Matching Supply with Demand: An Introduction to Operations Management

Solutions to End-of-Chapter Problems

(last revised February 25, 2008; make sure to visit www.cachon-terwiesch.net for the latest updates, excel files, ppt files and other information)

Chapter 2

Q2.1 Dell

The following steps refer directly to Exhibit 2.1.
#1: For 2001, we find in Dell's 10-k: Inventory=$400 (in million)
#2: For 2001, we find in Dell's 10-k: COGS=$ 26,442 (in million)
#3: Inventory turns$= \frac{26{,}442\$ / year}{400\$} = 66.105$ turns per year
#4: Per unit Inventory cost $= \frac{40\% \ per \ year}{66.105 \ per \ year} = 0.605\%$ per year

Q2.2. Airline

We use Little's law to compute the flow time, since we know both the flow rate as well as the inventory level:
Flow Time = Inventory / Flow Rate = 35 passengers / 255 passengers per hour = 0.137 hours
= *8.24 minutes*

Q2.3 Inventory Cost

(a) Sales = $60,000,000 per year / $2000 per unit = 30,000 units sold per year
Inventory = $20,000,000 / $1000 per unit = 20,000 units in inventory

Flow Time = Inventory / Flow Rate = 20,000 / 30,000 per year = 2/3 year = 8 months
Turns = 1 / Flow Time = 1 / (2/3 year) = *1.5 turns per year*

Note: we can also get this number directly by writing: Inventory turns=COGS/ Inventory

(b) Cost of Inventory: 25% per year / 1.5 turns=16.66%. For a $1000 product, this would make an absolute inventory cost of $166.66.

Q2.4. Apparel Retailing

(a) Revenue of $100M implies COGS of $50M (because of the 100% markup). Turns = COGS/Inventory = $50M/$5M = 10.
(b) The inventory cost, given 10 turns, is 40%/10 = 4%. For a 30$ item, the inventory cost is 0.4 x $30 = $1.20 per unit.

Q2.5. La Villa

(a) Flow Rate = Inventory / Flow Time = 1200 skiers / 10 days = *120 skiers per day*

(b) Last year: on any given day, 10% (1 of 10) of skiers are on their first day of skiing
This year: on any given day, 20% (1 of 5) of skiers are on their first day of skiing

Average amount spent in local restaurants (per skier)
Last year = 0.1 * $50 + 0.9 * $30 = $32
This year = 0.2 * $50 + 0.8 * $30 = $34
% change = ($34 - $32) / $32 = *6.25% increase*

Q2.6. Highway

We look at 1 mile of highway as our process. Since the speed is 60 miles per hour, it takes a car 1 minute to travel through the process (flow time).
There are 24 cars on ¼ of a mile, i.e. there are 96 cars on the 1 mile stretch (inventory).
Inventory=Flow Rate * Flow Time: 96 cars=Flow Rate * 1 minute
Thus, the Flow Rate is 96 cars per minute, corresponding to 96*60=5760 cars per hour.

Q2.7. Strohrmann Baking

The bread needs to be in the oven for 12 minutes (flow time). We want to produce at a flow rate of 4000 breads per hour, or 4000/60=66.66 breads per minute.

Inventory=Flow Rate * Flow Time: Inventory=66.66 breads per minute* 12 minutes
Thus, Inventory=800 breads, which is the required size of the oven.

Q2.8. Mt Kinley Consulting

We have the following information available from the question:

Level	Inventory (number of consultants at that level)	Flow Time (time spent at that level)
Associate	200	4 years
Manager	60	6 years
Partner	20	10 years

(a) We can use Little's law to find the flow rate for associate consultants:
Inventory=Flow Rate * Flow Time; 200 consultants=Flow Rate * 4 years; thus, the flow rate is 50 consultants per year, which need to be recruited to keep the firm in its current size (note: while there are also 50 consultants leaving the associate level, this says nothing about how many of them are dismissed vs how many of them are promoted to Manager level).

(b) We can perform a similar analysis at the manager level, which indicates that the flow rate there is 10 consultants. In order to have 10 consultants as a flow rate at the manager level, we need to promote 10 associates to manager level (remember, the firm is not

recruiting to the higher ranks from the outside). Hence, every year, we dismiss 40 associates and promote 10 associates to the manager level (the odds at that level are 20%)

Now, consider the partner level. The flow rate there is 2 consultants per year (obtained via the same calculations as before). Thus, from the 10 manager cases we evaluate every year, 8 are dismissed and 2 are promoted to partner (the odds at that level are thereby also 20%).

In order to find the odds of a new hire to become partner, we need to multiply the promotion probabilities: 0.2*0.2=0.04. Thus, a new hire has a 4% chance of making it to partner.

Q2.9. Major US Retailers

a. Product stays on average for 31.9 days in Costco's inventory
b. Costco has for a $5 product an inventory cost of $0.1311 which compares to a $0.2049 at Wal-Mart

Q2.10. McDonald's

a. Inventory turns for McDonald's were 92.3. They were 30.05 for Wendy's.
b. McDonald's has per unit inventory costs of 0.32%, which for a 3$ meal about $0.00975. That compares to 0.998% at Wendy's where the cost per meal is $0.0299.

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Questions for Chapter 2

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QUESTIONS WITH EMBEDDED ANSWERS

Butternut is a ski resort in Massachusetts. One of their triple chair lifts unloads 1296 skiers per hour at the top of the slope. (A triple chair lift can carry three passengers per chair.) The ride from the bottom to the top takes 5 minutes. How many skiers are riding on the lift at any one time?

*Answer: Use Little's Law. 1296skier/hour*5/60=108 skiers*

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Home Depot's annual turns are 4.7, its Cost of Goods Sold (COGS) is $44.7 Billion, and its gross margin is 33%. Recall, gross margin = (Revenue – COGS) / Revenue. What is the average inventory it holds in $ Billion?

Answer: $44.7 billion / 4.7 =$9.51 billion. Note that average inventory in $s is measured by the cost of goods sold, thus the gross margin does not play a role in the calculation.

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A company's holding cost is 16% per year. Its annual inventory turns are 9.5. The company buys an item for $50. What is the average cost ($s), to hold this item in inventory?

*Answer: the item will be turned 9.5 times a year. Thus, for each turn it stays in inventory, the holding cost is 16%/9.5 of the cost of the item. Thus, the average cost to hold this item in inventory is $50 * (16%/9.5)=$0.84*

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Trader Bob, an organic food retail chain, operates 365 days a year. In 2007, the company turned its inventory approximately 25 times. The company's COGS were 60% of its Sales and its annual Sales were about $7,000M that year.
What was Trader Bob's average inventory in 2007 (in $M)?

Answer: COGS = 0.6 x 7000 = 4200. Inventory = COGS / Turns = 4200 / 25 = $168M

Assuming Trader Bob's annual inventory holding costs are 20% (an item that cost $10 to purchase would cost $2 to hold in inventory for one year), what is the inventory cost of an item which sells for $20 and costs Trader Bob $12 to buy? Assume that this item has inventory turns of 25 per year.

Answer C: 20% per year with 25 turns is 20/25% = 0.8%. COGs is $12. So Inventory cost is 0.8% x $12 = $0.096

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Joe's Beer, Bait, & Tackle Co. is a small chain of fishing tackle stores in northern Minnesota. In 2009, the company's revenue was $4,300,000 and its cost of sales was $3,200,000. Assume 52 weeks and 365 days per year.

Joe keeps only 5.5 days-of-supply of inventory on average because much of his inventory is live bait and micro-brew beer, both of which have a short shelf life. What is his **annual inventory turns**?

Answer: 365/5.5=66.36

Given that he has 5.5-days-of-supply of inventory on average, how much inventory does Joe have on average (in **$s**)?

Answer: $3,200,000/(365/5.5)=$48219

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Which of the following best explains why slow turning items may not be profitable at a brick-and-mortar retailer?

a) If turns are low, days-of-supply will also be low
b) If turns are low, the gross margin will also be low
c) If turns are low, the setup costs to stock the shelf will be high
d) If turns are low, blocking and starving are more likely to occur
e) If turns are low, units spend a long time on the retailer's shelves

Answer: a) If turns are low, days-of-supply will be high. b) it is not necessary that the gross margin will be low, since various factors affect gross margin. c) setup costs are not affected by turns. d) starving is less likely to occur when turns are low. e) units spend too much time on the shelves and this will increase the inventory holding cost.

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Is it possible for two firms to have the same annual inventory turns and the same gross-margin but different days-of-supply?

a) Yes, because days-of-supply measures how long the firm can satisfy demand with its current inventory whereas inventory turns measures the frequency at which inventory turns over.
b) Yes, inventory turns and gross margin are related but they are independent of days-of-supply
c) Yes, the firm with the higher days-of-supply will have the lower return on invested capital.
d) No, if firms have the same gross-margin then they must have the same days-of-supply.
e) No, if firms have the same inventory turns then they must have the same days-of-supply.
f) None of the above.

Answer = E

ProofSmart Inc.

ProofSmart Inc., a supplier of home insulation materials, was burned down in a recent fire. From the remains of what used to be the accounting ledger, the following information was recovered:

	2006	2007
Inventory	$2,367,121	$2,418,257
Gross Margin	42%	45%
Inventory Turns	11	[unreadable]

Prior to the fire, ProofSmart saw a sales growth of 48% in 2007, a record performance for the 18 year-old company. (NOTE: Gross margin is defined as 1-(COGS/Sales).)

What was the sales for 2007?

Circle the answer closest to the correct answer.

a. $318,000
b. $38,000,000
c. $43,000,000
d. $66,000,000
e. $85,000,000

f. cannot be determined from the data given

d)
*2006 COGS = 2,367,121 * 11 = $26,038,331*
2006 Sales = 26,038,331 / (1-42%) = $44,893,674
*2007 Sales = 44,893,674 * 148% = $66,442,638*

What was the inventory turns for 2007?
Circle the answer closest to the correct answer.

a. 10
b. 11
c. 12
d. 13
e. 14
f. 15
g. cannot be determined from the data given
h. none of the above

f)
*2007 COGS = 66,442,638 * (1-45%) = $36,543,451*
2007 Inventory Turns = 36,543,451/2,418,257 = 15

CHEAP RETAILERS

The following table shows financial data (year 2006) for Dirt Cheap Wholesale and Kwiki-Mart, two US retailers.

	DIRT CHEAP WHOLESALE	KWIKI-MART STORES
Inventories ($MM)	4754	40894
Sales (net $MM)	59217	397206
COGS ($MM)	52762	326606

Assume that both companies have an average annual holding cost rate of 20% (i.e. it costs both retailers $2 to hold an item that they procured for $10 for one entire year).

How many days, on average, does a product stay in Dirt Cheap's inventory before it is sold? Assume that stores operate 365 days a year.

Dirt Cheap has a COGS=$52762M = flow rate R. Inventory I = $4754M. Therefore, flow time T = I/R = 4754/52762 = .09 years, or 32.89 days.

How much lower (expressed in $'s) is, on average, the inventory cost for Dirt Cheap compared to Kwiki-Mart of a house hold cleaner valued at $5 COGS? Assume that the unit cost of the house hold cleaner is the same for both companies and that the price and the inventory turns of an item are independent.

Inventory turns for Dirt Cheap *= 1/*.09 *= 11.1 turns. Flow time for Kwiki-Mart = Inventory/COGS =*40894/326606*= 0.125. Therefore inventory turns for Kwiki-Mart = 7.98. Holding costs per year = 20% or $1 per unit for one year. This means inventory costs per unit for Dirt Cheap = 1/11.1 = $0.09. For Kwiki-Mart, the inventory costs per unit = 1/7.98 = $0.125. So Dirt Cheap's costs are 3.5 cents lower.*