{12} + X_{13} + X_{14} >= 50$ calls
      District 1 = $X_{21} + X_{22} + X_{23} + X_{24} >= 80$ calls

District 1 = $X_{31} + X_{32} + X_{33} + X_{34} >= 100$ calls
District 1 = $X_{41} + X_{42} + X_{43} + X_{44} >= 60$ calls

3. **Non-negative number of calls**
   $X_{ij} >= 0$

4. **Integer**
   X_{ij} and Y_i Integer

Question 4

We plan to maximize profit to $17,755.56 by producing the right amount of turkey cutlets to sell to fast-food restaurants. This will be done by analyzing the profit of turkey cutlets. As well as some of the constraints of producing turkey cutlets and the amount of white and dark meat.

To maximize profit, we recommend producing 5000 pounds cutlet 1, 3000 pounds of cutlet 867 pounds of Turkey 1 and 322 pounds of Turkey 2. By doing this we will meet the requirement of at least 70% white meat and 30% dark meat. Cutlet 2 has met the requirement of at least 60% white meat and 40% dark meat. The other requirement is the amount of white and dark meat produced from Turkey 1 and 2 must be greater that Cutlet 1 and 2.

Using Simple Linear Programming in excel, we will maximize profit by deciding the right amount of cutlet 1 and 2 as well the amount of turkey 1 and 2. Considering the percentage of dark to white meat and the amount of yield needed for turkey to cutlets.

Technical Analysis:

1. **Decisions:**
   - Variables
     - X_1 – number of pounds produced in Cutlet 1
     - X_2 – number of pounds produced in Cutlet 2
     - Y_1 – number of pounds produced in Turkey 1
     - Y_2 – number of pounds produced in Turkey 2

2. **Objective:**

   Maximize profit by optimizing the amount of turkey culets to sell to fast-food restaurants.

3. **Objective Function:**

   Cost:
   - Profit = Revenue - Cost

     - Revenue = $4X_1 + 3X_2$
     - Cost = $10Y_1 + 8Y_2$
     - Profit = $4X_1 + 3X_2 - 10Y_1 + 8Y_2$

4. **Constraints:**

   1. **Non – Negativity of each turkey cutlets**

      $X_1, X_2, Y_1, Y_2 >= 0$
   2. **Limit on Cutlets produced**

Cutlet 1 X_1 <= 5000
Cutlet 2 X_2 <= 3000

3. **Need to Sell Turkey 1**

   Turkey 1 Y_1 >= 100

4. **Amount of White meat**

   White Meat >= 0.70 X_1
   White Meat >= 0.60 X_2

   White Meat = $5Y_1 + 3Y_2 >= 0.7X_1+0.6X_2$

5. **Amount of Dark meat**
   Dark Meat = $2Y_1 + 3Y_2 >= 0.3X_1+0.4X_2$

Appendix

Question 3

Values:

	A	B	C	D	E	F	G	H	I	J	K
1	**Problem: Call Centre**										
2											
3		**Actual Sales Call District in Hours**								Legend	
4	Rep's Base District	**1**	**2**	**3**	**4**		**Number of calls**			Decision	
5	1	1	4	5	7		District 1	50		Constraint	
6	2	4	1	3	5		District 2	80		Cost	
7	3	5	3	1	2		District 3	100			
8	4	7	5	2	1		District 4	60			
9											
10	Rep's Base District	Calls from District 1	Calls from District 2	Calls from District 3	Calls from District 4						
11	1	55	0	0	15						
12	2	0	85	0	15		**Cost**				
13	3	0	0	100	30		88000	$ 264,000.00			
14	4	0	0	0	0		80000(n)	$ 240,000.00			
15	Total Hours	55	85	100	60		Total Cost	$ 504,000.00			
16											
17											
18		**Number of Hours Per District**									
19	Rep's Base District	1	2	3	4	Total	Number of employees				
20	1	0.34375	0	0	0.65625	1	1				
21	2	0	0.53125	0	0.46875	1	1				
22	3	0	0	0.625	0.375	1	1				
23	4	0	0	0	0	0	0				
24		0.34375	0.53125	0.625	1.5		3				

Formula:

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Problem: Call Centre**											
2												
3		**Actual Sales Call District in Hours**										
4	Rep's Base District	**1**	**2**	**3**	**4**			**Number of calls**				
5	1	1	4	5	7		District 1	50		Legend		
6	2	4	1	3	5		District 2	80		Decision		
7	3	5	3	1	2	Must meet number of calls for district (left chart)	District 3	100		Constraint		
8	4	7	5	2	1		District 4	60		Cost		
9												
10	Rep's Base District	Calls from District 1	Calls from District 2	Calls from District 3	Calls from District 4							
11	1	55	0	0	15							
12	2	0	85	0	15			Cost				
13	3	0	0	100	30		88000	=$B$20*SUM(G20+G21+G22+G23)				
14	4	0	0	0	0		80000(n)	=$B$20*SUM(G20+G21+G22+G23)	Cost per district if >= 1			
15	Total Hours	=SUM(B11:B14)	=SUM(C11:C14)	=SUM(D11:D14)	=SUM(E11:E14)		Total Cost	=SUM(H13:H14)	Cost Per Representative			
16									Objective, Minimize			
17												
18		**Number of Hours Per District**										
19	Rep's Base District	1	2	3	4	Total	Number of employees					
20	1	=(B5/160)*B11	=(C5/160)*C11	=(D5/160)*D11	=(E5/160)*E11	=SUM(B20:E20)	1					
21	2	=(B6/160)*B12	=(C6/160)*C12	=(D6/160)*D12	=(E6/160)*E12	=SUM(B21:E21)	1					
22	3	=(B7/160)*B13	=(C7/160)*C13	=(D7/160)*D13	=(E7/160)*E13	=SUM(B22:E22)	1					
23	4	=(B8/160)*B14	=(C8/160)*C14	=(D8/160)*D14	=(E8/160)*E14	=SUM(B23:E23)	0					
24		=SUM(B20:B23)	=SUM(C20:C23)	=SUM(D20:D23)	=SUM(E20:E23)		=SUM(G20:G23)					
25												
26												
27												
28						Each rep will work 160 hours	Number of employees mus be an						

Question 4

Values

	A	B	C	D	E	F	G	H
1	**Turkey Cutlet Problem**							
2								
3		**Cutlet 1 (x1)**	**Cutlet 2 (x2)**	**Turkey 1 (y1)**	**Turkey 2 (y2)**		Legend	
4	**Cost**	$ -	$ -	$ 10.00	$ 8.00		Decision	
5	**Revenue**	$ 4.00	$ 3.00	$ -	$ -		Constraint	
6							Cost	
7		**Cutlet 1 (x1)**	**Cutlet 2 (x2)**	**Turkey 1 (y1)**	**Turkey 2 (y2)**			
8	**Produce**	5000	3000	867	322			
9								
10								
11								
12		**Cutlet 1 (x1)**	**Cutlet 2 (x2)**	**Turkey 1 (y1)**	**Turkey 2 (y2)**			
13		0.7	0.6	5	3			
14	1.White Meat	3500	1800	4333.333333	966.6666667			
15		5300		5300				
16		0.3	0.4	2	3			
17	2. Dark Meat	1500	1200	1733.333333	966.6666667			
18		2700		2700				
19								
20	3. Limit	5000	3000	0	0			
21	4. Sell at least	0	0	100	0			
22								
23	Revenue	$ 29,000.00						
24	Cost	$ 11,244.44						
25	Profit	$ 17,755.56						

Formula:

	A	B	C	D	E	F	G	H
1	**Turkey Cutlet Problem**							
2								
3		**Cutlet 1 (x1)**	**Cutlet 2 (x2)**	**Turkey 1 (y1)**	**Turkey 2 (y2)**			
4	**Cost**	0	0	10	8		Legend	
5	**Revenue**	4	3	0	0		Decision	
6							Constraint	
7		**Cutlet 1 (x1)**	**Cutlet 2 (x2)**	**Turkey 1 (y1)**	**Turkey 2 (y2)**		Cost	
8	**Produce**	5000	3000	867	322			
9								
10								
11	Constraint White Meat							
12	C1+C2 < y1+y2	**Cutlet 1 (x1)**	**Cutlet 2 (x2)**	**Turkey 1 (y1)**	**Turkey 2 (y2)**			
13		0.7	0.6	5	3			
14		=B8*B13	=C8*C13	=D8*D13	=E8*E13			
15		=SUM(B14:C14)		=SUM(D14:E14)				
16	Constraint Dark Meat	0.3	0.4	2	3			
17	C1+C2 < y1+y2	=B16*B8	=C16*C8	=D16*D8	=E16*E8			
18		=SUM(B17:C17)		=SUM(D17:E17)				
19	Constraint Limit							
20		5000	3000	0	0			
21		0	0	100	0			
22								
23	Revenue	=SUMPRODUCT(B5:E5,B8:E8)						
24	Cost	=SUMPRODUCT(B4:E4,B8:E8)		Revenue		Constraint Sell at least		
25	Profit	=B23-B24		Cost				
26				Objective, Minimize				