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TIM 125
Homework 7

Homework 7

Plan:

Saturday – start planning out the homework, create a plan
Sunday – Begin on working on the qualitative problems 1&2
Monday – Work on quantitative problems 3&4
Wednesday - Work on the rest of the homework 5 & 6
Thursday - Turn in the assignment

Problem 1: Transportation in a SCL D13.2, D13.5

Define:

D13.2 Why is it important to account for congestion when pricing the use of transportation infrastructure?

D 13.5 What Transportation challenges does peapod face? Compare transportation cost at online grocers and super market chains.

Plan

What information is available for solving the problem?

- Textbook
- Chapter 13
- Lecture notes
- Further research

Execute

D13.2- why is it important to account for congestion when pricing the use of transportation infrastructure.

Infrastructure requires government ownership and is not something that can be increased in capacity in short term. If congestion is not factored in to the price structure for infrastructure, then demand for the resources will exceed capacity and delays will happen. Pricing may be used to force users to internalize the marginal impact of their choices.

D13.5-What transportation challenges does peapod face? Compare Transportation cost at online grocers and supermarket chains.

Peapod had to face an expensive outbound transportation challenge. The cost was too high, and they had to take account for the delivery area. Peapod delivers their items on trucks, which has scheduled pricing incentives. These pricing varies during on peak and off-peak times and makes It inconvenient. This pushes the customers to order in higher amounts in order to lower transportation cost. Grocers and supermarket chains usually don't deliver their products.

Although they both pay an inbound transportation cost, there is no advantage by either approach.

Check your work

I have checked my work by making sure that I have answered all the equations. I then proceeded to go over my answers.

Learn and Generalize

These two discussion problems gave me a better understanding on transportation costs. For peapod, I was able to understand the burden of expensive outbound transportation and how much it can affect a company.

Problem 2: Networking Design in a SC: D5.1, D5.4, D5.6

Define

D5.1 – How do the location and size of warehouse affect the performance of a firm such as Amazon.com? What factors should Amazon.com take into account when making this decision?

D5.4 – Amazon.com has built new warehouses as it has grown. How does this change affect various cost and response times in the Amazon.com supply chain?

D5.6 – Consider a firm such as Dell, with very few production facilities worldwide. List the pros and cons of this approach and why it may or may not be suitable for the computer industry.

Plan

What information is available for solving the problem?

- Chapter 5
- Lecture notes
- SP²

Execute

- **D5.1** – How do the location and size of warehouse affect the performance of a firm such as Amazon.com? What factors should Amazon.com take into account when making this decision?

The location and size of warehouses for Amazon plays a big role in affect their performance especially because they are an online company that ships from their warehouses. One problem was that they had a main warehouse for textbooks. They had an issue with that because They were not able to keep up with demand when product desinations were all over the country. Eventually Amazon spread out their warehouses at different locations allowing shipping distance to get shorter and lowering shipping costs as well.

Amazon should consider where they might be currently underserving their demand markets and if they should add more warehouses in those markets to improve their service They would also need to factor in the cost of adding these warehouses and how it would affect their overall supply chain.

- **D5.4** – Amazon.com has built new warehouses as it has grown. How does this change affect various cost and response times in the Amazon.com supply chain?

This affects the allocation of resources where they are now more spread-out, but capacity at each warehouse decreased. This is due to the fact that there are more warehouses to perform the task that one or more warehouses used to do and the transportation costs should also decrease since the warehouses would be more dispersed to different areas. This would also affect responsiveness of the supply chain since Amazon will be able to send products quicker. The inventory cost and holding cost and safety stock would also be affected since there are more warehouses and the demand at each warehouse will be more dispersed, This would also decrease their transportation cost.

- **D5.6** – Consider a firm such as Dell, with very few production facilities worldwide. List the pros and cons of this approach and why it may or may not be suitable for the computer industry.

The pros would be they have lower production facilities cost because they do not have as many facilities compared to other companies. This also decreases the responsiveness of the supply chain. Most of their computers are made to order, hence by having fewer facilities it will make the supply chain be less responsive. The shipping cost and transportation cost may also be an issue for Dell since they would need to ship to farther distances compared to having less facilities to ship from. It may also require they would need to fill during high demand. The supply chain would just seem to incur higher shipping cost but they may need more inventory on hand too because they would not be able to restock as quick or get any other supplies from another factory.

Check your Work

I made sure I answered all of the questions and made sure that I have answered and addressed each question accordingly.

Learn and Generalize

The location of the supply chain for online stores make a big difference because it will greatly affect their supply chain and transportation costs. By having more warehouses, these online stores will decrease their shipping cost but also ensure that there is enough demand in the region.

Problem 3: Safety inventory Exercise 11.5 (re-assigned from HW#6)

Define

How much safety inventory should Sam's Club carry if he wants to provide a CSL of 95%? How does required safety inventory change as the standard deviation of lead time is reduced from 1.5 weeks to zero in intervals of 0.5 weeks?

Plan

What information is available for solving the problem?

- Look over 11.4 previous problem and read over current question again
- Read over notes
- Textbook

Execute

R(demand) = 250 σ of lead time = 1.5 CSL = .95 L(average lead time) = 2 weeks

$\sigma_l = 150$ standard deviation of demand

$$\sigma_1 = \sqrt{(L\sigma_D^2 + D^2s^2l)}$$

$$\sigma_1 = \sqrt{(2 * 150^2 + 250^2 * 1.5^2)} = 430.8 \quad F^{-1}(.95) = 1.64$$

$$SS = \sigma_1 * F^{-1}(.95) = 430.8 * 1.64 = 706.6 \text{ so about } \mathbf{707 \text{ units}}$$

As the standard deviation of lead time decreases, the units of safety inventory also decrease. Sam's Club should provide about 707 units if he wants to target a CSL of 95%.

Check your work

I checked my work and doubled checked the calculations to ensure that they are calculated accurately

Learn and Generalize

I learned that standard deviation of lead time is important in determining how much safety inventory is required. The lower the standard dev the better it is and makes sense that a company would want to lower safety inventory,

Problem 4 Safety Inventory (Aggregation) exercise 11.7 11.8

Define

-Exercise 11.7: Epson produces printers for sale in Europe in its Taiwan factory. Printers sold in different countries differ in terms of the power outlet as well as the language manuals. Currently, Epson assembles and packs printers. Weekly demand in different countries is normally. Distributed with means and standard deviations.

Assume demand in different countries to be independent. Given that the lead time from Taiwan factory is eight weeks. How much safety inventory does Epson require in Europe if it targets a SL of 95%?

Epson decides to build a central DC in Europe. It will ship base printers to DC. When an order is received, the DC will assemble power supplies, add manuals, and ship the printers to the appropriate country. The base printers are still to be manufactured in Taiwan with a lead time of eight weeks. How much safety inventory can Epson expect as a result?

- **Exercise 11.8:** Return to the data given in the previous Epson problem. Each printer cost Epson \$200 and they have a holding cost of 25%. What saving in holding cost can they expect as a result of building the European DC?

If final assembly in the European DC adds \$5 to the production cost of each printer, would you recommend the move?

Suppose that Epson is able to cut the production and delivery lead time from its Taiwan factory to four weeks using good information system. How much savings in holding cost can they expect without the European DC?

How much savings in holding cost can they expect with the European DC?

Plan

What information is available for solving the problem?

- Textbook
- Lecture Notes
- Structured Problem Solving
- Table 11.6

Execute

• **Exercise 11.7:** Epson produces printers for sale in Europe in its Taiwan factory. Printers sold in different countries differ in terms of the power outlet as well as the language manuals. Currently, Epson assembles and packs printers for sale in individual countries. Weekly demand in different countries is normally distributed with means and standard deviations as shown in Table. 11.6.

Weekly demand for Epson Printers in Europe

Country	Mean Demand	Std Dev
France	3000	2000
Germany	4000	2200
Spain	2000	1400
Italy	2500	1600
Portugal	1000	800
UK	4000	2400
Total		

Part 1

1) solve each regions SS

2) equations used are

$D_L = \text{Lead time} * \text{Mean Demand}$

$\text{Std. Dev}_L = (\text{Lead time})^{0.5} * \text{Std. Dev}$

$SS = \text{Std. Dev}_L * F_Z^{-1}(\text{CSL}) = \text{ROP} - D_L$

$\text{ROP} = \text{NORMINV}(S_L, D_L, \sigma_L)$

Country	Mean Demand	Std Dev	DL	Std DevL	ROP	SS
France	3000	2000	12000	4000.00	18579.41	6579.41
Germany	4000	2200	16000	4400.00	23237.36	7237.36
Spain	2000	1400	8000	2800.00	12605.59	4605.59
Italy	2500	1600	10000	3200.00	15263.53	5263.53
Portugal	1000	800	4000	1600.00	6631.77	2631.77
UK	4000	2400	16000	4800.00	23895.30	7895.30
Total			66000	20800		34212.96

This shows the SS values for each region.

The amount of inventory for each region is summed but if Europe creases a central distribution center, the sum of the safety inventory will decrease. The difference between the two stratifies is This is a significant cut down on safety inventory where the cost on safety inventory is cut by about half seeing how the amount needed to store is cut down by about half. The cut down on storage amount can also help the company decrease their uncertainty in demand as well.

- 11.8 Return to the data given in the previous Epson problem. Each printer cost Epson \$200 and they have a holding cost of 25%. What saving in holding cost can they expect as a result of building the European DC?

If final assembly in the European DC adds \$5 to the production cost of each printer, would you recommend the move?

Suppose that Epson is able to cut the production and delivery lead time from its Taiwan factory to four weeks using good information system. How much savings in holding cost can they expect without the European DC?

How much savings in holding cost can they expect with the European DC?

Country	Mean Demand	Std Dev	DL	Std DevL	ROP	SS
France	3000	2000	12000	4000.00	18579.41	6579.41
Germany	4000	2200	16000	4400.00	23237.36	7237.36
Spain	2000	1400	8000	2800.00	12605.59	4605.59
Italy	2500	1600	10000	3200.00	15263.53	5263.53
Portugal	1000	800	4000	1600.00	6631.77	2631.77
UK	4000	2400	16000	4800.00	23895.30	7895.30
Total			66000	20800		34212.96

With safety stock values and given holding cost information I computed the lead time of 8 and 4 weeks along the difference of having a DC or no DC for both situations and found

	No DC SS	Holding Cost	DC SS	Holding Cost
8 weeks	48384.43	2419221.28	20680.72	1034036.16
4 weeks	34212.96	171064.77	14623.48	731173.98
Difference	14171.47	2248156.51	6057.24	302862.18

From the table above, you can see that building an European DC with a leading time as 8 weeks, the difference in holding cost when compared to no DC would be $(14171.47 - 6057) = 8114.24$. What Epson would have in profit.

Now looking at the company if the lead time is 4 weeks, the difference in safety inventory would be 19589 units of printers. Also, the difference in holding cost would be \$979473 Comparing to the 8 weeks lead time, the company can now store less products in their SS which will decrease their cost, Also the amount that is saved also increases due to the short lead time.

If there is no European DC, then the company will decrease in profit and have a smaller SS. Therefore, having a European DC, the company can save about 270899.

Check your work

I checked the work by making sure that I have answered all the questions

Learn and Generalize

11.7: Using Excel Worksheet helped greatly in terms of organizing the given information and for calculating each value faster. All the equations used were given equations from the textbook and was thoroughly explained in class.

11.8: Continuing the previous exercise on Epson's printers, I have learned more in terms of how a small change in price or cost lead to more complicated situation. All the calculations was done using Excel worksheet, which is shown above.

Problem 5. SC Facilities, Network Optimization for Sunoil

Define

Work through the sunoil case study Chapter 5 using Excel and Solver

Plan

What information is available for solving the problem?

- Textbook
- Lecture notes
- Structured problem-solving Method

Execute

Given data

Supply Region	N. America	S. America	Europe	Asia	Africa	Fixed Cost	Low Capacity	Fixed Cost	High Capacity
N. America	81	92	101	130	115	6000	10	9000	20
S. America	117	77	108	98	100	4500	10	6750	20
Europe	102	105	95	119	111	6500	10	9750	20
Asia	115	125	90	59	74	4100	10	6150	20
Africa	142	100	103	105	71	4000	10	6000	20
Demand	12	8	14	16	7				

Using solver parameters from Excel program, you get the finalize result of the table

Inputs - Cost, Capacities, Demands									
Demand Region Production and Transportation Cost per 1,000,000 units									
Supply Region	N. America	S. America	Europe	Asia	Africa	Fixed Cost	Low Capacity	Fixed Cost	High Capacity
N. America	81	92	101	130	115	6000	10	9000	20
S. America	117	77	108	98	100	4500	10	6750	20
Europe	102	105	95	119	111	6500	10	9750	20
Asia	115	125	90	59	74	4100	10	6150	20
Africa	142	100	103	105	71	4000	10	6000	20
Demand	12	8	14	16	7				
Decision Variable									
Demand Region - Production Allocation (million units)									
Supply Region	N. America	S. America	Europe	Asia	Africa	Plants (1=open)	Plants (1=open)		
N. America	0	0	0	0	0	0	0	0	
S. America	12	8	0	0	0	0	0	1	
Europe	0	0	0	0	0	0	0	0	
Asia	0	0	4	16	0	0	0	1	
Africa	0	0	10	0	7	0	0	1	
Constraints									
Supply Region	Excess Capacity								
N. America	0								
S. America	0								
Europe	0								
Asia	0								
Africa	3								
Unmet Demand	N. America	S. America	Europe	Asia	Africa				
	12	8	14	16	7				
Objective Function									
Cost =	\$23,751								

Check your work

I have checked my work by making sure that I have answered all the equations. I then proceeded to go over my answers again and make sure that I had addressed the questions accordingly.

Learn and Generalize

The example and explanation from the book were dwell written and easy to follow.

Problem 6. Facilities Design for Dry Ice, Inc: Exercise 5.2

Define

Dry Ice, Inc, is a manufacture of air conditioners that has seen its demand grow significantly. The company anticipates nationwide demand for the next year to be 180,000 unites in the south, 120,000 units in the Midwest, 110,000 units in the East, and 100,000 unites in the West. Managers at Dry Ice are designing the manufacturing network and have selected four potential sites – New York, Atlanta, Chicago, and San Diego. Plants could have a capacity of either 200,000 or 400,000 units. The annual fixed cost at the four locations are shown in table 5-6, along with the cost of producing and shipping an air conditioner to each of the four markets. Where should Drylce Inc, build its factories and how large should they be?

Plan

What information is available for solving the problem?

- Textbook
- Lecture Notes
- Chapter 5
- Given data

Production and Transport Costs for Drylce, Inc.				
	New York	Atlanta	Chicago	San Diego
Annual fixed cost for 200,000 plants	\$6 million	5.5 million	5.6 millior	6.1 million
Annual fixed cost for 400,000 plants	\$10 million	9.2 million	9.3 millior	10.2 million
East	\$ 211.00	\$ 232.00	\$ 238.00	\$ 299.00
South	\$ 232.00	\$ 212.00	\$ 230.00	\$ 280.00
Midwest	\$ 240.00	\$ 230.00	\$ 215.00	\$ 270.00
West	\$ 300.00	\$ 280.00	\$ 270.00	\$ 225.00

Execute

Given the same steps that the previous exercise gave the resulting table

	East	South	Midwest	West	Fixed Cost	Low Capacity	Fixed Cost	High Capacity
New York	\$ 211.00	\$ 232.00	240	\$ 300.00	6000000	200000	10000000	400000
Atlanta	\$ 232.00	\$ 212.00	230	\$ 280.00	5500000	200000	9200000	400000
Chicago	\$ 238.00	\$ 230.00	215	\$ 270.00	5600000	200000	9300000	400000
San Diego	\$ 299.00	\$ 280.00	270	\$ 225.00	6100000	200000	10200000	400000
Demand	110000	180000	120000	100000				
Decision Variable								
Supply Region	East	South	Midwest	West	Plants (1 = Open)	Plants (1 = Open)		
New York	0	0	0	0	0	0		
Atlanta	110000	180000	120000	0	1	0		
Chicago	0	0	0	0	0	0		
San Diego	0	0	0	100000	1	0		
Constraints								
Supply Region	Excess Capacity							
NY	0							
ATL	5090000							
CHI	0							
SD	6000000							
	New York	Atlanta	Chicago	San Diego				
Unmet Demand	0	0	0	0				
Objective Functions								
Cost =	113780000							

Tried to follow the steps shown from the previous exercise

Check your work

I checked my work by making sure that I have answered all the equations. I then proceeded to go over my answers again and making sure that I had addressed the questions accordingly.

Learn and generalize

Doing this problem more manually compared to following the steps on the book like the sun oil Problem gave me a better understanding in terms of how to go the SunOil problem. I am not 100% sure about my answers.

Problem 7. Transportation for Books-On-Line: Exercise 13.2

Define

Books-on-Line, an online book seller, charges its customers a shipping charge of \$4 for the first book for \$1 for each additional book. The average customer order contains four books. Books-On-Line currently has one warehouse in Seattle and ships all orders from there. For shipping purposes, Book-on-Line divides the United States into Three Zones -Western, Central, and Eastern. Shipping cost Incurred by books-On-Line per customer order is \$12 within the same zone, \$3 between adjacent zones, and \$4 between non-adjacent zones.

Weekly demand forms each zone is independent and normally distributed, with a mean of 50,000 and a standard dev of 25,000. Each book cost on avg \$10, and the holding cost incurred by books-on-line is 25%. Books-On-Line replenishment lead time of one week.

A war house is designed to carry 50% more than the replenishment order+safety stock. The fixed cost of a warehouse is \$200,000 +x where x is its capacity in books. The weekly operation cost of a warehouse is \$0.10y, where y is the number of books shipped. Books-On-

Line is planning its network strategy. Which zones should have warehouses? Detail all cost involved.

Plan

What information is available for solving the problem?

- Lecture Notes
- Textbook

Execute

Given information

Shipping cost first book = \$4 Each book after = \$1

Avg purchase = 4 books

Shipping cost between same zone = \$2

Adjacent zones = \$3 nonadjacent zones = \$4

Weekly Demand for each zone:

Mean = 50,000

Std Dev = 25,000

Avg cost per book = \$10

Holding cost = 25%

CSL = 99.7%

Lead Time = 1 Week

Warehouse carries 50% more than replenishment order + SS

Fixed cost per Warehouse = \$200,000 + Capacity in books

Weekly opp cost is \$0.01y, where y= # of books shipped

Network structure

E= East, C= Central, W= West

001

010

111

Given equations

Fixed cost = Each Warehouse = \$200,000 + x [x = capacity in books]

Weekly Operational Cost = \$0.01y [y = # books shipped]

Weekly safety inventory cost = (ss)(hC)(1/52)

Weekly Cycle inventory holding cost = $(Q_L/2)(hC)(1/52)$

Transportation cost = $(2x+3y+4z)(\text{Weekly demand})$ [x=same zone, y= adjacent zone, z=noneadjacent]

Calculation of the network strategy that books on line should use; which they should build a warehouse in
001

Fixed cost = \$200,000 + x x=50% more than replenishment+SS

SS

$SS = \text{root}(L+T) * (\text{weekly Stdev}) * F_z^{-1}(.997)$

$= \text{root}(1+1) * (25,000/52) * 3.4$

=2,312

ROP

$ROP = 2,312(150,000/52) = \mathbf{5,197}$

Fixed Cost

$$\$200,000 + [1.5(5197 + 2312)] = \mathbf{211,264}$$

Weekly fixed cost

$$\$211,264 / 52 = \mathbf{\$4,063}$$

Operation Cost

$$\$0.01y = 0.01 * (150,000 / 52) = \mathbf{\$41}$$

Weekly cycle inventory holding cost

$$(1500,000 / 2) * (10 * .25) (1 / 52) = \mathbf{3,605}$$

Weekly Safety inventory holding cost

$$(2312) (10 * 0.25) (1 / 52) = \mathbf{111}$$

Weekly Transportation Cost

$$[(2 * 50,000) + ((3 * 50,000) + (4 * 50,000))] / 52 = \mathbf{\$8,653}$$

$$\mathbf{Total\ sum\ =\ \$15,933}$$

Check your Work

I have checked my work by making sure that I have answered all of the equations. I then proceeded to go over my answers and make sure that I have addressed everything

Learn and Generalize

I mostly did this problem by hand. Got used to using Excel.