

Supply Chain Management, 6e (Chopra/Meindl)
Chapter 8 Aggregate Planning in a Supply Chain

8.1 True/False Questions

1) The goal of aggregate planning is to satisfy demand in a way that minimizes profit.

Answer: FALSE

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

2) *Aggregate planning* is a process by which a company determines levels of capacity, production, subcontracting, inventory, stockouts, and even pricing over a specified time horizon.

Answer: TRUE

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

3) Traditionally, much of aggregate planning is focused within an enterprise and may not always be seen as a part of supply chain management.

Answer: TRUE

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

4) Short-term production serves as a broad blueprint for operations and establishes the parameters within which aggregate planning decisions are made.

Answer: FALSE

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

5) The aggregate planning problem is concerned with determining the production level, inventory level, and capacity level (internal and outsourced) for each period that maximizes the firm's profit over the planning horizon.

Answer: TRUE

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

6) To create an aggregate plan, a company must specify the planning horizon for the plan and the duration of each period within the planning horizon.

Answer: TRUE

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

7) A planning horizon is usually between three and five years.

Answer: FALSE

Diff: 2

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

8) A poor aggregate plan may result in a large amount of excess inventory and capacity, thereby raising costs.

Answer: TRUE

Diff: 2

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

9) The aggregate planner must make a trade-off between capacity, inventory, and backlog costs.

Answer: TRUE

Diff: 2

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

10) Most strategies that an aggregate planner actually uses are in combination, and are referred to as hybrid strategies.

Answer: TRUE

Diff: 1

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

11) To improve the quality of aggregate plans, forecast errors must be taken into account when formulating aggregate plans.

Answer: TRUE

Diff: 2

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

12) Forecasting errors are dealt with in aggregate plans using either *safety backlog* or *safety capacity*.

Answer: FALSE

Diff: 2

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

13) *Safety inventory* is defined as inventory held to satisfy demand that is higher than forecasted.

Answer: FALSE

Diff: 1

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

14) *Safety capacity* is defined as capacity used to satisfy demand that is lower than forecasted.

Answer: FALSE

Diff: 1

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

15) Companies should work with downstream partners to produce forecasts and with upstream partners to determine constraints when doing aggregate planning.

Answer: TRUE

Diff: 1

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

16) Given that forecasts are always wrong to some degree, the aggregate plan needs to have some flexibility built into it if it is to be useful.

Answer: TRUE

Diff: 2

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

17) As inputs into the aggregate plan change, managers do not need to make changes to the aggregate plan.

Answer: FALSE

Diff: 1

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

18) As capacity utilization increases, it becomes less important to perform aggregate planning.

Answer: FALSE

Diff: 2

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

19) The goal of aggregate planning is to build a plan that satisfies demand while minimizing downtime.

Answer: FALSE

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

20) Linear programming finds the solution that creates the highest profit while satisfying the constraints that a company faces.

Answer: TRUE

Diff: 1

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

8.2 Multiple Choice Questions

1) The process by which a company determines levels of capacity, production, subcontracting, inventory, stockouts, and even pricing over a specified time horizon is

- A) aggregate planning.
- B) detail planning.
- C) inventory planning.
- D) sales planning.

Answer: A

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

2) The goal of aggregate planning is to

- A) dissatisfy customers in a way that maximizes profit.
- B) dissatisfy customers in a way that minimizes profit.
- C) satisfy demand in a way that maximizes profit.
- D) satisfy demand in a way that minimizes profit.

Answer: C

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

3) Aggregate planning solves problems involving

- A) aggregate decisions and stock keeping unit (SKU) level decisions.
- B) aggregate decisions or stock keeping unit (SKU) level decisions.
- C) aggregate decisions rather than stock keeping unit (SKU) level decisions.
- D) stock keeping unit (SKU) level decisions rather than aggregate decisions.

Answer: C

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

4) Aggregate planning, to be effective, requires inputs from

- A) all customers.
- B) all departments.
- C) all suppliers.
- D) throughout the supply chain.

Answer: D

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

5) Much of aggregate planning has traditionally been focused

- A) on short-term production scheduling.
- B) on customer relationship management.
- C) within an enterprise.
- D) beyond enterprise boundaries.

Answer: C

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

6) The operational parameter concerned with the number of units completed per unit time (such as per week or per month) is

- A) production rate.
- B) workforce.
- C) overtime.
- D) backlog.

Answer: A

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

7) The operational parameter concerned with the number of workers/units of capacity needed for production is

- A) production rate.
- B) workforce.
- C) overtime.
- D) backlog.

Answer: B

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

8) The operational parameter concerned with the planned inventory carried over the various periods in the planning horizon is

- A) production rate.
- B) overtime.
- C) backlog.
- D) inventory on hand.

Answer: D

Diff: 1

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

- 9) Aggregate planning is concerned with determining
- A) the production level, sales level, and capacity for each period.
 - B) the demand level, inventory level, and capacity for each period.
 - C) the production level, inventory level, and capacity for each period.
 - D) the production level, staffing level, and capacity for each period.

Answer: C

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

- 10) The planning horizon is
- A) the time period over which the aggregate plan is to produce a solution.
 - B) the duration of each time period in the aggregate plan.
 - C) the length of time required to produce the aggregate plan.
 - D) the solution to the aggregate plan.

Answer: A

Diff: 1

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

- 11) The length of the planning horizon is usually between
- A) one and three months.
 - B) three and eighteen months.
 - C) one and three years.
 - D) three and five years.

Answer: B

Diff: 2

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

- 12) An aggregate planner requires information on constraints. Which of the following is one of the typical constraints for an aggregate planner?

- A) Inventory holding cost
- B) Labor/machine hours required per unit
- C) Stockout or backlog cost
- D) Limits on overtime

Answer: D

Diff: 2

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

13) _____ is used to determine customer service levels.

- A) Inventory held
- B) Backlog/stockout quantity
- C) Workforce hired/laid off
- D) Machine capacity increase/decrease

Answer: B

Diff: 3

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

14) A poor aggregate plan can result in

- A) appropriate inventory levels.
- B) efficient use of capacity.
- C) better sales and lost profits.
- D) lost sales and lost profits.

Answer: D

Diff: 3

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

15) Aggregate planning should consider information from

- A) only the enterprise as its breadth of scope.
- B) downstream partners to produce forecasts.
- C) upstream partners to determine constraints.
- D) all of the above

Answer: D

Diff: 1

Topic: 8.2 The Aggregate Planning Problem

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

16) The fundamental trade-offs available to an aggregate planner are between

- A) capability, inventory, and backlog costs.
- B) capability, inventory, and sales costs.
- C) capacity, inventory, and backlog costs.
- D) capacity, inventory, and sales costs.

Answer: C

Diff: 1

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

17) The strategy where the production rate is synchronized with the demand rate by varying machine capacity or hiring and laying off employees as the demand rate varies is the

A) adjustable strategy.

B) chase strategy.

C) level strategy.

D) mixed strategy.

Answer: B

Diff: 2

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

18) The strategy where workforce (capacity) is kept stable but the number of hours worked is varied over time in an effort to synchronize production with demand is the

A) flexibility strategy.

B) chase strategy.

C) level strategy.

D) mixed strategy.

Answer: A

Diff: 2

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

19) The strategy where a stable machine capacity and workforce are maintained with a constant output rate, with inventory levels fluctuating over time, is the

A) adjustable strategy.

B) chase strategy.

C) level strategy.

D) mixed strategy.

Answer: C

Diff: 3

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

20) Demand is forecast for the next five months as 200, 300, 500, 300, 200. The production planner decides to adopt a level strategy, so over the next five months they should produce

- A) 200, 300, 500, 300, 200.
- B) 500, 400, 300, 200, 100.
- C) 100, 200, 300, 400, 500.
- D) 300, 300, 300, 300, 300.

Answer: D

Diff: 3

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

21) Demand is forecast for the next five months as 200, 300, 500, 300, 200. The production planner decides to adopt a chase strategy, so over the next five months they should produce

- A) 200, 300, 500, 300, 200.
- B) 500, 400, 300, 200, 100.
- C) 100, 200, 300, 400, 500.
- D) 300, 300, 300, 300, 300.

Answer: A

Diff: 2

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

22) Most strategies that an aggregate planner actually uses are in combination and are referred to as the

- A) adjustable strategy.
- B) chase strategy.
- C) level strategy.
- D) mixed strategy.

Answer: D

Diff: 1

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

23) A highly effective tool for a company to use when it tries to maximize profits while being subjected to a series of constraints is

- A) aggregate programming.
- B) distribution programming.
- C) production programming.
- D) linear programming.

Answer: D

Diff: 2

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

Scenario 8.1 - Gang Aft Agley

Gang Aft Agley, a manufacturing company, faces the aggregate planning problem shown in the table below. Cost of regular production is \$5 per unit, the cost of producing the same unit on overtime is \$7.50, the cost of subcontracting is \$9 per unit, and the cost of carrying a unit in inventory from one month to the next is \$2.

	January	February	March	April	May
Forecast	500	750	1200	650	300
Beginning Inventory	100				
Regular Time					
Overtime					
Subcontracting					
Ending Inventory					

The labor contract at the plant prohibits both overtime and subcontracting output to exceed 300 units in any five month window. The plant capacity is 600 units per month produced using two shifts, regardless of the number of days in a month. By policy, management wants to avoid stockouts.

24) Use the information from Scenario 8.1 to determine the number of decision variables in this scenario.

- A) 10
- B) 15
- C) 20
- D) 24

Answer: A

Diff: 2

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

25) Use the information from Scenario 8.1 to determine the number of constraints in this scenario.

- A) 12
- B) 15
- C) 20
- D) 24

Answer: A

Diff: 2

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

26) Use the information from Scenario 8.1 to determine the objective function for this scenario.

- A) $\text{Max Output} = \sum \text{Regular} + \sum \text{Overtime} + \sum \text{Subcontracting}$
- B) $\text{Max Profit} = \sum \text{Revenue} - \$5 \sum \text{Regular} - \$7.5 \sum \text{Overtime} - \$9 \sum \text{Subcontracting} - \$2 \sum \text{Ending Inventory}$
- C) $\text{Min Cost} = \$5 \sum \text{Regular} + \$7.5 \sum \text{Overtime} + \$9 \sum \text{Subcontracting} + \$2 \sum \text{Ending Inventory}$
- D) $\text{Min Output} = \sum \text{Overtime} + \sum \text{Subcontracting}$

Answer: C

Diff: 2

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

27) Which of these is a constraint that is appropriate for Scenario 8.1?

- A) $\sum \text{Output} \geq 680$
- B) $\sum \text{Ending Inventory} \leq 0$
- C) $\sum \text{Subcontracting} + \sum \text{Overtime} \leq 300$
- D) $\sum \text{Subcontracting} \leq 300$

Answer: D

Diff: 2

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

28) Which of these statements about Scenario 8.1 is evident without even developing an aggregate plan?

- A) Some overtime will be needed.
- B) Ending inventory must be negative.
- C) Overtime must exceed subcontracting.
- D) Subcontracting must exceed regular time output.

Answer: A

Diff: 2

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

29) What is the optimal total cost of the aggregate plan developed to address Scenario 8.1?

- A) \$16,700
- B) \$18,950
- C) \$18,450
- D) \$16,250

Answer: B

Diff: 3

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

Scenario 8.2 - Willow

A company faces the aggregate planning problem shown in the table below. Cost of regular production is \$8 per unit, the cost of producing the same unit on overtime is \$15, the cost of subcontracting is \$12 per unit, and the cost of carrying a unit in inventory from one month to the next is \$6.

	January	February	March	April	May
Forecast	400	800	1200	700	300
Beginning Inventory	100				
Regular Time					
Overtime					
Subcontracting					
Ending Inventory					

The labor contract at the plant prohibits both overtime and subcontracting output to exceed 400 units in any five month window. The plant capacity is 20 units per day produced using two shifts and the plant runs seven days a week. By policy, management wants to avoid stockouts.

30) What is the optimal total cost of the aggregate plan developed to address Scenario 8.2?

- A) \$27,200
- B) \$20,960
- C) \$31,400
- D) \$26,600

Answer: C

Diff: 3

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

31) How many units are produced using overtime in the optimal aggregate plan developed to address Scenario 8.2?

- A) 360
- B) 200
- C) 400
- D) 280

Answer: D

Diff: 3

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

32) How many units are produced using overtime in the optimal aggregate plan developed to address Scenario 8.2?

- A) 360
- B) 200
- C) 400
- D) 280

Answer: D

Diff: 3

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

33) How many months does the regular time output exceed plant capacity in the optimal solution to Scenario 8.2?

- A) 0
- B) 1
- C) 2
- D) 3

Answer: A

Diff: 1

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

34) Without actually solving the aggregate planning problem, it is safe to conclude that in the optimal solution to Scenario 8.2,

- A) the total ending inventory will exceed the number of units made using overtime.
- B) the number of units made using subcontracting will exceed the number of units made using overtime.
- C) the number of units made using regular time will exceed the forecast.
- D) the number of units made using subcontracting will exceed the number of units made using regular time.

Answer: B

Diff: 1

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

- 35) When formulating aggregate plans,
A) forecast errors have no impact.
B) forecast errors must be taken into account.
C) forecast accuracy is assumed.
D) forecast accuracy is not a factor.

Answer: B

Diff: 2

Topic: 8.6 Aggregate Planning in Excel

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

- 36) Forecasting errors are dealt with using
A) safety backlog.
B) safety capacity.
C) safety inventory.
D) B and C only

Answer: D

Diff: 2

Topic: 8.6 Aggregate Planning in Excel

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

- 37) Inventory held to satisfy demand that is higher than forecasted is
A) safety backlog.
B) safety capacity.
C) safety inventory.
D) safety sales.

Answer: C

Diff: 1

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

- 38) Capacity used to satisfy demand that is higher than forecasted is
A) safety backlog.
B) safety capacity.
C) safety inventory.
D) safety sales.

Answer: B

Diff: 1

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

39) Which of the following is an approach a company can use to create a buffer for forecast error using safety inventory?

- A) Overtime
- B) Carry extra workforce permanently
- C) Build and carry extra inventories
- D) Subcontracting

Answer: A

Diff: 1

Topic: 8.6 Aggregate Planning in Excel

AACSB: Application of knowledge

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

40) What is the name of the plan that breaks apart the aggregate plan into distinct product families?

- A) Master production schedule
- B) Rough cut capacity plan
- C) SKU aggregate plan
- D) Process plan

Answer: B

Diff: 2

Topic: 8.7 Building a Rough Master Production Schedule

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

41) What information does a master production schedule provide that an aggregate plan does not?

- A) Expense information for the planning period
- B) Revenue information for the planning period
- C) Specific product family production information
- D) A specific machine schedule for each order

Answer: C

Diff: 2

Topic: 8.7 Building a Rough Master Production Schedule

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

42) The earliest IT supply chain products were

- A) aggregate planning modules.
- B) cloud-based.
- C) SaaS (software as a service).
- D) enterprise resource planning modules.

Answer: A

Diff: 2

Topic: 8.7 Building a Rough Master Production Schedule

AACSB: Application of knowledge

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

43) Advanced planning systems for aggregate planning rely heavily on _____ to deliver their full potential.

- A) forecasting
- B) the supply chain
- C) constraints
- D) data accuracy

Answer: D

Diff: 2

Topic: 8.8 The Role of IT in Aggregate Planning

AACSB: Information technology

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

44) Which of these software vendors offer advanced planning systems?

- A) SAP
- B) Solver
- C) Excel
- D) Google

Answer: A

Diff: 2

Topic: 8.8 The Role of IT in Aggregate Planning

AACSB: Information technology

Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

45) The quality of the aggregate plan can be improved by using information from

- A) only the local firm.
- B) only downstream partners.
- C) only upstream partners.
- D) all parts of the supply chain.

Answer: D

Diff: 2

Topic: 8.9 Implementing Aggregate Planning in Practice

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

46) The quality of the forecast can be improved by using information from

- A) the focal firm.
- B) downstream partners.
- C) upstream partners.
- D) competing supply chains.

Answer: B

Diff: 2

Topic: 8.9 Implementing Aggregate Planning in Practice

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

47) The aggregate plan should be communicated to

- A) only the local firm.
- B) only downstream partners.
- C) only upstream partners.
- D) all supply chain partners who will be affected by it.

Answer: D

Diff: 2

Topic: 8.9 Implementing Aggregate Planning in Practice

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

48) The aggregate plan needs to

- A) be a final product because changes are disruptive to the supply chain.
- B) be considered fixed because forecasts are usually accurate.
- C) have some flexibility built into it because forecasts are always wrong.
- D) have some flexibility built into it because forecasts are usually right.

Answer: C

Diff: 2

Topic: 8.9 Implementing Aggregate Planning in Practice

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

49) How frequently should the aggregate plan be rerun?

- A) Weekly
- B) Monthly
- C) Every 3 to 8 months
- D) As inputs to the aggregate plan change

Answer: D

Diff: 3

Topic: 8.9 Implementing Aggregate Planning in Practice

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

- 50) As capacity utilization increases,
A) it becomes less important to perform aggregate planning.
B) it becomes more important to perform aggregate planning.
C) it does not affect the importance of performing aggregate planning.
D) it lessens the importance of aggregate planning.

Answer: B

Diff: 2

Topic: 8.9 Implementing Aggregate Planning in Practice

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

8.3 Essay Questions

- 1) Discuss the primary objective and operational parameters of aggregate planning.

Answer: The goal of aggregate planning is to satisfy demand in a way that maximizes profit.

Aggregate planning is a process by which a company determines levels of capacity, production, subcontracting, inventory, stockouts, and even pricing over a specified time horizon. The aggregate planner's main objective is to identify the following operational parameters over the specified time horizon:

- *Production rate*: the number of units completed per unit time (such as per week or per month).
- *Workforce*: the number of workers/units of capacity needed for production.
- *Overtime*: the amount of overtime production planned.
- *Machine capacity level*: the number of units of machine capacity needed for production.
- *Subcontracting*: the subcontracted capacity required over the planning horizon.
- *Backlog*: demand not satisfied in the period in which it arises but carried over to future periods.
- *Inventory on hand*: the planned inventory carried over the various periods in the planning horizon.

The aggregate plan serves as a broad blueprint for operations and establishes the parameters within which short-term production and distribution decisions are made. The aggregate plan allows the supply chain to alter capacity allocations and change supply contracts.

Diff: 2

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

AACSB: Application of knowledge

Objective: LO 8.1: Understand the importance of aggregate planning as a supply chain activity.

2) Discuss the information required for aggregate planning.

Answer: An aggregate planner requires the following information:

- Demand forecast F_t for each Period t in the planning horizon that extends over T periods
- Production costs
- Labor costs, regular time (\$/hour), and overtime costs (\$/hour)
- Cost of subcontracting production (\$/unit or \$/hour)
- Cost of changing capacity; specifically, cost of hiring/laying off workforce (\$/worker) and cost of adding or reducing machine capacity (\$/machine)
- Labor/machine hours required per unit
- Inventory holding cost (\$/unit/period)
- Stockout or backlog cost (\$/unit/period)
- Constraints:
- Limits on overtime
- Limits on layoffs
- Limits on capital available
- Limits on stockouts and backlogs
- Constraints from suppliers to the enterprise

This information is used to create an aggregate plan that in turn helps a company make the following determinations:

- *Production quantity from regular time, overtime, and subcontracted time:* used to determine number of workers and supplier purchase levels.
- *Inventory held:* used to determine how much warehouse space and working capital is needed.
- *Backlog/stockout quantity:* used to determine what the customer service levels will be.
- *Workforce hired/laid off:* used to determine any labor issues that will be encountered.
- *Machine capacity increase/decrease:* used to determine if new production equipment needs to be purchased or idled.

The quality of an aggregate plan has a significant impact on the profitability of a firm. A poor aggregate plan can result in lost sales and lost profits if the available inventory and capacity are unable to meet demand. A poor aggregate plan may also result in a large amount of excess inventory and capacity, thereby raising costs. Therefore, aggregate planning is a very important tool in helping a supply chain maximize profitability.

Diff: 3

Topic: 8.1 The Role of Aggregate Planning in a Supply Chain

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Objective: LO 8.2: Describe the information needed to produce an aggregate plan and the outputs obtained.

3) Explain the basic strategies that an aggregate planner has available to balance the various costs and meet demand.

Answer: There are essentially three distinct aggregate planning strategies for achieving balance between these costs. These strategies involve trade-offs between capital investments, workforce size, work hours, inventory, and backlogs/lost sales. Most strategies that a planner actually uses are a combination of these three and are referred to as *mixed strategies*. The three strategies are as follows:

1. *Chase strategy—using capacity as the lever*: With this strategy, the production rate is synchronized with the demand rate by varying machine capacity or hiring and laying off employees as the demand rate varies. In practice, achieving this synchronization can be very problematic because of the difficulty in varying capacity and workforce on short notice. This strategy can be expensive to implement if the cost of varying machine or labor capacity over time is high. It can also have a significant negative impact on the morale of the workforce. The chase strategy results in low levels of inventory in the supply chain and high levels of change in capacity and workforce. It should be used when the cost of carrying inventory is very expensive and costs to change levels of machine and labor capacity are low.

2. *Time flexibility strategy—using utilization as the lever*: This strategy may be used if there is excess machine capacity (i.e., if machines are not used twenty four hours a day, seven days a week). In this case, the workforce (capacity) is kept stable but the number of hours worked is varied over time in an effort to synchronize production with demand. A planner can use variable amounts of overtime or a flexible schedule to achieve this synchronization. Although this strategy does require that the workforce be flexible, it avoids some of the problems associated with the chase strategy, most notably changing the size of the workforce. This strategy results in low levels of inventory but with lower average utilization. It should be used when inventory carrying costs are relatively high and machine capacity is relatively inexpensive.

3. *Level strategy—using inventory as the lever*: With this strategy, a stable machine capacity and workforce are maintained with a constant output rate. Shortages and surpluses result in inventory levels fluctuating over time. Here production is not synchronized with demand. Either inventories are built up in anticipation of future demand or backlogs are carried over from high-to low-demand periods. Employees benefit from stable working conditions. A drawback associated with this strategy is that large inventories may accumulate and customer orders may be delayed. This strategy keeps capacity and costs of changing capacity relatively low. It should be used when inventory carrying and backlog costs are relatively low.

Diff: 3

Topic: 8.3 Aggregate Planning Strategies

AACSB: Application of knowledge

Objective: LO 8.3: Explain the basic trade-offs to consider when creating an aggregate plan.

Scenario 8.1 - Gang Aft Agley

Gang Aft Agley, a manufacturing company, faces the aggregate planning problem shown in the table below. Cost of regular production is \$5 per unit, the cost of producing the same unit on overtime is \$7.50, the cost of subcontracting is \$9 per unit, and the cost of carrying a unit in inventory from one month to the next is \$2.

	January	February	March	April	May
Forecast	500	750	1200	650	300
Beginning Inventory	100				
Regular Time					
Overtime					
Subcontracting					
Ending Inventory					

The labor contract at the plant prohibits both overtime and subcontracting output to exceed 300 units in any five month window. The plant capacity is 600 units per month produced using two shifts, regardless of the number of days in a month. By policy, management wants to avoid stockouts.

4) Formulate the aggregate plan using linear programming.

Answer: Using the variables $R = \sum \text{regular production}$; $O = \sum \text{overtime production}$;

$S = \sum \text{subcontracted production}$; $I = \sum \text{average inventory}$; $EI = \text{ending inventory}$

Min Cost = $5R + 7.5O + 9S + 2I$

Subject to:

$O \leq 300$

$S \leq 300$

$EI_i \geq 0$ for all periods $i = 1$ to 5

$\text{regular production}_i \leq 600$ for all periods $i = 1$ to 5

Diff: 3

Topic: 8.5 Aggregate Planning Using Linear Programming

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

5) Formulate the aggregate plan using linear programming and solve it using Solver.

Answer: Using the variables $R = \sum \text{regular production}$; $O = \sum \text{overtime production}$;

$S = \sum \text{subcontracted production}$; $I = \sum \text{average inventory}$; $EI = \text{ending inventory}$

Min Cost = $5R + 7.5O + 9S + 2I$

Subject to:

$O \leq 300$

$S \leq 300$

$EI_i \geq 0$ for all periods $i = 1$ to 5

regular production $_i \leq 600$ for all periods $i = 1$ to 5

	January	February	March	April	May
Forecast	500	750	1200	650	300
Beginning Inventory	100	200	50	0	0
Regular Time	600	600	600	600	300
Overtime	0	0	250	50	0
Subcontracting	0	0	300	0	0
Ending Inventory	200	50	0	0	0

The total cost of this plan is \$18,950, with \$13,500 spent on regular production, \$2,250 on overtime production, \$2,700 on subcontracting, and \$500 on ending inventory charges.

Diff: 3

Topic: 8.6 Aggregate Planning in Excel

AACSB: Analytical thinking

Objective: LO 8.4: Formulate and solve basic aggregate planning problems using Microsoft Excel.

6) Discuss key issues to be considered when implementing aggregate planning.

Answer:

1. *Think beyond the enterprise to the entire supply chain.* Most aggregate planning done today takes only the enterprise as its breadth of scope. However, there are many factors outside the enterprise throughout the supply chain that can dramatically impact the optimal aggregate plan. Therefore, avoid the trap of only thinking about your enterprise when aggregate planning. Work with partners downstream to produce forecasts, with upstream partners to determine constraints, and with any other supply chain entities that can improve the quality of the inputs into the aggregate plan. As the plan is only as good as the quality of the inputs, using the supply chain to increase the quality of the inputs will greatly improve the quality of the aggregate plan. Also make sure to communicate the aggregate plan to all supply chain partners who will be affected by it.

2. *Make plans flexible because forecasts are always wrong.* Aggregate plans are based on forecasts of future demand. Given that these forecasts are always wrong to some degree, the aggregate plan needs to have some flexibility built into it if it is to be useful. By building flexibility into the plan, when future demand changes, or other changes occur, such as increases in costs, the plan can appropriately adjust to handle the new situation. A manager should perform sensitivity analysis on the inputs into an aggregate plan. Using sensitivity analysis on the inputs into the aggregate plan will enable the planner to choose the best solution for the range of possibilities that could occur.

3. *Rerun the aggregate plan as new data emerges.* Aggregate plans provide a map for the next three to eighteen months. This does not mean that a firm should only run aggregate plans once every three to eighteen months. As inputs into the aggregate plan change, managers should use the latest values of these inputs and rerun the aggregate plan. By using the latest inputs, the plan will avoid suboptimization based on old data and will produce a better solution. For instance, as new demand forecasts become available, aggregate plans should be reevaluated.

4. *Use aggregate planning as capacity utilization increases.* Surprisingly, many companies do not create aggregate plans and instead rely solely on orders from their distributors or warehouses to determine their production schedules. These orders are driven either by actual demand or through inventory management algorithms. If a company has no trouble efficiently meeting demand this way, then one could claim the lack of aggregate planning may not significantly harm the company. However, when utilization becomes high and capacity is an issue, relying on orders to set the production schedule can lead to capacity problems. When utilization is high, the likelihood of producing for all the orders as they arrive is very low. Planning needs to be done to best utilize the capacity to meet the forecasted demand. Therefore, as capacity utilization increases, it becomes more important to perform aggregate planning.

Diff: 3

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