Concept Question 1.1

Which of the following plans are the job of the operations manager, working with other functional areas of the firm?

- A. intermediate plans
- B. short-range plans
- C. long-range plans
- D. All three: short-range, intermediate, and long-range plans.

Concept Question 1.2

Capacity decisions are most critical to which of the following?

- A. intermediate plans
- B. short-range plans
- C. long-range plans
- D. sales and operations planning

Concept Question 1.3

Job assignments are a focused issue in which of the following?

- A. intermediate plans
- B. short-range plans
- C. sales and operations planning
- D. long-range plans

Concept Question 1.4

Which of the following statements is NOT true regarding the planning process?

- A. Short-range plans are usually for less than 3 months.
- B. Long-range plans require policies and strategies related to issues such as capacity and capital investment, facility location, new products and processes, and supply chain development.
- C. Short-range plans are the responsibility of operations personnel.
- D. Job scheduling is made as part of intermediate plans.

Concept Question 2.1

Aggregate planning is concerned with determining the quantity and timing of production in the

- A. intermediate term.
- B. short term.
- C. long term.
- D. next term.

Concept Question 2.2

Which of the following statements is NOT true about S&OP?

- A. S&OP is used to determine which plans are feasible in the coming months and which are not.
- B. When the resources appear to be substantially at odds with market expectations, S&OP provides advanced warning to top management.
- C. S&OP is typically done by cross-functional teams that align competing constraints.
- D. S&OP is also called an aggregate plan.

Concept Question 2.3

Which of the following is NOT one of the features that an S&OP process needs to generate a useful aggregate plan?

- A. A logical unit for measuring sales and output.
- B. A model that combines forecasts and costs.
- C. A method to determine the relevant costs.
- D. A forecast of demand for a reasonable long-term planning period in aggregate terms.

Concept Question 2.4

Which of the following statements is NOT true regarding aggregate plans?

- A. An aggregate plan often examines a 3- to 18-month time horizon.
- B. For service organizations, an aggregate schedule ties strategic goals to workforce schedules.
- C. An aggregate plan is the output of S&OP.
- D. Aggregate plans use information regarding individual products rather than product lines.

Concept Question 3.1

Which of the following statements is NOT true regarding the master production schedule?

- A. The master production schedule is a result of disaggregation.
- B. The master production schedule is a timetable that specifies what is to be made and when.
- C. The master production schedule provides input to material requirements planning systems.
- D. The master production schedule is a sales forecast.

Concept Question 3.2

What is the process of breaking an aggregate plan into greater detail?

- A. aggregation
- B. S&OP
- C. disaggregation
- D. decomposition

Concept Question 3.3

The objective of aggregate planning is usually to

A. provide input to material requirements planning systems.
B. specify what is to be made and when.
C. to determine which plans are feasible in the coming months and which are not.
D. meet forecast demand while minimizing cost over the planning period.

Concept Question 3.4

Which of the following occurs first within a production planning system?

A. master production schedule
B. priority scheduling for products
C. detailed work schedules for people
D. aggregate planning

Concept Question 4.1

Which of the following is NOT a capacity option of aggregate planning?

A. subcontracting
B. changing inventory levels
C. varying production rates through overtime or idle time
D. back ordering during high-demand periods

Concept Question 4.2

Which of the following is NOT a demand option of aggregate planning?

A. influencing demand
B. using part-time workers
C. counterseasonal product and service mixing
D. back ordering during high-demand periods

Concept Question 4.3

Which statement is characteristic of a mixed strategy for aggregate planning?

- A. Mixed plans typically yield a worse strategy than a pure plan.
- B. Mixed plans are less complex to develop than a level plan.
- C. Mixed plans are less complex to develop than a chase plan.
- D. Mixed plans seek a minimum cost via a combination of eight planning options.

Concept Question 4.4

Which of the following would likely result in the LEAST amount of inventory?

- A. Inventory levels are unaffected by the aggregate plan.
- B. mixed strategy
- C. chase strategy
- D. level strategy

Concept Question 5.1

What is the first step in the graphical method for aggregate planning?

- A. Determine the demand in each period.
- B. Find labor costs, hiring and layoff costs, and inventory holding costs.
- C. Determine capacity for regular time, overtime, and subcontracting each period.
- D. Consider company policy that may apply to the workers or to stock levels.

Concept Question 5.2

The transportation method of linear programming requires that

- A. beginning inventory be zero.
- B. ending inventory be zero.
- C. the number of rows be less than the number of columns.
- D. cost factors be linear and positive.

Concept Question 6.1

Successful techniques to control the cost of labor in service firms do NOT include:

A. Flexibility in rate of output or hours of work to meet changing supply.
B. Accurate scheduling of labor-hours to assure quick response to customer demand.
C. Flexibility of individual worker skills that permits reallocation of available labor.
D. An on-call labor resource that can be added or deleted to meet unexpected demand.

Concept Question 6.2

What is the primary aggregate planning vehicle in service industries?

A. management
B. labor
C. capital
D. inventory

Concept Question 6.3

In a service business with a highly variable demand, the general approach to aggregate scheduling does NOT involve

A. building very modest levels of inventory during slack periods.
B. depleting inventory during slack periods.
C. depleting inventory during peak periods.
D. using labor to accommodate most of the changes in demand.

Concept Question 6.4

What makes aggregate planning particularly complex in the airline industry?

A. the large number of dependent sites
B. union rules
C. significant hiring costs
D. the large capital investment cost of each airplane

Concept Question 7.1

Yield management is of interest to organizations having the characteristic of

A. low fixed costs.
B. stable demand.
C. high variable costs.
D. segmentable demand.

Concept Question 7.2

What is an alternative name for revenue management?

- A. cash flow management
- B. price and demand management
- C. yield management
- D. income management

Concept Question 7.3

For organizations that have perishable inventory, which of the following characteristics would NOT make yield management of interest?

- A. fluctuating demand
- B. relatively fixed capacity
- C. low variable costs and high fixed costs
- D. service or product cannot be sold in advance of consumption

Concept Question 7.4

Industries traditionally associated with revenue management operate in which quadrant of the Revenue Management Matrix?

- A. Quadrant 1: price tends to be fixed; use tends to be predictable.
- B. Quadrant 2: price tends to be variable; use tends to be predictable.
- C. Quadrant 4: price tends to be variable; use tends to be uncertain.
- D. Quadrant 3: price tends to be fixed; use tends to be uncertain.

Problem 13.1

Question Help

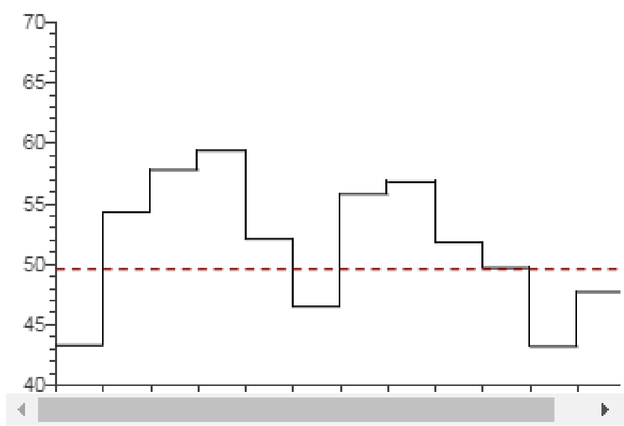
Prepare a graph of the monthly forecasts and average forecast demand for Chicago Paint Corp., a manufacturer of specialized paint for artists.

Compute the demand per day for each month *(round your responses to one decimal place)*.

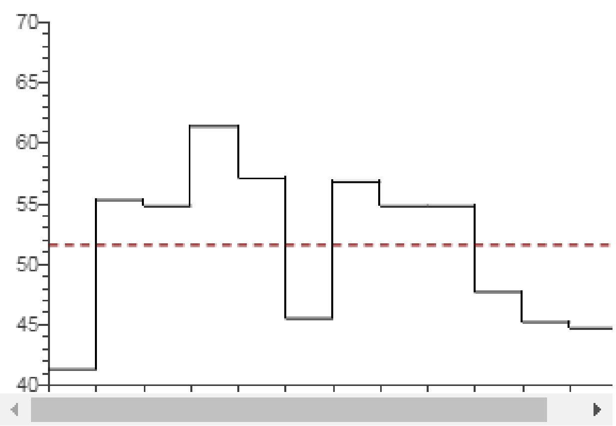
Month	Production Days	Demand Forecast	Demand per Day
January	23	950	41.3
February	19	1,050	55.3
March	21	1,150	54.8
April	22	1,350	61.4
May	21	1,200	57.1
June	22	1,000	45.5
July	22	1,250	56.8
August	21	1,150	54.8
September	21	1,150	54.8
October	22	1,050	47.7
November	21	950	45.2
December	19	850	44.7

Choose the correct graph of the forecast demands below.

A.



B.



Problem 13.13

Ram Roy's firm has developed the following supply, demand, cost, and inventory data.

	Supply Available			
Period	**Regular Time**	**Overtime**	**Subcontract**	**Demand Forecast**
1	30	15	10	40
2	35	15	10	50
3	30	20	10	50

Initial inventory	20 units
Regular-time cost per unit	\$100
Overtime cost per unit	\$160
Subcontract cost per unit	\$250
Carrying cost per unit per month	\$4

Assume that the initial inventory has no holding cost in the first period and backorders are not permitted.

Allocating production capacity to meet demand at a minimum cost using the transportation method, the total cost is \$ 13,540 *(enter your response as a whole number).*

Period		**Period 1**	**Period 2**	**Period 3**	...	**Ending inventory period n**	**Unused capacity**	**Capacity**
	Beginning inventory	0	h	$2h$	...	$(n-1)h$	0	I_0
1	Regular time	r	$r+h$	$r+2h$	...	$r+(n-1)h$	0	R_1
	Overtime	t	$t+h$	$t+2h$	...	$t+(n-1)h$	0	O_1
	Subcontract	s	$s+h$	$s+2h$	...	$s+(n-1)h$	0	S_1
2	Regular time	$r+b$	r	$r+h$	...	$r+(n-2)h$	0	R_2
	Overtime	$t+b$	t	$t+h$	...	$t+(n-2)h$	0	O_2
	Subcontract	$s+b$	s	$s+h$	...	$s+(n-2)h$	0	S_2
3	Regular time	$r+2b$	$r+b$	r	...	$r+(n-3)h$	0	R_3
	Overtime	$t+2b$	$t+b$	t	...	$t+(n-3)h$	0	O_3
	Subcontract	$s+2b$	$s+b$	s	...	$s+(n-3)h$	0	S_3
	Demand				...			Total

r = Regular production cost per unit
t = Overtime cost per unit
s = Subcontracting cost per unit
h = Holding cost per unit period
b = Back order cost per unit per period
n = Number of periods in planning horizon

Period	Regular Time	Overtime	Subcontract	Demand forecast	Ending Inventory	Total cost
					20	
1	30	15	10	40	20	2000
2	35	15	10	50	0	7150
3	30	20	10	50	0	8000
Capacity	***95***	***50***	***30***	***5.83***		
	30+35+30=**95**	15+15+20=**50**	10+10+10=**30**	(95+50+30)/30= **5.83**		**17150**
Initial inventory	20 units				2000+7150+8000=**1750**	
regular-time cost per unit (r)	100					
overtime cost per unit (t)	160					
subcontract cost per unit (s)	250					
carrying cost per unit per month (h)	4					

			period 1	period 2	period 3	Ending inventory period n	unused capacity	capacity
r= regular production cost per unit	period	Beginning inventory	20	4	8		0	
t= overtime cost per unit	1	regular time (r)	100 **20**	100+4=104 **10**	100+2*(4)= 108		0	
s=subcontracting cost per unit		overtime (t)	**160**				0	
h= holding cost per unit		subcontract (s)					0	
b= back order cost per unit period	2	regular time		100 **35**			0	
n= # of periods in planning period		overtime		160 **5**			0	
		subcontract					0	
	3	regular time			100 **30**		0	
		overtime			160 **20**		0	
		subcontract					0	
	Demand		20+20=40	10+35+5=50	30+20=50			
	13540	(100*20)+(104*10)+(100*35)+(160*5)+(100*30)+(160*20)=**13,540**						

Problem 13.14

Jerusalem Medical Ltd., an Israeli producer of portable kidney dialysis units and other medical products, develops a 4-month aggregate plan. Demand and capacity (in units) are forecast as follows:

Capacity Source	Month 1	Month 2	Month 3	Month 4
Labor				
Regular time	245	275	300	300
Overtime	15	24	26	18
Subcontract	14	17	15	15
Demand	260	316	331	301

The cost of producing each dialysis unit is $985 on regular time, $1,310 on overtime, and $1,600 on a subcontract. Inventory carrying cost is $100 per unit per month. There is to be no beginning or ending inventory in stock and backorders are not permitted.

Minimizing cost using the transportation method, the optimal cost is $ 1,224,860 *(enter your response as a whole number).*

Capacity Source	month 1	month 2	month 3	month 4	TOTAL
labor					
regular time	245	275	300	300	
overtime	15	24	26	18	
subcontract	14	17	15	15	
demand	260	316	331	301	
TOTAL	260975	329515	337560	296810	**1224860**
	260975+329515+337560+296810= **1,224,860**				
regular time	985				
overtime	1310				
subcontract	1600				

Problem 13.2A

A Juarez, Mexico, manufacturer of roofing supplies has developed monthly forecasts for a family of products. Data for the 6-month period January to June are presented in the table below. There are 8 hours of production per day.

This exercise only contains part a.

a) The firm would like to begin development of an aggregate plan. For this plan, plan 5, the firm wishes to maintain a constant workforce of 6, using subcontracting to meet remaining demand. Evaluate this plan.

To determine whether this plan is desirable, first calculate demand per day for each month *(enter your responses rounded to the nearest whole number).*

Table 1

	Month	Production Days	Demand Forecast	Avg Dem Per Prod. Day
1	January	22	950	43
2	February	18	750	42
3	March	21	750	36
4	April	21	1,000	48
5	May	22	1,300	59
6	June	20	1,050	53

Other data

Inventory carrying cost	$8 per unit per month
Subcontracting cost per unit	$12 per unit
Average pay rate	$5 per hour ($40 per day)
Overtime pay Rate	$7 per hour (above 8 hrs per day)
Labor-hours per unit	1.6 hrs per unit
Cost of increasing daily production rate (hiring & training)	$300 per unit
Cost of decreasing daily production rate (layoffs)	$600 per unit

The production rate per day = 30 units. *(Enter your response as a whole number.)*

Fill in the table below. *(Enter your responses as whole numbers.)*

	Month	Demand	Regular Production	Subcontract (Units)
1	January	950	660	290
2	February	750	540	210
3	March	750	630	120
4	April	1,000	630	370
5	May	1,300	660	640
6	June	1,050	600	450

The total regular production cost = $ 29,760. *(Enter your response as a whole number.)*

The total subcontracting cost = $ 24,960. *(Enter your response as a whole number.)*

Total cost with plan 5 = $ 54,720. *(Enter your response as a whole number.)*

	month	production days	demand forecast	avg. dem per prod. Day	Production rate per day	regular production	subcontract (units)	regular production cost	subcontracting cost
1	jan	22	950	950/22=**43**	30	30*22=**660**	950-660=**290**	22*6*8*5=**5280**	290*12=**3480**
2	feb	18	750	750/18=**42**	30	30*18=**540**	750-540=**210**	18*6*8*5=**4320**	210*12=**2520**
3	march	21	750	750/21=**36**	30	30*21=**630**	750-630=**120**	21*6*8*5=**5040**	120*12=**1440**
4	april	21	1000	1000/21=**48**	30	30*21=**630**	1000-630=**370**	21*6*8*5=**5040**	370*12=**4440**
5	may	22	1300	1300/22=**59**	30	30*22=**660**	1300-660=**640**	22*6*8*5=**5280**	640*12=**7680**
6	june	20	1050	1050/20=**53**	30	30*20=**600**	1050-600=**450**	20*6*8*5=**4800**	450*12=**5400**
								29760	24960
		production rate per day= # of employees *				**30**			
		total working hours/time req. per unit				6*(8/1.6)=**30**			
		Total production cost		5280+4320+5040+5040+5280+4800=**29760**					
		subcontracting cost		3480+2520+1440+4440+7680+5400=**24960**					
		Total Cost		29760+24960=**54,720**					

Problem 13.2B

A Juarez, Mexico, manufacturer of roofing supplies has developed monthly forecasts for a family of products. Data for the 6-month period January to June are presented in the table below. There are 8 hours of production per day.

Table 1

	Month	Production Days	Demand Forecast
1	January	22	800
2	February	18	650
3	March	21	850
4	April	21	1,100
5	May	22	1,200
6	June	20	1,250

Other data	
Inventory carrying cost	\$5 per unit per month
Subcontracting cost per unit	\$10 per unit
Average pay rate	\$5 per hour (\$40 per day)
Overtime pay Rate	\$7 per hour (above 8 hrs per day)
Labor-hours per unit	1.6 hrs per unit
Cost of increasing daily production rate (hiring & training)	\$300 per unit
Cost of decreasing daily production rate (layoffs)	\$600 per unit

This exercise only contains part b.

b) Juarez has yet a sixth plan. A constant workforce of 7 is selected, with the remainder of demand filled by subcontracting. Evaluate this plan.

The production rate per day = 35 units. *(Enter your response as a whole number.)*

Fill in the table below. *(Enter your responses as whole numbers.)*

	Month	Demand	Regular Production	Subcontract (Units)
1	January	800	770	30
2	February	650	630	20
3	March	850	735	115
4	April	1,100	735	365
5	May	1,200	770	430
6	June	1,250	700	550

The total regular production cost = \$ 34,720. *(Enter your response as a whole number.)*

The total subcontracting cost = \$ 15,100. *(Enter your response as a whole number.)*

Total cost with plan 6 = \$ 49,820. *(Enter your response as a whole number.)*

	month	production days	demand forecast	avg. demand	production rate per day	regular production	subcontracting	regular production cost	subcontracting cost
1	jan	22	800	800/22=**36**	35	35*22=**770**	800-770=**30**	22*7*8*5=**6160**	30*10=**300**
2	feb	18	650	650/18=**36**	35	35*18=**630**	650-630=**20**	18*7*8*5=**5040**	20*10=**200**
3	march	21	850	850/21=**40**	35	35*21=**735**	850-735=**115**	21*7*8*5=**5880**	115*10=**1150**
4	april	21	1100	1100/21=**52**	35	35*21=**735**	1100-735=**365**	21*7*8*5=**5880**	365*10=**3650**
5	may	22	1200	1200/22=**55**	35	35*22=**770**	1200-770=**430**	22*7*8*5=**6160**	430*10=**4300**
6	june	20	1250	1250/20=**63**	35	35*20=**700**	1250-700=**550**	20*7*8*5=**5600**	550*10=**5500**
							SUM	**34720**	**15100**
constant workforce	7	<u>production rate per day</u>= #of		**35**				Total Cost	**49,720**
inventory carrying cost	5 per unit	employees*(total working hours/time req.	per unit)	7*(8/1.6)=**35**				5600	
subcontracting	10 per unit		Total Production cost	6160+5040+5880+5880+6160+5600=**34720**					
avg. pay rate	5 per hour		Total Subcontracting cost	300+200+1150+3650+4300+5500=**15100**					
overtime pay rate	7 per hour		Total Cost	34720+15100=**49,820**					
labor-hours per unit	1.6 hrs per unit								
increasing daily	300 per unit								
decreasing daily	600 per unit								

Problem 13.3

The president of Hill Enterprises, Terri Hill, projects the firm's aggregate demand requirements over the next 8 months as follows:

January	1,200	May	2,300
February	1,600	June	2,300
March	1,600	July	1,800
April	1,800	August	1,800

Her operations manager is considering a new plan, which begins in January with 200 units of inventory on hand. Stockout cost of lost sales is $100 per unit. Inventory holding cost is $25 per unit per month. Ignore any idle-time costs. The plan is called plan A.

Plan A: Vary the workforce level to execute a strategy that produces the quantity demanded in the *prior* month. The December demand and rate of production are both 1,600 units per month. The cost of hiring additional workers is $55 per unit. The cost of laying off workers is $75 per unit. Evaluate this plan. (*Enter all responses as whole numbers.*)

Note: Both hiring and layoff costs are incurred in the month of the change. For example, going from 1,600 in January to 1,200 in February incurs a cost of layoff for 400 units in February.

Period	Month	Demand	Production	Hire (Units)	Layoff (Units)	Ending Inventory	Stockouts (Units)
0	December	1,600	1,600			200	
1	January	1,200	1,600	0	0	600	0
2	February	1,600	1,200	0	400	200	0
3	March	1,600	1,600	400	0	200	0
4	April	1,800	1,600	0	0	0	0
5	May	2,300	1,800	200	0	0	500
6	June	2,300	2,300	500	0	0	0
7	July	1,800	2,300	0	0	500	0
8	August	1,800	1,800	0	500	500	0

The total cost of hirings = $ 60,500. (*Enter your response as a whole number.*)

The total cost of layoffs = $ 67,500. (*Enter your response as a whole number.*)

The total inventory carrying cost = $ 50,000. (*Enter your response as a whole number.*)

The total stockout cost = $ 50,000. (*Enter your response as a whole number.*)

The total cost, excluding normal time labor costs, is = $ 228,000. (*Enter your response as a whole number.*)

period	month	demand	production	Hire/layoffs= Demand - Production; positive=hire, negative=layoff	hire (units)	layoff (units)	ending inventory	stockouts (units)	hiring cost (55 per unit)	layoff cost(75 per unit)	inventory holding cost (25 per unit)	stockout cost (100 per unit)
0	december	1600	1600					0	0*55=0	0*75=0	200*25=**5000**	0*100=**0**
1	jan	1200	1600	1600-1600=**0**	**0**	**0**	1600+200-1200=**600**	**0**	0*55=**0**	0*75=**0**	600*25=**15000**	0*100=**0**
2	feb	1600	1200	1200-1600=**-400**	**-400**	**400**	1200+600-1600=**200**	**0**	0*55=**0**	400*75=**30000**	200*25=**5000**	0*100=**0**
3	march	1600	1600	1600-1200=**400**	**400**	**0**	1600+200-1600=**200**	**0**	400*55=**22000**	0*75=**0**	200*25=**5000**	0*100=**0**
4	april	1800	1600	1600-1600=**0**	**0**	**0**	1600+200-1800=**0**	**0**	0*55=**0**	0*75=**0**	0*25=**0**	0*100=**0**
5	may	2300	1800	1800-1600=**200**	**200**	**0**	1800+0-2300=**-500**	**500**	200*55=**11000**	0*75=**0**	0*25=**0**	500*100=**50000**
6	june	2300	2300	2300-800=**500**	**500**	**0**	2300+0-2300=**0**	**0**	500*55=**27500**	0*75=**0**	0*25=**0**	0*100=**0**
7	july	1800	2300	2300-2300=**0**	**0**	**0**	2300+0-1800=**500**	**0**	0*55=**0**	0*75=**0**	500*25=**12500**	0*100=**0**
8	august	1800	1800	1800-2300=**-500**	**-500**	**500**	1800+500-1800=**500**	**0**	0*55=**0**	500*75=**37500**	500*25=**12500**	0*100=**0**
SUM		16000	15800		**1100**	**900**	**1200**	**500**	**60500**	**67500**	**55000**	**50000**
			Total Costs		**60500**	**67500**		**50000**				
ending inventory= production			Total Hires	400+200+500=**1100**								
+ ending inventory of			Total cost of hirings	1100*55=**60,500**								
previous month - Demand			Total Layoffs	400+500=**900**								
stockouts- same as ending												
invenory formula, if the value			Total Cost of Layoffs	900*75=**67,500**								
is on the negative side it will												
have stock outs			Total stock outs	500								
			Total stockout cost	500*10=**50,000**								
			Total Cost	60500+67500+50000+50000=**228,000**								

Problem 13.4

The president of Hill Enterprises, Terri Hill, projects the firm's aggregate demand requirements over the next 8 months as follows:

January	1,500	May	2,300
February	1,700	June	2,100
March	1,600	July	1,700
April	1,900	August	1,500

Her operations manager is considering a new plan, which begins in January with 200 units on hand and ends with zero inventory. Stockout cost of lost sales is $125 per unit. Inventory holding cost is $25 per unit per month. Ignore any idle-time costs. The plan is called plan B.

Plan B: Produce at a constant rate of 1,500 units per month, which will meet minimum demands. Then use subcontracting, with additional units at a premium price of $80 per unit. Subcontracting capacity is limited to 800 units per month. Evaluate this plan by computing the costs for January through August.

In order to arrive at the costs, first compute the ending inventory and subcontracting units for each month by filling in the table below *(enter your responses as whole numbers)*.

Period	Month	Demand	Production	Ending Inventory	Subcontract Units
0	December			200	
1	January	1,500	1,500	200	0
2	February	1,700	1,500	0	0
3	March	1,600	1,500	0	100
4	April	1,900	1,500	0	400
5	May	2,300	1,500	0	800
6	June	2,100	1,500	0	600
7	July	1,700	1,500	0	200
8	August	1,500	1,500	0	0

The total subcontracting cost = $ 168,000. *(Enter your response as a whole number.)*

The total inventory carrying cost = $ 5,000. *(Enter your response as a whole number.)*

The total cost, excluding normal time labor costs, is = $ 173,000. *(Enter your response as a whole number.)*

period		month	demand	production	ending inventory	subcontract units
	0	december			200	
	1	jan	1500	1500	200+1500-1500=**200**	0
	2	feb	1700	1500	200+1500-1700=**0**	0
	3	march	1600	1500	**0**	1500-1600=-**100**
	4	april	1900	1500	**0**	1500-1900=-**400**
	5	may	2300	1500	**0**	1500-2300=-**800**
	6	june	2100	1500	**0**	1500-2100=-**600**
	7	july	1700	1500	**0**	1500-1700=-**200**
	8	august	1500	1500	**0**	1500-1500=**0**
					200+200=**400**	100+400+800+600+200=**2100**
production		1500 units per month			80*400=**32000**	
subcontracting		80 per unit				
subcontracting capacity		800 units			Total Subcontracting cost	2100*80=**168,000**
inventory holding cost		25			Total ending inventory	1500+200-1500=**200**
ending inventory=production+ending					Total inventorying cost	200*25=**5,000**
inventory of previous month - Demand					Total Cost	168,000+5,000=**173,000**