

EconS450 Assignment #6, Due Wed, April 18th

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You run multiple fresh pack apple facilities across Washington and there are multiple demand centers where the apples need to be delivered to. Your task is to find the shipping schedule that minimizes cost. Each supply facility has a maximum supply S . Each demand center has a minimum quantity, D , that must be delivered. In order to guarantee the existence of a solution assume that the total quantity supplied is equal to total quantity demanded. $i = 1, \dots, m$ indexes supply facilities and $j = 1, \dots, n$ indexes demand centers. S_i is the maximum supply at facility i . D_j is the minimum demand quantity for facility j . x_{ij} is the quantity shipped from supply facility i to demand center j . c_{ij} is the cost of shipping from supply facility i to demand center j .

The optimization problem can be written concisely in mathematical notation as

$$\begin{aligned} \text{minimize} \quad & \sum_{i=1}^m \sum_{j=1}^n x_{ij} c_{ij} \\ \text{subject to} \quad & \sum_{j=1}^n x_{ij} = S_i \\ & \sum_{i=1}^m x_{ij} = D_j \end{aligned}$$

The apples can be shipped by rail or water. The first table below shows truck transportation costs and the second table shows waterway shipping costs.

Table 1: Cost per unit of trucking transport in \$10,000

Supply	D1	D2	D3	D4	D5
S1	51	62	35	45	56
S2	59	68	50	39	46
S3	49	56	53	51	37

Table 2: Cost per unit of water transport in \$10,000

Supply	D1	D2	D3	D4	D5
S1	48	68	48	N/A	54
S2	66	75	55	49	57
S3	N/A	61	64	59	50

The quantity of apples supplied is 15, 20, and 15 million pounds from S1, S2, and S3. The quantity of apples demanded is 11, 12, 9, 10, and 8 million pounds at markets 1 through 5. If you have a combination that is not possible use a very large number in the excel model.

Expanding on the the example in class, answer the following questions.

1. How much does it cost to use rail transport exclusively (done in class but still report the answer)?
2. How much does it cost to use ships exclusively?
3. How much does it cost to use the cheapest available mode of transportation?

4. Suppose there is a fixed annual cost of \$100,000 to operate any ships, what is the optimal production plan?
5. How much would your answer change if supply at S2 and demand at D3 both increased by 10 million pounds?

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Building on the production system you developed in the first half of the class and on the last question to Assignment #5 your task is to consider how your optimal production decision changes when considering risk.

2.1

- Take the risk preferences quiz and go the Estimate My Risk Preference Calculator at and choose your preferred production plan on the following website http://risknavigatorsrm.com/toolbox/RiskPreferenceCalculator/Risk_Preference_Calculator.swf.
- Report your scores for the quiz and for the calculator.
- Explain how this is relevant to finding your optimal production plan for the production setting you are interested in.

2.2

Specify at least 3 resource constraints for your production system where one of them must be operating capital. Identify the optimal production plan by incorporating risk in the following ways:

- Find the optimal production level first where your objective function is just profit and then when your objective function is the weighted sum of expected profit and variance of profits. Expected profit and variance of profits should be based on a historical price series for your output. Provide a table of the data series you used.
- Reduce each of your resource constraints by 10% and report the change in profit at the maximizing production point. Discuss how likely it is that you could unexpectedly have 10% less of each resource. Considering the likelihood of having 10% less and the impact on profitability together, what does this tell you about the relative sources of risk for your production environment?