

## Operations Analytics MOOC: Practice Problems for Week 2

---

### 1. Making Turkish Delight at the Rahat Industries.

Rahat Industries (RI) is a New York City-based company that manufactures and distributes Turkish delight to grocery chains in New York and New Jersey. The product line includes two main flavors: *Ortaköy* (O), and *Beyoglu* (B). Each flavor is sold in standard 10 oz. boxes. The table below shows *R*'s profit contribution for each flavor (in \$ per box).

Flavor	Profit per box (\$)
O	5.0
B	5.3

Given the relatively small size of the market for Turkish delight, RI cannot sell more than 250 boxes of *Ortaköy*, and more than 400 boxes of *Beyoglu* in the coming week.

Both flavors use the following set of main ingredients with limited supply: starch, sugar, and fruit juice. Each flavor also uses other ingredients, such as gelatin, pectin, etc., but RI has an essentially unlimited supply of those ingredients. For the coming week, the amounts of the three main ingredients the company has in storage are as follows:

Ingredient	Availability
Starch	150 lbs
Sugar	130 lbs
Fruit Juice	15 gallons

The *Ortaköy* and *Beyoglu* flavors use the following amounts of the main ingredients (per box):

Flavor	Starch (lbs)	Sugar (lbs)	Fruit Juice (gallons)
O	0.1	0.05	0.03
B	0.3	0.1	0.02

The company needs to decide how many boxes of each flavor to make during the coming week to maximize its weekly profit without exceeding the availabilities of the ingredients or the size of the Turkish delight market.

Let  $N_O$  be a decision variable that expresses the number of boxes of the *Ortaköy* flavor to make during the coming week, and let  $N_B$  be a decision variable that expresses the number of boxes of the *Beyoglu* flavor to make during the coming week.

#### Questions:

- Suppose that RI decides to make 250 boxes of *Ortaköy* and 350 boxes of *Beyoglu*. What is the weekly profit that it will earn?
- How many gallons of fruit juice will the production plan  $N_O = 250$  and  $N_B = 350$  require?

## Operations Analytics MOOC: Practice Problems for Week 2

- (c) RI is considering setting its production for the next week at the maximum levels that the market will bear - in other words, it is considering a production plan  $N_O = 250$  and  $N_B = 400$ . Is this plan feasible?
- (d) Write down an algebraic expression for RI's weekly profit, in \$, as a function of the decision variables  $N_O$  and  $N_B$ .
- (e) Using the decision variables  $N_O$  and  $N_B$ , write down a linear algebraic expression for the following constraint: "The amount of fruit juice used in production during the coming week cannot exceed 15 gallons".
- (f) Below is a picture of an excerpt from an Excel file set-up to model RI's profit maximization problem, with the number in cell D3 hidden.

	A	B	C	D	E
1			Ortaköy	Beyoglu	
2	Profit Contribution (\$/box)		5	5.3	
3	Units to Make		100		
4					
5			Resource requirements		
6			Ortaköy	Beyoglu	Required
7	Starch		0.1	0.3	100
8	Sugar		0.05	0.1	
9	Fruit Juice		0.03	0.02	
10					
11					

The formula in cell E7 is =SUMPRODUCT(\$C\$3:\$D\$3,C7:D7). What is the value in cell D3?

- (g) If the formula in cell E7 is copied and pasted into the cell E8, what value will appear in cell E8?
- (h) Use the file Zooter.xlsx as a template to set up and solve an optimization problem RI faces using Excel and Solver. What are the optimal values of the decision variables? What is the optimal objective function value?

### 2. Transporting Fruits at Florida Logistics.

Florida Logistics (FL) ships avocados and mangos once a week from South Florida to Philadelphia. This morning they have 39 tons of avocados and 36 tons of mangos on hand. The fruits all go to the Italian Market in Philadelphia and therefore can be mixed on the company's three trucks.

The capacities of trucks 1, 2, and 3 are 27, 31, and 28 tons, respectively. Fruits are packed in 20 pound cartons. Assume that there are 2000 pounds in a ton, so that 39 tons of avocado are packed into 3900 cartons, and 36 tons of mangos are packed into 3600 cartons.

The travelling costs of the trucks are negligible and independent of what fruits they ship; all three trucks will be used in this shipment.

Spoilage occurs during the transportation of fruit from Florida to Philadelphia. Because of differences in their refrigeration systems, the fruit losses differ by truck as follows:

## Operations Analytics MOOC: Practice Problems for Week 2

---

% Losses in Transit		
Truck no.	Avocado	Mango
1	5	10
2	4	12
3	3	11

For example, 5% of avocados in each carton placed in truck 1 and 11% of the mangoes placed in truck 3 will be spoiled upon arrival in Philadelphia.

FL sells the unspoiled avocados for \$20 per carton and unspoiled mangoes for \$32 per carton. Because of spoilage during transport to Philadelphia, however, FL must discount the amounts for which it sells cartons of fruit. For example, because 5% of the avocados shipped in truck 1 will be spoiled by the time they reach Philadelphia, FL will be able to sell cartons shipped on truck 1 for only  $\$20 \times (1 - 0.05) = \$19$ . Similarly, because 11% of the mangoes shipped on truck 3 will have spoiled, FL can sell cartons of mangoes shipped on truck 3 for only  $\$32 \times (1 - 0.11) = \$28.48$ . FL needs to determine the number of cartons of each fruit to load on each truck to maximize its revenue from selling fruits in Philadelphia.

FL wishes to determine the number of cartons of each fruit to load on each truck to maximize its revenue from selling fruits in Philadelphia.

Let  $A_1$ ,  $A_2$ , and  $A_3$  be the number of cartons of avocado loaded on trucks 1, 2, and 3, respectively, and let  $M_1$ ,  $M_2$ , and  $M_3$  be the numbers of cartons of mango loaded on trucks 1, 2, and 3, respectively.

### Questions:

- (a) Suppose that FL plans to put the same number of cartons for each fruit on each truck, in other words, suppose that FL sets  $A_1 = A_2 = A_3 = 1300$  and  $M_1 = M_2 = M_3 = 1200$ . Is this a feasible plan?
- (b) Irrespective of whether or not the plan in part a) is feasible, what is the total revenue that FL would earn under this plan?
- (c) Write down an algebraic expression for the revenue as a function of decision variables  $A_1$ ,  $A_2$ ,  $A_3$ ,  $M_1$ ,  $M_2$ ,  $M_3$ .
- (d) Using these decision variables, write down an algebraic expression for the constraint “the total number of fruit cartons shipped in truck 1 cannot exceed this truck’s capacity”.
- (e) Use the file *Keystone.xlsx* as a template to set up and solve the FL’s optimization problem using Excel and Solver. What is the optimal solution? What is the optimal objective function value?