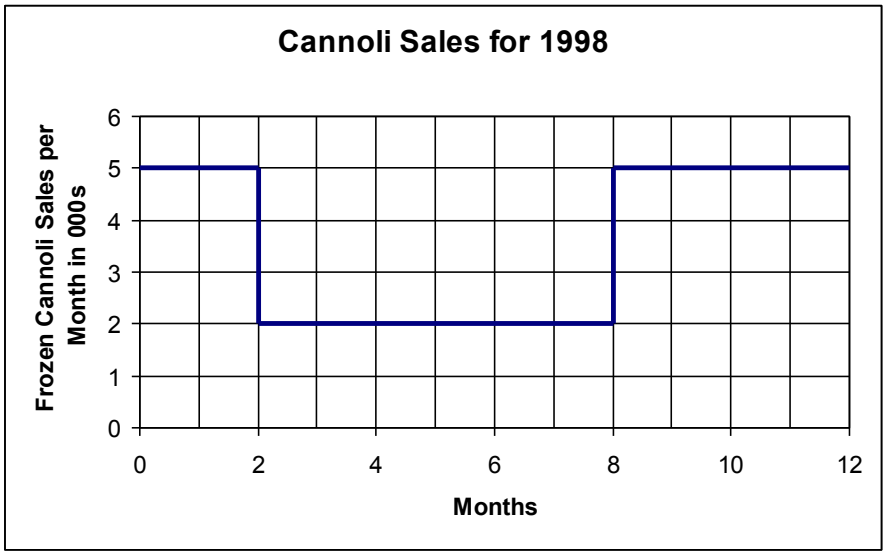
BA 380N Anderson **Name: SOLUTIONS**

Homework-6

MORE INVENTORY BUILDUP ANALYSIS

Examine the following graph of Frozen Cannoli sales for Cannoli Inc. in 1998.



Frozen cannoli demand is highly seasonal. However, they effectively never spoil, so inventories can be used to smooth out production during the year. In 1998, Cannoli, Inc. (CI) was over-capacitized, so it could easily satisfy all demand. However, the new manager, Santiago Maley wants to try a new approach by using less labor (i.e. lower Cannoli, Inc.'s capacity). Assume you start at the beginning of 1999 with 1000 cannolis in inventory, and that there are no losses in thruput due to yield or downtime problems. Additionally, you cannot backlog orders. If demand in 1999 follows the pattern of sales in 1998, please answer the following questions. (Note that freezer storage space is not a constraint.)

a) If capacity throughout the year is smooth at 4,000 cannolis per month and you operate at 100% utilization year round**, what will the inventory be at time = 6.0 months?**

Let "c" = cannolis
I(0) = 1000 cannolis; S = 4000 cannolis/month;

I(Tb) = I(Ta) + (S – D) x (Tb – Ta)
I(2) = I(0) + (4000 c/mo – 5000 c/mo) x (2 – 0) mo
= 1000 + (-1000 c/mo) x 2 mos = -1000 cannolis

This clearly in incorrect because we can't have negative inventory, so we'll have to find out when we run out of inventory:

Tb =T(I=0)=Ta + (Ib –Ia)/(S-D) =
Tb = 0 mo + (1000 c – 0 c)/(4000 c/mo – 5000 c/mo) = 1 mo

→ **I(1) = 0 cannolis**
I(2) = 0 cannolis, because of starvation

I(6) = I(2) + (4000 c/mo – 2000 c/mo) x (6 mos – 2 mos) = 0 + (2000 c/mo) x (4 mos) = 8000 cannolis

b) Given the assumptions of part a, **what will your inventory at the end of 1999? What will be the approximate average time in storage for a frozen cannoli?**

Continuing onward
I(8) = I(6) + (4000 c/mo – 2000 c/mo) x (8 mos – 6mos) = 8000 c + (2000 c/mo) x (2 mos) = 12,000 cannolis

I(12) = I(8) + (4000 c/mo – 5000 c/mo) x (12 mos – 8 mos)
= 12,000 c + (-1000 c/mo) x (4 mos) = 8000 cannolis

Summarizing

Time (mos)	Inventory (cannolis
0	1000
1	0
2	0
8	12,000
12	8,000

Avg Inventory Calculation

	Months	Avg Inventory (Cannolis)
0-1	1	(1000 + 0)/2 = 500
1-2	1	0
2-8	6	(0 + 12,000)/2 = 6000
8-12	4	(12,000 + 8000)/2 = 10,000

$$I_{avg} = L = \frac{1 \text{ mo x } 500 \text{ c} + 1 \text{ mo x } 0 \text{ c} + 6 \text{ mos x } 6000 \text{ c} + 4 \text{ mos x } 10{,}000 \text{ c}}{12 \text{ mos}} = 6375c$$

$$Thruput = \frac{1 \text{ mo x } 5000 \text{ c/mo} + 1 \text{ mo x } 4000 \text{ c/mo} + 6 \text{ mos x } 2000 \text{ c/mo} + 4 \text{ mos x } 5{,}000 \text{ c/mo}}{12 \text{ mos}} = 3417c / mo$$

$$FT = \frac{L}{Thruput} = \frac{6417 \text{ c}}{3417c / mo} = 1.87 months$$

c) **Again using the assumptions of problem a, what will the average sales per month be for 1999 if the freezer capacity is only 1000 cannolis. Comment on the effect of freezer capacity on sales.**

From above I(2) = 0, at that point Tb=Ta + (Ib-Ia)/(S-D) =
= 2 mos + (1000 c – 0 c)/(4000 c/mo -2000 c/mo) = 2.5 mos

I(2.5) = 1000 c
I(8) = 1000 c, because of blockage
I(9) = I(8) + (4000 c/mo – 5000 c/mo) x (9 mos – 8 mos) Note: The 9 months was a guess
= 1000 c + (-1000 c/mo) x (1 mo) = 0 cannolis
I(12) = 1000, from blockage

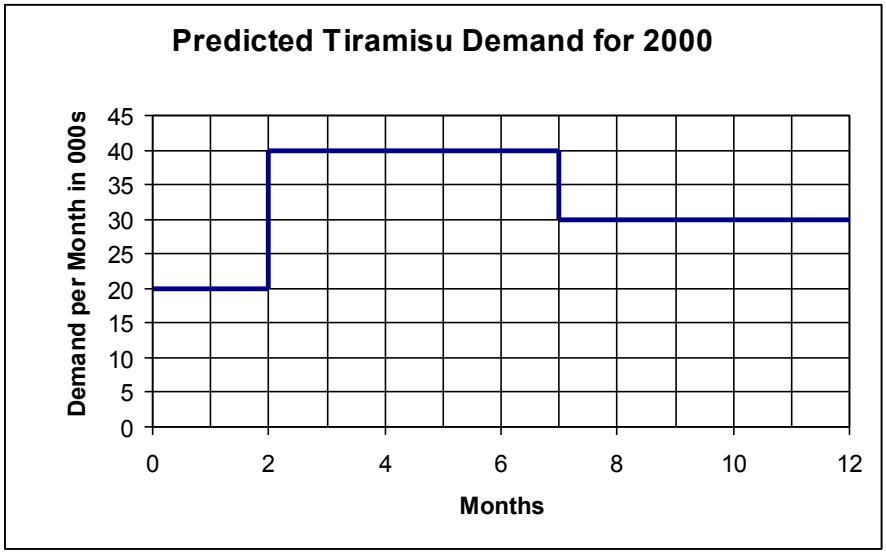
Avg Thruput Calculation

	Months	Avg Thruput
0-1	1	5000 c/mo
1-2	1	4000 c/mo
2-8	6	2000 c/mo
8-9	1	5000 c/mo
9-12	3	4000 c/mo

$$Thruput = \frac{1 \text{ mo x } 5000 \text{ c/mo} + 1 \text{ mo x } 4000 \text{ c/mo} + 6 \text{ mos x } 2000 \text{ c/mo} + 1 \text{ mo x } 5000 \text{ c/mo} + 3 \text{ mos x } 4{,}000 \text{ c/mo}}{12 \text{ mos}} = 3167 c / mo$$

Comments will vary. However, they are selling (3417 -3167) c/mo = 300 c/mo less, which is 3000 cannolis less per year.

d) Late in 1999, Santiago makes plans for CI's tiramisu cake production line for the year 2000. Marketing has given him the predicted demand below.



Assume that once Santiago makes his capacity (labor) decision for the year, that he cannot change it. Each cake per month of capacity has a fixed cost of $12 per year (or $1.00 per month). He has called in you as a world-renowned inventory expert to help him with his capacity planning for next year. Assume that materials cost $3.00 per cake and that the cakes sell for $5.00 each. Finally, assume that freezer capacity is not a constraint and that he starts 2000 with zero inventory. Neglecting other costs and assuming no backlogging of lost sales, **what is the maximum profit that CI can make during 2000 for the entire year?**

Iteration will work fine. However, you can also use the following logic.

You will satisfy all demand at the following capacity (let k = this capacity):

(k – 20,000 cakes/mo) x 2 mos = (40,000 cakes/mo-k) x 5 mos

→ k = 34,280 cakes/mo

Any additional capacity above k will not sell any more cakes, because all demand is satisfied. Hence, there is no point in additional capacity.

On the other hand, for each unit of production under k cakes/mo, you will lose

Annual profit per unit of capacity = - [7 mos x (1 cake/mo) x (P –VC/unit) – FC]

= -[7 cakes x ($5/cake - $3/cake) - $12]

= - $2 / (cake/mo)

Note, we are assuming that you are not producing more than 30,000 cakes/month from month 7.0 on because there is no demand for those excess cakes in 2000.

So, the best capacity is 34,280 cakes/month. This will give you the following profit

[30,000 cakes/mo x 12 mos + (34,280 – 30,000) cakes/mo x 7 mos] x ($5/cake - $3/cake) – 34,280 cakes/mo x $12/(cake/mo) = $370,000

*Note: We deducted the variable cost per unit of cakes in inventory at the beginning of the year because we wanted to follow GAAP and accrue costs when the products are sold. You could acceptably argue, however, that the true contribution of those 1000 cakes is a full $5 per cake.