Antoine Rocha
T.I.M 125
Final

T.I.M 125 Final

Problem 1: Planning

Define

a) Create a plan and time- schedule for completing the final exam. Use the appropriate table to track how well you executed your schedule and make notes on any obstacles and problems you encounter.
b) Review my solution to the midterm. Correct all mistakes and omissions on your midterm and turn in the corrected midterm as an appendix to the final exam.

Plan

a) Create a plan to follow for completing the final exam
   - Begin with a Time Schedule plan
   - Begin a problem schedule
b) Review midterm and go over any corrections that were made during the re-grade.

Execute

a) Time schedule plan:
   a) (Problem 1) Planning and Reading (1Hour)
   - Read over the final and midterm
   - Do correction to midterm

   b) (Problem 2) SCM Design/Analysis Framework (1.5 Hours)
   - Review notes on SCM

   c) (Problem 3) Optimal Lot size & Special Packaging (1 Hour)
   - Review noes on optimal lot size

   d) (Problem 4) Safety inventory for polystyrene Resin at SPC (1 Hour)
   - Review notes on safety inventory and problem on midterm

   e) (Problem 5) Sourcing for SPC (1 Hour)
   - Review sourcing in a supply chain
   - Review which supplier is best
   - Review results from previous problem

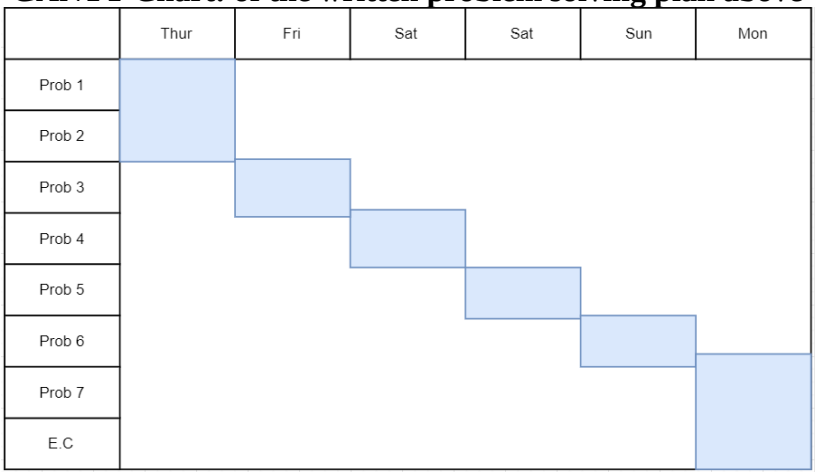
   f) (Problem 6) Transportation Design for SPC(1.5 Hours)
   - Read section on trade offs
   - Develop excel file
   - Go over transportation notes

   g) (problem 7) Execution of my plan (1 Hour)
   - Develop table to compare plan to problem
   - Make notes draw conclusions
   - Check all problems and calculations

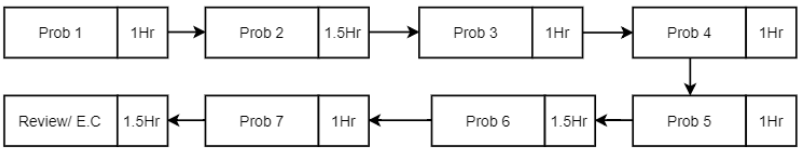
b) Problem solving Plan:

	Problem 1&2	Problem 3&4	Problem 5	Problem 6	Problem 7
3/14	Do corrections and do problems				
3/15		Problem 4 was tedious and took time to do			
3/16			Did whole problem in one sitting		
3/17				Finished in the library	
3/18					Review and compare

-GANTT Chart: of the written problem solving plan above



-Pert chart



Check your work

I believe that my work is correct I did the GANTT chart based on my written problem-solving plan which was a sudo GANTT chart. In terms of assumptions I believe the Final is doable given the allocated time I placed

Learn and Generalize

I have found that this final isn't something to do last minute and planning is required given how complex the final is itself. I planned with a time buffer for some problems so the final will take longer than expected. The plan seems to be good and I will compare and contrast at the end of the final

Problem 2 SCM Design/Analysis Framework

Define

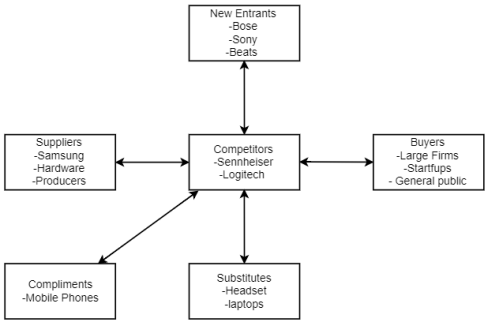
a) You have been hired as a consultant by Plantronics, a medium sized company "headquartered" in Santa Cruz, which is the world leader in communication head-sets. You have been asked to design their supply chain all the way form "high-level" converses, through analysis and procures to actual integrated software that will be used to manage their supply chain.

Plan

a) Review lecture notes on supply chain management
b) Look over slides on Plantronics and homework

Execute

Porter five (Six)forces analysis



Threat of new Entrants (High): There are many competitors that enter this market and actually become successful. If new entrants have the right amount of capital, they can succeed. There are not many barriers, expect the dedication to do R&D, but just about anyone can make decent headsets, wireless or wired.

Rivalry Among Competitors (High): Since there are multiple players in the market, the one who satisfy demand gets the business. There are also factors that have to be taken into account; technology progress with time meaning they improve while becoming cheaper. Competitors can easily improve their products to gain the majority of the market. An example would be Bluetooth tech advancing.

Buyer Power (High): Because all wireless/Wired Technology in a headset is essentially the same, competitors can keep providing supply to consumers. Consumers can then choose which one to buy, resulting in price sensitivity as consumer will buy the cheaper one.

Threat of Substitutes (Low): There aren't many substitutes for enterprise grade headsets, except for variables such as personal preference. Phones can be an alternative, but an inefficient one.

Supplier (Low): Because Plantronics has suppliers all over the world. The parts are abundant, meaning that Plantronics can switch parts with little to no switching cost. Plantronics has high competition and new entrants are slowly establishing. Plantronics seems to be heading towards the differentiation strategy. This is because their unified communications. They also have a stellar quality control, which makes them stand out compared to other low-quality items. After analysis, Plantronics seems to fall under this business model.

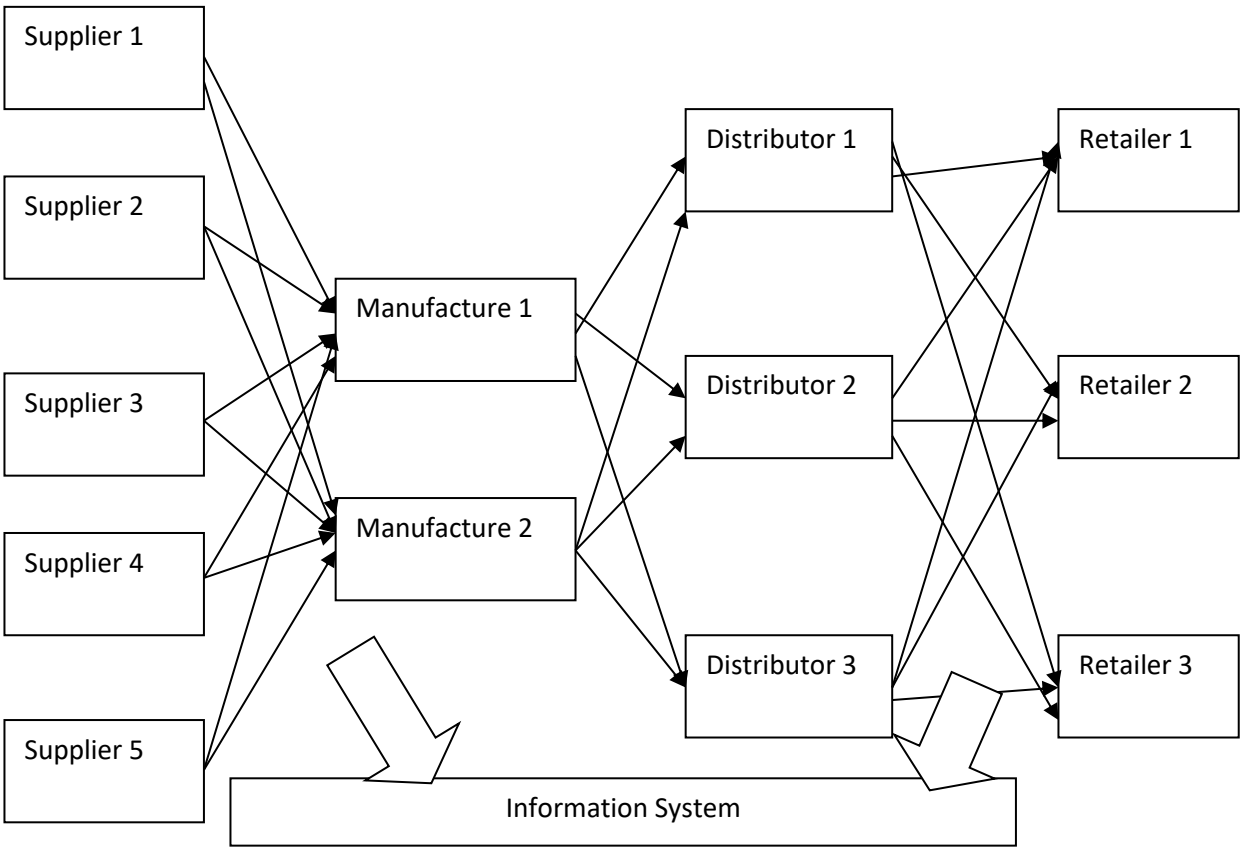
Compliments (High): The voice hardware is highly tied to telecommunications industry and the handset production industry. Thus if either one the parent industries are effected then the voice communication headset industry is greatly affected.

Overall attractiveness of the industry: Medium

Focus Sennheiser	Low cost leadership Logitech
Differentiation Plantronics	

After determining the competitive strategy, we will have to design a supply chain strategy. It will start with the high-level supply chain and adjust in accordance to how the supply chain strategy should be aligned with the competitive strategy.

Supply Chain Network

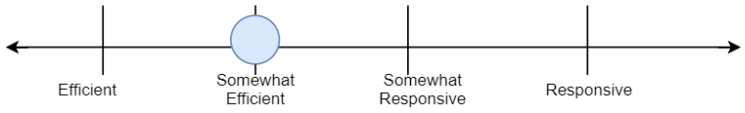


All the suppliers are connected to the manufacture, to the distributors, and to the retailers, which later get sent to their valued consumers, all the boxes are connected and then everything is later linked back to the information system.

-Responsiveness vs Efficiently

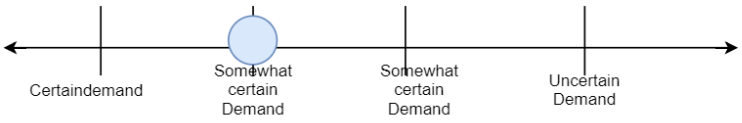
The efficiency/ responsiveness spectrum is a line that displays how efficient or responsive the company is. The line ranges from the company either really efficient or really responsive. IDU spectrum shows how uncertain the company is.

-Responsiveness vs Efficiently spectrum



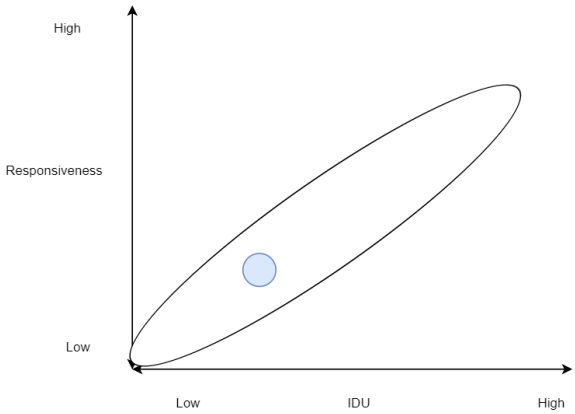
- Plantronics should have a somewhat efficient supply chain in order to minimize Cost and reduce lead time, while continuously producing the high-quality products.

-IDU Spectrum



- Plantronics has a focused competitive strategy and therefore have a set customer base that they aim to sell too. However, it is not guaranteed that the consuming firms will need new products or not reach out to a competitor, leaving the IDU at somewhat uncertain.

-Zone of strategic fit



This is the graphed using the responsive vs efficient and IDU spectrums shown previously

-Supply chain drivers

- **Inventory**: Shows how many products the inventory can hold in conjunction with cycle inventory, safety inventory, and various inventory-related costs. Finding the optimal low size and order frequency can help the company save a lot of money.
- **Transportation**: how products are transported from one facility to another. The type of transportation, routes, and costs are all taken into consideration.
- **Facilities**: Where each facility is located, the type, their product capacity and how much they cost to maintain them.
- **Information**: How Plantronics keep track of essentially everything and responds to customer demands.

Check your work

I believe my work is correct in most detail and that my assumptions are reasonable since the question was to propose and describes the framework that I would use to solve the supply chain management problem

Learn and Generalize

I found that I had to do research and analysis for a company to make it efficient in delivering a product to a customer. I also learned that SCM is very important in a business model. The results didn't affect my assumptions. The results are good I concluded everything I learned throughout the quarter.

Problem 3 Optimal lot size and Cycle inventory for specialty Packaging Company

Define

a) What is the optimal lot size and required cycle inventory if the holding cost h =12(rather than h=10), what is the required cycle inventory for polystyrene resin? Use these new numerical values in the problems below.

Plan

a) Find and review problem 4 of the midterm
b) Review holding cost lecture and notes
c) Calculate

Execute

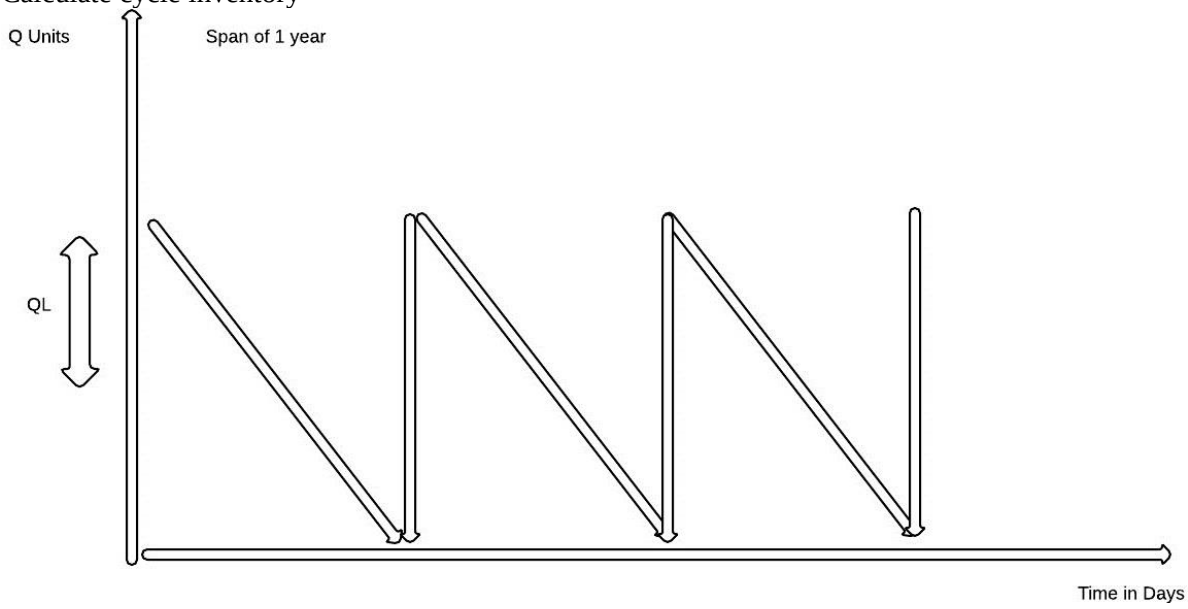
Information from the midterm

- Percent holding cost = 0.12
- Annual demand for 2007(Winters method) = 40,549
- Order cost: $300
- Unit cost: $20

a) Calculate EOQ

- $Q_L^* = \sqrt{\frac{2DS}{hC}} = \sqrt{\frac{2*40{,}549*300}{0.12*20}} = 3{,}184\ units$
- $n = \frac{D}{Q_L} = \frac{40{,}549}{3{,}184} = 13\ shipments/year$

b) Calculate cycle inventory



- $\frac{Q_L}{2} = \frac{3{,}184}{2} = 1{,}592\ units$
- Cycle inventory holding cost $HC = \left(\frac{Q^*}{2}\right)(hC) = 1{,}592 * (0.12 * 20) = \$3{,}820$
- Replenishment cycle time $T = \frac{365}{n} = \frac{365}{13} = \sim 28\ days$
- Average flow time $F = \frac{Q^*}{2D} * 365 = 1{,}592 * \frac{365}{40{,}549} = \sim 15\ days$

Check your work

- I checked the problem four on my midterm for information
- Checked with notes and previous assignments to ensure that I got the formulas correct

Learn and Generalize

This problem didn't take too long since it was mostly making sure that I had the correct formulas from the midterm. This was a great refresher for which formulas to use and which variables to use affect what part of the cycle inventory. I also couldn't find a original midterm paper or PDF so I relied on the given information written on problem 4 of the midterm.

Problem 4: Safety Inventory for Polystyrene at SPC

Define

- use the results from problem 3 for all calculations
- answer the following questions about safety inventory for polystyrene resin at SPC:

a) Why should SPC have a safety inventory? What is the average weekly demand for clear plastic (and therefore polystyrene resin) for 2007? If the coefficient of variation (cv) for clear plastic is .20, what is the standard deviation in the weekly demand.
b) The polystyrene supplier has a lead-time of 2 weeks. SPC would like its cycle service level (CSL) to be 0.96. Determine the necessary safety inventory (safety stock) level for polystyrene resin for a continuous replenishment policy. What is the re-order point (ROP)? What is the fill rate? What is the average inventory? What is the average flow time?
c) Create a diagram that shows all the relevant quantities form part (b)
d) In general, is the demand during the lead time greater that or less than the lot size? Explain your answer with the help of the diagram from part (c).

Plan

- Review the case study
- Identify why SPC should be kept a safety inventory
- Identify the weekly demand for clear plastic in 2007
- Determine the standard deviation in weekly demand
- Determine the necessary safety stock level for continuous replenishment policy
- Calculate the re-order point
- Calculate the fill rate
- Calculate the average inventory
- Calculate the average flow time
- Create a diagram that shows the relevant quantities calculated
- Use the diagram to explain how demand is greater to less than the lot size

Execute

- Safety stock is useful in case customer demand is over the anticipated or predicted amount. The safety inventory can then be used to fill customer orders until the next shipment of products arrive. Keeping safety inventory does increase the inventory holding cost. As for SPC, they should have safety inventory because their demand is ever increasing, even when taking into account the seasonality. By keeping safety inventory, SPC can ensure to keep up with any demand when it exceeds the forecasted amount.

- Average weekly demand D_w = = $\frac{Annual\ Demand}{52} = \frac{40{,}549}{52} = 779 = 779\ units$

- Coefficiant of variation = 0.12

- Standard deviation of weekly demand $\sigma_{D_w} = D_w * \mu = 779 * 0.12 = 93\ units$

- $L = 2\ weeks$

- $CSL = 96\% = 0.96$

- Calculate safety inventory:

  - $D_L = D_w * L = 779 * 2 = 1{,}558$

  - $\sigma_L = \sqrt{L} * \sigma_{D_w} = \sqrt{2} * 93 = 131$

- $ss = F^{-1}(CSL) * \sigma_L = F^{-1}(0.96) * 131 = 1.76 * 131 = 230\ units$

- Calculate re-order point:
  - $ROP = ss + D_L = 230 + 1{,}558 = 1{,}788\ units$
- Calculate fill rate:
  - Density function $F\left(\frac{ss}{\sigma_L}\right) = F\left(\frac{230}{131}\right) = F(1.7557) = .9599$
  - Expected shortage per cycle $ESC = -ss(1 - .9599) + \sigma_L * .9599$

    $= -230(0.0401) + 131 * .9599$

    $=116$
  - Fill rate $FR = \frac{(Q_L - ESC)}{Q_L} = \frac{3{,}184 - 116}{3{,}184} = 0.9626 = 96.35\%$
- Calculate average inventory:
  - Average inventory $= \frac{Q_L}{2} + ss = 1{,}592 + 230 = 1{,}822\ units$
- Calculate average flow time:
  - $F = \frac{Q_L^*}{2D_L} = \frac{3{,}184}{2*779} = 2.04$

- Diagram

Lead-time demand	D_L	$D_w * L$	1,558
Std. dev. of lead time	σ_L	$\sqrt{L} * \sigma_{D_w}$	131
Safety inventory	ss	$F^{-1}(CSL) * \sigma_L$	230
Re-order point	ROP	$ss + D_L$	1,788
Density function	$F(z)$	$F\left(\frac{ss}{\sigma_L}\right)$	.9599
Exp. shortage/cycle	ESC	$-ss\left(1 - F\left(\frac{ss}{\sigma_L}\right)\right) + \sigma_L * F\left(\frac{ss}{\sigma_L}\right)$	116
Fill rate	FR	$\frac{(Q_L - ESC)}{Q_L}$	.96

Average inventory		$\frac{Q_L}{2} + ss$	1,822
Average flow time	F	$\frac{Q_L^*}{2D_L}$	2.04

Input

DW	Deviation	lead time	csl desire	QI
779	93	2	0.96	116

Intermediates

DL	ΣI	esc
1558	131.5219	2.123596

Result

ss	ROP	fill rate
230.2534906	1788.253	0.981693

Differentiation between table above and excel spreadsheet would be rounding error when done by hand.

- $EOQ = 3{,}184$ and $D_L = 1{,}558$

  Demand during lead time is less than the optimal lot size, as can be seen form the calculations in problem 3 in conjunction with the diagram above. This is good for SPC as it shows that they usually won't have too much stock and not enough capacity to contain it all.

Check your work

I have checked lecture notes for the equations, and double checked with the textbook. Referenced the demand numbers in the midterm case study

Learn and Generalize

I mostly used the given equations to solve the problems and used the statistical table handed out in class to find the F(z) parts. In total this problem was a refresher of inventory in the course and how the it fits into the overall picture.

Problem 5: Sourcing for SPC

Define

- Read the first four sections on "*Sourcing Decisions in a Supply Chain*" from the textbook
    - Sections 14.1 – 14.4
- Use the results from Problem 3 for all calculations
- Julie Williams needs to make a choice between the following two suppliers:
    - Supplier 1: selling price = $15.0 per unit (1 unit = 1000lb); average lead time = 1 week; standard deviation of lead time = 0.5 weeks; Batch or lot size = 2000 units
    - Supplier 2: selling price = $12 per unit (1 unit = 1000lb); average lead time = 2 weeks; standard deviation of lead time = 1 week; Batch or lot size = 4000 units

- Answer the following Questions
    a) Which supplier should Julie choose, based on minimizing total cost, if her inventory holding cost h = 0.12 and her target CSL = 96%?
    b) Create a supplier scoreboard that Julie can use to compare different suppliers. (Hint use the utility function approach developed in TIM 105 for choosing between alternatives, as well as ideas form the text)

Plan

a) Read the first four sections on "Sourcing Decisions in a Supply chain" in the textbook.
b) Look over the answers from problem 3 & 4 and use the data to help figure out the answers to this problem.
c) List out the given data
d) Calculate annual cost
e) Calculate safety inventory
f) Calculate annual safety inventory holding cost
g) Calculate annual cycle inventory
h) Calculate annual cycle inventory holding cost
i) Calculate total costs

Execute

List out the given data

- Supplier 1:
  - $C = \$15.0$
  - $L = 1$
  - $\sigma_L = 0.5$
  - $Q = 2{,}000$
- Supplier 2:
  - $C = \$12$
  - $L = 2$
  - $\sigma_L = 1$
  - $Q = 4{,}000$
- $h = 0.12$
- $CSL = 96\% = 0.96$
- $D = 40{,}549$
- $D_w = 779$

<u>Supplier 1:</u>

Annual cost $= D * C = 40{,}549 * 15 = \$608{,}235$

Safety inventory $ss = F^{-1}(CSL) * \sigma_L * D_w = F^{-1}(0.96) * 0.5 * 779$

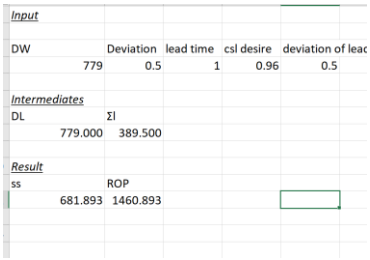
$$= 1.76 * 0.5 * 779 = \ 685\ units$$

Annual ss holding cost $= ss * hC = 685 * 0.12 * 15 = \$1{,}233$

Annual cycle inventory $= \frac{Q_L}{2} = \frac{2000}{2} = 1{,}000$

Annual cycle inventory holding cost $= \frac{Q_L}{2} * hC = 1{,}000 * 0.12 * 15 = \$1{,}800$

Total costs $= 608{,}235 + 1{,}233 + 1800 = \$611{,}268$



Input				
DW	Deviation	lead time	csl desire	deviation of lead
779	0.5	1	0.96	0.5
Intermediates				
DL	ΣI			
779.000	389.500			
Result				
ss	ROP			
681.893	1460.893			

Supplier 2:

Annual cost $= D * C = 40{,}549 * 12 = \$486{,}588$

Safety inventory $ss = F^{-1}(CSL) * \sigma_L * D_w = F^{-1}(0.96) * 1 * 547$

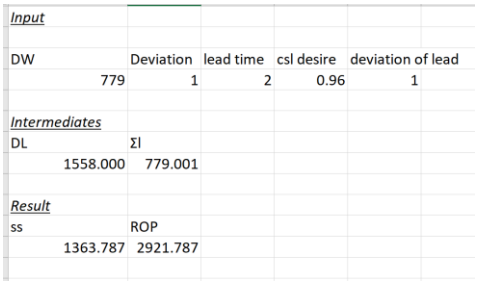
$$= 1.76 * 1 * 779 = 1{,}371\ units$$

Annual ss holding cost $= ss * hC = 1{,}371 * 0.12 * 12 = \$1{,}974$

Annual cycle inventory $= \frac{Q_L}{2} = \frac{4000}{2} = 2{,}000$

Annual cycle inventory holding cost $= \frac{Q_L}{2} * hC = 2{,}000 * 0.12 * 12 = \$2{,}880$

Total costs $= 486{,}588 + 1{,}974 + 2{,}880 = \$491{,}442$



Input				
DW	Deviation	lead time	csl desire	deviation of lead
779	1	2	0.96	1
Intermediates				
DL	ΣI			
1558.000	779.001			
Result				
ss	ROP			
1363.787	2921.787			

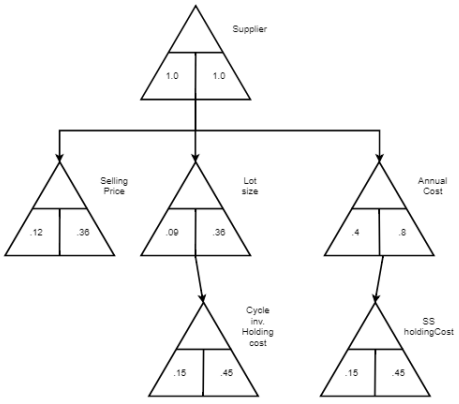
Table citing the total costs

	Supplier 1:	Supplier 2:
Annual cost	$608,235	$486,588
Safety inventory	685 *units*	1,371 *units*
Annual safety inventory holding cost	$1,233	$1,974
Annual cycle inventory	1,000	2,000

Annual cycle inventory holding cost	$1,800	$2,880
Total costs	$\mathbf{611,268}$	$\mathbf{491,442}$

- From comparing the two suppliers, Julie should go with supplier 2 if she is looking to minimize cost
- Supplier scoreboard to compare the different suppliers
- Rate on a scale 1- 5

Utility diagram



		Supplier 1		Supplier 2	
	Weight	Rating	Utility	Rating	Utility
Selling price	0.12	4	0.36	3	0.48
Lead time	0.09	3	0.36	3	0.27

Lot size	0.09	4	0.36	3	0.36
Annual cost of supplier	0.4	1	0.8	3	1.2
ss holding cost	0.15	3	0.45	3	0.3
Cycle inv. holding cost	0.15	3	0.45	3	0.3
Total	1.00		2.98		3.0

Using the utility function, we can also see that the utility of supplier two ranks higher than that of Supplier 1, making it the better choice of the two suppliers for Julie in order to minimize cost

Check your work

I checked the text to ensure that I had the correct formulas, and calculations & all worked is shown I had to reference TIM 105 to refresh myself on the utility function.

Learn and Generalize

This problem was not that hard, I felt as if I had to continually check my previous number to make sure that they made sense and that I was doing everything correctly, which I think I did. The results and final numbers may be off but that is due to rounding I checked my calculations thoroughly and the process is correct to my knowledge.

Problem 6 Transportation Design for SPC

Define

Read the section on "*Trade-offs in Transportation design*" from the textbook

- Section 13.5

Answer the following questions about transportation design for SPC:

a) Create the appropriate table in Excel for comparing rail versus truck delivery options for modes of transportation

b) Use the table from (a) to select the optimal mode of transportation. Provide quantitative evidence to support your selection

- Use information on costs given in the case-study, and make appropriate assumptions about transportation costs

Plan

- Read the "Trade-Offs in Transportation design" section in the textbook
- Go over notes on transportation
- Calculate necessary formulas

Execute

Data from previous calculation/Problems

- $D = 40{,}549$
- $D_w = 779$
- $h = 0.12$
- $C = \$20$
- $S = \$300$
- $L = 2\ weeks$
- $hC = 0.12 * 20 = \$2.4/unit$

(assuming data form previous problem, supplier 2) table with data from the book:

	Rail	Truck
Ship time days	5	3
Lot inventory	5	4
Safety inventory	5	4
In-Transit cost	5	4
Transportation	5	3
Trans time	2	3

Railways can transport a lot size of 5,000 units in 4 days
Truck can transport a lot size of 3,000 in 3 days

- Daily demand $D_D = \frac{D}{365} = \frac{40{,}549}{365} = 111\ units$
- Railway calculations:
  - Cycle inventory $\frac{Q_L}{2} = \frac{5000}{2} = 2{,}500\ units$
  - Safety inventory $ss = \frac{L}{2} * D_D = 1 * 111 = 111\ units$
  - In-transit inventory $T = D_D * 4 = 444\ units$
  - Inventory costs $= \left(\frac{Q_L}{2} + ss + T\right) * hC = (2500 + 111 + 444) * 2.4 = \$3{,}055$
  - Transportation costs $= D *$ transit cost per unit $= 40{,}549 * 7.5 = \$304{,}117.5$
    - \$7.5/unit is taken from an example in section 13.5
  - **Total costs** $= 3{,}055 + 304{,}117.5 = \$\mathbf{307{,}172.5}$
- Truck calculations:
  - Cycle inventory $\frac{Q_L}{2} = \frac{3000}{2} = 1{,}500\ units$
  - Safety inventory $ss = \frac{L}{2} * D_D = 1 * 111 = 111\ units$
  - In-transit inventory $T = D_D * 3 = 333\ units$
  - Inventory costs $= \left(\frac{Q_L}{2} + ss + T\right) * hC = (1{,}500 + 111 + 333) * 2.4 = \$1{,}944$
  - Transportation costs $= D *$ transit cost per unit $= 40{,}549 * 6.5 = \$263{,}568.5$
    - \$6.5/unit is taken from an example in section 13.5
  - **Total costs** $= 1{,}944 + 263{,}568.5 = \$\mathbf{265{,}512.5}$

Size	lot size	demand annual	holding cost	trans unit cost	lead time (days)	transit time	transit cost	adjusted lead	cycle inventory	safety inventory	in-transit inventory	inventory cost	total cost
Rail	5000	40,549	2.4	7.5	28	4	304117.5	32	2500	111	444.3726027	7332.894247	311450.3942
TL	3000	40,549	2.4	6.5	28	3	263568.5	31	1500	111	333.2794521	4666.270685	268234.7707

When looking to minimize transportation cost, transportation via trucks is less expensive and therefore the optimal option by (307,172.5 – 265,512.5) = \$41,660 dollars per year. Although they carry smaller lot sizes and make more shipments the lower cost per order combined with lower trans cost makes it the obvious option than using rail.

Check your Work
The numbers seem a little drastic but after going over them again they come out to be the same. I believe my assumptions are reasonable as instructed. The results are reflected on the small rounding errors.

Learn and Generalize
By comparing alternatives in transportation and suppliers SPC can save more money by choosing the low-cost supplier and the low transportation method of train. The results are that trucks are faster option and would cost less.

Problem 7 Execution of your plan

Define

Use a table to compare your plan from Problem 1 (column 1) with its execution (column 2). Indicate the reasons for the difference between the plan and its execution (column 3). Add additional columns to capture recommendations for improved execution of your plans in the future

Write down three key lessons you learned in this course

Plan

- Create table update it while working on this exam with obstacles and if I stayed within m time schedule.
- Elaborate on how long it took to complete each problem and whether or not it was completed on schedule.
- Add ways I can improve on my problems in the future.
- Determine and explain key lessons throughout the course

Execute

	Scheduled time	Actual time taken	Reason for difference	What to improve on

Problem 1	Complete Thursday, 1.5Hrs	1.5 Hrs		
Problem 2	Complete Thursday, 1.5Hrs	1.5 Hrs	Review Plantronics	More time on tasks
Problem 3	Complete Friday, 1.5HRS	1.5 Hrs		
Problem 4	Complete Friday 2 HRS	2-3 Hrs	Procrastination	Don't procrastinate
Problem 5	Complete Saturday, 2 hours	3 Hrs	Reviewing material	Review material earlier
Problem 6	Complete Sunday 2Hrs	Finished on Saturday, 2Hrs		

- **Key lessons**
  - **I.** The intricates of the supply chain and how it can affect a company's operations. Selling and marketing a product is very important, but this course had me realize that a company SC strategy is critical to its success. Reading about different companies such as Plantronics was interesting.
  - **II.** Teamwork. Being able to work with the same group and adapt to everyone's schedule to push forward is an essential skill to have learned In this course.
  - **III.** Time management/ scheduling. This course helped me improve my time management skills.

Learn and Generalize
Thank you for teaching me everything this quarter