Solutions Manual

# Chapter 17: Sales and Operations Planning

1. The S&OP process framework consists of six phases; a restaurant might use the data-gathering step to identify the availability of seasonal ingredients and their prices and set targets for meal cost and anticipated demand. The restaurant would develop a marketing plan and review any historical data for the night of the week and similar specials and determine how these specials would be promoted. The manager and chefs would confirm that suppliers can deliver enough produce and proteins to meet the expected level of demand and schedule enough wait staff to manage the anticipated customer load. The financial plan would ensure that vendors and wait staff, cooks, and other kitchen personnel could be paid. Any disconnects in the financial, marketing, and operational elements can be reconciled in the pre-S&OP meeting. Finally, the executive level employees would review the marketing, financial, and operational plans to resolve any issues and imbalances and ensure that the restaurant can deliver on its promises made by the menu and promotional campaign.

Cognitive Domain: Comprehension

Difficulty Level: Medium

2. The goal of demand planning is to achieve consensus among the various stakeholders on different demand scenarios. A video game developer is tasked with a) ascertaining the level of demand of a customer population that may not be participating in the job market and b) designing products that rely on high tech, an industry that changes rapidly. The demand plan must anticipate interest level and take into account what competitors are producing, along with other items in its own product portfolio. Since video games are not necessities, developers must also keep an eye on the economy, as it will influence the level of disposable income its customers possess. The uncertainties associated with demand planning are higher for launching new video games than updating existing ones because of the lack of data from past histories.

Cognitive Domain: Comprehension

Difficulty Level: Medium

3. Top-down planning is driven by an aggregate forecast and is most appropriate for a combination of products that require similar resources. Some items in men’s sportswear would exhibit relatively constant demand throughout the year, so the S&OP team could begin with aggregate numbers for these items and then distribute sales across this product family using an historical multiplier. The primary advantage of a top-down approach is simplicity. Bottom-up planning is driven by all of the constituent items in a product portfolio. The resource requirements for each item are determined and then aggregated to provide an overall picture of resource requirements. Items that have demand that varies widely from one period to the next are best suited for bottom-up planning. Bottom-up planning permits product managers to provide input on items within their product line; such individual attention might yield information that a top-down approach would overlook.

Cognitive Domain: Comprehension

Difficulty Level: Medium

4. The golf store can advertise in various media, run discounts or offer coupons, provide lessons, or partner with golf courses to provide for a location to use the equipment. Counter seasonal products or services could include re-gripping clubs, indoor simulators, and vacation trips to locations where golf is played when it is not played in their area. The golf equipment store can take orders and use back orders if demand outstrips supply and customers are patient.

Cognitive Domain: Comprehension

Difficulty Level: Medium

5. The restaurant can hire or idle servers and cooks during periods of unusually high (November–March) or low demand or use overtime or slack time if demand does not vary too much from normal levels, such as the entry and exit points from the high season. A restaurant has difficulty using inventories to influence supply if they use only fresh produce and proteins; however, if they use frozen produce and proteins, they can lay in a stock during a period of low demand (or low prices) and draw down that stock when demand surges. Using inventory this way may put less strain on their suppliers and allow them to ship a constant amount of supply each period. Part-time workers and subcontractors can be hired during periods of high demand, although the latter is unusual for the restaurant industry. Varying the level of the workforce by hiring/firing, using overtime/slack time, and bringing on and releasing part-timers and subcontractors allows a restaurant to control labor expenses and keep operational efficiency high.

Cognitive Domain: Comprehension

Difficulty Level: Medium

6. A level plan of regular production supplemented with overtime results in the lowest cost.

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| *Month* | *1* | *2* | *3* | *4* | *5* | *6* |
| Forecast | 570 | 600 | 630 | 650 | 670 | 690 |
| Beginning inventory | 0 | 30 | 30 | 0 | 0 | 0 |
| Regular output | 600 | 600 | 600 | 600 | 600 | 600 |
| Overtime | 0 | 0 | 0 | 50 | 70 | 60 |
| Subcontracting | 0 | 0 | 0 | 0 | 0 | 30 |
| Total production | 600 | 600 | 600 | 650 | 670 | 690 |
| Ending inventory | 30 | 30 | 0 | 0 | 0 | 0 |
| Average inventory | 15 | 30 | 15 | 0 | 0 | 0 |

*Total Cost = Regular + Overtime + Subcontracting + Holding*

Total Cost = $40 × 3600 + $60 × 180 + $80 × 30 + $10 × 60 = $157,800

Cognitive Domain: Knowledge

Difficulty Level: Easy

7.

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| *Month* | *1* | *2* | *3* | *4* | *5* | *6* |
| Forecast | 430 | 400 | 440 | 450 | 480 | 480 |
| Beginning inventory | 0 | 0 | 0 | 0 | 0 | 0 |
| Regular output | 400 | 400 | 400 | 400 | 400 | 400 |
| Overtime | 30 | 0 | 40 | 40 | 40 | 40 |
| Subcontracting | 0 | 0 | 0 | 10 | 40 | 40 |



Cognitive Domain: Knowledge

Difficulty Level: Easy

8. If the S&OP must satisfy all demand, then this plan yields a cost of

$40 x 3600 + $60 x 120 + $80 x 50 + $10 x 60 + $30 x 50 = $157,300.

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| *Month* | *1* | *2* | *3* | *4* | *5* | *6* |
| Forecast | 570 | 600 | 630 | 650 | 670 | 690 |
| Beginning inventory | 0 | 30 | 30 | 0 | 0 | 0 |
| Regular output | 600 | 600 | 600 | 600 | 600 | 600 |
| Overtime | 0 | 0 | -0 | 40 | 40 | 40 |
| Subcontracting | 0 | 0 | 0 | 10 | 20 | 20 |
| Ending inventory | 30 | 30 | 0 | 0 | 0 | 0 |
| Average inventory | 15 | 30 | 15 | 0 | 0 | 0 |
| Backorder | 0 | 0 | 0 | 0 | 10 | 40 |

Cognitive Domain: Knowledge

Difficulty Level: Easy

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| *Month* | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
| Forecast | 140 | 155 | 150 | 145 | 155 | 145 | 130 |
| Regular | 140 | 140 | 140 | 140 | 140 | 140 | 130 |
| Overtime |  | 15 | 10 | 5 | 15 | 5 |  |



Cognitive Domain: Knowledge

Difficulty Level: Easy

10.

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| *Month* | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
| Forecast | 140 | 155 | 150 | 145 | 155 | 145 | 130 |
| Regular | 140 | 140 | 140 | 140 | 140 | 140 | 140 |
| Overtime | 0 | 15 | 10 | 5 | 15 | 5 |  |
| Ending inv |  |  |  |  |  |  | 10 |
| Backorder |  |  |  |  |  |  |  |
| Avg inv |  |  |  |  |  |  | 5 |

*Total Cost = Regular + Overtime + Inventory + Backorder*

Total Cost = $50 x 980 + $70 x 50 + $10 x 5 = $53,550

Cognitive Domain: Knowledge

Difficulty Level: Easy

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| *Month* | *Forecast* | *Beginning Inventory* | *Regular*  *Output* | *Subcontract* | *Backorder* | *Ending*  *Inventory* | *Avg*  *Inventory* | *Number of Workers* | Hiring | Firing |
| Jan | 9,000 | 9,000 | 10,000 | 1,000 | 1,000 | 12,000 | 10,500 | 250 | 150 |  |
| Feb | 7,000 | 12,000 |  |  |  | 5,000 | 8,500 |  |  | 250 |
| Mar | 5,000 | 5,000 |  |  |  |  |  |  |  |  |
| Apr | 4,000 |  | 4,000 |  |  |  |  | 100 | 100 |  |
| May | 2,000 |  | 2,000 |  |  |  |  | 50 |  | 50 |
| Jun | 1,500 |  | 1,520 |  |  | 20 | 10 | 38 |  | 12 |
| Jul | 1,000 |  | 1,000 |  |  |  |  | 25 |  | 13 |
| Aug | 1,200 |  | 1,200 |  |  |  |  | 30 | 5 |  |
| Sep | 1,600 |  | 1,600 |  |  |  |  | 40 | 10 |  |
| Oct | 3,000 |  | 3,000 |  |  |  |  | 75 | 35 |  |
| Nov | 5,700 |  | 5,720 |  |  | 20 | 10 | 143 | 68 |  |
| Dec | 7,000 |  | 7,000 |  |  |  |  | 175 | 32 |  |

Total Cost = Regular + Subcontract + Backorder + Inventory + Hiring + Firing

Total Cost = $300 x 37,040 + $420 x 1,000 + $30 x 1,000 + $10 x 19,020 + $500 x 400 + $300 x 325 = $12,049,700

Cognitive Domain: Analysis

Difficulty Level: Medium

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| *Month* | *Forecast* | *Beginning*  *Inventory* | *Regular*  *Output* | *Overtime* | *Backorder* | *Ending*  *Inv* | *Average*  *Inv* | *Subcontract* |
| Jan | 9,000 | 4,000 | 3,000 | 500 | 1,500 |  | 2,000 |  |
| Feb | 7,000 | 0 | 3,000 | 500 | 5,000 |  | 0 |  |
| Mar | 5,000 | 0 | 3,000 | 500 | 6,500 |  | 0 |  |
| Apr | 4,000 | 0 | 3,000 | 500 | 7,000 |  | 0 |  |
| May | 2,000 | 0 | 3,000 | 500 | 5,500 |  | 0 |  |
| Jun | 1,500 | 0 | 3,000 | 500 | 3,500 |  | 0 |  |
| Jul | 1,000 | 0 | 3,000 |  | 1,500 |  | 0 |  |
| Aug | 1,200 | 0 | 3,000 |  |  | 300 | 150 |  |
| Sep | 1,600 | 300 | 3,000 |  |  | 1700 | 1,000 |  |
| Oct | 3,000 | 1,700 | 3,000 |  |  | 1700 | 1,700 |  |
| Nov | 5,700 | 1,700 | 3,000 |  | 1,000 |  | 850 |  |
| Dec | 7,000 | 0 | 3,000 | 500 | 0 |  | 0 | 4,500 |



Total Cost = Regular + Overtime + Backorder + Inventory + Subcontract

Total Cost = $300 x 360,000 + $360 x 3,500 + $30 x 31,500 + $10 x 5,700 + $420 x 4,500 = #14,952,000

Cognitive Domain: Analysis

Difficulty Level: Medium

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| *Month* | *Forecast* | *Beg*  *Inventory* | *Regular*  *Output* | *Overtime* | *Subcontracting* | *End*  *Inventory* | *Average*  *Inventory* |
| Jan | 700 | 0 | 900 |  |  | 200 | 100 |
| Feb | 850 | 200 | 900 |  |  | 250 | 225 |
| Mar | 900 | 250 | 900 |  |  | 250 | 250 |
| Apr | 1,000 | 250 | 900 |  |  | 150 | 200 |
| May | 1,250 | 150 | 900 | 200 |  | 0 | 75 |
| Jun | 1,350 | 0 | 900 | 300 | 200 | 50 | 25 |
| Jul | 1,450 | 50 | 900 | 300 | 200 | 0 | 25 |
| Aug | 1,300 | 0 | 900 | 300 | 100 |  | 0 |
| Sep | 1,000 | 0 | 900 | 100 |  |  |  |
| Oct | 880 | 0 | 900 |  |  | 20 | 10 |
| Nov | 720 | 20 | 600 | 100 |  |  | 20 |
| Dec | 600 | 0 | 600 |  |  |  | 0 |

*Total Cost = Regular + Overtime + Inventory + Subcontracting*

*Total Cost =* $200 x 10,200 + $300 x 1,300 + $10 x 930 +$350 x 500 = $2,614,300

Cognitive Domain: Analysis

Difficulty Level: Medium

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|  | *January* | *February* | *March* | *April* | *May* | *June* |
| Forecast | 700 | 850 | 900 | 1,000 | 1,250 | 1,350 |
| Number of working days | 22 | 20 | 23 | 22 | 24 | 22 |
| Regular production | 880 | 680 | 920 | 1,012 | 1,248 | 1,320 |
| Overtime production units |  | 0 |  |  | 0 |  |
| Number of workers required | 16 | 17 | 20 | 23 | 26 | 30 |
| Number of workers hired | 0 | 0 | 3 | 3 | 3 | 4 |
| Number of workers fired | 5 | 3 | 0 | 0 | 0 | 0 |
| Workers on payroll | 20 | 17 | 20 | 23 | 26 | 30 |
| Ending inventory | 180 | 10 | 30 | 42 | 40 |  |
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|  | *July* | *August* | *September* | *October* | *November* | *December* | *Total* |
| Forecast | 1,450 | 1,300 | 1,000 | 880 | 720 | 600 | 12,000 |
| Number of working days | 23 | 17 | 21 | 22 | 20 | 20 | 256 |
| Regular production | 1,150 | 850 | 1,008 | 880 | 720 | 600 |  |
| Overtime production units | 300 | 450 |  |  |  |  |  |
| Number of workers required | 32 | 39 | 24 | 20 | 18 | 15 |  |
| Number of workers hired | 0 | 0 | 0 | 0 | 0 | 0 |  |
| Number of workers fired | 5 | 0 | 1 | 4 | 2 | 3 |  |
| Workers on payroll | 25 | 25 | 24 | 20 | 18 | 15 |  |
| Ending inventory |  |  | 8 | 8 | 8 | 8 |  |
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Total Cost = Regular + Firing + Overtime + Inventory + Hiring = $200 x 11,268 + $300 x 23 + $300 x 750 + $10 x 330 + $400 x 13 = $2,494,000

Cognitive Domain: Analysis

Difficulty Level: Medium

15a.

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|  | *January* | *February* | *March* | *April* | *May* | *June* | ***Total*** |
| Forecast | 20,000 | 30,000 | 45,000 | 20,000 | 25,000 | 50,000 | 190,000 |
| Regular production | 20,000 | 29,600 | 44,800 | 20,000 | 25,000 | 50,000 |  |
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| Beginning inventory |  |  | 400 | 200 | 200 | 0 |  |
| Ending inventory |  | 400 | 200 | 200 | 200 | 400 |  |
| Average inventory |  | 200 | 300 | 200 | 100 | 200 |  |
| Number of workers required | 25 | 38 | 56 | 25 | 31 | 63 |  |
| Number of workers hired | 0 | 13 | 18 | 0 | 6 | 32 |  |
| Number of workers fired | 15 | 0 | 0 | 31 | 0 | 0 |  |
| Workers on payroll | 25 | 38 | 56 | 25 | 31 | 63 |  |
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Total Cost = Regular + Inventory + Hiring + Firing = $10 x 190,400 + $3 x 1,000 + $1,200 x 69 + $1,000 x 46 = $2,035,800

15b.

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|  | *January* | *February* | *March* | *April* | *May* | *June* | ***Total*** |
| Forecast | 20,000 | 30,000 | 45,000 | 20,000 | 25,000 | 50,000 | 190,000 |
| Regular production | 20,000 | 29,600 | 44,800 | 20,000 | 25,000 | 50,000 |  |
| Production | 32,000 | 32,000 | 32,000 | 32,000 | 32,000 | 32,000 | 192,000 |
| Beginning inventory | 0 | 12,000 | 14,000 | 1,000 | 13,000 | 20,000 |  |
| Ending inventory | 12,000 | 14,000 | 1,000 | 13,000 | 20,000 | 2,000 |  |
| Average inventory | 6,000 | 13,000 | 7,500 | 7,000 | 16,500 | 11,000 | 61,000 |
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Total Cost = Regular + Inventory = $10 x 192,000 + $3 x 61,000 = $2,103,000

15c.

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|  | *January* | *February* | *March* | *April* | *May* | *June* | ***Total*** |
| Forecast | 20,000 | 30,000 | 45,000 | 20,000 | 25,000 | 50,000 | 190,000 |
| Regular production | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 180,000 |
| Overtime production units |  | 0 | 5,000 |  | 0 | 5,000 | 10,000 |
| Beginning inventory | 0 | 10,000 | 10,000 | 0 | 10,000 | 15,000 |  |
| Ending inventory | 10,000 | 10,000 | 0 | 10,000 | 15,000 | 0 |  |
| Average inventory | 5,000 | 10,000 | 5,000 | 5,000 | 12,500 | 7,500 | 45,000 |
| *Production and Inventory Costs* |  |  |  |  |  |  |  |
| Reg. time production cost in $ | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | 300,000 | $1,800,000 |
| Overtime production cost in $ | 0 | 0 | 60,000 | 0 | 0 | 60,000 | $120,000 |
| Holding cost | 15,000 | 30,000 | 15,000 | 15,000 | 37,500 | 22,500 | $135,000 |
| **Total cost in $** | 315,000 | 330,000 | 375,000 | 315,000 | 337,500 | 382,500 | **$2,055,000** |

Cognitive Domain: Analysis

Difficulty Level: Hard

16a.

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|  | *January* | *February* | *March* | *April* | *May* | *June* |
| Forecast | 200 | 300 | 350 | 600 | 450 | 150 |
| Number of working days | 22 | 20 | 23 | 22 | 24 | 22 |
| Production | 440 | 400 | 460 | 440 | 480 | 440 |
| Beginning inventory | 0 | 240 | 340 | 450 | 290 | 320 |
| Ending inventory | 240 | 340 | 450 | 290 | 320 | 610 |
| Average inventory | 120 | 290 | 395 | 370 | 305 | 465 |
| *Production and Inventory Costs* |  |  |  |  |  |  |
| Reg. time production cost in $ |  |  |  |  |  |  |
| Inventory holding cost in $ | $1,200 | $2,900 | $3,950 | $3,700 | $3,050 | $4,650 |
| Backorder cost in $ | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total cost in $** | $3,400 | $4,900 | $6,250 | $5,900 | $5,450 | $6,850 |

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|  | *July* | *August* | *September* | *October* | *November* | *December* | ***Total*** |
| Forecast | 190 | 260 | 360 | 490 | 340 | 160 | 3,850 |
| Number of working days | 23 | 17 | 21 | 22 | 20 | 20 |  |
| Production | 460 | 340 | 420 | 440 | 400 | 400 | 5,120 |
| Beginning inventory | 610 | 880 | 960 | 1,020 | 970 | 1,030 |  |
| Ending inventory | 880 | 960 | 1,020 | 970 | 1,030 | 1,270 |  |
| Average inventory | 745 | 920 | 990 | 995 | 1,000 | 1,150 | 7,745 |
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Total Cost = Regular + Inventory = $100 x 5,120 + $10 x 7,745 = $589,450

16b.

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|  | *January* | *February* | *March* | *April* | *May* | *June* |
| **Forecast** | 200 | 300 | 350 | 600 | 450 | 150 |
| Number of working days | 22 | 20 | 23 | 22 | 24 | 22 |
| Production | 200 | 300 | 350 | 600 | 450 | 150 |
|  |  |  |  |  |  |  |
| Beginning inventory | 0 | 20 | 0 | 18 | 12 | 18 |
| Ending inventory | 20 | 0 | 18 | 12 | 18 | 0 |
| Average inventory | 10 | 10 | 9 | 15 | 15 | 9 |
| Workers on payroll | 10 | 14 | 16 | 27 | 19 | 6 |
| Number of workers hired | 0 | 4 | 2 | 11 | 0 | 0 |
| Number of workers fired | 10 | 0 | 0 | 0 | 8 | 13 |
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|  | *July* | *August* | *September* | *October* | *November* | *December* | *Total* |
| **Forecast** | 190 | 260 | 360 | 490 | 340 | 160 | 3,850 |
| Number of working days | 23 | 17 | 21 | 22 | 20 | 20 | 256 |
| Production | 190 | 260 | 360 | 490 | 340 | 160 |  |
|  |  |  |  |  |  |  |  |
| Beginning inventory | 0 | 17 | 12 | 9 | 3 | 3 |  |
| Ending inventory | 17 | 12 | 9 | 3 | 3 | 3 |  |
| Average inventory | 8.5 | 14.5 | 10.5 | 6 | 3 | 3 |  |
| Workers on payroll | 9 | 15 | 17 | 22 | 17 | 8 |  |
| Number of workers hired | 3 | 6 | 2 | 5 | 0 | 0 |  |
| Number of workers fired | 0 | 0 | 0 | 0 | 5 | 9 |  |
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Total Cost = Regular + Inventory + Hiring + Firing = $100 x 3,853 + $10 x 1,135 + $400 x 33 + $200 x 45 = $408,635

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|  | *January* | *February* | *March* | *April* | *May* | *June* |
| Forecast | 200 | 300 | 350 | 600 | 450 | 150 |
| Number of working days | 22 | 20 | 23 | 22 | 24 | 22 |
| Regular production | 440 | 440 | 440 | 440 | 440 | 440 |
| Overtime production units |  | 0 | 0 | 160 | 10 | 0 |
| Units lost to idle time | 240 | 140 | 60 | 0 | 0 | 290 |
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|  | *July* | *August* | *September* | *October* | *November* | *December* |  |
| Forecast | 190 | 260 | 360 | 490 | 340 | 160 |  |
| Number of working days | 23 | 17 | 21 | 22 | 20 | 20 |  |
| Regular production | 440 | 440 | 440 | 440 | 440 | 440 |  |
| Overtime production units | 0 | 0 | 0 | 50 | 0 | 0 |  |
| Units lost to idle time | 250 | 180 | 80 | 0 | 100 | 280 |  |
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Total Cost = Regular + Overtime + Idle time = $100 x 3,850 + $150 x 220 + $60 x 1,650 = $517,000

Cognitive Domain: Analysis

Difficulty Level: Hard

17a.

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|  | *1* | *2* | *3* | *4* | *5* | *6* | *7* |
| **Forecast** | 160 | 140 | 190 | 160 | 270 | 320 | 360 |
| Regular production | 160 | 140 | 190 | 160 | 200 | 200 | 200 |
| Temporary production |  |  |  |  | 20 | 20 | 20 |
| Subcontract |  |  |  |  | 30 | 70 | 70 |
| Backlog |  |  |  |  | 20 | 50 | 120 |
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|  | *8* | *9* | *10* | *11* | *12* |  |
| **Forecast** | 250 | 170 | 150 | 130 | 180 |  |
| Regular production | 200 | 170 | 150 | 130 | 180 |  |
| Temporary production |  |  |  |  |  |  |
| Subcontract | 50 |  |  |  |  |  |
| Backlog |  |  |  |  |  |  |

Total Cost = Regular + Temp + Subcontract + Backlog = $8 x 2,080 + $30 x 60 + $15 x 220 + $10 x 190 = $23,640

17b.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *1* | | *2* | | *3* | | *4* | *5* | | *6* | |
| **Forecast** | 160 | | 140 | | 190 | | 160 | 270 | | 320 | |
| Regular production | 200 | | 200 | | 200 | | 200 | 200 | | 200 | |
| Subcontracting amount |  | |  | |  | | 0 | 0 | | 30 | |
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|  |  | |  | |  | |  |  | |  | |
| Beginning inventory | 0 | | 40 | | 100 | | 110 | 150 | | 80 | |
| Ending inventory | 40 | | 100 | | 110 | | 150 | 80 | | 0 | |
| Average inventory | 20 | | 70 | | 105 | | 130 | 130 | | 40 | |
|  | *7* | *8* | | *9* | | *10* | | | *11* | | *12* | |  |
| **Forecast** | 360 | 250 | | 170 | | 150 | | | 130 | | 180 | |  |
| Regular production | 200 | 200 | | 200 | | 200 | | | 200 | | 200 | |  |
| Subcontracting amount | 30 | 30 | | 30 | | 30 | | |  | |  | |  |
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| Beginning inventory | 0 | 0 | | 0 | | 0 | | | 0 | | 50 | |  |
| Ending inventory | 0 | 0 | | 0 | | 0 | | | 50 | | 70 | |  |
| Average inventory | 0 | 0 | | 0 | | 0 | | | 25 | | 60 | |  |
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Total Cost = Regular + Inventory + Subcontract + Backlog = $8 x 2,400 + $4 x 565 + $15 x 150 + $10 x 430 = $28,010

Cognitive Domain: Analysis

Difficulty Level: Hard

18.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Demand | 3,000 | 3,200 | 1,800 | 2,700 | 3,400 | 2,200 |
| Regular time capacity | 2,500 | 2,700 | 1,000 | 2,000 | 2,600 | 1,700 |
| Overtime capacity | 500 | 500 | 300 | 500 | 500 | 500 |
| Subcontracting capacity | 600 | 600 | 600 | 600 | 600 | 600 |
| Regular | 2,500 | 2,700 | 1,000 | 2,000 | 2,600 | 1,700 |
| OT | 500 | 500 | 300 | 500 | 500 | 500 |
| Sub | 0 | 0 | 0 | 100 | 300 | 0 |
| Beginning inv | 600 | 600 | 600 | 100 | 0 | 0 |
| Ending inv | 600 | 600 | 100 | 0 | 0 | 0 |
| Avg inv | 600 | 600 | 350 | 50 | 0 | 0 |
|  |  |  |  |  |  |  |
| Total cost | $1,408,000 | |  |  |  |  |

Total Cost = Regular + Overtime + Subcontract + Inventory = $80 x 12,500 + $120 x 2,800 + $140 x 400 + $10 x 1,600 = $1,408,000

Cognitive Domain: Analysis

Difficulty Level: Medium

19a.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *January* | *February* | *March* | *April* | *May* | *June* |  | |
| Forecast | 3,500 | 4,600 | 5,800 | 7,600 | 6,700 | 4,700 |  | |
| Regular | 5,483 | 5,483 | 5,483 | 5,483 | 5,483 | 5,483 |  | |
| Overtime | 0 | 0 | 0 | 0 | 2 | 2 |  | |
| Subcontracting | 0 | 0 | 0 | 0 | 0 | 0 |  | |
| Beginning inventory | 0 | 1,983 | 2,866 | 2,549 | 432 | 0 |  | |
| Ending inventory | 1,983 | 2,866 | 2,549 | 432 | 0 | 0 |  | |
| Average inventory | 991.5 | 2,424.5 | 2,707.5 | 1,490.5 | 216 | -392 |  | |
| Backlog |  |  |  |  | 785 |  |  | |
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Total Cost = Regular + Overtime + Backlog + Inventory = $15 x 32,898 + $22 x 4 + $10 x 785 + $2 x 7,830 = $517,024

19b. In the absence of a limit on regular capacity, the plan for part a remains the lowest cost.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *January* | *February* | *March* | *April* | *May* | *June* |  | |
| Forecast | 3,500 | 4,600 | 5,800 | 7,600 | 6,700 | 4,700 |  | |
| Regular | 5,483 | 5,483 | 5,483 | 5,483 | 5,483 | 5,483 |  | |
| Overtime | 0 | 0 | 0 | 0 | 600 | 0 |  | |
| Subcontracting | 0 | 0 | 0 | 0 | 185 | 0 |  | |
| Beginning inventory | 0 | 1,983 | 2,866 | 2,549 | 432 | 0 |  | |
| Ending inventory | 1,983 | 2,866 | 2,549 | 432 | 0 | 783 |  | |
| Average inventory | 991.5 | 2,424.5 | 2,707.5 | 1,490.5 | 216 | 391.5 |  | |
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Total Cost = Regular + Overtime + Subcontract + Inventory = $15 x 32,898 + $22 x 600 + $25 x 185 +$2 x 8,221.5 = $527,738

19c. In the absence of a limit on regular capacity, the plan for part a remains the lowest cost.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *January* | *February* | *March* | *April* | *May* | *June* |  | |
| Forecast | 3,500 | 4,600 | 5,800 | 7,600 | 6,700 | 4,700 |  | |
| Regular | 5,483 | 5,483 | 5,483 | 5,483 | 5,483 | 5,483 |  | |
| Overtime | 0 | 0 | 0 | 0 | 700 | 0 |  | |
| Backlog | 0 | 0 | 0 | 0 | 85 | 0 |  | |
| Beginning inventory | 0 | 1,983 | 2,866 | 2,549 | 432 | 0 |  | |
| Ending inventory | 1,983 | 2,866 | 2,549 | 432 | 0 | 698 |  | |
| Average inventory | 991.5 | 2,424.5 | 2,707.5 | 1,490.5 | 216 | 349 |  | |
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Total Cost = Regular + Overtime + Backlog + Inventory = $15 x 32,898 + $22 x 700 + $10 x 85 + 2 x 8179 = $526,078

Cognitive Domain: Analysis

Difficulty Level: Hard

20a.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Month* | *Jan* | *Feb* | *March* | *April* | *May* | *June* |
| Rocking chair | 700 | 730 | 745 | 690 | 540 | 420 |
| Windsor chair | 1,220 | 1,550 | 1,700 | 2,070 | 2,250 | 2,400 |
| Number of workers | 30 | 30 | 30 | 30 | 30 | 30 |
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|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Regular output | 1,429 | 1,429 | 1,429 | 1,429 | 1,429 | 1,429 |
|  |  |  |  |  |  |  |
| Overtime | 491 | 851 | 1,016 | 1,331 | 1,361 | 1,391 |
| Beginning inventory | 0 | 0 | 0 | 0 | 0 | 0 |
| Ending inventory | 0 | 0 | 0 | 0 | 0 | 0 |
| Average inventory | 0 | 0 | 0 | 0 | 0 | 0 |
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| --- | --- | --- | --- | --- | --- | --- | --- |
| *Month* | *July* | *August* | *Sept* | *Oct* | *Nov* | *Dec* |  |
| Rocking chair | 870 | 770 | 910 | 830 | 400 | 780 |  |
| Windsor chair | 1,700 | 1,310 | 1,890 | 1,640 | 890 | 1,460 |  |
| Number of workers | 30 | 30 | 30 | 30 | 30 | 30 |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Regular output | 1,429 | 1,429 | 1,429 | 1,429 | 1,429 | 1,429 |  |
|  |  |  |  |  |  |  |  |
| Overtime | 0 | 0 | 0 | 0 | 0 | 0 |  |
| Beginning inventory | 0 | 0 | 0 | 0 | 0 | 139 |  |
| Ending inventory | 0 | 0 | 0 | 0 | 139 | 0 |  |
| Average inventory | 0 | 0 | 0 | 0 | 69.5 | 69.5 |  |
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Total Cost = Regular + Overtime + Inventory = $400 x 17,148 + $550 x 11,317 + $20 x 139 = $13,086,330

20b.

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| --- | --- | --- | --- | --- | --- | --- |
| *Month* | *Jan* | *Feb* | *Mar* | *Apr* | *May* | *Jun* |
| Rocking chair | 700 | 730 | 745 | 690 | 540 | 420 |
| Windsor chair | 1,220 | 1,550 | 1,700 | 2,070 | 2,250 | 2,400 |
| Starting number of workers | 30 | 41 | 48 | 51 | 58 | 59 |
| Hired | 11 | 7 | 3 | 7 | 1 | 0 |
| Fired | 0 | 0 | 0 | 0 | 0 | 0 |
| Ending number of workers | 41 | 48 | 51 | 58 | 59 | 59 |
| Regular output | 1,952 | 2,286 | 2,429 | 2,762 | 2,810 | 2,810 |
| Subcontracted | 0 | 0 | 0 | 0 | 0 | 0 |
| Overtime | 0 | 0 | 0 | 0 | 0 | 0 |
| Beginning inventory | 0 | 32.00 | 38.00 | 22.00 | 24.00 | 44.00 |
| Ending inventory | 32.00 | 38.00 | 22.00 | 24.00 | 44.00 | 34.00 |
| Average inventory | 16 | 35 | 30 | 23 | 34 | 39 |
|  |  |  |  |  |  |  |
| Hiring cost | $3,300 | $2,100 | $900 | $2,100 | $300 | $0 |
| Firing cost | $0 | $0 | $0 | $0 | $0 | $0 |
| Regular time cost | $780,800 | $914,400 | $971,600 | $1,104,800 | $1,124,000 | $1,124,000 |
| Subcontracting cost | $0 | $0 | $0 | $0 | $0 | $0 |
| OT cost | $0 | $0 | $0 | $0 | $0 | $0 |
| Carrying cost | $320 | $700 | $600 | $460 | $680 | $780 |
| Backorder cost | $0 | $0 | $0 | $0 | $0 | $0 |
|  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| *Month* | *Jul* | *Aug* | *Sep* | *Oct* | *Nov* | *Dec* | *Totals* |
| Rocking chair | 870 | 770 | 910 | 830 | 400 | 780 | 8385 |
| Windsor chair | 1700 | 1310 | 1890 | 1640 | 890 | 1460 | 20080 |
| Starting number of workers | 59 | 54 | 43 | 59 | 52 | 27 |  |
| Hired | 0 | 0 | 16 | 0 | 0 | 20 | 65 |
| Fired | 5 | 11 | 0 | 7 | 25 | 0 | 48 |
| Ending number of workers | 54 | 43 | 59 | 52 | 27 | 47 |  |
| Regular output | 2,571 | 2,048 | 2,810 | 2,476 | 1,286 | 2,238 | 28478 |
| Subcontracted | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Overtime | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beginning inventory | 34.00 | 35.00 | 3.00 | 13.00 | 19.00 | 15.00 |  |
| Ending inventory | 35.00 | 3.00 | 13.00 | 19.00 | 15.00 | 13.00 |  |
| Average inventory | 34.5 | 19 | 8 | 16 | 17 | 14 | 285.5 |
|  |  |  |  |  |  |  |  |
| Hiring cost | $0 | $0 | $4,800 | $0 | $0 | $6,000 | $19,500 |
| Firing cost | $2,000 | $4,400 | $0 | $2,800 | $10,000 | $0 | $19,200 |
| Regular time cost | $1,028,400 | $819,200 | $1,124,000 | $990,400 | $514,400 | $895,200 | $11,391,200 |
| Subcontracting cost | $0 | $0 | $0 | $0 | $0 | $0 | 0 |
| OT cost | $0 | $0 | $0 | $0 | $0 | $0 | 0 |
| Carrying cost | $690 | $380 | $160 | $320 | $340 | $280 | $5,710 |
| Backorder cost | $0 | $0 | $0 | $0 | $0 | $0 | 0 |
|  |  |  |  |  |  | Total cost | $11,435,610 |

20c. The chase plan is less expensive.

Cognitive Domain: Analysis

Difficulty Level: Hard

21a.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Month* | *1* | *2* | *3* | *4* | *5* | *6* | *Totals* |
| Forecast | 1,200 | 1,300 | 900 | 700 | 1,500 | 1,700 | 7,300 |
| Production cost in $/unit | 90 | 95 | 100 | 105 | 100 | 100 |  |
| Overtime cost in $/unit | 135 | 142.5 | 150 | 157.5 | 150 | 150 |  |
| Subcontracting cost in $/unit | 150 | 150 | 150 | 150 | 150 | 150 |  |
| Inventory holding cost $/unit | 5 | 5 | 5 | 5 | 5 | 5 |  |
| Beginning inventory | 100 | 100 | 0 | 300 | 800 | 500 |  |
| Regular output | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 | 7,200 |
| Overtime output |  |  |  |  |  |  | 0 |
| Subcontracting output |  |  |  |  |  |  | 0 |
| Ending inventory | 100 | 0 | 300 | 800 | 500 | 0 |  |
| Average inventory | 100 | 50 | 150 | 550 | 650 | 250 |  |
| *Cost Calculations* |  |  |  |  |  |  |  |
| Regular output cost | $108,000 | $114,000 | $120,000 | $126,000 | $120,000 | $120,000 | $708,000 |
| Overtime output cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Subcontract output cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Holding cost | $500 | $250 | $750 | $2,750 | $3,250 | $1,250 | $8,750 |
| Total cost | $108,500 | $114,250 | $120,750 | $128,750 | $123,250 | $121,250 | $716,750 |

21b.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Month* | *1* | *2* | *3* | *4* | *5* | *6* | *Totals* |
| Forecast | 1,200 | 1,300 | 900 | 700 | 1,500 | 1,700 | 7,300 |
| Production cost in $/unit | 90 | 95 | 100 | 105 | 100 | 100 |  |
| Overtime cost in $/unit | 135 | 142.5 | 150 | 157.5 | 150 | 150 |  |
| Subcontracting cost in $/unit | 150 | 150 | 150 | 150 | 150 | 150 |  |
| Inventory holding cost per unit | 5 | 5 | 5 | 5 | 5 | 5 |  |
| Beginning inventory | 100 | 0 | 0 | 100 | 400 | 0 |  |
| Regular output level | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 6,000 |
| Overtime output level | 100 | 200 |  |  | 100 | 350 | 750 |
| Subcontracting output level |  | 100 |  |  |  | 350 | 450 |
| Ending inventory | 0 | 0 | 100 | 400 | 0 | 0 |  |
| Average inventory | 50 | 0 | 50 | 250 | 200 | 0 |  |
| *Cost Calculations* |  |  |  |  |  |  |  |
| Regular output cost | $90,000 | $95,000 | $100,000 | $105,000 | $100,000 | $100,000 | $590,000 |
| Overtime output cost | $13,500 | $28,500 | $0 | $0 | $15,000 | $52,500 | $109,500 |
| Subcontracting output cost | $0 | $15,000 | $0 | $0 | $0 | $52,500 | $67,500 |
| Holding cost | $250 | $0 | $250 | $1,250 | $1,000 | $0 | $2,750 |
| Total cost | $103,750 | $138,500 | $100,250 | $106,250 | $116,000 | $205,000 | $769,750 |

21c.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Month* | *1* | *2* | *3* | *4* | *5* | *6* | *Totals* |
| Forecast | 1,200 | 1,300 | 900 | 700 | 1,500 | 1,700 | 7,300 |
| Production cost in $/unit | 90 | 95 | 100 | 105 | 100 | 100 |  |
| Overtime cost in $/unit | 135 | 142.5 | 150 | 157.5 | 150 | 150 |  |
| Subcontracting cost in $/unit | 150 | 150 | 150 | 150 | 150 | 150 |  |
| Inventory holding cost per unit | 5 | 5 | 5 | 5 | 5 | 5 |  |
| Beginning inventory | 100 | 0 | 0 | 0 | 0 | 0 |  |
| Regular output level | 1,100 | 1300 | 900 | 700 | 1,500 | 1,700 | 7,200 |
| Overtime output level | 0 | 0 |  |  | 0 | 0 | 0 |
| Subcontracting output level |  | 0 |  |  |  | 0 | 0 |
| Ending inventory | 0 | 0 | 0 | 0 | 0 | 0 |  |
| Average inventory | 50 | 0 | 0 | 0 | 0 | 0 |  |
| *Cost Calculations* |  |  |  |  |  |  |  |
| Regular output cost | $99,000 | $123,500 | $90,000 | $73,500 | $150,000 | $170,000 | $706,000 |
| Overtime output cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Subcontracting output cost | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Holding cost | $250 | $0 | $0 | $0 | $0 | $0 | $250 |
| Total cost | $99,250 | $123,500 | $90,000 | $73,500 | $150,000 | $170,000 | $706,250 |

21d. The chase strategy is the lowest-cost approach since it avoids carrying costs and uses only regular time production because there is no plant capacity constraint.

Cognitive Domain: Analysis

Difficulty Level: Hard