

*Cost Accounting, Cdn. Ed., 7e (Horngren)*  
**Chapter 10 Analysis of Cost Behaviour**

10.1 Use standard mathematical notation to specify a cost function that can be graphed as a straight line.

1) A linear cost function is a function in which the graph of total costs versus a single cost driver forms a straight line, within the relevant range.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-1

2) When estimating linear cost functions, it is assumed that variations in total cost of a cost object cannot be explained by variations in a single cost driver.

Answer: FALSE

Explanation: Variations in the level of a single activity (the cost driver) explain the variations in the related total costs.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-1

3) A mixed cost has a fixed element.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-1

4) Correctly identifying the cost driver and separating fixed from variable costs are important inputs for many management decisions.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-1

5) When estimating a cost function, cost behavior can be approximated by a linear cost function within the relevant range.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-1

6) Which of the following is an equation of a variable cost function?

A)  $Y = ax + bx$

B)  $Y = a + bx$

C)  $Y = b$

D)  $Y = a$

E)  $Y = bx$

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-1

7) Which of the following describes the intercept in a linear cost function?

A) the component of fixed costs that, within the relevant range, does not vary with changes in the level of the cost driver

B) the component of fixed costs that, within the relevant range, does vary with changes in the level of the cost driver

C) the component of variable costs that, within the relevant range, does not vary with changes in the level of the cost driver

D) the component of variable costs that, within the relevant range, does vary with changes in the level of the cost driver

E) the sum of the components of both fixed and variable costs that, within the relevant range, do not vary with changes in the level of the cost driver

Answer: A

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-1

8) For April, the month just ended, the cost components to make tapes were \$2 per tape plus fixed costs of \$10,000. One thousand tapes were produced. For May the cost to make tapes will be \$2.20 per tape plus fixed costs of \$10,000. Fifteen hundred tapes are expected to be produced. What are the estimates for the intercept and slope coefficient for May, respectively?

A) \$2.00 and \$10,000.00

B) \$2.20 and \$10,000.00

C) \$10,000.00 and \$2.00

D) \$10,000.00 and \$2.20

E) \$22,000 and \$10,000

Answer: D

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-1

- 9) The cost function  $y = 1,000 + 5X$   
A) has a slope coefficient of 1,000.  
B) is curvilinear because of the  $5X$ .  
C) is a straight line.  
D) represents a fixed cost.  
E) is missing the slope coefficient.

Answer: C

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-1

10) Which of the following statements related to assumptions about estimating linear cost functions is TRUE?

- A) Variations in a single cost driver explain variations in total costs.  
B) A cost object is anything for which a separate measurement of costs is desired.  
C) A linear function approximates cost behaviour at all ranges of production.  
D) Correlation refers to the relationship between fixed and variable costs.  
E) The graph of total costs does not form a straight line within the relevant range because of variable costs.

Answer: A

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-1

11) Brandt Cheque Encoders employs 30 individuals. Ten employees are paid \$10 per hour for 173 hours a month and the rest are salaried employees paid \$6,000 a month. How would total costs of personnel be classified?

- A) variable and fixed  
B) a fixed cost within a relevant range  
C) a variable cost within a relevant range  
D) a mixed cost  
E) a fixed cost

Answer: D

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-1

12) For February, the cost components of a picture frame include \$0.25 for the glass, \$.65 for the wooden frame, and \$0.80 for assembly. The assembly desk and tools cost \$400. 1,000 frames are expected to be produced in the coming year. What cost function best represents these costs?

- A)  $y = 1.70 + 400X$
- B)  $y = 400 + 1.70X$
- C)  $y = 2.10 + 1,000X$
- D)  $y = .90 + 400X$
- E)  $y = 400 + 0.90X$

Answer: B

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-1

13) The cost components of a heater include \$35 for the compressor, \$12 for the sheet molded compound frame, and \$80 per unit for assembly. The factory machines and tools fixed cost is \$55,000. The company expects to produce 1,500 heaters in the coming year. What cost function best represents these costs?

- A)  $y = 1,500 + 127X$
- B)  $y = 1,500 + 55,000X$
- C)  $y = 55,000 + 1,500X$
- D)  $y = 55,000 + 127X$
- E)  $y = 55,080 + 47X$

Answer: D

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-1

14) Compute the estimated costs for each of the following equations assuming the following costs for July:

Fixed manufacturing cost	\$80,000
Variable cost per machine-hour	6
Number of hours used	2,000

In addition, state whether each is for a variable, fixed, or mixed cost.

- a. Total estimated costs = intercept
- b. Total estimated costs = constant
- c. Total estimated costs = constant + (slope  $\times$  cost driver)
- d. Total estimated costs = slope coefficient  $\times$  cost driver

In addition, state whether each is for a variable, fixed, or mixed cost.

Answer:

- a. fixed, \$80,000
- b. fixed, \$80,000
- c. mixed,  $\$80,000 + (\$6 \times 2,000) = \$92,000$
- d. variable,  $\$6 \times 2,000 = \$12,000$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-1

15) Compute the estimated costs for each of the following equations, assuming the following costs for July:

Fixed manufacturing cost	\$40,000
Variable cost per machine-hour	6
Number of hours used	1,000

In addition, state whether each is for a variable, fixed, or mixed cost.

- a. Total estimated costs = intercept
- b. Total estimated costs = constant
- c. Total estimated costs = constant + (slope  $\times$  cost driver)
- d. Total estimated costs = slope coefficient  $\times$  cost driver

Answer:

- a. fixed, \$40,000
- b. fixed, \$40,000
- c. mixed,  $\$40,000 + (\$6 \times 1,000) = \$46,000$
- d. variable,  $\$6 \times 1,000 = \$6,000$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-1

16) Write a linear cost function equation for each of the following conditions. Use y for estimated costs and X for activity of the cost driver.

- a. Direct manufacturing labour is \$20 per hour.
- b. Direct materials cost \$8.00 per cubic metre.
- c. Utilities have a minimum charge of \$2,000 plus a charge of \$0.05 per kilowatt hour.
- d. Factory supplies average \$10 per day plus \$1.00 for each machine-hour per day.
- e. Total manufacturing amortization includes \$5,000 for straight-line plant amortization plus machinery amortization of \$100 for each day operated.

Answer:

- a.  $y = \$20X$
- b.  $y = \$8X$
- c.  $y = \$2,000 + \$0.05X$
- d.  $y = \$10 + \$1X$
- e.  $y = \$5,000 + \$100X$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-1

17) Write a linear cost function equation for each of the following conditions. Use  $y$  for estimated costs and  $X$  for activity of the cost driver.

- a. Direct manufacturing labour is \$10 per hour.
- b. Direct materials cost \$9.20 per cubic yard.
- c. Utilities have a minimum charge of \$1,000, plus a charge of \$0.05 per kilowatt-hour.
- d. Machine operating costs include \$200,000 of machine depreciation per year, plus \$75 of utility costs for each day the machinery is in operation.

Answer:

- a.  $y = \$10X$
- b.  $y = \$9.20X$
- c.  $y = \$1,000 + \$0.05X$
- d.  $y = \$200,000 + \$75X$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-1

18) Write a linear cost function equation for each of the following conditions. Use  $y$  for estimated costs and  $X$  for activity of the cost driver.

- a. Direct materials cost is \$1.50 per kilogram.
- b. Direct labor cost is \$33.50 per hour.
- c. Auto rental has a fixed fee of \$150.00 per day plus \$1.00 per kilometre driven.
- d. Machine operating costs include \$700 of maintenance per month, and \$10.00 of coolant usage costs for each day the machinery is in operation.

Answer:

- a.  $y = \$1.50X$
- b.  $y = \$33.50X$
- c.  $y = \$150 + \$1.00X$
- d.  $y = \$700 + \$10X$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-1

19) Write a linear cost function equation for each of the following conditions. Use y for estimated costs and X for activity of the cost driver.

- a. Direct materials cost is \$.75 per kilogram.
- b. Direct labour cost is \$16.75 per hour.
- c. Auto rental has a fixed fee of \$75.00 per day plus \$.50 per kilometre driven.
- d. Machine operating costs include \$350 of maintenance per month, and \$5.00 of coolant usage costs for each day the machinery is in operation.

Answer:

- a.  $y = $.75X$
- b.  $y = \$16.75X$
- c.  $y = \$75 + \$0.50X$
- d.  $y = \$350 + \$5X$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-1

20) Describe the two assumptions upon which managers often estimate cost functions.

Answer: Managers often estimate cost functions based on two assumptions:

- 1. Variations in the level of a single activity (the cost driver) explain the variations in the related total costs.
- 2. Cost behaviour is approximated by a linear cost function within the relevant range. A relevant range is the range of the activity in which there is a relationship between total cost and the level of activity. For a linear cost function represented graphically, total cost versus the level of a single activity related to that cost is a straight line within the relevant range.

Diff: 2 Type: ES

Skill: Remember

Objective: LO 10-1

10.2 Explain the importance of causality in estimating cost functions.

- 1) A cause-and-effect relationship, relative to cost drivers and resulting costs, may develop because of physical relationships, contractual relationships, or implicit relationships.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-2

- 2) The selection of the best measure of benefit will depend upon the corresponding change in the cost pool.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-2

3) There is a homogeneous relationship between the individual cost items in the dependent variable pool and the cost driver when each activity whose costs are included in the dependent variable has the same cost driver.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-2

4) Managers should use past data to create a cost function and then use the exact information provided by that cost function to create the budgetary forecast for the next year.

Answer: FALSE

Explanation: Managers are interested in estimating past cost-behavior functions because the estimates can help them make more accurate cost predictions, or forecasts, about future costs. But better management decisions, cost predictions, and estimation of cost functions can be achieved only if managers correctly identify the factors that affect costs.

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-2

5) Which of the following statements regarding a linear cost function is TRUE?

A) When there are only fixed costs, total material costs increase as the number of units produced increases.

B) The slope coefficient of a mixed cost line intersects the vertical axis at zero.

C) The relationship between the cost driver and the fixed cost is represented by the cost-benefit relationship.

D) It is easier to identify a single measure of benefit in a more heterogeneous cost pool.

E) A linear cost function for manufacturing overhead can be graphed when there is a cause-and-effect relationship between the level of activity and the costs related to that level of activity.

Answer: E

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-2

6) Which of the following does NOT represent a cause-and-effect relationship?

A) Material costs increase as the number of units produced increases.

B) A company is charged 40 cents for each brochure printed and mailed.

C) Utility costs increase at the same time that insurance costs increase.

D) It makes sense that if a complex product has a large number of parts it will take longer to assemble than a simple product with fewer parts.

E) The amount of direct labour used.

Answer: C

Diff: 3 Type: MC

Skill: Understand

Objective: LO 10-2



7) Understanding the drivers of costs is crucially important for managing costs. Provide two causes that create a cause-and-effect relationship between a cost driver and a cost.

Answer: Any two of:

1. *A physical relationship between the level of activity and costs.*
2. *A contractual arrangement.*
3. *Knowledge of operations.* For example, when number of parts is used as the activity measure of ordering costs, a product with many parts will incur higher ordering costs than a product with few parts.

Diff: 2 Type: ES

Skill: Remember

Objective: LO 10-2

10.3 Understand the various methods of cost estimation.

1) The account analysis method estimates cost functions by classifying various cost accounts as variable, fixed, or mixed with respect to the identified level of activity.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-3

2) All of the following are approaches to cost estimation EXCEPT

- A) the account analysis method.
- B) the conference method.
- C) the flexible cost analysis method.
- D) the industrial engineering method.
- E) quantitative analysis.

Answer: C

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-3

3) Which of the following statements about the cost estimation methods is FALSE?

- A) With the conference method, the accuracy of the cost estimates largely depends on the accuracy and details of the inputs.
- B) The methods require more historical data than most quantitative analysis.
- C) The methods are not mutually exclusive.
- D) There are four methods generally used for cost estimation.
- E) Many organizations use a combination of the approaches.

Answer: B

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-3

- 4) The industrial-engineering method is
- A) for analyzing relationships between inputs and outputs in physical terms.
  - B) for significant costs which cannot be easily traced.
  - C) used only for governmental contracts which are cost plus based.
  - D) used with qualitative rather than quantitative information.
  - E) used with both qualitative and quantitative information.

Answer: A

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-3

- 5) The collection of information on costs and their drivers, gathered through observations and interviews, from departments within an organization is known as the
- A) account analysis method.
  - B) conference method.
  - C) industrial-engineering method.
  - D) quantitative analysis method.
  - E) departmental analysis method.

Answer: B

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-3

- 6) Which cost estimation method typically uses qualitative analysis rather than quantitative analysis?
- A) the account analysis method
  - B) the conference method
  - C) the industrial-engineering method
  - D) the quantitative analysis method
  - E) the departmental analysis method

Answer: A

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-3

- 7) Which cost estimation method would be described as a formal method to fit linear cost functions to past data observations?
- A) the account analysis method
  - B) the conference method
  - C) the industrial-engineering method
  - D) the quantitative analysis method
  - E) the departmental analysis method

Answer: D

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-3

*Answer the following question(s) using the information below.*

Penny's TV and Appliance Store is a small company that has the following information pertaining to current year operations.

Sales (2,000 televisions)	\$900,000
Cost of goods sold	400,000
Store manager's salary per year	70,000
Operating costs per year	157,000
Advertising and promotion per year	15,000
Commissions (4% of sales)	36,000

8) What was the Penny's TV variable cost per unit sold?

- A) \$18
- B) \$235
- C) \$339
- D) \$200
- E) \$218

Answer: E

Explanation: E)  $(\$400,000 + \$36,000)/2,000 = \$218$  per unit

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

9) What were total fixed costs at Penny's TV for the current year?

- A) \$242,000
- B) \$436,000
- C) \$678,000
- D) \$227,000
- E) \$278,000

Answer: A

Explanation: A)  $\$70,000 + \$157,000 + \$15,000 = \$242,000$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

10) What are the estimated total costs if Penny's expects to sell 3,000 units next year?

- A) \$896,000
- B) \$678,000
- C) \$1,259,000
- D) \$269,000
- E) \$542,000

Answer: A

Explanation: A)  $\$896,000 = \$70,000 + \$157,000 + \$15,000 + [(\$400,000 + \$36,000)/2,000] \times 3,000$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

11) Which cost estimation method is being used by Penny's TV and Appliance Store?

- A) the industrial engineering method
- B) the conference method
- C) the high-low method
- D) the quantitative analysis method
- E) the account analysis method

Answer: E

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-3

*Use the information below to answer the following question(s).*

Raymaster is a small computer software company which uses the account analysis method and has hired you to perform some management advisory services. The company sold 2,500 high quality payroll programs last year.

Cost of goods sold	\$600,000
Store manager's salary	80,000
Secretary's salary	40,000
Operating costs (Store)	120,000
Sales Personnel 4 employees	
Salary	\$29,000 each
Commissions of 15% of sales	?
Advertising and promotion per year	20,000
Sales	1,200,000

12) What is the variable cost per unit sold?

- A) \$180,000
- B) \$320
- C) \$312
- D) \$240
- E) \$72

Answer: C

Explanation: C)  $(\$600,000 / 2,500 \text{ units}) = \$240$

$(\$1,200,000 \times .15 = \$180,000 / 2,500 \text{ units} = \underline{72})$   
\$312

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

13) What is the total cost per unit sold?

- A) \$240.00
- B) \$288.00
- C) \$358.40
- D) \$362.40
- E) \$462.40

Answer: E

Explanation: E)  $y = a + bx$

$$y = [\$80,000 + \$40,000 + \$120,000 + \$29,000(4) + \$20,000] + (\$312 \times 2,500) = \$1,156,000$$

$$\text{cost per unit} = \$1,156,000 / 2,500 = \$462.40$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

14) What would be their estimated cost per unit if Raymaster expects to sell 2,000 units next year?

- A) \$300
- B) \$312
- C) \$370
- D) \$498
- E) \$500

Answer: E

$$\text{Explanation: E) } y = \$376,000 + (312 \times 2,000 \text{ units}) = \$1,000,000$$

$$\text{cost per unit} = \$1,000,000 / 2,000 = \$500 \text{ per unit}$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

15) What is the predicted indirect manufacturing labour cost if 160 machine-hours are budgeted and 170 are actually worked, assuming the estimated cost function is  $y = \$81.04 + 5.32x$ ?

- A) \$985.44
- B) \$932.24
- C) \$904.40
- D) \$851.20
- E) \$81.04

Answer: B

$$\text{Explanation: B) } y = \$81.04 + (\$5.32 \times 160) = \$932.24$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

*Answer the following question(s) using the information below:*

At the Todd Company, the cost of the personnel department has always been charged to the various departments based upon the number of employees. Recently, opinions gathered from the department managers indicated that the number of new hires might also be a predictor of personnel costs to be assigned. Total personnel costs are \$320,000.

<b>Cost Driver</b>	<b>Department <u>A</u></b>	<b>Department <u>B</u></b>	<b>Department <u>C</u></b>
Number of employees	30	270	100
Number of new hires	8	12	5

16) If the number of employees is considered the cost driver, what amount of personnel costs will be allocated to Department A?

- A) \$24,000
- B) \$10,667
- C) \$102,400
- D) \$40,000
- E) \$50,000

Answer: A

Explanation: A)  $[30/(30 + 270 + 100)] \times \$320,000 = \$24,000$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

17) If the number of new hires is considered the cost driver, what amount of personnel costs will be allocated to Department A?

- A) \$24,000
- B) \$10,667
- C) \$102,400
- D) \$40,000
- E) \$50,000

Answer: C

Explanation: C)  $[8/(8 + 12 + 5)] \times \$320,000 = \$102,400$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-3

18) The cost of the personnel department at the Miller Company has always been charged to the production departments based upon number of employees. Recently, opinions gathered from the department managers indicated that the number of new hires might also be a predictor of personnel costs to be assigned. Total personnel department costs are \$120,000.

	Department	Department	Department
<u>Cost Driver</u>	<u>A</u>	<u>B</u>	<u>C</u>
Number of employees	300	250	50
The number of new hires	15	25	10

Required:

Using the above data, prepare a report that contrasts the different amounts of personnel department cost that would be allocated to each of the production departments if the cost driver used is:

- number of employees.
- the number of new hires.
- Which cost estimation method is being used by Miller Company?

Answer:

	Department	Department	Department
<u>Cost Driver</u>	<u>A</u>	<u>B</u>	<u>C</u>
a. Number of employees	300/600 \$60,000	250/600 \$50,000	50/600 \$10,000
b. The number of new hires	15/50 \$36,000	25/50 \$60,000	10/50 \$24,000

- Miller Company is using the *conference method* for cost estimation.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-3

19) At the Christopher Company, the cost of the library and information centre has always been charged to the various departments based upon the number of employees. Recently, opinions gathered from the department managers indicated that the number of engineers might also be a predictor of personnel costs to be assigned. Total library and information costs are \$150,000.

	Department	Department	Department
<u>Cost Driver</u>	<u>A</u>	<u>B</u>	<u>C</u>
Number of employees	125	500	125
Number of engineers	0	75	25

Required:

Using the above data, prepare a report that contrasts the different amounts of the library and information centre cost that would be allocated to each of the departments if the cost driver used is:

- number of employees.
- the number of engineers.
- Which cost estimation method is being used by Christopher Company?

Answer:

	Department	Department	Department
<u>Cost Driver</u>	<u>A</u>	<u>B</u>	<u>C</u>
a. Number of employees	125/750 \$25,000	500/750 \$100,000	125/750 \$25,000
b. The number of new hires	0/100 \$ 0	75/100 \$112,500	25/100 \$37,500

- Miller Company is using the *conference method* for cost estimation.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-3

20) Miller's Good Value Appliance Store is a small company that has hired you to perform some management advisory services. The following information pertains to 2016 operations.

Sales (5,000 microwave ovens)	\$1,350,000
Cost of goods sold	540,000
Store manager's salary per year	75,000
Operating costs per year	225,000
Advertising and promotion per year	25,000
Commissions (4% of sales)	67,500

Required:

Determine the operating costs using the account analysis method if Miller's expects to sell 6,500 units next year.

Answer:  $\$1,114,750 = (\$75,000 + \$225,000 + 25,000) + [(\$540,000 + \$67,500)/5000] \times 6,500$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-3



21) Munir Hassan, controller, gathered data on overhead costs and direct labour-hours over the past 12 months. List and discuss the different approaches Munir can use to estimate a cost function for overhead costs using direct labour-hours as the cost driver.

Answer: The four approaches to cost estimation are:

1. Industrial engineering method
2. Conference method
3. Account analysis method
4. Quantitative analysis of current or past cost relationships

The industrial engineering method, also called the work-measurement method, estimates cost functions by analyzing the relationship between inputs and outputs in physical terms.

The conference method estimates cost functions on the basis of analysis and opinions about costs and their drivers gathered from various departments of an organization (purchasing, process engineering, manufacturing, employee relations, etc.).

The account analysis method estimates cost functions by classifying cost accounts in the ledger as variable, fixed, or mixed with respect to the identified cost driver.

Quantitative analysis of cost relationships are formal methods, such as the high-low method or regression, to fit linear cost functions to past data observations.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-3

10.4 Outline the steps in estimating a cost function.

1) There is poor *goodness of fit* if the predicted values do not match actual cost observation.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-4

2) Cross-sectional data pertain to the same entity over successive past periods.

Answer: FALSE

Explanation: *Time-series data* pertain to the same entity (organization, plant, activity, and so on) over successive past periods.

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-4

3) The advantage of the high-low method when compared to regression analysis is that it considers multiple data points.

Answer: FALSE

Explanation: The disadvantage of the high-low method is that it ignores information from all but two observations when estimating the cost function.

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-4

4) For cost estimation purposes data must be collected using both time-series data and cross-sectional data.

Answer: FALSE

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-4

5) Time-series data analysis includes

A) using a variety of time periods to measure the independent variable.

B) using the highest and lowest observation.

C) observing different entities during the same time period.

D) comparing information in different cost pools.

E) analyzing cost drivers at different levels of production.

Answer: A

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-4

6) Cross-sectional data analysis includes

A) using a variety of time periods to measure the dependent variable.

B) using the highest and lowest observation.

C) analyzing different cost drivers.

D) comparing information in different cost pools.

E) observing different entities during the same time period.

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-4

Use the information below to answer the following question(s).

Presented below is the production data for the last six months of the year for the mixed costs incurred by Wagner Company.

<u>Month</u>	<u>Cost</u>	<u>Units</u>
July	\$24,450	8,200
August	20,120	6,400
September	32,400	10,600
October	44,200	15,000
November	29,000	9,600
December	36,680	13,200

7) Using the high-low method, the cost function would be stated as

A)  $y = \$2,200 + \$2.80x$ .

B)  $y = \$17,816 + \$0.36x$ .

C)  $y = \$536 + \$3.06x$ .

D)  $y = \$24,450 + \$0.33x$ .

E)  $y = \$39,250 + \$0.33x$ .

Answer: A

Explanation: A)  $b = (\$44,200 - \$20,120) / (15,000 - 6,400) = \$2.80$

$$\$44,200 = a + \$2.80 (15,000)$$

$$\$2,200 = a$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

8) The total cost at an operating level of 10,000 units would be

A) \$31,136.

B) \$30,200.

C) \$21,416.

D) \$42,550.

E) \$46,625.

Answer: B

Explanation: B)  $y = \$2,200 + \$2.80x$

$$y = \$2,200 + \$2.80(10,000)$$

$$y = \$30,200$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

Use the information below to answer the following question(s).

The Skip Corporation has assembled the following data pertaining to certain costs which cannot be easily identified as either fixed or variable. Skip Corporation has heard about a method of measuring cost functions called the high-low method and has decided to use it in this situation.

<u>Cost</u>	<u>Hours</u>
\$20,000	7,000
12,200	4,000
17,000	5,200
15,640	4,900
18,200	6,000
22,080	7,800
21,200	7,480
18,600	6,760

9) The cost function would be stated as

A)  $y = \$13,386 + \$0.46x$ .

B)  $y = \$10,680 + \$0.38x$ .

C)  $y = \$5,056 + \$2.16x$ .

D)  $y = \$1,800 + \$2.16x$ .

E)  $y = \$1,800 + \$2.60x$ .

Answer: E

Explanation: E)  $b = (\$22,080 - \$12,200) / (7,800 - 4,000) = \$2.60$

$$\$22,080 = a + \$2.60 (7,800)$$

$$\$1,800 = a$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

10) The total cost at an operating level of 2,850 hours would be

A) \$19,210.

B) \$11,763.

C) \$14,697.

D) \$11,212.

E) \$9,210.

Answer: E

Explanation: E)  $y = \$1,800 + \$2.60x$

$$y = \$1,800 + \$2.60(2,850)$$

$$y = \$9,210$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

Use the information below to answer the following question(s).

The Monroe Company uses the high-low method to estimate the cost function. The information for the current year is provided below.

	Machine <u>Hours</u>	Labour <u>Costs</u>
Highest observation of cost driver	240	\$4,000
Lowest observation of cost driver	110	2,960

11) What is Monroe Company's slope coefficient per machine hour?

- A) \$26.91
- B) \$18.00
- C) \$16.67
- D) \$10.00
- E) \$8.00

Answer: E

Explanation: E) Slope =  $(\$4,000 - \$2,960) / (240 - 110) = \$8.00$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

12) What is the constant for the estimating cost equation?

- A) \$2,080
- B) \$2,960
- C) \$3,970
- D) \$4,000
- E) \$8,000

Answer: A

Explanation: A) EITHER: Constant =  $\$4,000 - (\$8.00 \times 240 \text{ hours}) = \$2,080$

OR: Constant =  $\$2,960 - (\$8.00 \times 110 \text{ hours}) = \$2,080$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

13) What is the estimate of Monroe's cost function when 200 machine hours are used?

- A) \$1,840.00
- B) \$1,997.50
- C) \$2,280.00
- D) \$3,333.33
- E) \$3,680.00

Answer: E

Explanation: E)  $y = \$2,080 + (\$8 \times 200) = \$3,680$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

*Use the information below to answer the following question(s).*

At the high point of the relevant range, labour hours at Bradco Restoration were 10,000 and wages were \$22,500. At the low point of the relevant range, labour hours were 7,500 and wages were \$17,500.

14) Using the high-low method determine the slope coefficient per labour hour at Bradco Restoration?

- A) \$5.25
- B) \$4.00
- C) \$2.00
- D) \$0.50
- E) \$0.25

Answer: C

Explanation: C) Slope =  $(\$22,500 - \$17,500) / (10,000 - 7,500) = \$2.00$  per labour hour

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

15) Using the high-low method determine the constant at Bradco Restoration?

- A) \$17,500
- B) \$13,750
- C) \$2,500
- D) \$1,250
- E) \$750

Answer: C

Explanation: C) EITHER: Constant =  $\$22,500 - (\$2 \times 10,000) = \$2,500$

OR: Constant =  $\$17,500 - (\$2 \times 7,500) = \$2,500$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

16) What is the high-low estimate of the labour costs at Bradco Restoration when 8,000 hours are used?

- A) \$21,500
- B) \$18,500
- C) \$17,750
- D) \$17,250
- E) \$17,125

Answer: B

Explanation: B)  $y = \$2,500 + (\$2 \times 8,000) = \$18,500$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

- 17) When using the high-low method, the denominator in the equation that determines the slope is the
- A) dependent variable.
  - B) independent variable.
  - C) difference between the high and low observations of the cost driver.
  - D) difference between the high and low observations of the dependent variables.
  - E) the intercept.

Answer: C

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-4

- 18) When using the high-low method, the two observations used are the high and low observations of the
- A) cost driver.
  - B) dependent variables.
  - C) outliers.
  - D) mixed costs.
  - E) total pool cost.

Answer: A

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-4

*Answer the following question(s) using the information below.*

The Taranto Company uses the high-low method to estimate its cost function. The information for the current year is provided below:

	Machine-hours	Costs
Highest observation of cost driver	2,000	\$225,000
Lowest observation of cost driver	1,000	\$125,000

- 19) What is the slope coefficient per machine-hour?

- A) \$125.00
- B) \$12.50
- C) \$10.00
- D) \$100.00
- E) \$0.50

Answer: D

Explanation: D) Slope =  $(\$225,000 - \$125,000) / (2,000 - 1,000) = \$100$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

20) What is the constant for the estimating cost equation?

- A) \$125,000
- B) \$225,000
- C) \$25,000
- D) \$0
- E) \$12,500

Answer: C

Explanation: C) EITHER: Constant =  $\$225,000 - (\$100.00 \times 2,000 \text{ hours}) = \$25,000$

OR: Constant =  $\$125,000 - (\$100.00 \times 1,000 \text{ hours}) = \$25,000$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

21) What is the estimate of the total cost when 1,100 machine-hours are used?

- A) \$125,000
- B) \$135,000
- C) \$150,000
- D) \$200,000
- E) \$136,000

Answer: B

Explanation: B)  $y = \$25,000 + (\$100 \times 1,100) = \$135,000$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4



Use the information below to answer the following question(s).

The Barnett Company has assembled the following data pertaining to certain costs that cannot be easily identified as either fixed or variable. Barnett Company has heard about a method of measuring cost functions called the high-low method and has decided to use it in this situation.

<u>Cost</u>	<u>Hours</u>
\$24,900	5,250
24,000	5,500
36,400	7,500
44,160	9,750
45,000	9,500

22) What is the cost function derived from using the high-low method?

A)  $y = \$43,191 + \$0.19x$

B)  $y = \$4,875 + \$4.28x$

C)  $y = \$41,900 + \$0.23x$

D)  $y = \$2,430 + \$4.28x$

E)  $y = -\$4,875 + \$5.25x$

Answer: D

Explanation: D)  $b = (\$44,160 - \$24,900) / (9,750 - 5,250) = \$4.28$  for the highest and lowest values of the cost driver

$$\$44,160 = a + (\$4.28 \times 9,750)$$

$$a = \$2,430$$

Cost function is  $y = \$2,430 + \$4.28x$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

23) What is the estimated total cost at an operating level of 8,000 hours?

A) \$39,115

B) \$36,670

C) \$44,711

D) \$43,470

E) \$37,125

Answer: B

Explanation: B)  $b = (\$44,160 - \$24,900) / (9,750 - 5,250) = \$4.28$  for the highest and lowest values of the cost driver

$$\$44,160 = a + (\$4.28 \times 9,750)$$

$$a = \$2,430$$

Cost function is  $y = \$2,430 + \$4.28x$

$$\$36,670 = \$2,430 + (\$4.28 \times 8,000)$$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-4

24) The managers of the production department have decided to use the production levels of 2013 and 2016 as examples of the highest and lowest years of operating levels. During 2013 the department used 280,000 litres of chemicals and during 2016 it used 240,000 litres. The department's costs for 2013 were \$460,000, but only \$400,000 in 2016.

Required:

Using the high-low method determine the cost estimating equation for the department if litres of direct material are used as the cost driver?

$$\begin{aligned}\text{Answer: Slope (variable cost)} &= (\$460,000 - \$400,000)/(280,000 - 240,000) \\ &= \$60,000/40,000 \\ &= \$1.50\end{aligned}$$

$$\begin{aligned}\text{Constant (fixed cost)} &= \$400,000 - \$1.50(240,000) \\ &= \$40,000\end{aligned}$$

$$\text{Estimating equation} = \$40,000 + \$1.50D$$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

25) Cari's Locker Service ran its freezer in January, a slow month, for 200 hours for a total cost of \$60,000. In June, a peak month, the freezer ran for 1,000 hours for a total cost of \$92,000.

Required:

Using the high-low method determine the average cost of running the machine one hour in a month were the freezer ran for 800 hours?

$$\begin{aligned}\text{Answer: Slope (variable costs)} &= (\$92,000 - \$60,000)/(1,000 - 200) \\ &= \$32,000/800 \text{ hours} \\ &= \$40\end{aligned}$$

$$\text{Constant (fixed cost)} = \$92,000 - (1,000 \times \$40) = \$52,000$$

$$\text{Estimating equation} = \$52,000 + \$40D$$

$$\text{Total costs of 800 hours} = \$52,000 + \$40(800) = \$84,000$$

$$\text{Average cost at 800 hour level} = \$84,000/800 = \$105 \text{ per hour}$$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

26) A cost analyst collected the following information for the Machining Department:

<u>Observation</u>	<u>Machine-hours</u>	<u>Total Operating Costs</u>
July	8,000	\$60,000
August	9,200	66,000
September	7,600	61,000
October	8,800	64,000
November	9,000	65,000

Required:

- Determine the estimating cost function with machine-hours as the cost driver using the high-low method.
- If December's estimated machine-hours total 8,400, what is the estimated cost of the Machining Department?

Answer:

- $$\begin{aligned}\text{Slope coefficient} &= (\$66,000 - \$61,000) / (9,200 - 7,600) \\ &= \$5,000 / 1,600 \\ &= \$3.125 \text{ per machine-hour}\end{aligned}$$

$$\begin{aligned}\text{Constant} &= \$66,000 - (\$3.125 \times 9,200) \\ &= \$66,000 - \$28,750 \\ &= \$37,250\end{aligned}$$

Estimating equation =  $\$37,250 + \$3.125x$

- December's estimated costs =  $\$37,250 + \$3.125(8,400)$   
 $= \$63,500$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

27) Birch Canvas and Tarp manufactures canvas products in a highly automated assembly plant in Edmonton, Alberta. Their automated system is in its first year of operation, and management is still unsure of the best way to estimate the overhead costs of operations for budgetary purposes. For the first six months of operations the following data were collected:

<u>Observation</u>	<u>Machine-hours</u>	<u>Kilowatt-hours</u>	<u>Total Overhead Costs</u>
January	1,950	2,260,000	\$116,000
February	1,825	2,170,000	114,000
March	1,900	2,250,000	115,000
April	1,650	2,145,000	114,000
May	1,625	2,100,000	105,000
June	1,550	2,060,000	100,000

Required:

- Compute a cost estimating equation for each independent variable (machine-hours and kilowatt-hours) using the high-low method.
- For July the company ran the machines for 1,600 hours and used 2,075,000 kilowatt hours of power. The overhead costs totalled \$95,000. Which driver was the best predictor for July?

Answer:

a.

Machine-hours:

$$\begin{aligned}\text{Slope coefficient} &= (\$116,000 - \$100,000)/(1,950 - 1,550) \\ &= \$16,000/400 \\ &= \$40.00 \text{ per machine-hour}\end{aligned}$$

$$\begin{aligned}\text{Constant} &= \$116,000 - (\$40 \times 1,950) \\ &= \$38,000\end{aligned}$$

$$\text{Machine-hour estimating equation} = \$38,000 + \$40x$$

Kilowatt-hours:

$$\begin{aligned}\text{Slope coefficient} &= (\$116,000 - \$100,000)/(2,260,000 - 2,060,000) \\ &= \$16,000/200,000 \\ &= \$0.08 \text{ per kilowatt-hour}\end{aligned}$$

$$\begin{aligned}\text{Constant} &= \$116,000 - (\$0.08 \times 2,260,000) \\ &= \$(64,800)\end{aligned}$$

$$\text{Kilowatt-hour estimating equation} = -\$64,800 + \$0.08x$$

b.

July's estimated costs:

$$\text{with machine-hours} = \$38,000 + \$40(1,600) = \$102,000$$

$$\text{with kilowatt-hours} = -\$64,800 + \$0.08(2,075,000) = \$101,200$$

The best estimator for July was the kilowatt-hour cost driver.

Diff: 3 Type: ES

Skill: Apply

Objective: LO 10-4

28) Tessmer Manufacturing Company produces inventory in a highly automated assembly plant in Windsor, Ontario. The automated system is in its first year of operation and management is still unsure of the best way to estimate the overhead costs of operations for budgetary purposes. For the first six months of operations, the following data were collected:

	<u>Machine-hours</u>	<u>Kilowatt-hours</u>	<u>Total Overhead Costs</u>
January	3,800	4,520,000	\$138,000
February	3,650	4,340,000	136,800
March	3,900	4,500,000	139,200
April	3,300	4,290,000	136,800
May	3,250	4,200,000	126,000
June	3,100	4,120,000	120,000

Required:

- Use the high-low method to determine the estimating cost function with machine-hours as the cost driver.
- Use the high-low method to determine the estimating cost function with kilowatt-hours as the cost driver.
- For July, the company ran the machines for 3,150 hours and used 4,180,000 kilowatt-hours of power. The overhead costs totaled \$114,000. Which cost driver was the best predictor for July?

Answer:

- Machine-hours:

$$\begin{aligned}\text{Slope coefficient} &= (\$139,200 - \$120,000) / (3,900 - 3,100) \\ &= \$24.00 \text{ per machine-hour} \\ \text{Constant} &= \$139,200 - (\$24 \times 3,900) = \$45,600 \\ \text{Machine-hour estimating equation} &= \$45,600 + \$24X\end{aligned}$$

- Kilowatt-hours:

$$\begin{aligned}\text{Slope coefficient} &= (\$138,000 - \$120,000) / (4,520,000 - 4,120,000) \\ &= \$0.045 \text{ per kilowatt-hour} \\ \text{Constant} &= \$138,000 - (\$0.045 \times 4,520,000) = -\$65,400 \\ \text{Kilowatt-hour estimating equation} &= -\$65,400 + \$0.045\text{KWH}\end{aligned}$$

- July's estimated costs:

$$\begin{aligned}\text{with machine-hours} &= \$45,600 + (\$24 \times 3,150) = \$121,200 \\ \text{with kilowatt-hours} &= -\$65,400 + (\$0.045 \times 4,180,000) = \$122,700\end{aligned}$$

The best estimator for July was the machine-hour cost driver.

Diff: 3 Type: ES

Skill: Apply

Objective: LO 10-4

29) The Wildcat Company has provided the following information for the factory overhead cost pool:

<u>Units of Output</u>	<u>30,000 Units</u>	<u>42,000 Units</u>
Indirect materials	\$180,000	\$252,000
Indirect labour	1,080,000	1,512,000
Supervisors' salaries	312,000	312,000
Equipment depreciation	151,200	151,200
Maintenance	81,600	110,400
Utilities	<u>384,000</u>	<u>528,000</u>
Total	<u>\$2,188,800</u>	<u>\$2,865,600</u>

Required:

Using the high-low method and the information provided above,

- identify the linear cost function equation and
- estimate the total cost at 36,000 units of output.

Answer:

a. Variable cost =  $(\$2,865,600 - \$2,188,800) / (42,000 - 30,000) = \$56.40$

Fixed cost =  $\$2,865,600 - (\$56.40 \times 42,000) = \$496,800$

Cost function is  $y = \$496,800 + \$56.40x$

b. Output level of 36,000 units =  $\$496,800 + (\$56.40 \times 36,000) = \$2,527,200$  total cost

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

30) Patrick Ross, the president of Ross's Wild Game Company, has asked for information about the cost behaviour of manufacturing overhead costs. Specifically, he wants to know how much overhead cost is fixed and how much is variable. The following data are the only records available:

<u>Month</u>	<u>Machine-hours</u>	<u>Overhead Costs</u>
February	1,700	\$20,500
March	2,800	22,250
April	1,000	19,950
May	2,500	21,500
June	3,500	23,950

Required:

Using the high-low method, determine the overhead cost equation. Use machine-hours as your cost driver.

Answer: High: June	3,500	\$23,950
Low: April	<u>1,000</u>	<u>19,950</u>
Difference	2,500	\$4,000

Variable cost per MH:  $\$4,000 / 2,500 = \$1.60$  per MH

Fixed cost:  $\$19,950 = a + \$1.60 \times 1,000$   
 $a = \$18,350$

Estimated cost equation:  $y = \$18,350 + \$1.60x$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4



31) As part of his job as cost analyst, Max Thompson collected the following information concerning the operations of the Machining Department:

<u>Observation</u>	<u>Machine-hours</u>	<u>Total Operating Costs</u>
January	4,000	\$45,000
February	4,600	49,500
March	3,800	45,750
April	4,400	48,000
May	4,500	49,800

Required:

- Use the high-low method to determine the estimating cost function with machine-hours as the cost driver.
- If June's estimated machine-hours total 4,200, what are the total estimated costs of the Machining Department?

Answer:

- Slope coefficient =  $(\$49,500 - \$45,750) / (4,600 - 3,800) = \$4.6875$  per machine-hour

$$\text{Constant} = \$49,500 - (\$4.6875 \times 4,600) = \$27,937.50$$

$$\text{Estimating equation} = \$27,937.50 + \$4.6875x$$

- June's estimated costs =  $\$27,937.50 + \$4.6875 \times 4,200 = \$47,625$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

32) Wimmer's Storage ran its freezer in February, a slow month, for 360 hours for a total cost of \$57,600. In July, a peak month, the freezer ran for 720 hours for a total cost of \$82,080.

Required:

- Using the high-low method, determine the overhead cost equation for the department if hours of freezer use are used as the cost driver?
- What is the estimated total cost at an operating level of 500 hours?

Answer:

- Slope (variable costs) =  $(\$82,080 - \$57,600) / (720 - 360) = \$68$

$$\text{Constant (fixed cost)} = \$82,080 - (720 \times \$68) = \$33,120$$

$$\text{Estimating equation} = \$33,120 + \$68\text{DLH}$$

- Total costs of 500 hours =  $\$33,120 + \$68 \times 500 = \$67,120$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

33) The managers of the production department have decided to use the production levels of 2014 and 2016 as examples of the highest and lowest years of operating levels. Data for those years are as follows:

<u>Year</u>	<u>Chemicals used</u>	<u>Overhead Costs</u>
2014	140,000 litres	\$115,000
2016	120,000 litres	\$100,000

Required:

Using the high-low method, determine the overhead cost equation for the department if litres of chemicals are used as the cost driver?

Answer: Slope (variable cost) =  $(\$115,000 - \$100,000) / (140,000 - 120,000) = \$0.75$

Constant (fixed cost) =  $\$100,000 - \$0.75(120,000) = \$10,000$

Estimating equation =  $\$10,000 + \$0.75DM$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

34) Presented below are the production data for the first six months of the year for the mixed costs incurred by Gallup Company.

<u>Month</u>	<u>Cost</u>	<u>Units</u>
January	\$4,890	4,100
February	4,024	3,200
March	6,480	5,300
April	8,840	7,500
May	5,800	4,800
June	7,336	6,600

Required:

Using the high-low method determine the forecasted cost for July if the number of units produced is expected to be 5,000.

Answer:  $b = (\$8,840 - \$4,024) / (7,500 - 3,200) = \$1.12$

$\$8,840 = a + (\$1.12 \times 7,500)$

$a = \$440$

Cost function is  $y = \$440 + \$1.12x$

$y = \$440 + (\$1.12 \times 5,000 \text{ units}) = \$6,040$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

35) The Gangwere Company has assembled the following data pertaining to certain costs that cannot be easily identified as either fixed or variable. Gangwere Company has heard about a method of measuring cost functions called the high-low method and has decided to use it in this situation.

<u>Month</u>	<u>Cost</u>	<u>Hours</u>
January	\$40,000	3,500
February	24,400	2,000
March	31,280	2,450
April	36,400	3,000
May	44,160	3,900
June	42,400	3,740

Required:

Using the high-low method determine the forecasted cost for July if the number of hours used is expected to be 3,200.

Answer:  $b = (\$44,160 - \$24,400) / (3,900 - 2,000) = \$10.40$

$\$44,160 = a + \$10.40 \times 3,900$

$a = \$3,600$

$y = \$3,600 + (\$10.40 \times 3,200 \text{ hours}) = \$36,880$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-4

36) List and briefly describe the five steps in estimating a cost function using quantitative analysis.

Answer: **Step 1: Choose the dependent variable.** Choice of the **dependent variable** (the cost to be predicted and managed) will depend on the cost function being estimated.

**Step 2: Identify the independent variable, or cost driver.** The **independent variable** (level of activity or cost driver) is the factor used to predict the dependent variable (costs).

**Step 3: Collect data on the dependent variable and the cost driver.** This is usually the most difficult step in cost analysis. Cost analysts obtain data from company documents, from interviews with managers, and through special studies. These data may be time series data or cross-sectional data.

**Step 4: Plot the data.** The general relationship between the cost driver and costs can be readily observed in a graphical representation of the data, which is commonly called a plot of the data. The plot provides insight into the relevant range of the cost function, and reveals whether the relationship between the driver and costs is approximately linear.

**Step 5: Estimate the cost function and evaluate the cost driver of the estimated cost function.** The high—low method and regression analysis are the two most frequently described forms of quantitative analysis.

Diff: 2 Type: ES

Skill: Remember

Objective: LO 10-4

## 10.5 Explain nonlinear cost functions

1) An "economy of scale" function is an example of a linear cost function.

Answer: FALSE

Explanation: A nonlinear cost function is a cost function for which the graph of total costs is not a straight line within the relevant range. In an economy of scale situation, where there is a possibility of producing double the product for less than double the cost; the function would be nonlinear.

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-5

2) A step cost function is an example of a linear function.

Answer: FALSE

Explanation: A step cost function is a nonlinear cost function.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-5

3) A nonlinear cost function

A) has two constants and a single slope.

B) does not effectively describe the behaviour of outside the relevant range.

C) never describes the behaviour of costs in relation to the cost driver.

D) always describes the behaviour of costs in relation to the cost drivers.

E) means the relevant range cannot be determined for that cost.

Answer: B

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-5

4) Discuss the potential use of nonlinear curves in cost functions and cost analysis. Give some examples.

Answer: Cost functions are not always linear. A nonlinear cost function is a cost function for which the graph of total costs is not a straight line within the relevant range of operations. One example is a series of straight line segments that change their slopes at critical intersection points within the range of operation. Another example would be a step function. A step function is a function where the cost remains the same over various ranges of the level of activity, but the cost increases by discrete amounts (or steps) as the level of activity advances from one range to another. In addition to the examples mentioned above, there are situations where the cost or use of resources can be represented by a curve instead of a single straight line or a group of segmented straight lines. One example of a curve is a learning curve. A learning curve is a function that measures how labour-hours per unit decline as units of production increase because workers are learning and becoming better at their jobs.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-5

10.6 Describe the impact of time as a cost driver.

1) The customer response time reveals how quickly customers respond to a company's new products.

Answer: FALSE

Explanation: Customer-response time is the length of time between a customer placing an order for a product or service and the time the product or service is delivered to the customer.

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-6

2) Customer response time is the time between when a company first markets a new product, and when sales exceed supplies on hand (test inventory).

Answer: FALSE

Explanation: Customer-response time is the length of time between a customer placing an order for a product or service and the time the product or service is delivered to the customer.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

3) Uncertainty about when customers will demand a product or service is generally credited as being the primary cause of bottlenecks.

Answer: FALSE

Explanation: Bottlenecks due to limited capacity.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

4) Manufacturing lead time is a combination of order receipt time and order manufacturing time.

Answer: FALSE

Explanation: Manufacturing cycle time (also called manufacturing lead time ) is the length of time between receiving an order and producing a finished good; it is the sum of waiting time and manufacturing time for an order.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

5) Manufacturing lead times can affect costs but do not affect sales revenue.

Answer: FALSE

Explanation: Manufacturing cycle times affect both revenues and costs.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

6) Customer-response time is a measure of how long it takes for the customer to return a call.

Answer: FALSE

Explanation: Customer response time is how long it takes from the time a customer places an order for a product or service to the time the product or service is delivered to the customer.

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-6

7) Manufacturing lead time is the sum of waiting time and manufacturing time for an order.

Answer: TRUE

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

8) Two important drivers of time are limited capacity and bottlenecks.

Answer: FALSE

Explanation: The drivers of time are uncertainty and limited capacity (also known as bottleneck).

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

9) The average waiting time is the average amount of time an order will wait at the company's shipping office before it is sent to the customer.

Answer: FALSE

Explanation: The average waiting time is the average amount of time that an order will wait in line before it is set up and processed.

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

10) Inventory carrying costs include the opportunity cost of the investment.

Answer: TRUE

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-6

11) Which of the following is NOT included in customer response time?

A) order delivery time

B) order manufacturing time

C) order waiting time

D) order receipt time

E) order opening time

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-6

12) Manufacturing lead time includes

- A) all indirect time.
- B) waiting time.
- C) marketing time.
- D) time to process the customer's order to delivery.
- E) all indirect time and waiting time.

Answer: B

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-6

13) \_\_\_\_\_ is the amount of time from when a customer places an order for a product or requests a service to when the product or service is delivered to the customer.

- A) A bottleneck
- B) A time driver
- C) Customer response time
- D) Manufacturing lead time
- E) Quality customer time

Answer: C

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-6

14) On-time performance is

- A) the time it takes distribution to pick up an order and deliver it to the customer.
- B) within 2 standard deviations of customer response time.
- C) within 2 standard deviations of manufacturing time.
- D) equal to customer response time, divided by the number of orders from a specific customer.
- E) when the product is delivered at the time scheduled to be delivered.

Answer: E

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-6

15) \_\_\_\_\_ refers to the average amount of time that an order will be in line before it is set up and processed.

- A) Average manufacturing cycle time
- B) Average customer response time
- C) Average waiting time
- D) Average on-time performance
- E) Average setup time (per cycle)

Answer: C

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-6

16) A factor where the change in the factor causes a change in the speed with which an activity is undertaken is referred to as

- A) a bottleneck.
- B) value added time.
- C) opportunity cost.
- D) cycle time.
- E) a time driver.

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-6

17) The annual capacity of a machine is 12,000 hours, with the balance being taken for routine maintenance. It takes 10 hours to process one job (each job = 1 batch),. Altogether, there are seven employees who operate the machine at different times. Orders for the first six months of the year, which are typical, have averaged 50 jobs per month. The company expects 300 orders over the next six months. Which of the following is TRUE?

- A) Expected capacity utilization = 700 batches.
- B) Expected capacity utilization = 650 batches.
- C) Expected capacity utilization = 600 batches.
- D) Average waiting time is not relevant when expected capacity utilization is less than capacity.
- E) Waiting time for at least one order will be nil.

Answer: E

Explanation: E) Since annual capacity exceeds utilization, at least one unit will have a zero wait time. Average wait time will not be zero, however.

Diff: 3 Type: MC

Skill: Understand

Objective: LO 10-6

18) For a fast-food restaurant the average waiting time might be formulated as which of the following equations?

- A) 
$$\frac{[(\text{average number of customers}) \times (\text{average serving time})^2]}{2 \times [\text{serving capacity} - (\text{ave. \# of customers} \times \text{ave. serving time})]}$$
- B) 
$$[(\text{average number of customers}) \times (\text{average serving time})]/\text{capacity}$$
- C) 
$$\frac{[(\text{average customers per hour}) \times (\text{average serving time})]}{60 \text{ minutes}}$$
- D) 
$$\frac{[(\text{average customers per hour}) \times (\text{average serving time})]}{(60 \text{ minutes}) \times (\text{number of workers})}$$
- E) 
$$[(\text{average number of employees}) \times (\text{average serving time})]/\text{serving time}$$

Answer: A

Diff: 3 Type: MC

Skill: Remember

Objective: LO 10-6



19) The demand for Ballard's Glass Company's products varies, ranging from 10 to 20 windows a day with an average of 15. John Ballard is the only worker and he works a maximum of eight hours a day, five days a week. Each order is one window, and each window takes 26 minutes to install. What is the average waiting time in minutes?

- A) 1.6
- B) 4.4
- C) 28.2
- D) 56.33
- E) 82.3

Answer: D

Explanation: D) Waiting minutes =  $[15 \times 26^2] / [2 \times (480 \text{ minutes per day} - (15 \times 26))] = 10,140 / 180 = 56.33$  minutes

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-6

20) The demand for Ballard's Glass Company's products varies. Each order is one window, and each window takes 26 minutes to install. Assuming wait time is 12 minutes, and order receipt time equals 21 minutes what is the cycle time for an order on average?

- A) 21 minutes
- B) 26 minutes
- C) 38 minutes
- D) 41 minutes
- E) 59 minutes

Answer: C

Explanation: C) Cycle time = waiting time + manufacturing time =  $12 + 26 = 38$  because wait time is assumed in the question

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-6

21) The demand for Ballard's Glass Company's products varies, ranging from 10 to 20 windows a day with an average of 15. John Ballard is the only worker and he works a maximum of eight hours a day, five days a week. Each order is one window, and each window takes 26 minutes to install. The company plans to add doors to its product line and anticipates selling an average of 5 doors per day. Each door takes 12 minutes to install. What is the average waiting time if Ballard is the only worker?

- A) 38.0 minutes
- B) 112.4 minutes
- C) 181.0 minutes
- D) 410.0 minutes
- E) 523.4 minutes

Answer: C

Explanation: C)  $WT = \frac{(15 \times 26^2) + (5 \times 12^2)}{[2 \times (480 - (15 \times 26) - (5 \times 12))]}$

$$= 10,860/60$$

$$= 181 \text{ minutes}$$

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-6

22) The demand for Ballard's Glass Company's products varies, ranging from 10 to 20 windows a day with an average of 15. John Ballard is the only worker and he works a maximum of eight hours a day, five days a week. Each order is one window, and each window takes 26 minutes to install. The company plans to add doors to its product line and anticipates that they will sell an average of 5 doors per day. Each door takes 12 minutes to install.

Ballard is concerned with the increased waiting time if it adds doors. To offset this concern it can hire a part-time employee. This will decrease window time to 20 minutes and door time to 10 minutes; increase the costs of windows from \$10 to \$12 and doors from \$6 to \$7.50. Since Ballard is giving customers faster service it will increase its prices from \$17 to \$20 for windows and from \$10 to \$12 for doors.

What is the expected daily revenue with and without doors, respectively, assuming average sales units are used and the company hires a part-time employee if doors are sold?

- A) \$230 and \$170
- B) \$260 and \$200
- C) \$360 and \$255
- D) \$315 and \$300
- E) \$400 and \$340

Answer: C

Explanation: C) With doors =  $(15 \times \$20) + (5 \times \$12) = \$360$

Without doors =  $15 \times \$17 = \$255$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-6

23) The demand for Ballard's Glass Company's products varies, ranging from 10 to 20 windows a day with an average of 15. John Ballard is the only worker and he works a maximum of eight hours a day, five days a week. Each order is one window, and each window takes 26 minutes to install. The company plans to add doors to its product line and anticipates that they will sell an average of 5 doors per day. Each door takes 12 minutes to install.

Ballard is concerned with the increased waiting time if it adds doors. To offset this concern it can hire a part-time employee. This will decrease windows time to 20 minutes and doors to 10 minutes. However, this will increase the costs of windows from \$10 to \$12 and doors from \$6 to \$7.50. Since he is giving customers faster service he will increase his prices from \$17 to \$20 for windows and from \$10 to \$12 for doors.

What is the daily contribution margin if he sells both windows and doors and the part-time person is hired?

- A) \$185.00
- B) \$142.50
- C) \$140.00
- D) \$97.50
- E) \$72.00

Answer: B

Explanation: B) Sales  $(15 \times \$20) + (5 \times \$12)$  \$360.00

Variable costs  $(15 \times \$12) + (5 \times \$7.50)$  217.50

Contribution margin \$142.50

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-6

24) A company has identified the following data:

order waiting time	8 minutes
order manufacturing lead time	18 minutes
order receipt time	7 minutes
order manufacturing cycle time	72 minutes

What is the order manufacturing time?

- A) 25 minutes
- B) 15 minutes
- C) 18 minutes
- D) 64 minutes
- E) 79 minutes

Answer: D

Explanation: D)  $72 - 8 = 64$  minutes

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-6

25) Quick Shop Printing has two workstations, cutting and pasting. The cutting station is limited by the speed of operating the cutting machine. Pasting is limited by the speed of the workers. Pasting normally waits on work from cutting. Each department currently works an eight-hour day.

The company is considering having cutting begin work two hours earlier than pasting each day, the two departments would then finish their work at the same time. Not only does this eliminate the bottleneck, but it increases finished units produced each day by 80 units. All units produced can be sold even though the change increases inventory stock by 10 percent from 200 units. The cost of operating the cutting department two more hours each day is \$800. The contribution margin of the finished products is \$3 each. Inventory carrying costs are \$0.20 per unit per day.

What is the change in the daily contribution margin if the change is made?

- A) \$(396)
- B) \$(564)
- C) \$240
- D) \$236
- E) \$(604)

Answer: B

Explanation: B) Total contribution margin ( $80 \times \$3$ )	\$240
Carrying costs ( $20 \times \$0.20$ )	-4
Increased costs	<u>-800</u>
Net change in contribution margin	<u>\$(564)</u>

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-6

*Answer the following question(s) using the information below:*

The tool crib at a large manufacturing company is responsible for providing tools to the factory workers on demand. The tool crib has a variable demand. Historically, its demand has ranged from 150 to 250 small tools per day with an average of 200. Diane, the tool crib attendant, works eight hours a day, five days a week. Each order is for one small tool and each small tool takes Diane 2 minutes to retrieve from the bins.

26) What is the average waiting time, in minutes?

- A) 2
- B) 3
- C) 5
- D) 2.5
- E) 7

Answer: C

Explanation: C) Waiting minutes =  $[200 \times (2^2)] / \{2 \times [480 \text{ minutes per day} - (200 \times 2)]\} = 5 \text{ minutes}$

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-6

27) What is the tool crib cycle time for an order?

- A) 2 minutes per tool
- B) 3 minutes per tool
- C) 5 minutes per tool
- D) 7 minutes per tool
- E) 4 minutes per tool

Answer: D

Explanation: D) Waiting minutes =  $[200 \times (2 \text{ squared})] / \{[2 \times [480 \text{ minutes per day} - (200 \times 2)]]\} = 5 \text{ minutes}$

Cycle time = waiting time + manufacturing time = 5 + 2 = 7 minutes

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-6

28) Diane has been asked to consider plans to add the retrieval of larger tooling fixtures to her duties. She anticipates that there would be an average of 12 tooling fixtures per day requested. Each tooling fixture would take Diane 4 minutes to retrieve.

What is the average waiting time, in minutes, if Diane continues to be the only worker that would retrieve the small tools as well as the larger tooling fixtures?

- A) 5.0 minutes
- B) 10.0 minutes
- C) 15.5 minutes
- D) 18.5 minutes
- E) 31.0 minutes

Answer: C

Explanation: C) WT =  $\frac{(200 \times (2)^2) + (12 \times (4)^2)}{\{2 \times [480 - (200 \times 2) - (12 \times 4)]\}} = 992/64 = 15.5 \text{ minutes}$

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-6

29) Brown Laundry has a variable demand. The daily demand ranges from 100 to 140 customers a day with an average of 5 items. The average daily demand is 110 customers. The laundry operates 10 hours a day. Each order takes approximately 5 minutes.

Required:

- What is the average customer waiting time in minutes?
- What is the cycle time for an order?
- The manager has decided that the waiting time is too long and has increased the work day to 11 hours. What is the waiting time now? Will the customers be any happier?

Answer:

- Waiting minutes =  $[110 \times 5^2] / [2 \times (600 \text{ minutes per day} - (110 \times 5))] = 2,750 / 100 = 27.5 \text{ minutes}$
- Cycle time = waiting time + processing time  
 $= 27.5 + 5$   
 $= 32.5 \text{ minutes}$
- Waiting minutes =  $[110 \times 5^2] / [2 \times (660 \text{ minutes per day} - (110 \times 5))] = 2,750 / 220 = 12.5 \text{ minutes}$

The customers are probably not much happier unless they change the time when they stop by the laundry. If the customers now fill the 11-hour day, the new reduced waiting time will be a definite improvement.

Diff: 3 Type: ES

Skill: Apply

Objective: LO 10-6

30) Norton's Convenience store has a variable demand. The daily demand ranges from 270 to 330 customers a day who average purchasing 5 items each. The average daily demand is 300 customers. The convenience store currently operates 12 hours a day. Each order takes approximately 2 minutes.

Required:

- What is the average customer waiting time, in minutes?
- What is the cycle time for an order?
- What is the waiting time if the average daily demand remains at 300 customers?

Answer:

- Waiting minutes =  $[300 \times (2)^2] / [2 \times [720 \text{ minutes per day} - (300 \times 2)]] = 5 \text{ minutes}$
- Cycle time = waiting time + processing time =  $5 + 2 = 7 \text{ minutes}$
- Waiting minutes =  $[300 \times (2)^2] / [2 \times [900 \text{ minutes per day} - 300 \times 2]] = 2 \text{ minutes}$

Diff: 3 Type: ES

Skill: Apply

Objective: LO 10-6

31) Canevil Unlimited makes small motorcycles. The monthly demand ranges from 80 to 100 motorcycles. The average demand is 92 motorcycles. The plant operates 300 hours a month. Each cycle takes approximately 1.5 hours.

If the company adds a new line of scooters, initial demand will be 20 per month. Each scooter will take 1 hour to make. To offset approaching production capacity, expanding the assembly line is possible. This will decrease manufacturing time for all products by 20 percent. However, this will increase the costs of cycles from \$400 to \$500 and scooters from \$200 to \$240. The change will also cause increases in prices from \$700 to \$750 for cycles and from \$450 to \$500 for scooters.

Required:

- a. What is the average waiting time for cycles if they are the only item manufactured?
- b. What is the average waiting time if both cycles and scooters are produced and the assembly line is not enlarged?
- c. What is the average waiting time if both cycles and scooters are produced and the assembly line is enlarged?
- d. What is the expected monthly margin without scooters if the company sells all 92 cycles it manufactures?
- e. What are the expected monthly contribution margins if scooters are made with the current assembly line and with the new assembly line? Assume average sales and that sales equal production.
- f. What action do you recommend?

Answer:

a. Waiting time =  $[92 \times 1.5^2 / [2 \times (300 \text{ hr. a month} - (92 \times 1.5))]] = 207/324 =$   
 $= 0.639 \text{ hours}$

b.  $WT = (92 \times 1.5^2) + (20 \times 1^2) / [2 \times (300 - (92 \times 1.5) - (20 \times 1))] = 227/284 =$   
 $= 227/284$   
 $= 0.799 \text{ hours}$

c.  $WT = (92 \times 1.2^2) + (20 \times 0.8^2) / [2 \times (300 - (92 \times 1.2) - (20 \times 0.8))] =$   
 $= 145.28/347.2$   
 $= 0.418 \text{ hours}$

d. Motorcycle Sales ( $92 \times \$700$ )	\$64,400
Manufacturing costs ( $92 \times \$400$ )	<u>36,800</u>
Expected margin	<u>\$27,600</u>

e. Without changing assembly line.	
Motorcycle Sales	\$64,400
Scooter Sales ( $20 \times \$450$ )	<u>9,000</u>
Total expected sales	\$73,400
Manufacturing costs:	
Motorcycles ( $92 \times \$400$ )	\$36,800
Scooters ( $20 \times \$200$ )	<u>4,000</u>
Expected margin	<u>\$32,600</u>

With new assembly line.	
Motorcycle Sales ( $92 \times \$750$ )	\$69,000
Scooter Sales ( $20 \times \$500$ )	<u>10,000</u>
Total expected sales	79,000
Manufacturing costs:	
Motorcycles ( $92 \times \$500$ )	\$46,000
Scooters ( $20 \times \$240$ )	<u>4,800</u>
Expected margin	<u>\$28,200</u>

f. Unless there are critical customer relation problems with a slower response time, the scooters should be added without changing the assembly line. The expected margin is \$4,400 higher without the new assembly line.

Diff: 3 Type: ES

Skill: Apply

Objective: LO 10-6



32) Brix, Inc. prepares frozen food for fast-food restaurants. It has two workstations, cooking and assembly. The cooking station is limited by the cooking time of the food. Assembly is limited by the speed of the workers. Assembly normally waits on food from cooking. Because the demand has increased in recent months to 2,800 dozen units, management is considering adding another cook station or else having the cooks start to work earlier. The monthly cost of operating the cooking station one more hour each day is \$2,400. The cost of adding another cook station would add an average of \$10 per hour. The current operating hours total eight hours a day, 22 days a month. The contribution margin of the finished products is currently \$8 per dozen. Inventory carrying costs average \$2.00 per dozen per month. Either the extra hour or the new cook station would increase production by 20 dozen a day with a long-run increase of 80 dozen units in finished goods inventory to 280 dozen.

Required:

- What is the total production per month if the change is made?
- What is the increase in the expected monthly product contribution for each of the possible changes? Assume long-run production equals sales.

Answer:

a. Total dozen per month =  $2,800 + (22 \times 20) = 3,240$

b.

Current product contribution margin ( $2,800 \times \$8$ )	\$22,400
Carrying costs ( $200 \times \$2$ )	<u>400</u>
Current net contribution	<u>\$22,000</u>

More hours:

Expected product contribution margin ( $3,240 \times \$8$ )		\$25,920
Carrying costs ( $280 \times \$2$ )	\$560	
Increased costs	<u>2,400</u>	<u>2,960</u>
Expected net product contribution		<u>\$22,960</u>

New cook station:

Expected product contribution margin $3,240 \times \$8$		\$25,920
Carrying costs ( $280 \times \$2$ )	\$560	
Increased costs ( $\$10 \times 22 \times 8$ )	<u>1,760</u>	<u>2,320</u>
Expected net product contribution		<u>\$23,600</u>

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-6

33) Sof-T, Inc. manufactures foam products for upholstery companies. It has two workstations, mixing/heating and cutting/assembly. The mixing/heating station is limited by the capacity of the equipment. Cutting/assembly is limited by the speed of the cutting machine workers. Cutting/assembly normally lags behind mixing/heating. Because the demand has increased in recent months, management is considering adding another person to cutting/assembly. This would increase the department's costs by \$4,000 a month. If the person is moved from mixing/heating, that department's cost would decline by \$3,000. By keeping mixing/heating labourers the same, the department can increase production on-call by 10 percent. Current idle time in mixing/heating averages one-half person a day for a net cost of \$1,400 a month.

Required:

- a. What is the net effect of moving the employee from mixing/heating to cutting/assembly?
- b. What is the net effect if a new employee is hired for cutting/assembly?

Answer:

a.	
Additional costs of cutting/assembly	\$4,000
Savings from mixing/heating	(3,000)
Savings from idle time in mixing/heating	<u>(1,400)</u>
Net savings	<u><u>\$(400)</u></u>
b.	
Addition of new employee	\$4,000
Opportunity cost of idle time	<u>0</u>
Net costs	<u><u>\$4,000</u></u>

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-6

34) Aunt Lydia's Cookies, Inc., prepares frozen gourmet cookies for shipment to upscale grocery stores as well as mailing to web and catalog customers. The company has two workstations, cooking and distribution. The cooking station is limited by the cooking time of the food. Distribution is limited by the speed of the workers. Distribution normally waits on food from cooking. Because the demand has increased in recent months to 4,000 dozen cookies, management is considering adding another oven in the cooking station or else having the cooks start to work earlier. The monthly cost of operating the cooking station one more hour each day is \$1,500. The cost of adding another cooking station would add an average of \$8 per hour. The current operating hours total eight hours a day, 24 days a month. The contribution margin of the finished products is currently \$2 per dozen. Inventory carrying costs average \$0.50 per dozen per month. Either the extra hour or the new cooking station would increase production by 50 dozen a day, with a long-run increase of 100 dozen units in finished goods inventory to 500 dozen.

Required:

- What is the total production per month if the change is made?
- What is the increase in the expected monthly product contribution for each of the possible changes? Assume long-run production equals sales.
- What course of action would you recommend?

Answer:

- Total dozen per month =  $4,000 + (24 \times 50) = 5,200$
- 

Current product contribution margin ( $4,000 \times \$2$ )		\$8,000
Carrying costs ( $400 \times \$0.50$ )		(200)
Current net contribution		<u>\$7,800</u>
More hours:		
Expected unit contribution margin ( $5,200 \times \$2$ )		\$10,400
Carrying costs ( $500 \times \$0.50$ )	\$250	
Increased costs	<u>1,500</u>	<u>(1,750)</u>
Expected net product contribution		<u>\$8,650</u>
Increase = $\$8,650 - \$7,800 =$		\$850
New oven in the cooking station:		
Expected unit contribution margin ( $5,200 \times \$2$ )		\$10,400
Carrying costs ( $500 \times \$0.50$ )	\$250	
Increased costs ( $\$8 \times 24 \times 8$ )	<u>1,536</u>	<u>(1,786)</u>
Expected net product contribution		<u>\$8,614</u>
Increase = $\$8,614 - \$7,800 =$		\$814

- The most cost effective option is to have the cooks start to work an hour earlier and work an extra hour each day.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-6

35) Bank of Bowmanville has variable demand for its counter services. The daily demand ranges from 200 to 250 customers a day and the average banking transaction takes 6 minutes. The average daily demand is 228 customers. The bank currently has 5 staff members serving the counter and operates 7 hours a day.

Required:

- a. What is the average customer waiting time in minutes?
- b. In an effort to reduce costs, the bank is considering eliminating one of its counter services staff and having a manager fill in during two hours of the day. What would be the effect of this change on wait time? What might the customers' reaction be?

Answer:

a.

Capacity =  $5 * 7 * 60$  minutes = 2,100 minutes/day

Waiting minutes =  $[228 * 6^2] / [2 * (2,100 \text{ minutes per day} - (228 * 6))] = 2,750/100 = 8,208/1,464$   
= 5.6 minutes

b.

Capacity =  $[4 * 7 * 60] + [1 * 2 * 60] = 1,680 + 120 = 1,800$

Waiting minutes =  $[228 * 6^2] / [2 * (1,800 \text{ minutes per day} - (228 * 6))] = 2,750/100 = 8,208/864$   
= 9.5 minutes

This would increase the average wait time by 3.9 minutes to 9.5 minutes. This would likely not be perceived well by customers. This might cause customers to use more online banking services or look at competitors' services.

Diff: 3 Type: ES

Skill: Apply

Objective: LO 10-6

36) Acme Janitor Service has always taken pride in the fact that it had one of the highest customer response times in the home cleaning service industry. However, as the products manufactured for this industry have become more complex, the company's customer response time has declined.

Required: Why do you think that response time declined if all other quality factors have remained the same?

Answer: If quality production was one of the other control factors, and the products became more complex, it probably takes more time to inspect and verify the quality of the finished products. Therefore, to maintain the same level of quality, additional time had to be put into the product cycle. Apparently this was not allowed for in the setting of the production times of the newer, more complex products.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-6

10.7 Describe quality control and its implications as a cost driver.

1) The number of defects in units shipped to customers as a percentage of total units shipped, is a non-financial measure.

Answer: TRUE

Diff: 1 Type: TF

Skill: Understand

Objective: LO 10-7

2) Costs of quality (COQ) reports usually do not consider opportunity costs.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-7

3) Costs of Quality (COQ) are classified into four categories: prevention costs, appraisal costs, inspection costs, and warranty costs.

Answer: FALSE

Explanation: Costs of Quality (COQ) are classified into four categories: prevention costs, appraisal costs, internal failure costs, and external failure costs.

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-7

4) The costs relating to product testing are classified as prevention costs.

Answer: FALSE

Explanation: The costs relating to product testing are classified as appraisal costs.

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-7

5) The costs relating to new materials testing are classified as appraisal costs.

Answer: FALSE

Explanation: The costs relating to product testing are classified as prevention costs.

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-6

6) An example of a nonfinancial balanced scorecard measure concerning internal business processes would be the percentage of products that fail soon after delivery.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-7

7) A measurement of market share is considered a financial measure of customer satisfaction in a balanced scorecard.

Answer: FALSE

Explanation: A measurement of market share is considered a nonfinancial measure of customer satisfaction in a balanced scorecard.

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-7

8) Costs of quality include all of the following EXCEPT

- A) correction costs.
- B) external failure costs.
- C) internal failure costs.
- D) prevention costs.
- E) appraisal costs.

Answer: A

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-7

9) Costs incurred in detecting which of the individual units do not conform to specifications are called

- A) correction costs.
- B) external failure costs.
- C) internal failure costs.
- D) prevention costs.
- E) appraisal costs.

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-7

10) Warranty repair costs are

- A) prevention costs.
- B) appraisal costs.
- C) an internal failure cost.
- D) a marketing cost.
- E) an external failure cost.

Answer: E

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-7

11) Try-Us-First Motors manufactures and sells off-road vehicles. The September sales were \$6,000,000. Monthly design costs are \$112,000 and rework is running at \$75,000 per month. Its painting department is fully automated and requires substantial inspection to keep the machines operating properly. An improperly painted vehicle is very expensive to correct, and inspection hours for the 8,000 vehicles painted in September totaled 2,000 hours by 14 employees, who earn an average of \$28 an hour. Ten litres of paint were used on average for each vehicle. The standard amount of paint per vehicle is nine litres. The cost of inspection for September was equal to the budgeted amount of \$56,000.

What are appraisal costs as a percentage of sales?

- A) 0.93%
- B) 1.25%
- C) 1.87%
- D) 2.20%
- E) 2.80%

Answer: A

Explanation: A)  $56,000/6,000,000 = 0.93\%$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-7

12) Supplier evaluations are an example of

- A) appraisal costs.
- B) prevention costs.
- C) internal failure costs.
- D) design costs.
- E) external failure costs.

Answer: B

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-7

13) Internal failure costs include

- A) field repairs.
- B) rework.
- C) liability claims
- D) warranty expenses.
- E) supplier evaluations.

Answer: B

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-7

14) Prevention costs include all of the following EXCEPT

- A) quality training.
- B) design engineering.
- C) product testing.
- D) supplier evaluations.
- E) testing of new materials.

Answer: C

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-7

15) Appraisal costs include all of the following EXCEPT

- A) inspection.
- B) spoilage.
- C) product testing.
- D) process inspection.
- E) online product manufacturing.

Answer: B

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-7

16) External failure costs include all of the following EXCEPT

- A) scrap.
- B) customer support.
- C) liability claims.
- D) transportation costs on repaired products.
- E) warranty costs.

Answer: A

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-7

17) Costs incurred by a nonconforming product detected before it is shipped to customers are

- A) prevention costs.
- B) appraisal costs.
- C) internal failure costs.
- D) external failure costs.
- E) design costs.

Answer: C

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-7



18) Preventive equipment maintenance is an example of

- A) prevention costs.
- B) appraisal costs.
- C) internal failure costs.
- D) external failure costs.
- E) rework costs.

Answer: A

Diff: 1 Type: MC

Skill: Understand

Objective: LO 10-7

19) An example of a nonfinancial measure for customer satisfaction is

- A) delivery delay.
- B) employee turnover.
- C) number of defects on the production line.
- D) process yield.
- E) number of employees trained.

Answer: A

Diff: 1 Type: MC

Skill: Understand

Objective: LO 10-7

20) An example of a nonfinancial measure for customer satisfaction is

- A) Average manufacturing time for for key products.
- B) Contribution margin.
- C) Percentage of products that fail soon after delivery.
- D) Number of employees trained on managing bottleneck operations.
- E) Number of units reworked.

Answer: C

Diff: 1 Type: MC

Skill: Understand

Objective: LO 10-7

*Use the information below to answer the following question(s).*

Dylan Products has a budget of \$1,200,000 in 2015 for prevention costs. If it decides to automate a portion of its prevention activities, it will save \$90,000 in variable costs. The new method will require \$40,000 in training costs and \$150,000 in annual equipment costs. Management is willing to adjust the budget for an amount up to the cost of the new equipment. The budgeted production level is 210,000 units.

Appraisal costs for the year are budgeted at \$500,000. The new prevention procedures will save appraisal costs of \$50,000. Internal failure costs average \$20 per failed unit of finished goods. The internal failure rate is expected to be 4% of all completed items. The proposed changes will cut the internal failure rate by one-half. Internal failure units are destroyed. External failure costs average \$48 per failed unit. The company's average external failures average 2.5% of units sold. The new proposal will reduce this rate to 1%. Assume all units produced are sold and there are no ending inventories.

21) What is the net change in the budget of prevention costs if the procedures are automated in 2015? Will management agree with the changes?

- A) \$100,000 decrease, yes
- B) \$90,000 decrease, yes
- C) \$190,000 increase, no
- D) \$100,000 increase, yes
- E) \$90,000 increase, no

Answer: D

Explanation: D) New costs:	Training	\$ 40,000
	New equipment	<u>150,000</u>
		\$190,000
Savings		<u>(90,000)</u>
Net increase in budget		<u>\$ 100,000</u>

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-7

22) How much will appraisal costs change assuming that the new prevention methods reduce material failures by 30% in the appraisal phase?

- A) \$150,000 decrease
- B) \$229,000 decrease
- C) \$50,000 increase
- D) \$50,000 decrease
- E) \$84,000 decrease

Answer: D

Explanation: D) The new prevention procedures will save appraisal costs of \$50,000.

Diff: 1 Type: MC

Skill: Apply

Objective: LO 10-7

23) How much will internal failure costs change if the internal product failures are reduced by 50% with the new procedures?

- A) \$168,000 decrease
- B) \$126,000 decrease
- C) \$ 84,000 decrease
- D) \$ 84,000 increase
- E) \$50,000 decrease

Answer: C

Explanation: C) Internal failure rate  $(210,000 \times 0.04)$  8,400

Cost per unit  $\times \$20$

Total \$168,000

Savings rate  $\times 0.50$

Savings \$84,000

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-7

24) How much do external failure costs change if all the changes are as the new prevention procedures anticipated? Assume all units produced are sold and there are no ending inventories.

- A) \$126,000 decrease
- B) \$156,400 decrease
- C) \$100,800 decrease
- D) \$158,900 decrease
- E) \$151,200 decrease

Answer: E

Explanation: E) External failure costs - before  $(210,000 \times 0.025 \times \$48)$  \$252,000

External failure costs - after  $(210,000 \times 0.01 \times \$48)$  ~~(\$100,800)~~

Savings \$151,200

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-7

25) Carl Clarkson and Lenny Lenid have been assigned to review the costs of quality at the Sprotton Chemicals Ltd. for the month of September. All amounts are in thousands (000's).

Cost Item	Amount
Product testing	\$350
Clean up of toxic spills within the plant	\$14,200
Employee training	\$200
Quality Engineering	\$675
Supplies used in testing	\$500
Statistical Process Control	\$1,750
Payments on lawsuits from product failures	\$25,000

Some information from a competitor, Sheltonville Industries, has been leaked. You learn that Sheltonville's costs of quality (as a percentage of total costs of quality) is 15% on external failure, 20% on internal failure, 35% on appraisal and the rest on prevention.

Required:

- Prepare a cost of quality report for September for the Sprotton Chemicals including calculations of each cost category as a percentage of total costs of quality.
- Compare Sprotton's approach to quality management to Sheltonville's. Comment on your findings. (What are the implications of the differences?)

Answer:

a.

	Sprotton Sept	% of Cost	Sheltonville
<i>Prevention:</i>			
Quality Engineering	\$675		
Employee Training	\$200		
Statistical Process Control	\$1,750		
Total Prevention Costs	\$2,625	6.15%	30.00%
<i>Appraisal:</i>			
Product Testing	\$350		
Supplies used in Testing	\$500		
Total Appraisal Costs	\$850	1.99%	35.00%
<i>Internal Failure:</i>			
Cleanup of toxic spills in plant	\$14,200		
Total Internal Failure	\$14,200	33.27%	20.00%
<i>External Failure:</i>			
Lawsuits	\$25,000		
Total External Failure	\$25,000	58.58%	15.00%
Total Costs of Quality	\$42,675		

b.

There is a distinct difference as to the distribution of the costs of quality between the two organizations. Sheltonville invests more in upstream costs (65% in prevention and appraisal costs) compared to Sprotton (8.14%). Failures downstream are generally more costly in terms of both actual costs (product costs are incurred when units fail and external failure costs tend to be high) and the opportunity costs from lost sales.

Diff: 3 Type: ES

Skill: Analyze

Objective: LO 10-7

26) Tri-State Manufacturing expects to spend \$800,000 in 2016 in appraisal costs if it does not change its incoming materials inspection method. If it decides to implement a new receiving method, it will save \$80,000 in fixed appraisal costs and variable costs of \$0.40 per unit of finished product. The new method involves \$120,000 in training costs and an additional \$160,000 in annual equipment rental. It takes two units of material for each finished product.

Internal failure costs average \$160 per failed unit of finished goods. During 2011, 5% of all completed items had to be reworked. External failure costs average \$400 per failed unit. The company's average external failures are 1% of units sold. The company carries no ending inventories, because all jobs are on a per order basis and a just-in-time inventory ordering method is used.

Required:

- What is the net effect on appraisal costs for 2016, assuming the new receiving method is implemented and that 800,000 material units are received?
- How much will internal failure costs change, assuming 800,000 units of materials are received and that the new receiving method reduces the amount of UNACCEPTABLE product units in the manufacturing process by 10%?

Answer:

a.			
Current costs			\$800,000
Savings:			
Fixed	\$ (80,000)		
Variable	<u>(320,000)</u>	(\$400,000)	
New method:			
Training cost	\$ 120,000		
Equipment cost	<u>160,000</u>	<u>280,000</u>	(120,000)
New costs of method			<u>680,000</u>
Net change — Decrease			<u>\$ 120,000</u>

b.		
Internal failure costs $[(800,000/4) \times 0.05 \times \$160$		\$1,600,000
10% reduction from new method	<u><math>\times 0.10</math></u>	
Savings		<u>\$ 160,000</u>

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-7

27) LaCrosse Products has a budget of \$900,000 in 2016 for prevention costs. If it decides to automate a portion of its prevention activities, it will save \$80,000 in variable costs. The new method will require \$40,000 in training costs and \$100,000 in annual equipment costs. Management is willing to adjust the budget for an amount up to the cost of the new equipment. The budgeted production level is 150,000 units.

Appraisal costs for the year are budgeted at \$600,000. The new prevention procedures will save appraisal costs of \$50,000. Internal failure costs average \$15 per failed unit of finished goods. The internal failure rate is expected to be 3% of all completed items. The proposed changes will cut the internal failure rate by one-third. Internal failure units are destroyed. External failure costs average \$54 per failed unit. The company's average external failures average 3% of units sold. The new proposal will reduce this rate by 50%. Assume all units produced are sold and there are no ending inventories.

Required:

- What is the net change in the budget of prevention costs if the procedures are automated in 2016? Will management agree with the changes?
- How much will internal failure costs change if the internal product failures are reduced by 1/3 with the new procedures?
- How much do external failure costs change if all changes are as anticipated with the new prevention procedures? Assume all units produced are sold and there are no ending inventories.

Answer:

a.			
New costs:	Training	\$40,000	
	New equipment	<u>100,000</u>	\$140,000
Savings			
Variable costs			<u>(80,000)</u>
Net increase in budget			<u>\$ 60,000</u>

b.	
Internal failure rate (150,000 × 0.03)	4,500
Cost per unit	<u>× \$15</u>
Total	\$67,500
Savings rate	<u>× 1/3</u>
Savings	<u>\$22,500</u>

c.	
External failure costs (150,000 × 0.03 × \$54) =	\$243,000
Savings rate	<u>× 0.50</u>
Savings	<u>\$121,500</u>

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-7

28) Discuss how a manufacturer of personal computers such as Dell Computer can benefit from the introduction of a quality improvement program.

Answer: A quality improvement program for Dell would result in substantial savings in operating costs and higher revenues. Operating costs would be reduced since fewer funds would be spent checking output and correcting defective products. Higher revenues would result since existing customers would likely increase their orders and the higher quality output would attract additional customers. In addition, a number of competitors will likely be implementing quality programs. Dell must meet the competition to succeed.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-7



29) Cari and Jereme just bought a bed and breakfast inn at a very attractive price. The business had been doing poorly. Before they reopened the inn for business, they attended a seminar on operating a high quality business. Now that they are ready to open the inn, they need some advice on quality costs and management.

Required:

Identify four categories of quality costs. In addition, identify three items that would be classified in each of the categories.

Answer: Prevention:

Hiring employees with good references.

Training of owners and employees.

Good security.

Good reservation system.

Purchasing quality furniture.

Appraisal:

Verifying accuracy of reservation and registration procedures.

Inspecting rooms, facilities, building and grounds regularly.

Observing activities of employees.

Testing furniture and fixtures.

Taste testing food.

Internal failure:

Recleaning rooms and facilities.

Restocking rooms with linens, glasses, etc.

Out of stock supplies.

Reinspection.

Failure to bill on a timely basis.

External failure:

Responding to complaints about rooms and food.

Responding to complaints about reservations.

Emergency cleaning of rooms when not ready on time.

Customer refunds because of unsatisfactory conditions.

Opportunity cost of lost revenue resulting from unhappy customers.

Diff: 3 Type: ES

Skill: Understand

Objective: LO 10-7

30) Define cost of quality (COQ), list the four categories, and provide an example of each.

Answer: The cost of quality (COQ) are costs incurred to prevent or rectify the production of a low-quality product. These costs focus on conformance quality and are incurred in all areas of the value chain. They are broken into four categories:

1. **Prevention costs:** costs incurred in precluding the production of products that do not conform to specifications.
2. **Appraisal costs:** costs incurred in detecting which of the individual units of products do not conform to specifications.
3. **Internal failure costs:** costs incurred when a nonconforming product is detected before it is shipped to customers.
4. **External failure costs:** costs incurred when a nonconforming product is detected after it is shipped to customers.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-7

31) Compare financial and nonfinancial performance, and explain why planning and control systems should consider both.

Answer: Some objectives of responsibility centres are financial in nature, such as operations budgets, profit targets and required return on investment. Other objectives are nonfinancial, such as quality, productivity and customer satisfaction. A well-designed management control system functions alike for both financial and nonfinancial objectives to develop and report measures of performance.

Financial performance measures are more readily available than nonfinancial measures, but are no more important to the overall goals of the organization. By considering nonfinancial measures, the organization can improve operational control. Superior financial performance usually follows from superior nonfinancial performance.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-7

32) A corporation can measure its quality performance by using financial or nonfinancial measures of quality. Discuss the merits of each method and whether the use of one precludes the use of the other.

Answer: Financial measures of quality are quantifiable. The business can calculate the costs of setting up quality control systems, the costs of noncompliance with quality in terms of the internal and external costs (rework, warranty costs, etc.), and estimate the revenues lost as a result of quality problems.

Nonfinancial measures of quality are useful indicators of future long-run performance. They are helpful in revealing future needs and preferences of customers and in indicating the specific areas that need improvement.

The use of one measure does not preclude the use of the other. Financial measures tend to be short term in nature (what is happening now). Nonfinancial measures tend to be long term and are useful in terms of estimating trends.

Financial performance measures are more readily available than nonfinancial measures, but they are no more important to the overall goals of the organization. By considering nonfinancial measures, the organization can improve operational control. Superior financial performance usually follows from superior nonfinancial performance.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-7

33) Wilson's Language School manufactures CDs and DVDs to teach English as a Second Language.

Wilson has just prepared a Cost of Quality Report, and the staff has noticed a decline in prevention costs as a percentage of total sales over a three-year period. What changes might Wilson expect to see in appraisal costs as a percentage of sales, internal failure costs as a percentage of sales, and external failure costs as a percentage of sales given this trend?

Answer: Most likely, the decline in prevention costs as a percentage of sales over a three-year period would result in increased internal and external failure costs as a percentage of sales during this same period. The reduced prevention activities might result in more defective products. Appraisal costs as a percentage of sales might also rise as management attempts to compensate for the higher failure rates by increasing inspection and appraisal costs to prevent defects from reaching the final customer.

Diff: 3 Type: ES

Skill: Understand

Objective: LO 10-7

34) The Brick Shirt House is concerned about its declining sales, especially the reduction in the number of customers. For the last two years its shirts have won industry awards for high quality and trend-setting styles. At the latest executive managers' meeting everyone was blaming everyone else for the decline. After much discussion, and the presenting of some fact-finding information, it was determined that sales relationships were the cause of most of the problems.

Required: What may be some of the causes and how can the causes be detected if product quality is not an issue?

Answer: The causes may be customer satisfaction with sales staff (poor sales skills), delivery problems (not on time), accounting problems (poor billing and collection procedures), or poor returns and allowance policies.

The causes may be detected by comparing nonfinancial measures of the company with those found in the industry. These might include measures of: number of shipments incorrect or not on time, number of customer complaints about certain areas (billing, shipping, etc.), response time to customer complaints, or a questionnaire about why former customers quit buying from the company.

Diff: 2 Type: ES

Skill: Understand

Objective: LO 10-7

Nidek manufactures sport swear. Classify each of the following quality costs as prevention, appraisal, internal failure or external failure.

- A) External failure
- B) Internal failure
- C) Appraisal
- D) Prevention

35) Disposal of spoiled work in process

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

36) Downtime due to quality problems

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

37) Expediting work to meet delivery schedule

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

38) Field testing

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

39) Maintaining a complaint department

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

40) Product liability

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

41) Quality training

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

42) Reinspection

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

43) Rework direct manufacturing labour and overhead

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

44) Scrap

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

45) Testing and inspecting of machinery

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

46) Testing and inspecting of direct materials

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

47) Utilities in inspection area of plant

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

48) Warranty repairs

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

Answers: 35) B 36) B 37) B 38) C 39) A 40) A 41) D 42) B 43) B 44) B 45) D 46) D 47) C 48) A

The Door Company manufactures doors. Classify each of the following quality costs as prevention costs, appraisal costs, internal failure costs, or external failure costs.

- A) Appraisal
- B) External failure
- C) Internal failure
- D) Prevention

49) Retesting of reworked products

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

50) Downtime due to quality problems

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

51) Analysis of the cause of defects in production

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

52) Depreciation of test equipment

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

53) Warranty repairs

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

54) Lost sales arising from a reputation for poor quality

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

55) Quality circles

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

56) Rework direct manufacturing labour and overhead

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

57) Net cost of spoilage

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

58) Technical support provided to suppliers

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

59) Audits of the effectiveness of the quality system

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

60) Plant utilities in the inspection area

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

61) Reentering data because of keypunch errors

Diff: 2 Type: MA

Skill: Understand

Objective: LO 10-7

Answers: 49) C 50) C 51) C 52) A 53) B 54) B 55) D 56) B 57) C 58) D 59) A 60) A 61) C

#### 10.8 Understand issues of data collection and quality.

1) The ideal database for estimating cost functions quantitatively includes values for the independent variable over a wide range.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-8

2) Data collection problems arise when

A) data are recorded electronically rather than manually.

B) accrual-basis costs are used rather than cash-basis costs.

C) outliers are removed.

D) purely inflationary price effects are removed.

E) fixed and variable costs are not separately identified and both are allocated to products on a per unit basis.

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-8



- 3) A better database for estimating cost functions has the following characteristics.
- A) Fixed costs are allocated as if they are variable costs.
  - B) Extreme observations are adjusted or removed.
  - C) Time periods differ for measuring items included in the dependent variable and the cost driver(s).
  - D) Homogeneous relationships between individual cost items in the dependent variable pool and cost drivers may not be present.
  - E) There is no causal, economically plausible relationship between individual cost items in a heterogeneous mixed pool and a single cost driver.

Answer: B

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-8

4) Brad Henry has just purchased the film studio of a movie company that specializes in action adventures. He found that the company did not try to estimate the cost of making a movie. Instead it just gave the producer a budget and told him/her to make a movie within budget. Mr. Henry does not like the former movie-budget concept and desires to establish a formal cost estimation system.

Required:

What are some of the potential problems that may be encountered in changing from a budget to a cost estimation movie-making system?

Answer: One of the first problems will be the timing of matching the cost drivers with the actual movie production process. Under the former budget system, the relationships with many of the cost drivers were probably forced to meet budget, or else poorly kept because they were substantially under budget and control over them was weak.

Next will be the problem of determining which costs were fixed and which were variable under the budget system. It may be difficult to determine those which were truly variable.

Timing problems will also have to be reconciled. Some costs may be incurred monthly rather than by movie, and some type of accrual will have to be made to keep the costs allocated to the proper cost driver.

Lastly, there may be gaps in the historical data because only total costs had to be maintained within the budget. There was probably little attention paid to cost categories, thereby causing reliable cost data to be scarce.

Diff: 3 Type: ES

Skill: Understand

Objective: LO 10-8

5) The ideal database for estimating cost functions has two characteristics:

1. The database should contain numerous reliably measured observations of the cost driver (the independent variable) and the related costs (the dependent variable).
2. It includes values for the independent variable over a wide range.

Unfortunately, management accountants rarely have the advantage of working with a database that has both characteristics.

Required:

Following are a list of data problems that may be encountered. Select three, then for each selection describe the cause/effect of the problem and provide a remedy.

1. The time period for measuring the dependent variable does not match the period for measuring the independent variable.
2. Fixed costs are allocated as if they were variable.
3. Data are either unavailable for all observations or not uniformly available.
4. Extreme values of observations, or outliers, occur when recording costs.
5. There is no causal, economically plausible relationship between the individual cost items in a heterogeneous mixed pool and a single cost driver.
6. Inflation affects the dependent variable, the independent variable(s), or both.

Answer:

1. Cause/Effect: Financial accounting records are cash based rather than accrual based resulting in sporadic recording of costs. that do not correlate with a cost driver. Remedy: Keep records on an accrual basis.
2. Cause/Effect: Variability results from multiplying a unit fixed cost based on a specific quantity of input by a different quantity of input units. Remedy: Divide total fixed costs by actual input in the relevant range, then adding unit variable costs to arrive at a total cost per output unit.
3. Cause/Effect: Inattention to data collection and recording results in errors and missing data. Remedy: Formalize procedures and automate processing.
4. Cause/Effect: Abnormal operations such as those resulting from a machine break-down can create anomalies in the data. Remedy: Clean up the data by adjusting or eliminating outliers.
5. Cause/Effect: The size and composition of the cost pool result in poor correlation between total cost and potential cost drivers. Remedy: Employ ABC to create cost pools that have better correlation with cost drivers.
6. Cause/Effect: Inflation systematically effects cost pools when there is no change in the quantity of cost driver consumed. Remedy: re-specify the cost function to include inflation as a second variable and conduct multiple regression analysis.

Diff: 3 Type: ES

Skill: Understand

Objective: LO 10-8

10.9 Discuss the interpretation of regression models.

1) Statistical significance of independent variables is determined by comparing the  $t$ -value to a threshold called degrees of freedom.

Answer: FALSE

Explanation: Statistical significance of independent variables is determined by comparing the  $t$ -value to a threshold  $t$ -value

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-9

2) The standard error of the estimated coefficient indicates whether a relationship exists between the predictor variable and the outcome variable that cannot be attributed to chance alone.

Answer: TRUE

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-9

3) Multicollinearity exists in multiple linear regression when two or more predictor variables are highly correlated with each other.

Answer: TRUE

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-9

4) The coefficient of determination ( $r^2$ ) measures the percentage of variation in  $Y$  explained by  $X$  (the independent variable).

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-9

5) The  $t$ -value of the  $b$  coefficient measures how large the value of the estimated coefficient is relative to its specification.

Answer: FALSE

Explanation: The  $t$ -value of the  $b$  coefficient measures how large the value of the estimated coefficient is relative to its standard error.

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-9

6) The use of a single independent variable (X) to estimate the dependent variable (y) is known as

- A) high-low method.
- B) multiple regression.
- C) simple regression.
- D) singular regression.
- E) least squares regression.

Answer: C

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-9

7) Simple regression analysis provides the means to evaluate a line of regression which is fitted to a plot of data and represents

- A) the way costs change in respect to the independent variable.
- B) the way costs change in respect to the dependent variable.
- C) the variability of expense with dollars of operation.
- D) the variability of expense with dollars of production.
- E) the estimated variability in costs.

Answer: A

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-9

8) Regression analysis differs from high-low analysis in that regression analysis

- A) measures the average amount of change in the dependent variable.
- B) measures the total amount of change in the dependent variable.
- C) ignores the high and low observations of the dependent variable.
- D) ignores non-representative data.
- E) ignores both the high and low observations of the dependent variable, and non-representative data.

Answer: A

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-9

9) The slope of the line of regression is

- A) the rate at which the dependent variable varies.
- B) the rate at which the independent variable varies.
- C) the level of total fixed costs.
- D) the level of total variable costs.
- E) equal to the intercept.

Answer: A

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-9

10) Pam's Stables used two different independent variables (trainer hours and number of horses) in two different equations to evaluate the cost of training horses. The most recent results of the two regressions are as follows:

Trainer's hours:

Variable	Coefficient	Standard Error	t-Value
Constant	\$913.32	\$198.12	4.61
independent variable	\$20.90	\$2.94	7.11

$$r^2 = 0.56$$

Number of horses:

Variable	Coefficient	Standard Error	t-Value
Constant	\$4,764.50	\$1,073.09	4.44
Independent Variable	\$864.98	\$247.14	3.50

$$r^2 = 0.63$$

What is the estimated total cost for the coming year if 16,000 trainer hours are incurred and the stable has 400 horses to be trained, based on the best cost driver?

- A) \$99,929.09
- B) \$350,756.50
- C) \$335,313.32
- D) \$84,233.50
- E) \$47,238.12

Answer: B

Explanation: B)  $y = \$4,764.50 + (\$864.98 \times 400) = \$350,756.50$  based on highest  $r^2$ , which uses # of horses as the cost driver

Diff: 3 Type: MC

Skill: Apply

Objective: LO 10-9

11) Craig's Cola was to manufacture 1,000 cases of cola next week. The accountant provided the following analysis of total manufacturing costs.

Variable	Coefficient	Standard Error	t-Value
Constant	100	71.94	1.39
Independent Variable	200	91.74	2.18

$$r^2 = 0.82$$

What is the estimated cost of producing the 1,000 cases of cola?

- A) \$200,100
- B) \$72,032
- C) \$100,200
- D) \$9,000
- E) \$91,812

Answer: A

Explanation: A)  $y = \$100 + (\$200 \times 1,000) = \$200,100$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-9

12) What common sense criteria should be applied to statistical analysis when evaluating cost drivers using regression analysis?

- A) goodness of fit
- B) economic plausibility
- C) the significance of the difference between the costs associated with the highest and lowest observations of the cost driver
- D) the significance of the difference between the *unit values* for the highest and lowest observations of the cost driver
- E) the Durbin-Watson statistic

Answer: B

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-9

13) In multiple regression, when two or more independent variables are correlated with one another, the situation is known as

- A) heteroscedasticity.
- B) homoscedasticity.
- C) spurious correlation.
- D) autocorrelation.
- E) multicollinearity.

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-9

14) Multicollinearity exists when which of the following conditions is present?

- A) At least two variables change due to changes in the cost driver.
- B) There are at least two cost pools (usually separated for fixed and variable costs).
- C) The underlying value of the coefficient can only be explained in relation to dependent variables.
- D) There are two or more statistically significant observations of at least two independent variables.
- E) Two or more independent variables are highly correlated with each other.

Answer: E

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-9

15) In regression analysis, the term independence of residuals means

- A) the residual term for any one observation is not related to the residual term of any other observation.
- B) the data exhibit serial correlation.
- C) the data exhibit autocorrelation.
- D) there is a systematic pattern of positive residuals.
- E) there is a systematic pattern of either only positive or only negative residuals.

Answer: A

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-9

16) C. M. Chain was to manufacture 1,000 chain saws next month. Its accountant has provided the following analysis of the total manufacturing costs.

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	200	143.88	1.39
Predictor Variable	400	183.49	2.18

$r^2 = 0.71$

What is the estimated cost of producing the 1,000 chain saws?

- A) \$400,200
- B) \$284,142
- C) \$200,400
- D) \$18,000
- E) \$9,000

Answer: A

Explanation: A)  $Y = 200 + (400 \times 1000) = 400,200$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-9

17) Goodness-of-fit measures how well the predicted values in a cost estimating equation

- A) match the cost driver.
- B) match the actual cost observations.
- C) fit the coefficient of determination.
- D) rely on the independent variable.
- E) rely on the dependent variable

Answer: B

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-9

18) Which of the following statements about a high correlation between two variables  $s$  and  $t$  is FALSE?

- A)  $s$  may cause  $t$ .
- B)  $t$  may cause  $s$ .
- C) They both may be affected by a third variable.
- D) The correlation establishes an economically plausible relationship between costs and their cost drivers.
- E) The correlation may be due to random chance.

Answer: D

Diff: 2 Type: MC

Skill: Understand

Objective: LO 10-9

19) The Bhaskara Corporation used regression analysis to predict the annual cost of indirect materials.

The results were as follows:

Intercept coefficient	\$21,890
Standard error of Y estimate	\$4,560
$r^2$	0.7832
Number of observations	22
Independent variable coefficient	11.75
Standard error of coefficient(s)	2.1876

What is the linear cost function?

- A)  $y = \$4,560 + \$2.1876X$
- B)  $y = \$4,560 + \$11.75X$
- C)  $y = \$21,890 + \$4.56X$
- D)  $y = \$21,890 + \$2.1876X$
- E)  $y = \$21,890 + \$11.75X$

Answer: E

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-9



20) Simple regression differs from multiple regression in that

A) multiple regression uses all available data to estimate the cost function whereas simple regression only uses simple data.

B) simple regression is limited to the use of only the outcome variables and multiple regression can use both outcome and predictor variables.

C) simple regression uses only one predictor variable and multiple regression uses more than one predictor variable.

D) simple regression uses only one outcome variable and multiple regression uses more than one outcome variable.

E) the least squares technique cannot be used for simple regression whereas it can be used for multiple regression.

Answer: C

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-9

21) A paper company manufactures cardboard boxes. Because the efforts of manufacturing are approximately equal between labour and machinery, management is considering other possible cost drivers. By considering different cost drivers, it is anticipated that the estimating process can be improved. The following cost estimating equations with their  $r^2$  values have been determined for 2015:

10-1.  $x = \text{glueing time}$        $y = \$39,000 + \$17x$        $r^2 = 0.60$

10-2.  $x = \text{labour}$        $y = \$10,000 + \$23x$        $r^2 = 0.46$

10-3.  $x = \text{machinery}$        $y = \$99,000 + \$3x$        $r^2 = 0.53$

Required:

a. Which equation should be selected for the analysis?

b. What are other factors that should be included in the selection of the estimating equation?

Answer:

a. Equation 1 for glueing time is slightly better than the other two equations based on  $r^2$  values.

Generally an  $r^2$  above 0.30 indicates a goodness of fit that is acceptable for most situations. Therefore all three equations are acceptable when considering only the coefficient of determination.

However, because the values are so close together, other factors should be considered.

b. Other factors to be considered are economic plausibility, the significance of independent variables, and specification analysis. The best cost drivers of the dependent variables are those that meet all these criteria plus that of best coefficient of determination.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

22) Arfaei Company manufactures chairs. Because the efforts of manufacturing are approximately equal between labour and machinery, management is considering other possible cost drivers. By considering different cost drivers, it is anticipated that the estimating process can be improved. The following cost estimating equations with their  $r^2$  values have been determined for 2016:

1.  $X = \text{cutting time}$        $y = \$19,500 + \$20X$        $r^2 = 0.65$
2.  $X = \text{labour}$        $y = \$5,000 + \$25X$        $r^2 = 0.49$
3.  $X = \text{machinery}$        $y = \$44,500 + \$5X$        $r^2 = 0.55$

Required:

- a. Which equation should be selected for the analysis?
- b. What other factors should be included in the selection of the estimating equation?

Answer:

- a. Equation 1 for cutting time is slightly better than the other two equations based on  $r^2$  values.

Generally, an  $r^2$  above 0.30 indicates a goodness of fit that is acceptable for most situations. Therefore, all three equations are acceptable when considering only the coefficient of determination. However, because the values are so close together, other factors should be considered.

- b. Other factors to be considered are economic plausibility, the significance of independent variables, and specification analysis. The best cost drivers of the dependent variables are those that meet all these criteria plus that of best coefficient of determination.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

23) Review the following report of the results of a simple regression program for cost estimation.

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	24.88	17.90	1.39
Independent Variable	444.70	179.31	2.48

$r^2 = 0.72$

Required:

- a. What is the cost estimation equation according to the report?
- b. What is the goodness of fit? What does it tell about the estimating equation?

Answer:

- a.  $y = \$24.88 + \$444.70x$

- b. Goodness of fit is 0.72. It measures how well the predicted values match the actual observations. In this case the equation passes the goodness of fit test because it is substantially above 0.30, the threshold of acceptance.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

24) The new cost analyst in your accounting department has just received a computer-generated report that contains the results of a simple regression program for cost estimation. The summary results of the report appear as follows:

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	\$35.92	\$16.02	2.24
Independent Variable	\$563.80	\$205.40	2.74

$$r^2 = 0.75$$

Required:

- What is the cost estimation equation according to the report?
- What is the goodness of fit? What does it tell about the estimating equation?

Answer:

- $y = \$35.92 + \$563.80X$
- Goodness of fit is 0.75. It measures how well the predicted values match the actual observations.

In this case, the equation passes the goodness of fit test because it is substantially above 0.30, the threshold of acceptance.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

25) A Manufacturing Company uses two different independent variables in two different equations to evaluate the cost activities of the packaging department, machine-hours and number of packages. The most recent month's results of the two regressions are as follows:

Machine hours:

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	652.32	209.75	3.11
Predictor Variable	44.30	24.61	1.88

$$r^2 = 0.29$$

Number of packages:

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	65.08	75.04	2.20
Predictor Variable	4.30	2.00	2.15

$$r^2 = 0.61$$

Required:

- What are the estimating equations for each cost driver?
- Which cost driver is best and why?

Answer:

a. machine-hours  $y = \$652.32 + \$44.30x$

number of packages  $y = \$65.08 + \$4.30x$

- b. Machine-hours has a low  $r^2$  which implies that a small proportion of the variance is explained by machine-hours, thereby making it less attractive than number of packages as a cost predictor.

Also, for the independent variable, number of packages, the t-value of 2.15 indicates that a relationship exists between the independent and dependent variables. For machine-hours, the t-value is below 2.00, indicating that the coefficient is not significantly different from zero and that there may not be a relationship between the independent and dependent variables.

The t-value of the constant terms (g) for both drivers is greater than 2.00, therefore no distinguishing characteristic between the constants.

Given the above findings, it appears that number of packages is the best predictor of costs of the packaging department.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

26) Schotte Manufacturing Company uses two different independent variables (machine-hours and number of packages) in two different equations to evaluate costs of the packaging department. The most recent results of the two regressions are as follows:

Machine-hours:

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	\$748.30	\$341.20	2.19
Predictor Variable	\$52.90	\$35.20	1.50

$$r^2 = 0.33$$

Number of packages:

<u>Variable</u>	<u>Coefficient</u>	<u>Standard Error</u>	<u>t-Value</u>
Constant	\$242.90	\$75.04	3.24
Predictor Variable	\$5.60	\$2.00	2.80

$$r^2 = 0.73$$

Required:

- What are the estimating equations for each cost driver?
- Which cost driver is best and why?

Answer:

- Machine-hours  $y = \$748.30 + \$52.90X$   
Number of packages  $y = \$242.90 + \$5.60X$

- Machine-hours has a low  $r^2$  which implies that a small proportion of the variance is explained by machine-hours, thereby making it less attractive than number of packages as a cost predictor.

Also, for the independent variable, number of packages, the t-value of 2.80 indicates that a relationship exists between the independent and dependent variables. For machine-hours, the t-value (1.50) is below 2.00, indicating that the coefficient is not significantly different from zero and that there may not be a relationship between the independent and dependent variables.

The t-values of the constant terms (g) for both drivers is greater than 2.00, therefore, there is no distinguishing characteristic between the constants.

Given the above findings, it appears that number of packages is the best predictor of costs of the packing department.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

27) Newton Company used linear regression analysis to obtain the following output:

Payroll Department Cost <u>Explained by Number of Employees</u>	
Constant	\$5,800
Standard error of Y estimate	630
$r^2$	0.8924
Number of observations	20
X coefficient	\$1.902
Standard error of coefficient	0.0966

Required:

- What is the total fixed cost?
- What is the variable cost per employee?
- Prepare the linear cost function.
- What is the coefficient of determination? Comment on the goodness of fit.

Answer:

- The constant or intercept is the total fixed cost of \$5,800.
- The variable cost per employee is the X coefficient of \$1.902.
- $y = \$5,800 + \$1.902X$
- The coefficient of determination is the  $r^2$  of 0.8924. This represents a very high goodness of fit. The closer to 1.0, the better the cost driver explains the cost. Therefore, the conclusion can be drawn that there is a significant relationship between the cost of the payroll department and the number of employees.

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-9

28) Stow-a-way Luggage Ltd. manufactures luggage for the traveler concerned about excessive airline luggage fees. They have two designs of carry-on luggage. The "Exec" is targeted to business travelers and the "Companion" for those on a holiday. The company used simple regression to budget indirect costs of \$823,400 based on the following equation:  $y = \$542,400 + \$5.62X$ , where  $X$  is 50,000 direct labour hours for a budgeted production of 250,000 units. At the end of the year the company's controller evaluated the actual costs for producing 220,000 units. Using simple regression that actual indirect cost of \$810,825; represented by the following equation  $y = \$535,400 + \$5.75X$  for the 47,900 actual direct labour hours.

Required:

- Determine the rate, efficiency/production-volume variances for the indirect costs.
- What statistical measure of serial correlation could the controller use to determine if the independence of the residuals is within an acceptable range?

Answer:

a.

$$\text{VMO rate variance} = (\$5.62 - \$5.75) \times 47,900 \text{ hours} = \$6,227 \text{ U}$$

$$\text{VMO efficiency variance} = (44,000^* - 47,900) \times \$5.62 = \$21,918 \text{ U}$$

$$\text{FMO budget variance} = (\$542,400 - \$535,400) = \$7,000 \text{ F}$$

$$\text{FMO production-volume variance} = \$542,400 - (44,000 \times \$10.848^{**}) = \$65,088 \text{ U}$$

$$* \text{ standard hours allowed for output achieved} = (50,000/250,000) \times 220,000 \text{ units} = 44,000 \text{ hours}$$

$$** \$542,400/44,000 \text{ hours} = \$10.848$$

b. Durbin-Watson statistic

Diff: 3 Type: ES

Skill: Analyze

Objective: LO 7-3; LO 8-2; LO 10-9

29) List and describe the assumptions that must hold if simple regression procedures are to give reliable estimates of coefficient values.

Answer:

- Linearity within the relevant range.** A common assumption that a linear relationship exists between the independent variable  $X$  and the dependent variable  $Y$  within the relevant range.
- Constant variance of residuals.** The vertical deviation of the observed value  $Y$  from the regression line estimate  $\hat{y}$  is called the *residual term*, *disturbance term*, or *error term*,  $u = Y - \hat{y}$ . The assumption of constant variance implies that the residual terms are unaffected by the level of the cost driver. The assumption also implies that there is a uniform scatter, or dispersion, of the data points about the regression line.
- Independence of residuals.** The assumption of independence of residuals is that the residual term for any one observation is not related to the residual term for any other observation. The problem of *serial correlation* (also called *autocorrelation*) in the residuals arises when there is a systematic pattern in the sequence of residuals such that the residual in observation  $n$  conveys information about the residuals in observations  $n + 1$ ,  $n + 2$ , and so on.
- Normality of residuals.** The normality of residuals assumption means that the residuals are distributed normally around the regression line.

Diff: 3 Type: ES

Skill: Remember

Objective: LO 10-9

Match the description with the appropriate term.

- A) specification analysis
- B) standard error of the regression
- C) Durbin-Watson statistic
- D) *t*-value
- E) heteroscedasticity
- F) autocorrelation
- G) homoskedasticity
- H) goodness of fit
- I) economic plausibility
- J) constant variance of residuals

30) Measures how large the value of the estimated coefficient is relative to its standard error.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

31) The testing of the assumptions of regression analysis.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

32) An alternative measure to the coefficient of determination ( $r^2$ ).

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

33) A criteria used to prevent the indiscriminate inclusion of independent variables that have an acceptable correlation.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

34) Measures the percentage of variation in Y (the dependent variable) explained by X (the independent variable).

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

35) The implication that error terms are unaffected by the level of the cost driver.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9



36) A constant variance of the residuals.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

37) A systematic pattern in the sequence of residuals.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

38) A measure of the serial correlation in the estimated residuals.

Diff: 2 Type: MA

Skill: Remember

Objective: LO 10-9

Answers: 30) D 31) A 32) B 33) I 34) H 35) J 36) G 37) F 38) C

10.10 Describe a learning curve model.

1) In the incremental unit-time learning model, the incremental unit time decreases by a constant percentage each time the cumulative quantity of units produced is doubled.

Answer: TRUE

Diff: 2 Type: TF

Skill: Remember

Objective: LO 10-10

2) A learning curve measures the effect of learning on efficiency.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-10

3) Plotting learning curve observations is helpful in selecting the appropriate learning curve model.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-10

4) When new products are introduced, learning-curve effects can have a major influence on production scheduling.

Answer: TRUE

Diff: 1 Type: TF

Skill: Understand

Objective: LO 10-10

5) It is appropriate to incorporate expected learning-curve efficiencies when evaluating performance.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-10

6) The cumulative average-time learning model with a 90% learning curve indicates that if it takes 100 minutes to manufacture the first unit of a new model, then the second unit will take only 90 minutes to manufacture.

Answer: FALSE

Explanation:  $100 \times .90 = 90$ ;  $(100 + X)/2 = 90$ ;  $X = 80$  minutes

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-10

7) The incremental unit-time learning model with a 90% learning curve indicates that if it takes 100 minutes to manufacture the first unit of a new model, then the second unit will take only 90 minutes to manufacture.

Answer: TRUE

Diff: 2 Type: TF

Skill: Understand

Objective: LO 10-10

8) A learning curve is a function that measures how labour-hours per unit decrease, as units of production increase.

Answer: TRUE

Diff: 1 Type: TF

Skill: Remember

Objective: LO 10-10

9) What is the time needed to produce the last unit when production doubles from 100 units to the 200 unit level, given that the incremental unit time learning model has a 60% learning curve, and the corresponding time at the 100 unit level of production is 4.0 minutes?

A) 8.0 minutes

B) 6.4 minutes

C) 4.0 minutes

D) 2.4 minutes

E) 1.6 minutes

Answer: D

Explanation: D)  $60\% \times 4.0 = 2.4$  minutes

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-10

10) When an average unit of time declines by a constant percentage each time that the cumulative quantity of units produced is doubled, it is known as

- A) cumulative average time.
- B) incremental unit time.
- C) last unit time.
- D) relative unit time.
- E) cumulative unit time.

Answer: B

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-10

11) A learning curve is a function

- A) that measures the decline in labour-hours per unit due to workers becoming better at a job.
- B) that increases at a greater rate as workers become more familiar with their tasks.
- C) where unit costs increase as productivity increases.
- D) that is linear.
- E) that measures productivity improvements from new technology.

Answer: A

Diff: 1 Type: MC

Skill: Remember

Objective: LO 10-10

12) An experience curve

- A) is a narrower application of the learning curve.
- B) measures the decline in cost per unit as production decreases for various value-chain functions such as marketing as production increases.
- C) only measures the decline in labour-hours per unit as units produced increases.
- D) measures the increase in cost per unit as productivity increases.
- E) measures the increase in labour-hours per unit as units produced increases.

Answer: B

Diff: 2 Type: MC

Skill: Remember

Objective: LO 10-10

13) To complete the first setup on a new machine took an employee 200 minutes. Using an 80% cumulative average-time learning curve indicates that the second setup on the new machine is expected to take

- A) 160 minutes.
- B) 120 minutes.
- C) 80 minutes.
- D) 60 minutes.
- E) 128 minutes.

Answer: B

Explanation: B)  $200 \times .80 = 160$ ;  $(200 + X)/2 = 160$ ;  $X = 120$  minutes

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-10

14) To complete the first setup on a new machine took an employee 200 minutes. Using an 80% incremental unit-time learning curve indicates that the second setup on the new machine is expected to take

- A) 160 minutes.
- B) 120 minutes.
- C) 80 minutes.
- D) 60 minutes.
- E) 128 minutes.

Answer: A

Explanation: A)  $200 \times .80 = 160$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-10

15) Vestor Ltd. has estimated a 90% cumulative average-time learning curve applies to labour time to manufacture its new product. The first unit took 18 hours. If Vestor's estimates are correct, how many hours will be used to manufacture 4 total units?

- A) 14.58 hours
- B) 64.80 hours
- C) 72.00 hours
- D) 64.01 hours
- E) 58.32 hours

Answer: E

Explanation: E)  $18 \times .9 \times .9 = 14.58$  average  $14.58 \times 4 = 58.32$  hours

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-10

16) Vestor Ltd. has estimated a 90% incremental unit time learning curve applies to labour time to manufacture its new product. The first unit took 18 hours. If Vestor's estimates are correct, how many hours will be used to manufacture 4 total units?

- A) 14.58 hours
- B) 64.80 hours
- C) 72.00 hours
- D) 64.01 hours
- E) 58.32 hours

Answer: D

Explanation: D) A 90% learning curve is a factor of  $-0.1520$  ( $\text{LN } 90\% / \text{LN } 2$ )

$18 + (18 \times .9) + 15.23 + 14.58 = 64.01$  hours  $15.23 = 18 \times 3^{-.1520}$

Diff: 2 Type: MC

Skill: Apply

Objective: LO 10-10

17) Each time Maiertree Care hires a new employee it must wait for some period of time before the employee can meet production standards. Management is unsure of the learning curve in its operations but it knows the first job by a new employee averages 60 hours and the second job averages 48 hours. Assume all jobs to be equal in size.

Required:

- a. What is the learning curve percentage, assuming the cumulative average-time method?
- b. What is the time for a new employee to build 16 units with this learning curve using the cumulative average-time method? Assume the rate of learning factor is -0.1520.

Answer:

a. Job	Hours	Cumulative	Cumul. Average
1	60	60	60
2	48	108	54

$$\text{learning percentage} = 54/60 = 0.90$$

$$\begin{aligned}
 \text{b. } Y &= p \times q \\
 &= 60 \times 16^{-0.1520} \\
 &= 39.366
 \end{aligned}$$

$$\begin{aligned}
 \text{or } 1 \text{ unit} &= 60 \\
 2 \text{ units} &= 60 \times 0.9 = 54.000 \\
 4 \text{ units} &= 54 \times 0.9 = 48.600 \\
 8 \text{ units} &= 48.6 \times 0.9 = 43.740 \\
 16 \text{ units} &= 43.74 \times 0.9 = 39.366
 \end{aligned}$$

$$16 \times 39.366 = 629.900 \text{ hours}$$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-10

18) Andrew Pallet Co., Inc. manufactures pallets for various manufacturing companies. Each new employee takes 10 hours to make the first pallet and 8 hours to make the second. The manufacturing overhead charge per hour is \$80.

Required:

- What is the learning curve percentage assuming the cumulative average method?
- What is the time needed to build 8 pallets by a new employee using the cumulative average-time method? Assume the rate of learning factor is -0.1520.
- What is the time needed to produce the 16th pallet by a new employee using the incremental unit-time method? Assume the rate of learning factor is -0.3219.

Answer:

a.	<u>Job</u>	<u>Hours</u>	<u>Cumulative</u>	<u>Cumul. Average</u>
	1	10	10	10
	2	8	18	9

$$\text{learning percentage} = 9/10 = 0.90$$

$$\text{Learning curve percentage} = 8/10 = 0.80$$

$$\begin{aligned} \text{b. } Y &= p \times q \\ &= 10 \times 8^{-0.1520} \\ &= 7.29 \text{ hours} \end{aligned}$$

$$\begin{aligned} \text{or } 1 \text{ unit} &= 10 \\ 2 \text{ units} &= 10 \times 0.9 = 9.00 \\ 4 \text{ units} &= 9 \times 0.9 = 8.10 \\ 8 \text{ units} &= 8.1 \times 0.9 = 7.29 \end{aligned}$$

$$\begin{aligned} \text{c. } Y &= p \times q \\ &= 10 \times 8^{-0.3219} \\ &= 4.096 \text{ hours} \end{aligned}$$

$$\begin{aligned} \text{or } 1 \text{ unit} &= 10 \\ 2 \text{ units} &= 10 \times 0.8 = 8 \\ 4 \text{ units} &= 8 \times 0.8 = 6.4 \\ 8 \text{ units} &= 6.4 \times 0.8 = 5.12 \\ 16 \text{ units} &= 5.12 \times 0.8 = 4.096 \end{aligned}$$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-10

19) Harry's Picture manufactures various picture frames. Each new employee takes 5 hours to make the first picture frame and 4 hours to make the second. The manufacturing overhead charge per hour is \$20.

Required:

- What is the learning-curve percentage, assuming the cumulative average method?
- What is the time needed to build 8 picture frames by a new employee using the cumulative average-time method? Assume the rate of learning factor is -0.1520.
- What is the time needed to produce the 16th frame by a new employee using the incremental unit-time method? Assume the rate of learning factor is -0.3219.

Answer:

a. Job	Minutes	Cumulative	Cumulative Average
1	5	5	5
2	4	9	4.5

$$\text{Learning percentage} = 4.5/5 = 0.90$$

$$\begin{aligned} \text{b. } Y &= p \times q \\ &= 5 \times 8^{-0.1520} \\ &= 3.65 \text{ hours} \end{aligned}$$

$$\begin{aligned} \text{or } 1 \text{ unit} &= 5 \\ 2 \text{ units} &= 5 \times 0.9 = 4.5 \\ 4 \text{ units} &= 4.5 \times 0.9 = 4.05 \\ 8 \text{ units} &= 4.05 \times 0.9 = 3.65 \text{ hours} \\ \text{Time to build 8 units: } 8 \times 3.65 &= \underline{\underline{29.2}} \text{ hours} \end{aligned}$$

$$\begin{aligned} \text{c. } Y &= p \times q \\ &= 5 \times 16^{-0.3219} \\ &= 2.048 \text{ hours} \end{aligned}$$

$$\begin{aligned} \text{or } 1 \text{ unit} &= 5 \\ 2 \text{ units} &= 5 \times 0.8 = 4 \\ 4 \text{ units} &= 4 \times 0.8 = 3.2 \\ 8 \text{ units} &= 3.2 \times 0.8 = 2.56 \\ 16 \text{ units} &= 2.56 \times .8 = 2.048 \text{ hours} \end{aligned}$$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-10

20) Joe's Copy Centre hires a new employee. Joe knows he has to be patient with the employee until the employee gains enough experience to meet production standards. Joe is unsure of the learning curve in his operation, but he knows the first job by a new employee averages 40 minutes and the second job averages 32 minutes. Assume all jobs to be equal in size.

Required:

- What is the learning-curve percentage, assuming the cumulative average-time method?
- What is the time for a new employee to do 32 jobs with this learning curve using the cumulative average-time method? You may use an index of -0.1520.

Answer:

a. <u>Job</u>	<u>Minutes</u>	<u>Cumulative</u>	<u>Cumulative Average</u>
1	40	40	40
2	32	72	36

$$\text{Learning percentage} = 36/40 = 0.90$$

$$\begin{aligned} \text{b. } Y &= p \times q \\ &= 40 \times 16^{-.1520} \\ &= 23.62 \text{ minutes} \end{aligned}$$

$$\begin{aligned} \text{or } 1 \text{ unit} &= 40 \\ 2 \text{ units} &= 40 \times 0.9 = 36 \\ 4 \text{ units} &= 36 \times 0.9 = 32.4 \\ 8 \text{ units} &= 32.4 \times 0.9 = 29.16 \\ 16 \text{ units} &= 29.16 \times 0.9 = 26.244 \\ 32 \text{ units} &= 26.244 \times 0.9 = 23.62 \text{ minutes} \end{aligned}$$

$$32 \times 23.62 = 755.827 \text{ minutes} = \text{Approximately 12 hours and 36 minutes}$$

Diff: 2 Type: ES

Skill: Apply

Objective: LO 10-10