# Session 1. Operation Strategy & Master Planning.

Key Terms :
- Business & Operation Strategy : Business Strategy & Environmental Scanning, Manufacturing Strategy.
- Demand Management : Roles of Forecasting, Forecasting Methods, Tracking Forecasting.
- Sales & Operations Planning : Concepts of S&OP, Production Planning.
- Master Scheduling : Definition of MPS, Master Scheduling Processes. MPS & ATP.

## Part 1. Business & Operation Strategy.

1. In order to forecast cash flow in a make-to-order company, which of the following must be converted into dollars ?
  A) Carrying cost of finished goods.
  B) Critical work center costs.
  C) Standard yield percentages.
  D) Final assembly schedule.

2. In order to maximize profit, a company must have all of the following objectives EXCEPT :
  A) Best customer service
  B) Most accurate production forecast
  C) Lowest inventory investment
  D) Lowest distribution cost

3. Which of the following statement is the BEST definition of demand lead time ?
  A) The time from the receipt of a customer order to the delivery of the product.
  B) The longest planned length of time to accomplish the activity in question.
  C) The total setup time plus the run time for a specific task.
  D) The amount of time potential customers are willing to wait for the delivery of a good.

4. In projecting demand for a standard design commodity, which of the following factors is typically most important ?
  A) Post-sales service                    B) Product features
  C) Quality controls                      D) Competitive pricing

5. The basic elements of the supply chain include :
  A) Supply, manufacture, distribution      B) Design, manufacture, inventory
  C) Engineer, design, manufacture          D) Supply, engineer, manufacture

6. In which of the following manufacturing environments would consumer products, such as film, food, etc. be classified?
  A) Assemble-to-order.          B) Make-to-stock.
  C) Make-to-order.              D) Engineer-to-order.

7. Which of the following is the statement about order winners ?
  A) Characteristics that cause a firm's customers to choose that firm's products and services over those of its competitors.
  B) Product characteristics that have the highest market share.
  C) Order winners usually focus on product quality for customer.
  D) A company's characteristics that are admired by their competitors.

8. Which of the following demand fulfillment approaches typically provides the longest delivery time ?

   A) Engineer-to-order                          B) Make-to-order

   C) Assemble-to-order                        D) Make-to-stock

9. In which of the following manufacturing environments are forward scheduling and finite loading BEST suited for providing customer promise dates ?

   A) Make-to-stock                             B) Make-to-order

   C) Assemble-to-order                        D) Configure-to-order

10. The ability to negotiate price is dependent on the type of product.  Which of the following products could generally be negotiated ?

   A) Maintenance, repair, and operating supplies             B) Copper, coal, wheat, metal

   C) Standard electronic components                    D) Made to order motors

11. Many different end items are made from a small number of components. What manufacturing environment would this be ?

   A) Make to stock                         B) Make to order

   C) Assemble to order                    D) Engineer to order

12. In which of the following manufacturing environments would consumer products, such as film, food, etc. be classified ?

   A) Assemble to order                    B) Engineer to order

   C) Make to order                          D) Make to stock

13. Which of the following statements would be TRUE regarding the delivery time in an engineer to order company ?
   A) Delivery time is shorter than a make-to-order company
   B) It would be the same as a make-to-stock item
   C) It would be longer than an assemble-to-order company
   D) It would be shorter than an assemble-to-order company

14. Flow systems are usually very cost effective for the following reasons ?
   A) Because workstation are designed to produce a varied product.
   B) Because material flows from one workstation to the next, there is large buildup of WIP inventory.
   C) Because manufacturing lead times are long.
   D) Because in their purest form, flow lines are inflexible.

15. In a certain manufacturing environment, routings are fixed, and work centers are arranged in the order of the routings. The production at each work center takes a similar amount of time.  This would describe :
   A) Project manufacturing               B) Intermittent manufacturing
   C) Flow manufacturing                  D) Specialty manufacturing

16. In a certain manufacturing environment, the flow of work is varied, workers must be flexible, and throughput times are long. This describes :
   A) Project manufacturing               B) Intermittent manufacturing
   C) Flow manufacturing                  D) Specialty manufacturing

17. Which of the following statement is correct regarding product layout EXCEPT ?
  A) It is continuous production.
  B) It is repetitive production.
  C) Work involves only to those stations required and skips the rest.
  D) Demand must be sufficient to justify setting up the process.

18. Which of the following production processes is most appropriate for high-volume bulk products ?
  A) Project        B) Jobbing        C) Batch        D) Continuous

19. Which of the following is generally a characteristic of a product-focused layout ?
  A) Large queues at workstations        B) Fixed flow of work
  C) Production to a work order        D) General purpose workstations

20. Many companies use standard costs for inventory transactions and other business decisions. These standard costs are often maintained for the entire fiscal year. Which of the following best describes the basis for establishing standard costs for the next year ?
  A) Budgeted costs and volumes.        B) This years purchase costs.
  C) Rate based calculations.        D) Capacity based calculations.

21. Process specifications can be best defined as a document which :
  A) Shows how the product will appear.
  B) Shows the steps needed to produce the end item.
  C) Details the capacity available at a work center.
  D) Flow charts various processes.

22. A company which can adapt swiftly to changes in the volume and mix of their products is:
  A) Good at sales and operation planning.　　B) Forecasting accurately.
  C) Process flexible.　　　　　　　　　　　　D) Six sigma certified.

23. In make to stock requirements, customer orders are satisfied from :
  A) Available capacity.　　　　　B) Work in process inventory.
  C) Finished goods inventory.　　D) Raw material inventory.

24. A company is planning to add new distribution channels, in new geographic regions, and new products to support this initiative. This information would most likely be found in the company's :
  A) Strategic plan.　　　　　B) Financial plan.
  C) Production plan.　　　　D) Supply chain plan.

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## Part 2. Forecasting.

1. Independent demand can be defined by all of the following EXCEPT :
   A) Demand not related to demand from higher level assemblies
   B) Forecasted demand
   C) Demand calculated based on parent demand
   D) Demand from customer orders

2. Which of the following is most likely to be a dependent demand item ?
   A) A manufactured subassembly          B) An item in a grocery store
   C) A service part                      D) An office supply item

3. Which of the following would BEST define dependent demand ?
   Ⅰ. Demand which is dependent on the forecast
   Ⅱ. Demand which is dependent on demand for a higher level assembly
   Ⅲ. Demand which is calculated

   A) Ⅰ only     B) Ⅰ and Ⅱ     C) Ⅱ and Ⅲ     D) Ⅲ

4. Which of the following would most likely be an independent demand item ?
   A) Inventoried subassembly for a printer      B) Manufactured subassembly in a car
   C) Purchased component for a fork truck       D) Spare part for a jet engine

5. Which of the following would be included in demand management ?
   Ⅰ. Forecasted requirements
   Ⅱ. Service parts requirements
   Ⅲ. Branch warehouse requirements
   Ⅳ. Inter-plant orders

   A) I, II, and III      B) II, III, and IV      C) I, III, and IV      D) I, II, III, and IV

6. Forecasts are usually wrong but we continue to use them. They are necessary because :
   A) Forecasters provide a service to the organization
   B) Forecasts are a prelude to business planning
   C) The Master Production Schedule needs one
   D) Materials Requirements Planning cannot operate without one

7. All of the following are principles of forecasting EXCEPT :
   A) Forecasts are usually wrong
   B) Forecasts are more accurate for end items
   C) Forecasts should include an estimate of error
   D) Forecasts are more accurate in the near term

8. A forecast is typically more accurate for
   A) Groups of items rather than for individual items
   B) Daily rather than monthly periods of time
   C) Physical units rather than monetary units
   D) Far out in the future rather than nearer time periods

9. Forecasts are typically more accurate for the near future than they are for the longer future. This occurs because:
  A) The near term holds less uncertainty than the long term
  B) More data is available in the near term
  C) Aggregate data is easier to forecast
  D) The future is more dynamic in the near term

10. In using exponential smoothing, the old forecast for June was 100, and the actual demand for June was 150. If $\alpha$ is 0.1. Which of the following is the forecast for July ?
  A) 100          B) 105          C) 110          D) 115

11. The following formula represents which forecasting technique ?
  · New forecast = (alpha)(latest demand) + (1-alpha)(previous forecast)

  A) Weighted moving average          B) Double exponential smoothing
  C) Exponential smoothing            D) Focus forecasting

12. Which of the following is a characteristic of exponential smoothing ?
  Ⅰ. It provides a routine method of updating item forecasts.
  Ⅱ. It works well for variable items.
  Ⅲ. It is satisfactory for long-range forecasts.
  Ⅳ. The forecast with the smaller $\alpha$ follow actual demand more remotely.

  A) Ⅰ only                 B) Ⅱ, Ⅲ only
  C) Ⅰ, Ⅳ only             D) Ⅰ, Ⅲ, Ⅳ only

13. When a company has historical data available for use in forecasting future demand, the technique for utilizing this data is called :
 A) Qualitative forecasting techniques   B) Quantitative forecasting techniques.
 C) Intrinsic forecasting techniques    D) Causal forecasting techniques

14. Which of the following does a tracking signal identify in a forecast ?
 A) Mean absolute deviation     B) Standard deviation
 C) Bias            D) Aggregate summarization

15. Which measures of forecast error express the size of error irrespective of whether it's positive or negative ?
 Ⅰ. MAD.
 Ⅱ. Standard deviation.
 Ⅲ. Tracking signals.
 Ⅳ. Bias

 A) Ⅰ only    B) Ⅰ, Ⅱ only    C) Ⅰ, Ⅲ only    D) All

16. The annual demand for a product is 1200 but during July, the product sells 150 units. What is the seasonal index for the product in July ?
 A) 1.0    B) 1.5    C) 1.75    D) 2.00

17. Which of the following detects bias in a forecast model ?
  A) Tracking signal                          B) Mean absolute deviation (MAD)
  C) Demand filter                            D) Standard deviation

18. A tracking signal is used to :
  A) Monitor the quality of the forecast
  B) Determine the variation in the production plan
  C) Measure whether the schedule is being met
  D) Measure the material plan

19. The forecast for a part is 200 units per week. The actual shipments for the last 5 weeks have been 250, 260, 210, 240, and 220. If the MAD is 20, what would the tracking signal equal ?
  A) 3             B) 6             C) 9             D) 12

20. Based on the following data, what would the projected forecast for month 5 be, using a 3 month moving average ?

| Month | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Forecast | 200 | 200 | 200 | 200 |
| Actual Demand | 190 | 210 | 190 | 170 |

  A) 170          B) 180          C) 190          D) 200

21. A forecast analyst has just extracted the recent actual sales history and, in reviewing the data, notices several outliers. The analyst should most likely :
  A) Rerun the data to ensure there were no errors in the extract.
  B) Rerun the data but remove the outliers.
  C) Ignore the outliers and use the forecasts as is.
  D) Refer to the tracking signal.

22. A collaborative forecast is best described as :
  A) One where the seasonal demand is dampened by the trend.
  B) A forecast where the tracking signal is equal to one.
  C) A forecast where the customer and the supplying firm have reached a consensus about the forecast.
  D) A forecast which has a MAD of 2.06 or less.

23. The average demand for January has been 90, and the average annual demand has been 1800. Calculate the seasonal index for January. If the company forecasts annual demand next year at 200 units, what is the forecast for January next year ?

24. Calculate the deseasonalized demands for the following :

| Quarter | Actual Demand | Seasonal Index | Deseasonalized Demand |
|---------|---------------|----------------|-----------------------|
| 1 | 130 | 0.62 | |
| 2 | 170 | 1.04 | |
| 3 | 375 | 1.82 | |
| 4 | 90 | 0.52 | |
| Total | | | |

※ The old deseasonalized forecast is 100 units, α = 0.2, and the actual demand for the last month was 130 units. If the seasonal index for the last month is 1.2 and the next month is 0.9.

25. Calculate the deseasonalized actual demand for the last month.

26. Calculate the deseasonalized forecast for next month using exponential smoothing.

27. Calculate the forecast of actual demand for the next month.

28. A company uses a tracking signal trigger of ±4 to decide whether a forecast should be reviewed. Given the following history, determine in which period the forecast should be reviewed. MAD for the item is 15. Is there any previous indication that the forecast should be reviewed ?

| Period | Forecast | Actual | Deviation | Cumulative Deviation | Tracking Signal |
|--------|----------|--------|-----------|----------------------|-----------------|
| 1 | 100 | 110 | | | |
| 2 | 105 | 90 | | | |
| 3 | 110 | 85 | | | |
| 4 | 115 | 110 | | | |
| 5 | 120 | 105 | | | |
| 6 | 125 | 95 | | | |

* Tracking Signal = $\dfrac{\text{Cumulative Deviation}}{\text{MAD}}$

29. A company wants to produce 500 units over the next four months at a level rate. The months have 19, 22, 20, and 21 working days, respectively. On the average, how much should the company produce each day to level production ?  How much will be produced in each of the four months ?

## Part 3. Sales & Operation Planning.

1. The sales and operation planning is done at the level :
   A) Part(component)                B) Subassembly
   C) Product family(group)          D) Final assembly

2. Which of the following statement is correct about S&OP (Sales and Operation Planning)
   A) The level of detail is not high.
   B) Sales and operation planning is set by the master production schedule.
   C) It is a plan for the production of individual end item.
   D) The planning horizon is usually very short.

3. Which of the following are the objectives of the sales and operations planning ?
   Ⅰ. Build teamwork.
   Ⅱ. Manage change effectively.
   Ⅲ. Consume the forecast with customer orders

   A) Ⅰ only          B) Ⅰ, Ⅱ only          C) Ⅰ, Ⅲ only          D) Ⅱ, Ⅲ only

4. Which of the following links product family planning and component planning ?
   A) Production planning                B) Master scheduling
   C) Material requirements planning     D) Resource requirements planning

5. Which of the following are strategies to use in developing a production plan ?
ㅣ. Chase strategy
ㅣㅣ. Delphi strategy
ㅣㅣㅣ. Level strategy
ㅣV. Backlog strategy

A) I and II          B) I and III          C) II and IV          D) III and IV

6. A company wants to produce 1000 units over the next four months using a level strategy. The months have 20, 21, 19 and 22 working days in each one. Based on this strategy, how much would be produced in the first month ?
A) 244          B) 254          C) 260          D) 262

7. If the opening backlog is 400 units, forecast demand is 600 units, and production is 800 units, what will be the ending backlog ?

8. A company wants to develop a level production plan for a family of products. The opening inventory is 100 units, and an increase to 130 units is expected by the end of the plan. The demand for each period is given in what follows. How much should be the company produce each period ? What will be the ending inventories in each period ? All periods have the same number of working days.

| Period | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| Forecast Demand | 100 | 120 | 130 | 140 | 120 | 110 | |
| Planned Production | | | | | | | |
| Planned Inventory    100 | | | | | | | |

9. The opening backlog is 800 units. Forecast demand is shown in the following. Calculate the weekly production for level production if the backlog is to be reduced to 400 units.

| Period | | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|
| Forecast Demand | | 600 | 700 | 700 | 700 | 600 | 500 | |
| Planned Production | | | | | | | | |
| Projected Backlog | 800 | | | | | | | |

10. Amalgamated Mailbox Company manufactures a family of two mailboxes. The production plan and the MPS are developed on a quarterly basis. The forecast for the product group follows. The opening inventory is 270 units, and the company wants to reduce this to 150 units at the end of the year. Develop a level production plan and MPS of each product.

Production Plan.

| Quarter | | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|
| Forecast Sales | | 220 | 300 | 200 | 200 | |
| Projected Available | 270 | | | | | |
| Production Plan | | | | | | |

Mailbox A.    (Lot size = 200)

| Quarter | | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|
| Forecast Sales | | 120 | 180 | 100 | 120 | |
| Projected Available | 120 | | | | | |
| MPS | | | | | | |

Mailbox B.    (Lot size = 200)

| Quarter | | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|
| Forecast Sales | | 100 | 120 | 100 | 80 | |
| Projected Available | 150 | | | | | |
| MPS | | | | | | |

## Part 4. Master Scheduling.

1. The end items and quantities to be produced by period are defined by which of the following ?
  A) Strategic business plan.        B) Production plan.
  C) Master production schedule.    D) Dispatch list.

2. Which of the following BEST describes the Master Production Schedule ?
  A) It is the actual build schedule for manufacturing.
  B) It is the final assembly schedule.
  C) It is driven by materials requirements planning.
  D) It is the planned build schedule for manufacturing.

3. The MPS is used to facilitate communication between which two groups ?
  A) Manufacturing and Logistics.      B) Sales and Marketing.
  C) Manufacturing and Finance.      D) Sales and Manufacturing.

4. The minimum planning horizon for the MPS should be :
  A) Twelve months in weekly amounts.
  B) Equal to the longest cumulative lead time.
  C) As long as it takes to acquire new capacity.
  D) Twice the longest component lead time.

5. Which of the following are objectives when establishing the MPS ?
   I. Efficient use of resources.
   II. Efficient final assembly.
   III. High customer service levels.
   IV. Efficient use of inventory.

   A) I, II, and III     B) I, II, and IV     C) I, II, III, and IV     D) I, III, and IV

6. Which of the following are steps in developing a Master Production Schedule ?
   I. Develop a preliminary MPS.
   II. Check the schedule against the capacity available.
   III. Check MPS against the production plan to ensure they are equal.

   A) I and II        B) I and III
   C) II and III       D) I, II, and III

7. Which of the following are inputs to a realistic MPS ?
   I. Production plan.
   II. Forecasts for end items.
   III. Product costs for end items.
   IV. Capacity constraints.

   A) I, II, and III     B) I, II, and IV     C) II, III, and IV     D) I, III, and IV

8. You are working as a Master Scheduler in a discrete manufacturing company.  A large customer has asked if you can deliver an order, but you have some short term capacity constraints.  Which of the following actions could be taken so the order can be delivered ?
　Ⅰ. People could be hired.
　Ⅱ. Overtime could be worked.
　Ⅲ. Inventory could be built in slow times.
　Ⅳ. Work could be subcontracted.

　A) I, II, and III　　　　　B) II, III, and IV　　　　　C) I, III, and IV　　　　　D) I, II, and IV

9. The time fence zone known as the liquid zone would have which of the following characteristics ?
　A) Any change can be made to the MPS within the production plan.
　B) Changes must be minimized due to the expense of changing the MPS.
　C) Capacity and materials are committed to specific orders.
　D) Changes should be authorized at the senior manager level.

10. A time fence which is included in the frozen zone has which of the following characteristics ?
　A) Any change can be made as long as it is within the production plan.
　B) Capacity and materials have been committed to specific orders.
　C) Changes can be made if capacity is available.
　D) Costs for changing are not excessive.

11. The primary reason for a time fence is to :
　A) Determine how to use the forecast.
　B) Manage schedule changes most effectively.
　C) Provide a stable schedule for the suppliers.
　D) Maintain a steady shipment schedule.

12. Rough cut capacity planning can be BEST described as :
 A) Checking to be sure that critical resources are available to support the preliminary MPS.
 B) Making sure warehouse space is available for raw materials.
 C) Making certain the load at each work center is less than capacity.
 D) Ensuring resources are available by product family.

13. The portion of a company's inventory and planned production which is not already committed is :
 A) Inventory allocation.              B) Inventory commitment.
 C) Available to promise.              D) Multi-plant planning.

14. Which of the following provides better order-promising and due-date performance
 A) Reducing batch size.              B) Reducing queue.
 C) Improving forecast accuracy.      D) Reducing LT.

15. Which of the following is a good measure of customer focus ?
 A) High organizational turnover.      B) High quality levels.
 C) Many performance measures.         D) Many supplier contacts.

16. Final assembly scheduling usually occurs when :
 A) A customer order is received.      B) Planning a build schedule.
 C) The MPS is established.            D) Capacity is constrained.

17. The portion of a company's inventory and planned production which is not already committed is :

A) Inventory allocation.         B) Inventory commitment.

C) Available to promise.         D) Multi-plant planning.

18. Based on the below, what action can the planner take regarding an order for 60 in week 3 ?

| Week | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Customer Orders | 60 | 30 | 20 | 40 | |
| MPS | 110 | | 110 | | |
| ATP | 20 | | 50 | | |

A) Reject the order for 60; tell the customer 50 are available.

B) Accept the order for week 4 for 60.

C) Accept the order for week 2 for 60.

D) Accept the order for week 3 for 60.

19. Often, when placing an order, a customer will ask when the order will ship. The ability to answer this question rests with check of the uncommitted material and available capacity. Which of the following tools will most often be used to answer the question "when will my order ship? "

A) Pegging report to understand where demand is coming from.

B) Available to promise portion of the MPS.

C) The resource requirements at the key work centers.

D) The ability of the supplier to provide materials within lead time.

20. The quantity calculated as available-to-promise really is meant to answer the question :
   A) When can you ship the product ?    B) What available capacity is left ?
   C) What is the projected available inventory ?    D) How much is on hand to ship ?

※ The Acme Widget Company makes widgets in two models, and the bottleneck operation is in work center 10. Following is the resource bill (in hours per part)

| Work Center | Hours per Part | |
| --- | --- | --- |
| | Model A | Model B |
| 10 | 2.4 | 3.2 |

The master production schedule for the next five weeks is :

| Quarter | 1 | 2 | 3 | 4 | 5 |
| --- | --- | --- | --- | --- | --- |
| Model A | 70 | 50 | 50 | 60 | 45 |
| Model B | 20 | 40 | 55 | 30 | 45 |

21. Using the resource bill and the master production schedule, calculate the number of hours required in work center 10 for each of the five weeks.

| Quarter | 1 | 2 | 3 | 4 | 5 |
| --- | --- | --- | --- | --- | --- |
| Model A | | | | | |
| Model B | | | | | |
| Total Hours | | | | | |

22. If the available capacity at work station 10 is 260 hours per week, suggest possible ways of meeting the demand in week 3.

23. Calculate the available to promise using the following data. There are 100 units on hand.

| Week | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Customer Order | 70 | 50 | 30 | 30 | 20 | |
| MPS | | 100 | | 100 | | 100 |
| ATP | | | | | | |

24. Given the following data, calculate the PAB, planned MPS, and ATP. The order quantity is 200.

| Week | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Forecast | 80 | 80 | 80 | 80 |
| Customer Order | 100 | 90 | 50 | 40 |
| PAB            160 | | | | |
| MPS | | | | |
| ATP | | | | |

■ **Solutions.**

**Part 1. Business & Operation Strategy.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|----|
| D | B | D | D | A | B | A | A | B | D |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| B | D | C | D | C | B | C | D | B | A |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| B | C | C | A | | | | | | |

**Part 2. Forecasting.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|----|
| C | A | C | D | D | B | B | A | A | B |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| C | C | C | C | B | D | A | A | C | C |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| B | C | | | | | | | | |

23.
- · Seasonal Index for January
    - = The average demand for January / The average annual demand
    - = 90 / 150 = 0.6
- · Forecast for next January.
    - - The average demand for each month = 2000 / 12 = 166.7.
    - - Forecast for next January = (The average demand) (Seasonal Index)
        - = 166.7 × 0.6 = 100.02

24.

| Quarter | Actual Demand | Seasonal Index | Deseasonalized Demand |
|---------|---------------|----------------|------------------------|
| 1 | 130 | 0.62 | 130 / 0.62 = 209.6 |
| 2 | 170 | 1.04 | 170 / 1.04 = 163.4 |
| 3 | 375 | 1.82 | 375 / 1.82 = 206.0 |
| 4 | 90 | 0.52 | 90 / 0.52 = 173.0 |
| Total | | | |

25.　　· Deseasonalized last month's demand = 130 / 1.2 = 108.

26.　　· Deseasonalized forecast for next month using exponential smoothing

$$= 0.2 \times 108 + (1 - 0.2) \times 100 = 101.6$$

27.　　· Forecast of seasonal demand = 101.6 × 0.9 = 91.4

28.

| Period | Forecast | Actual | Deviation | Cumulative Deviation | Tracking Signal |
|--------|----------|--------|-----------|----------------------|-----------------|
| 1 | 100 | 110 | + 10 | + 10 | + 0.67 |
| 2 | 105 | 90 | − 15 | − 50 | − 0.33 |
| 3 | 110 | 85 | − 25 | − 30 | − 2.00 |
| 4 | 115 | 110 | − 50 | − 35 | − 2.33 |
| 5 | 120 | 105 | − 15 | − 50 | − 3.33 |
| 6 | 125 | 95 | − 30 | − 80 | − 5.33 |

* Tracking Signal = $\dfrac{\text{Cumulative Deviation}}{\text{MAD}}$

29.

· Average daily production

$$= \frac{500}{(19 + 22 + 20 + 21)} = 6.1 \text{ units}$$

· Production for each months
  - Month 1 : 6.1 units × 19 = 115.9 units
  - Month 2 : 6.1 units × 22 = 134.2 units
  - Month 3 : 6.1 units × 20 = 122 units
  - Month 4 : 6.1 units × 21 = 128.1 units

**Part 3. Sales & Operations Planning.**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| C | A | B | B | B | A | | | | |

7.  · Ending backlog =  opening backlog + forecast demand - production

=  400 + 600 - 800  = 200 units.

8.

| Period | | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|
| Forecast Demand | | 100 | 120 | 130 | 140 | 120 | 110 | |
| Planned Production | | 125 | 125 | 125 | 125 | 125 | 125 | |
| Planned Inventory | 100 | 125 | 130 | 125 | 110 | 115 | 130 | |

9.

| Period | | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|---|
| Forecast Demand | | 600 | 700 | 700 | 700 | 600 | 500 | |
| Planned Production | | 700 | 700 | 700 | 700 | 700 | 700 | |
| Projected Backlog | 800 | 700 | 700 | 700 | 700 | 600 | 400 | |

10.

Production Plan.

| Quarter | | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|
| Forecast Sales | | 220 | 300 | 200 | 200 | |
| Projected Available | 270 | 250 | 150 | 150 | 150 | |
| Production Plan | | 200 | 200 | 200 | 200 | |

**Mailbox A.** (Lot size = 200)

| Quarter | | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|
| Forecast Sales | | 120 | 180 | 100 | 120 | |
| Projected Available | 120 | 0 | 20 | 120 | 0 | |
| MPS | | | 200 | 200 | | |

**Mailbox B.** (Lot size = 200)

| Quarter | | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|
| Forecast Sales | | 100 | 120 | 100 | 80 | |
| Projected Available | 150 | 250 | 130 | 30 | 150 | |
| MPS | | 200 | | | 200 | |

## Part 4. Master Scheduling.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| C | D | D | B | D | A | B | B | A | B |

| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| B | A | C | A | B | A | C | D | B | A |

21.

| Quarter | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Model A | 70×2.4 | 50×2.4 | 50×2.4 | 60×2.4 | 45×2.4 |
| Model B | 20×3.2 | 40×3.2 | 55×3.2 | 30×3.2 | 45×3.2 |
| Total Hours | 232 | 248 | 296 | 240 | 252 |

22.

· Total available capacity to week 3 = 260 × 3 = 780.
· Total required capacity to week 3 = 232 + 248 + 296 = 776.

· One of Alternatives.

| Quarter | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Model A | 70×2.4 | 51×2.4 | 49×2.4 | 60×2.4 | 45×2.4 |
| Model B | 28×3.2 | 43×3.2 | 44×3.2 | 30×3.2 | 45×3.2 |
| Total Hours | 257.6 | 260 | 258.4 | 240 | 252 |

23.

| Week | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Customer Order | 70 | 50 | 30 | 30 | 20 | |
| MPS | | 100 | | 100 | | 100 |
| ATP | 30 | 20 | | 50 | | 100 |

24.

| Week | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Forecast | 80 | 80 | 80 | 80 |
| Customer Order | 100 | 90 | 50 | 40 |
| PAB          160 | 60 | 170 | 90 | 10 |
| MPS | | 200 | | |
| ATP | 60 | 20 | | |