5. Consider the following sales forecasts for products A and B:

	Forecast	
MONTH	PRODUCT A	PRODUCT B
January	3,600	600
February	3,200	1,000
March	2,900	1,200
April	2,200	1,900
May	2,100	2,100
June	1,800	2,400

Each unit of product A takes approximately 2.5 labor hours, while each unit of product B takes only 1.8 hours.

a. (**) What is the combined (aggregate) sales forecast for products A and B? If this were the *only* information you had, would you expect resource requirements to increase or decrease from January to June?

b. (**) Use the planning value information to calculate total labor hour requirements in each month. Compare your calculations to your answer to part a. Interpret the results.

c. (**) Would top-down planning or bottom-up planning be better suited to S&OP in this situation? Explain.

6. (**) Complete the *level production plan* using the following information. The only costs you need to consider here are layoff, hiring, and inventory costs. If you complete

Planning values	
Starting inventory:	1000
Starting and ending workforce:	227
Hours worked per month per worker:	160
Hours per unit:	20
Hiring cost per worker:	$3.500
Layoff cost per worker:	$4.500
Monthly per-unit holding cost:	$6

Second Table for Problem 6

MONTH	FORECASTED SALES	SALES IN WORKER HOURS	WORKERS NEEDED TO MEET SALES AVERAGE = [redacted]	ACTUAL WORKERS	ACTUAL PRODUCTION	LAYOFFS	HIRINGS	ENDING INVENTORY
March	1,690							
April	1,350							
May	1,240							
June	1,300							
July	1,504							
August	1,992							
September	2,504							
October	2,504							
November	3,200							
December	3,000							
January	2,504							
February	2,000							

7. (**) Complete the *chase production plan*, using the following information. The only costs you need to consider here are layoff, hiring, and inventory costs. If you complete the plan cor-

Planning values	
Starting inventory:	1,000
Starting and ending workforce:	227
Hours worked per month per worker:	160
Hours per unit:	20
Hiring cost per worker:	$3,000
Layoff cost per worker:	$2,000
Monthly per-unit holding cost:	$6

MONTH	FORECASTED SALES	SALES IN WORKER HOURS	WORKERS NEEDED TO MEET SALES AVERAGE = [redacted]	ACTUAL EMPLOYEES	ACTUAL PRODUCTION	LAYOFFS	HIRINGS	ENDING INVENTORY
March	1,592							
April	1,400							
May	1,200							
June	1,000							
July	1,504							
August	1,992							
September	2,504							
October	2,504							
November	3,000							
December	3,000							
January	2,504							
February	1,992							

8. (**) Consider the following partially completed sales and operations plan. Using the planning values and filled-in values as a guide, complete the plan and calculate the layoff, hiring, and inventory costs. Does this sales and operations plan reflect a chase, level, or mixed strategy? Explain.

Planning values	
Starting inventory:	500
Starting and ending workforce:	50
Hours worked per month per worker:	160
Hours per unit:	4
Hiring cost per worker:	$300
Layoff cost per worker:	$200
Monthly per-unit holding cost:	$4

MONTH	FORECASTED SALES	SALES IN WORKER HOURS	WORKERS NEEDED TO MEET SALES AVERAGE = [redacted]	ACTUAL WORKERS	ACTUAL PRODUCTION	LAYOFFS	HIRINGS	ENDING INVENTORY
March		8,000				3	0	380
April		7,680				0	0	
May		7,360				0	0	
June	1,800	7,200				0	0	
July	1,800					0	0	
August	1,800					0	0	
September	1,750					11	0	
October	1,640					0	0	
				50		0	14	

10. Castergourd Home Products makes two types of butcher-block tables: the Beefeater and the Deutschlander. The two tables are made in the same facility and require the same amount of labor and equipment. In addition, we know the following:

- Each table costs $300 to make, and each requires, on average, 3.2 hours of labor.
- Each employee works 160 hours per month, and there is no effective limit on the number of employees.
- The cost of hiring or laying off an employee is $300.
- The monthly holding cost for a table is $15.
- For planning purposes, Castergourd will begin and end with 20 employees and 0 tables in inventory.

Forecasted sales for the tables are as follows:

MONTH	BEEFEATER	DEUTSCHLANDER
November 2012	650	3,048
December	676	2,899
January 2013	624	3,198
February	624	2,671
March	696	2,919
April	475	3,102
May	566	2,964
June	819	2,409
July	754	3,381
August	982	3,965

a. (***) Develop a top-down *level production plan* for Castergourd for the 10-month planning period. Calculate the total production, hiring, layoff, and inventory costs for your plan.

b. (***) Repeat part a, except in this case develop a *chase production plan.*

c. (**) Suppose hiring and layoff costs increase dramatically. In general, will this make a level plan look better or worse than a chase plan? Explain.

12. Consider the following information:

MONTH	FORECASTED SALES	REGULAR PRODUCTION	OVERTIME PRODUCTION	ENDING INVENTORY
January	800 units	1,150 units	0 units	350 units
February	1,000	1,150	0	500
March	1,200	1,150	0	450
April	1,400	1,150	0	200
May	1,600	1,150	150	0
June	1,500	1,150	350	0

Each unit sells for $500. Regular production and overtime production costs are $350 and $450 per unit, respectively. The cost to hold a unit in inventory for one month is $10.

a. (**) Develop a cash flow analysis for this problem. Be sure to calculate net cash flow and cumulative net cash flow for each month.

b. (**) Why do the net cash flows for April and May look so much better than those for the other months? What are the implications for building up and draining down inventories under a level production plan?

KEY FORMULAS

Projected ending inventory for the master schedule record (page 381):

$$EI_t = EI_{t-1} + MPS_t - \text{maximum}\,(F_t, OB_t) \tag{12.1}$$

where:

EI_t = ending inventory in time period t
MPS_t = master production schedule quantity available in time period t
F_t = forecasted demand for time period t
OB_t = orders booked for time period t

Available to promise for the master schedule record (page 383):

For the *first week* of the master schedule record:

$$ATP_t = EI_{t-1} + MPS_t - \sum_{i=t}^{z-1} OB_i \tag{12.2}$$

For any subsequent week in which $MPS > 0$:

$$ATP_t = MPS_t - \sum_{i=t}^{z-1} OB_i \tag{12.3}$$

where:

ATP_t = available to promise in week t
EI_{t-1} = ending inventory in week $t - 1$
MPS_t = master production schedule quantity in week t
$\sum_{i=t}^{z-1} OB_i$ = sum of all orders booked from week t until week z (when the next positive *MPS* quantity is due)

Net requirements for the MRP record (page 389):

$$NR_t = \text{maximum}\,(0; GR_t - EI_{t-1} - SR_t) \tag{12.4}$$

where:

NR_t = net requirement in time period t
GR_t = gross requirement in time period t
EI_{t-1} = ending inventory from time period $t - 1$
SR_t = scheduled receipts in time period t

Projected ending inventory for the MRP record (page 389):

$$EI_t = EI_{t-1} + SR_t + PR_t - GR_t$$

where:

EI_t = ending inventory from time period t
EI_{t-1} = ending inventory from time period $t - 1$
SR_t = scheduled receipts in time period t
PR_t = planned receipts in time period t
GR_t = gross requirements in time period t

Critical ratio (page 396):

$$\text{Critical ratio} = \frac{\text{days until due}}{\text{total task time remaining}}$$

Complete the projected ending inventory and available to promise calculations for the following master schedule record. Interpret the results.

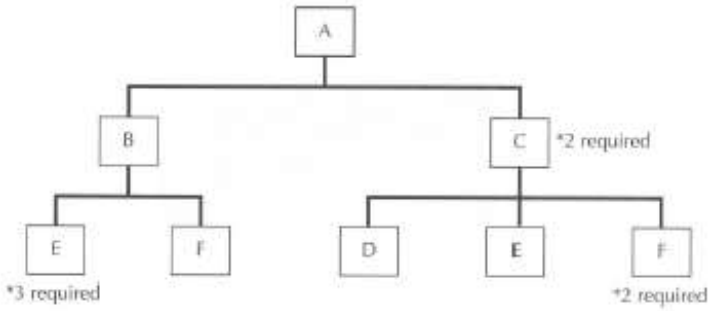
On-hand inventory at end of week 15: 222								
Week	16	17	18	19	20	21	22	23
Forecasted demand	220	220	215	215	210	210	205	205
Booked orders	192	189	233	96	135	67	85	40
Projected ending inventory								
Master production schedule		450		430		415		400
Available to promise								

8. (**) Complete the following MRP record. Note that the minimum order quantity is 900. What is the average ending inventory over the six weeks?

WEEK		1	2	3	4	5	6
B3	Gross requirements	0	500	500	500	0	500
LT (weeks) = 1	Scheduled receipts						
	Projected ending inventory: 0						
	Net requirements						
Min. order = 900	Planned receipts						
	Planned orders						

9. (**) Now suppose the minimum order quantity for item B3 in problem 8 is reduced to 400 units. Redo the MRP record. What is the new average ending inventory level over the six weeks? What are the implications for setting order quantities in an MRP environment?

10. (**) The following figure shows the bill of material (BOM) for the Acme PolyBob, a product that has proven unsuccessful in capturing roadrunners. Complete the MRP records. All the information you need is shown in the BOM and on the MRP records.



Item B: Lead time = 1 week; Minimum order quantity = 1

WEEK	1	2	3	4	5	6
Gross requirements		250	300	300	300	200
Scheduled receipts						
Projected ending inventory: 0						
Net requirements						
Planned receipts						
Planned orders						

Item C: Lead time = 3 weeks; Minimum order quantity = 500

WEEK	1	2	3	4	5	6
Gross requirements						
Scheduled receipts		500	600			
Projected ending inventory: 0						
Net requirements						
Planned receipts						
Planned orders						

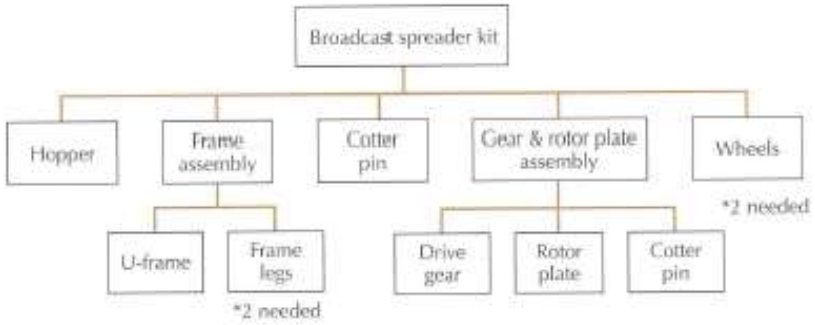
Item E: Lead time = 4 weeks; Minimum order quantity = 5,000

WEEK	1	2	3	4	5	6
Gross requirements						
Scheduled receipts						
Projected ending inventory: 5,750						
Net requirements						
Planned receipts						
Planned orders						

Item F: Lead time = 5 weeks; Minimum order quantity = 750

WEEK	1	2	3	4	5	6
Gross requirements						
Scheduled receipts						
Projected ending inventory: 4,750						
Net requirements						
Planned receipts						
Planned orders						

11. (**) Republic Tool and Manufacturing Company of Carlsbad, California, makes a wide variety of lawn care products. One of Republic's products is the Model Number 540 Broadcast Spreader:



Complete the following MRP records. Note the following:

- Republic intends to start assembling 2,000 broadcast spreader kits in weeks 2, 4, and 6.
- The gross requirements for the gear and rotor plate assembly have already been given to you. For the remaining items, you will need to figure out the gross requirements.
- All scheduled receipts, lead times, and beginning inventory levels are shown.
- Note that cotter pins appear *twice* in the bill of material.

Gear and rotor plate assembly: Lead time = 1 week; Minimum order quantity = 2,500

WEEK	1	2	3	4	5	6
Gross requirements		2,000		2,000		2,000
Scheduled receipts						
Projected ending inventory: 1,000						
Net requirements						
Planned receipts						
Planned orders						

Wheels: Lead time = 1 week; Minimum order quantity = 1

WEEK	1	2	3	4	5	6
Gross requirements						
Scheduled receipts						
Projected ending inventory: 0						
Net requirements						
Planned receipts						
Planned orders						

Cotter pins: Lead time = 3 weeks; Minimum order quantity = 15,000

WEEK	1	2	3	4	5	6
Gross requirements						
Scheduled receipts						
Projected ending inventory: 11,000						
Net requirements						
Planned receipts						
Planned orders						

15. (**) Consider the following job information. Each job must proceed sequentially through the different work areas, and each area can work on only one job at a time. Sequence the jobs according to the (1) first-come, first-served rule, (2) earliest due date, and (3) critical ratio. Calculate the average lateness under each rule. Which rule performs best? Are any of the results completely satisfactory? What are the implications?

	Estimated Days				
JOB	PAINTING	ASSEMBLY	PACKING	TOTAL TASK TIME	DAYS UNTIL DUE
A	1.5	2	0.5	4	15
B	4	3	1	8	16
C	3	2	0.5	5.5	8
D	6	4	1	11	20