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Review of the Exam 15-11-03

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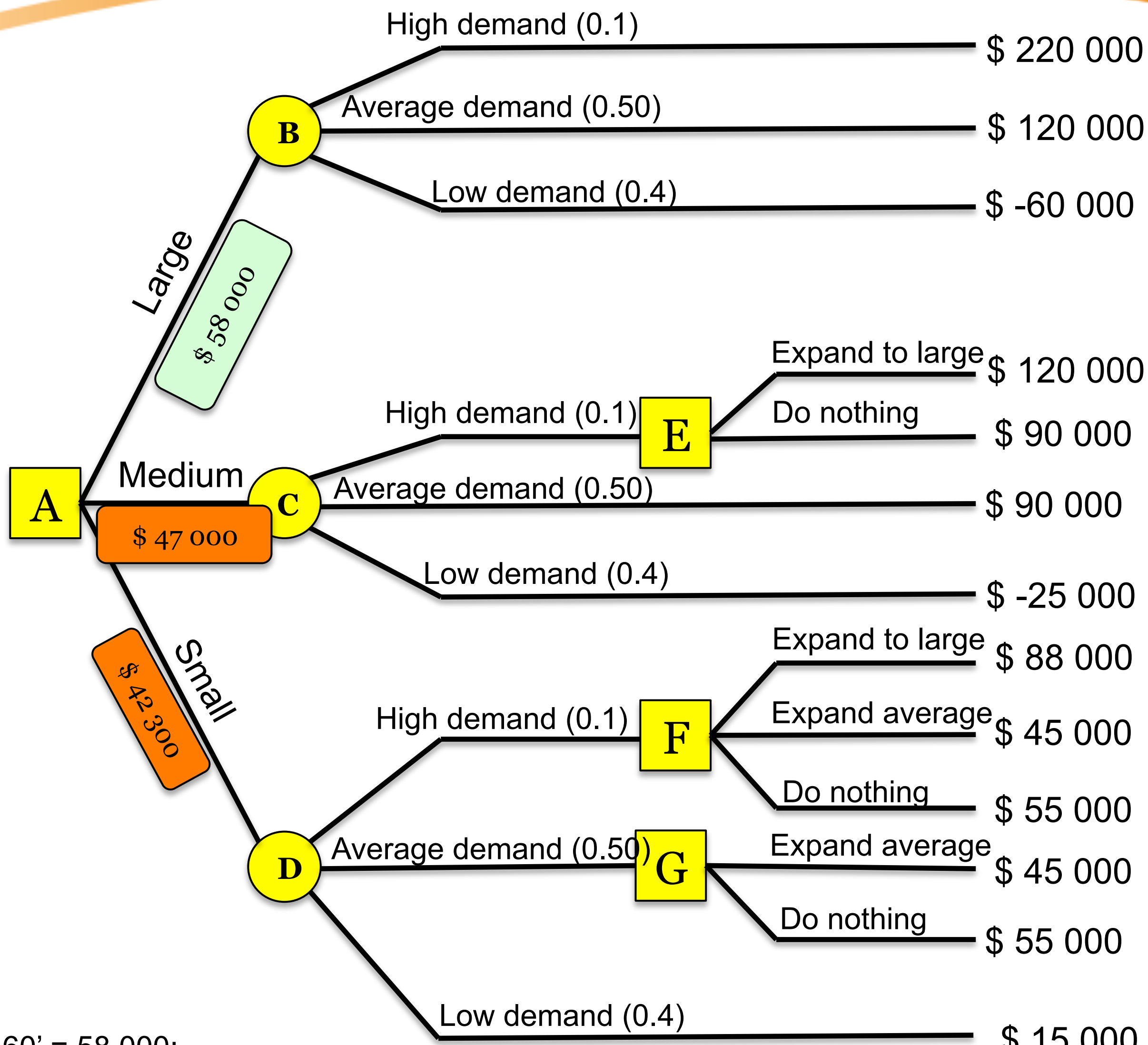
Question 1



Large: 0.1 x 220’ + 0.5 x 120’ - 0.4 x 60’ = 58 000:-
Medium: 0.1 x 120’ + 0.5 x 90’ - 0.4 x 25’ = 47 000:-
Small: 0.1 x 88’ + 0.5 x 55’ + 0.4 x 15’ = 42 300:-
Therefore, the best decision would be to build a large facility, with an expected payoff of $58 000:-

Question 2

μ = 9,   λ = 6

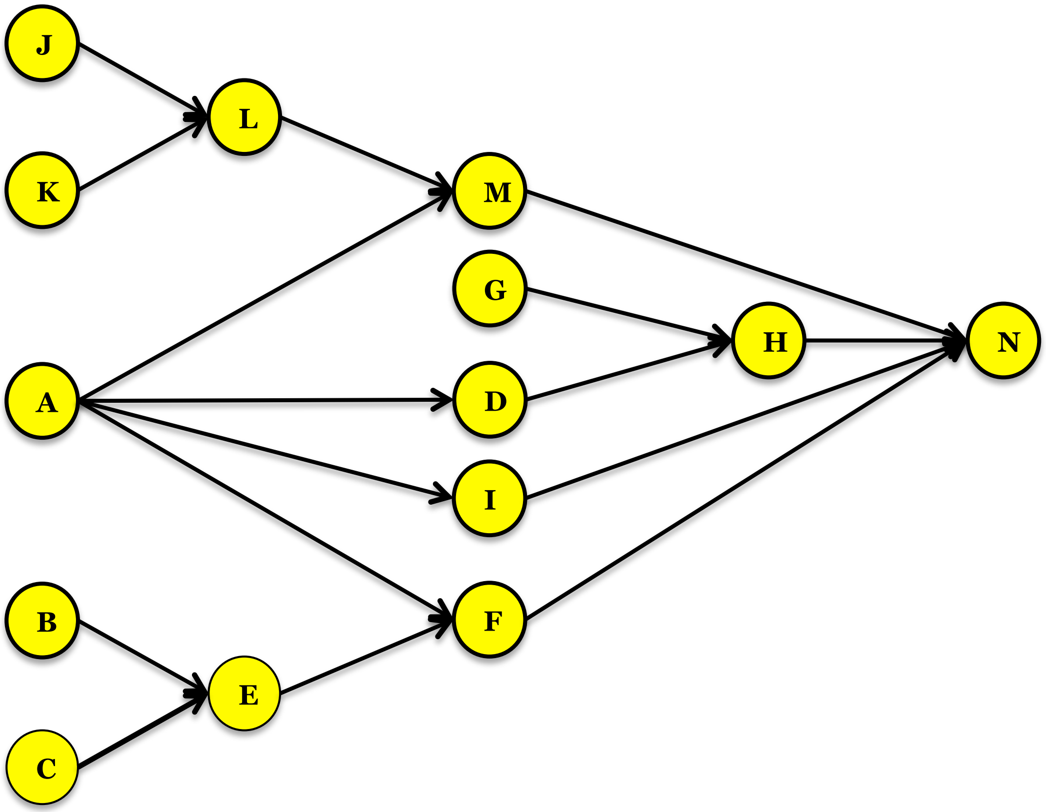
$$L_q = \rho L = \frac{6^2}{9(9-6)} = 1.33\, products$$

$$L = \frac{6}{9-6} = 2\, products$$

$$P_{n>7} = \left(\frac{6}{9}\right)^8 = 0.039 = 3.9\%$$

a) The queue will have an average of 1.33 products, which means that room for two products is necessary. In other words, 5 m^2 floor space should be required.
b) The average value of products in the testing system would be 2 x 2500 = 5000 €
c) The probability of having more than 7 units in the system is 3.9%

Question 3



b) CT = (450x60) / 270 = 100s/unit.

c) Total process time = 485s.
485/100 = 4.85, which means that at least 5 stations are required.

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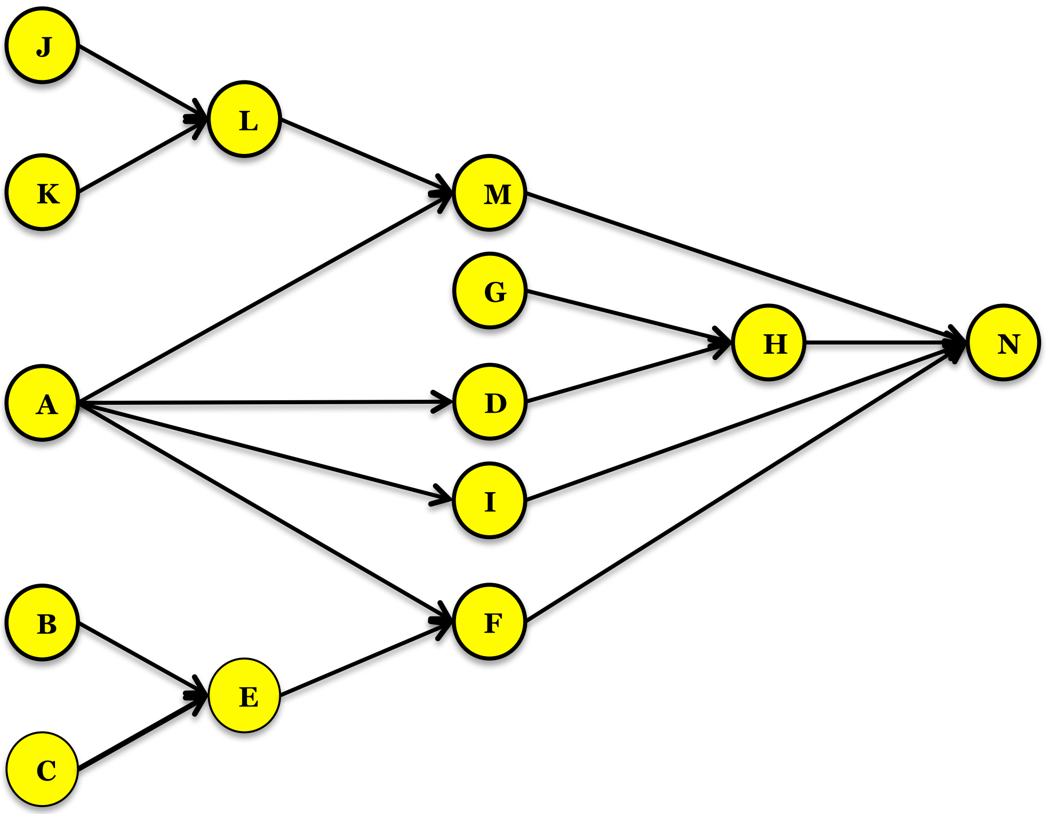
Question 3



c) Longest Work Element rule gives:

Station	Element	Cumulative time	Slack
S1	J	50	
	G	80	
	K	100	0
S2	L	40	
	B	65	
	C	75	
	A	85	15
S3	E	65	
	F	100	0
S4	D	35	
	I	80	
	H	100	0
S5	M	30	
	N	100	0

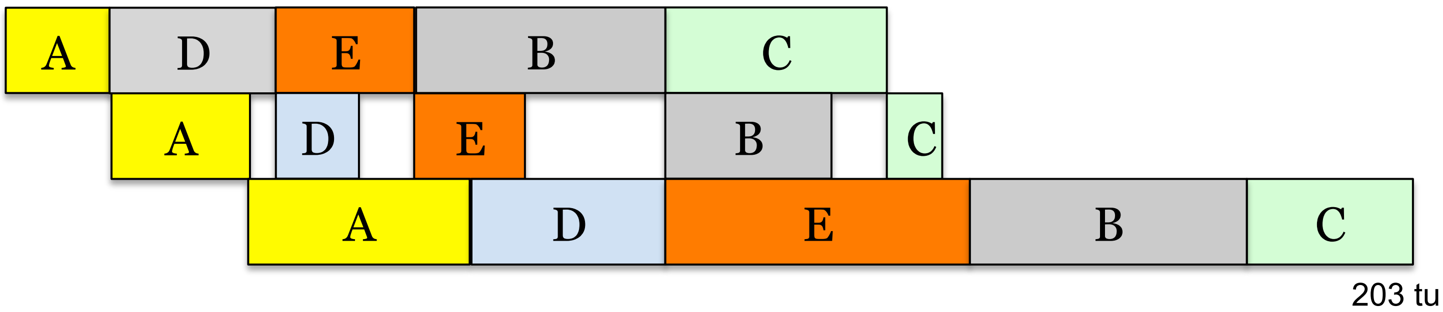
d) Efficiency: 485/(5x100) = 97%

Question 4

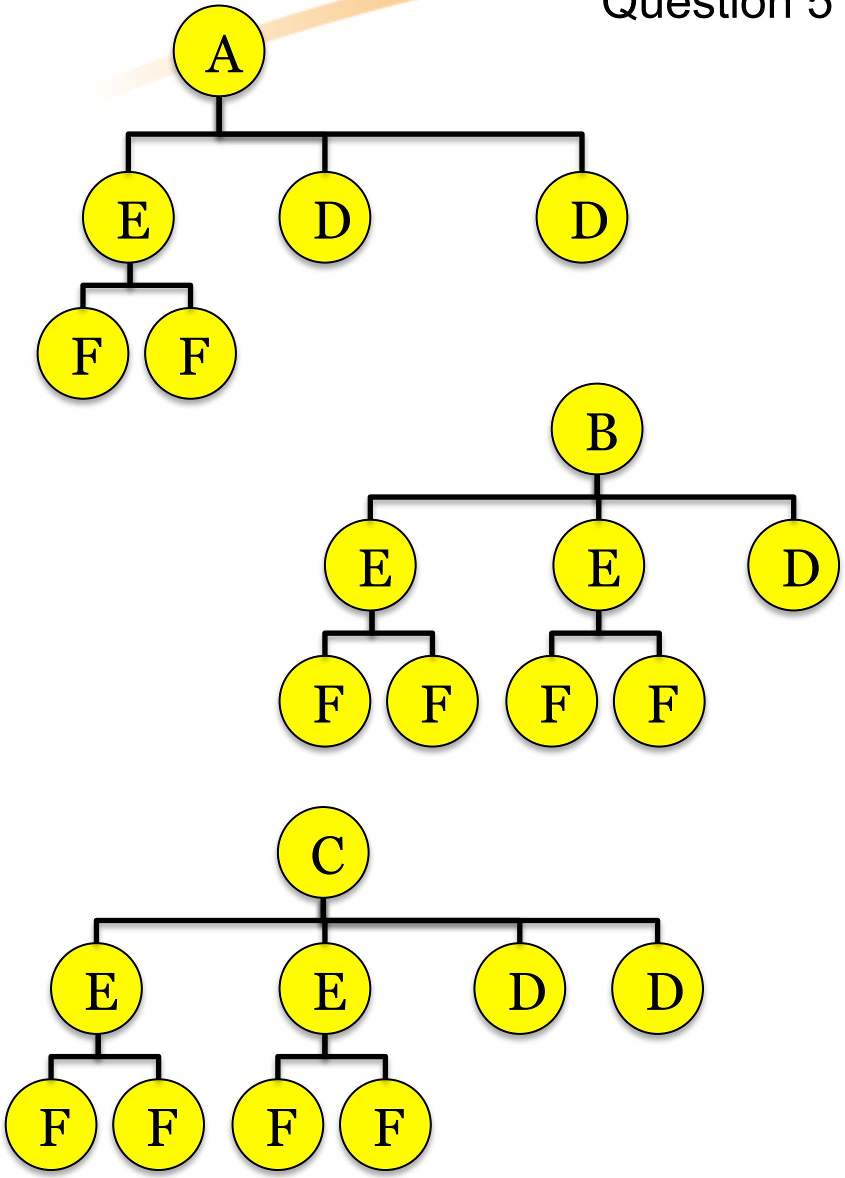
min t_{i1} = min {t_{11}, t_{21}, t_{31}, t_{41}, t_{51}, t_{61}, } = 15
max t_{i2} = max {t_{12}, t_{22}, t_{32}, t_{42}, t_{52}, t_{62}, } = 24
min t_{i3} = min {t_{11}, t_{21}, t_{31}, t_{41}, t_{51}, t_{61}, } = 24
Since max t_{i2} = min t_{i3} we may apply Johnson's rule

Job	M' 1	M' 2
A	35	52
B	60	64
C	40	32
D	36	40
E	36	60

Two possible solutions:
A, D, E, B, C; or: A, E, D, B, C.
The Gantt scheme below is based on the order: A, D, E, B, C



Question 5



MRP

Item: A		Week:	1	2	3	4	5	6	7	8
		Due:				100			55	
		Release:			100			55		

Item: B		Week:	1	2	3	4	5	6	7	8
		Due:							125	
		Release:					125			

Item: C		Week:	1	2	3	4	5	6	7	8
		Due:							80	
		Release:				80				

Item: D — Lot size: FOQ: 150; Lead time: 3w; Safety stock: 50

		Week: 1	2	3	4	5	6	7	8
Gross requirements				200	160	125	110		
Scheduled reciepts		250							
Projected on hand	150	400	400	200	190	65	105		
Planned reciepts					150		150		
Planned order releases		150		150					

Item: E — Lot size: L4L; Lead time: 1w; Safety stock: 0

		Week: 1	2	3	4	5	6	7	8
Gross requirements				100	160	250	55		
Scheduled reciepts			120						
Projected on hand		0	120	20	0	0	0		
Planned reciepts					140	250	55		
Planned order releases				140	250	55			

Item: F — Lot size: POQ: P=2; Lead time: 2w; Safety stock: 40

		Week: 1	2	3	4	5	6	7	8
Gross requirements				280	500	110			
Scheduled reciepts									
Projected on hand	100	100	100	540	40	40			
Planned reciepts				720		110			
Planned order releases		720		110					

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Question 6

Capacity \ Demand	85	65	105	95	Ui
50	**4** / 50	**10** / 10	**2** / -10	**6** / -14	0
125	**6** / 35	**2** / 65	**14** / 25	**8** / -14	2
175	**8** / 14	**12** / 22	**2** / 80	**10** / 95	-10
Vj	4	0	12	20	

Capacity \ Demand	85	65	105	95	Ui
50	**4** / 50	**10** / 10	**2** / 4	**6** / 0	0
125	**6** / 35	**2** / 65	**14** / 14	**8** / 25	2
175	**8** / 0	**12** / 8	**2** / 105	**10** / 70	4
Vj	4	0	-2	6	

Total cost:

50x4 = 200
35x6 = 210
65x2 = 130
25x8 = 200
105x2 = 210
70x10 = 700
Tot: 1650

Question 6 – Alternative 2

	Demand: 85	Demand: 65	Demand: 105	Demand: 95	Ui
Capacity 50	**4** 50	**10** 10	**2** -10	**6** -14	0
Capacity 125	**6** 35	**2** 65	**14** 25	**8** -14	2
Capacity 175	**8** 14	**12** 22	**2** 80	**10** 95	-10
Vj	4	0	12	20	

	Demand: 85	Demand: 65	Demand: 105	Demand: 95	Ui
Capacity 50	**4** 25	**10** 10	**2** 4	**6** 25	0
Capacity 125	**6** 60	**2** 65	**14** 14	**8** 0	2
Capacity 175	**8** 0	**12** 8	**2** 105	**10** 70	4
Vj	4	0	-2	6	

Total cost:

50x4 = 200
35x6 = 210
65x2 = 130
25x8 = 200
105x2 = 210
70x10 = 700
Tot: 1650

Question 7

The steps are the following:

1. Identify the bottlenecks
2. Exploit the bottlenecks
3. Subordinate all other decisions to step 2.
4. Elevate the bottlenecks.
5. Do not let inertia set in.

Further descriptions in the line of the description in the book pp. 266-267 (ed. 10)
Also in the PP Capacity and break-even analysis

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Question 8

<u>Forecasts (α = 0.5):</u>
June: 0.5x90 + 0.5x85 = 87.5
July: 0.5x86 + 0.5x87.5 = 86.75
August: 0.5x99 + 0.5x86.75 = 92.9
September: 0.5x105 + 0.5x92.9 = 99
October: 0.5x95 + 0.5x99 = 97
November: 0.5x101 + 0.5x97 = 99
December: 0.5x115 + 0.5x99 = 107
January: 0.5x108 + 0.5x107 = 107.5

Month	True demand	Forecast	Error (Abs)	Error %
June	86	88	2	2.3
July	99	87	12	12.1
August	105	93	12	11.4
Sept	95	99	4	4.2
October	101	97	4	4.0
November	115	99	16	13.9
December	108	107	1	0.9
Total:			51	48.8

$$MAD = \frac{\sum|E|}{n} = \frac{51}{7} = 7.29$$

$$MAPE\ \frac{\sum[|E_t|(100)]/D_t}{n} = \frac{48.8}{7} = 6.97$$

Question 9

Described in PP Inventory management

a) Functions of inventory may be the following:

1. To meet anticipated customer demand
2. To smooth production requirements
3. To buffer between operations
4. To protect against stock-outs
5. To exploit order cycles
6. To hedge against price raises
7. To permit operations (Pipeline inventory)

b) Three reasons for keeping high inventory may be:

1. Better customer service level
2. Minimizing ordering costs
3. Minimizing setup costs
4. Increased utilization of staff and equipment
5. Decreasing transportation costs
6. Quantity discounts

Question 10

$$EOQ_{1.8} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2\times2000\times55}{0.15\times1.8}} = 903\ units$$

This is an infeasible solution, since 903 units can't be ordered for €1.8/unit. Therefore, we calculate the EOQ at the next lowest price €2:5:

$$EOQ_{2.5} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2\times2000\times55}{0.15\times2.5}} = 766\ units$$

This is also an infeasible solution, since 766 units can't be ordered for €2.5/unit. Therefore, we calculate the EOQ at the next lowest price €2:8:

$$EOQ_{2.8} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2\times2000\times55}{0.15\times2.8}} = 724\ units$$

This is a feasible solution. Next, we calculate the total cost at EOQ and at higher discount quantities:

Question 10

$$C = \frac{Q}{2}(H) + \frac{D}{Q}(S) + PD$$

$$C_{724} = \frac{724}{2}(0.15\times2.8) + \frac{2000}{724}(55) + 2.8\times2000 = 5904\ €$$

$$C_{800} = \frac{800}{2}(0.15\times2.5) + \frac{2000}{800}(55) + 2.5\times2000 = 5287.5\ €$$

$$C_{1200} = \frac{1200}{2}(0.15\times1.8) + \frac{2000}{1200}(55) + 1.8\times2000 = 3854\ €$$

The cost for ordering 1200 is the lowest.

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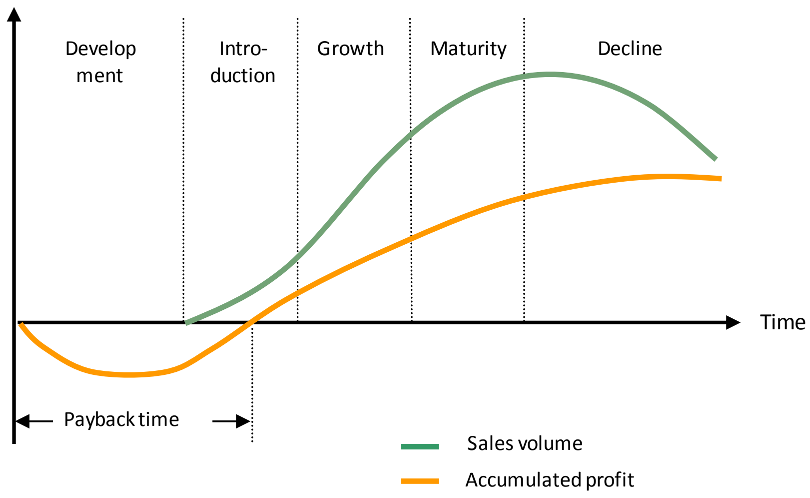
Question 11

Product life cycle (PLC)

The **physical distribution strategy** differs for each stage.

- During the introductory stage, the strategy is a cautious one, with stocking restricted to relatively few locations. Product availability is limited.
- The growth stage may be fairly short
- During the maturity stage, sales growth is slow or stabilized at a peak level. At this time the product has its widest distribution.
- During the decline stage, sales volume declines as a result of technological change, competition, or waning consumer interest.



Question 11

The Pareto principle

The Pareto Principle (also called 80/20 rule)

The 80/20 rule means that in anything, a few (20 percent) are vital and many (80 percent) are trivial.

Question 11

The Pareto principle

The **product line** of a typical firm is made up of individual products at different stages of their respective life cycles and with different degrees of sales success.

E.g. 80 % of a firm's sales are generated by 20 % of the product line items.

=> important to primarily control these (and not the other 80 %).

Question 12

$$ELS = \sqrt{\frac{2DS}{H}}\sqrt{\frac{p}{p-d}} = \sqrt{\frac{2\times 20500\times 200}{0.21}}\sqrt{\frac{360}{360-30}} = 6527\ barrels$$

C $$= \frac{Q}{2}\left(\frac{p-d}{p}\right)H + \frac{D}{Q}S = \frac{6527}{2}\left(\frac{360-30}{360}\right)0.21 + \frac{20500}{6527}200 = 1256.4\$$$

$$TBO_{ELS} = \frac{ELS}{D}350(days/year) = \frac{6527}{20500}350 = 111.4 \approx 111\ days$$

$$t_P = \frac{ELS}{P} = \frac{6527}{360} = 18.1 \approx 18\ days$$

Question 13

Chase strategy

Month	A: Net requirements	B: Capacity/employee	C: A/B staff required
Jan	1420	20x0.45 = 9	167.7 = 158
Feb	960	24x0.45 = 10.8	88.88 = 89
Mar	1350	18x0.45 = 8.1	166.67 = 168
Apr	1800	26x0.45 = 11.7	153.8 = 154
May	3000	22x0.45 = 9.9	303.03 = 303
June	2100 + 900 = 3000	15x0.45 = 6.75	444.44 = 445

Question 13

Chase strategy

Month	Workforce	Hired	Dismissed	Production	Ending inventory
Dec.	(160)				(500)
Jan	158	-	2	1422	2
Feb	89	-	69	961	3
Mar	167	78	-	1352	5
Apr	154	-	13	1801	6
May	303	149	-	2999	5
June	444	141	-	2997	902
Tot	1315	368	84		923

Total cost:

Wages:	1315x3000	=	3945000
Hiring:	368x3000	=	1104000
Dismissals:	84x5000	=	420000
Inventory:	923x10	=	9230
	Total cost	=	5478230

Question 13

Level strategy

Month	A: Cumulated requirements	B: Cumulated Capacity/employee	C: A/B staff required
Jan	1420	9	157.78 =158
Feb	2380	19.8	120.2 =121
Mar	3730	27.9	133.7 =134
Apr	5530	39.6	139.6 =140
May	8530	49.5	172.3 =173
June	11530	56.25	205

Question 13

Level strategy

Month	Workforce	Hired	Dismissed	Production	Ending inventory
Dec.	(160)				(500)
Jan	205	45	-	1845	425
Feb	205	-	-	2214	1679
Mar	205	-	-	1660	1989
Apr	205	-	-	2398	2587
May	205	-	-	2029	1616
June	205	-	-	1383	599
Tot	1230	45	-		8895

Total cost:

Wages:	1230x3000	= 3690000
Hiring:	45x3000	= 135000
Dismissals:	0x5000	= 0
Inventory:	8895x10	= 88950
	Total cost	= 3913950

Question 14

No of teeth (X)	Cutting time (Y)	XY	X^2
23	112	2576	529
17	84	1428	289
10	53	530	100
28	135	3780	784
14	70	980	196
Total:	454	9294	1898

$$\bar{x} = \frac{\sum x}{n} = \frac{92}{5} = 18.4 \qquad \bar{y} = \frac{\sum y}{n} = \frac{454}{5} = 90.8$$

$$b = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2} = \frac{9294 - 5(18.4)(90.8)}{1898 - 5(18.4)^2} = 4.58$$

$$a = \bar{y} - b\bar{x} = 90.8 - 4.58 \times 18.4 = 6.528$$

The cutting time will be: a+bx = 6.528 + 4.58*32 = 153 minutes

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Question 15