Chapter 2
Cost Concepts, Behaviour, and Estimation
SOLUTIONS

LEARNING OBJECTIVES

Chapter 2 addresses the following learning objectives:

LO1 Explain the cost concepts and cost terms
LO2 Describe the different types of cost behaviour
LO3 Describe cost estimation techniques
LO4 Apply cost estimation techniques to determine the future costs
LO5 Utilize regression analysis in cost estimation
LO6 Appreciate the uses and limitations of cost estimates

These learning questions (LO1 through LO6) are cross-referenced in the textbook to individual exercises and problems.

QUESTIONS

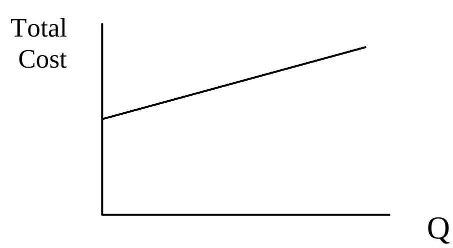
2.1 Fixed costs do not vary with small changes in activity levels. Fixed costs within a car rental agency include the salaries of managers, rent, lease, or depreciation on the building located on the rental lot, and advertising costs, among others.

2.2 Variable costs change proportionately with changes in activity levels. Variable costs in a car rental agency include the cost to wash each car, inspection costs after each rental, and the cost of maps and supplies for the paperwork for each rental, among others.

2.3 Mixed costs are partly fixed and partly variable. Examples of mixed costs in a car rental agency include the cost of wages if some part time workers have a regular schedule and others are called in during busy times. Another cost could be water used in washing the cars. Many water companies charge a flat fee for a minimum amount of water and then apply a charge that varies proportionately with the amount of water used.

2.4 Outliers do not reflect normal operations and are much higher or lower than the other observations. Because they lie outside the range of normal operations, they may bias the results of analysis when developing a cost function, resulting in estimates of cost that are either too high or too low.

2.5 This function has both fixed costs and variable costs. If at least part of the cost is variable; total cost increases as production volumes increase. If at least part of the cost is fixed, the average total per-unit cost decreases because the average fixed cost decreases as volume increases.



2.6 Several years' worth of data for August would be helpful for estimating the overhead cost function for subsequent Augusts, but the August data should not be used for estimating the overhead cost function for other months during the year. It is highly unlikely that the August data would reflect the data during normal operations. However, August's costs are probably a good estimate of the fixed costs for other months. When zero production occurs, only fixed costs are incurred.

2.7 Any changes in the operating environment will affect costs. Therefore, managers need to consider whether there are upcoming changes when they develop a cost function. Resource prices change from period to period, processes may become more efficient, or improvements may be made in overall operations or administrative functions. If the effects of these changes on costs are not considered, the cost function will not accurately predict costs.

2.8 The information leads to the conclusion that fixed costs exist because cost per unit changes between two levels of activity within the relevant range. The information is not sufficient to determine the amount of fixed costs or whether variable costs exist.

2.9 The opportunities foregone could include spectator or participative sports activities, movies, going out to dinner, the opportunity to work at a part-time job, etc. The relevant cash flows include the cost of transportation, parking, tickets, food and beverages, and so on. There is no way to assign a quantitative value to the social experiences. It is difficult to identify a true opportunity cost because the costs and benefits of the next best alternative must be compared. However, lost wages, less the cost of transportation, can be quantified if the next if the next best alternative is working.

2.10 Analysis of a scatter plot provides general information about whether a cost appears to be variable, fixed, or mixed. If there is a linear pattern in the scatter plot and the trend appears to go to zero, the cost could be variable. If a scatter plot with a linear trend intersects the vertical axis at a nonzero value, it could be mixed. If the pattern is linear with little or no slope, the cost could be fixed.

2.11 The pattern of a cost over time in the accounting system, together with knowledge of operations, is used to classify costs as variable, fixed, or mixed. Costs such as managers' salaries are usually fixed; they are often directly associated in the general ledger with a particular department or product. Costs for variable materials used in the production process are usually available in the general ledger or in production records. Costs such as manufacturing overhead are often mixed; they tend to include fixed costs such as insurance and property taxes for the plant and variable costs such as indirect supplies used in manufacturing. For costs identified as mixed, another cost estimation technique such as the two-point method or regression analysis must be used to determine the fixed and variable components.

2.12 Sunk costs are expenditures that have already been made. A common mistake that students make when dating is to consider their investment in time and money in deciding whether to break off a relationship that is no longer satisfactory. These are sunk costs that were invested to gather information about the person and relationship. A better decision can be made if only the current and relevant information is used in the decision. Students will have a variety of other examples from their personal experience.

2.13 Many factors affect accountants' abilities to identify measures used in a cost function. Historical data may be available and accurate, but cost behavior cannot be categorized perfectly for some costs. In addition, costs change over time and across a range of volumes, and these changes may be difficult to predict. If errors exist in the accounting records, costs will not be accurate and the cost function will not appropriately predict costs.

2.14 The trend line developed using regression analysis incorporates all of the cost observations, while the two-point method uses only two observations. Because there is fluctuation in cost over time, better estimates are developed using more observations, because they better reflect the past fluctuations and therefore should better estimate future fluctuations.

2.15 Small sample sizes may not reflect actual operations over a longer time period. Particularly if there is seasonality in production or sales, results from a small sample could be completely different from either the average volume of activity or the amount in high- or low-activity months.

MULTIPLE-CHOICE QUESTIONS

2.16 Which of the following statements is true?
- **a) A cost may be simultaneously direct and indirect to different cost objectives.**
- b) Indirect costs can be identified specifically with a given cost objective in an economically feasible way.
- c) Direct costs cannot be identified specifically with a given cost objective in an economically feasible way.
- d) Managers prefer to classify costs as indirect rather than direct.

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Ans: A

2.17 Costs that change abruptly at intervals of activity because the resources and their costs come in indivisble chunks are referred to as?
- a) Mixed Costs.
- **b) Stepwise Costs.**
- c) Variable Costs.
- d) Sunk Costs

Ans: B

Use the following information to answer Question 2.18 to 2.20.
KEI Ltd. had the following data for the first six months of 2012:

Month	Machine Hours	Maintenance Cost
January	2,150	$ 21,400
February	2,100	$ 21,400
March	2,400	$ 24,850
April	2,800	$ 27,700
May	2,800	$ 27,500
June	2,500	$ 24,100

2.18 What is the variable cost?
- a) $8.71
- **b) $9.00**
- c) $9.38
- d) $9.69

Ans: B High-Low method ($27,700 - $21,400) / (2,800 – 2,100) = $9.00 variable costs

2.19 What is the cost function for the maintenance cost?

a) Y = $ 562 + 9.69X
b) Y = $1,223 + 9.38X
c) Y = $2,500 + 9.00X
d) Y = $3,100 + 8.71X

Ans: C $27,700 - ($9.00 * 2,800) = $2,500 fixed costs; Y = $2,500 * 9.00X

2.20 KEI Ltd. Expects to use 2,650 machine hours in July. What would be the total maintenance cost, based on the cost function derived in 2.14?

a) $26,092.
b) $26,193.
c) $26,246.
d) $26,350.

Ans: D Y = $2,500 + $9.00 * 2,650 = $26,350

EXERCISES

2.21 Classification of Costs - Boca Manufacturers

Cost	Direct Cost	Indirect Cost	Variable Cost	Fixed Cost	Product Cost	Period Cost
Speaker	×		×		×	
Advertising		×		×		×
Design of LX Stereo	×			×	×	
Plant Janitor		×		×	×	
Machine Amortization		×		×	×	
Office Rent				×		×
Freight-in of components purchased		×	×		×	
Assembly workers	×		×		×	

2.22 Account Analysis Method, Cost Functions – Toonie Car Wash

Total Costs:	Var %	Variable	Fixed		
Direct Materials	$26,000	100%	$26,000	$0	
Direct Labour	38,000	100%	38,000	0	
Office Support	12,000	30%	3,600	8,400	
Utilities	40,000	20%	8,000	32,000	
Rent		42,000		0	42,000
Amortization	32,600		0	32,600	
	$ 75,600		$115,000		

A. Variable cost per car wash = $75,600/14,400 washes = $5.25 per car wash
Total fixed costs = $115,000

Cost Equation TC = $115,000 + $5.25*number of car washes

B. If Toonie has 16,800 car washes in 2013

TC = $115,000 + $5.25 * 16,800
= $203,200

C.

	Total Cost at 14,400 Washes	Increase	New Total Costs	Variable Rate	Variable portion	New VC/unit	New VC at 18,000 washes	New FC
Direct Materials	26,000	3%	26,780	100%	26,780	1.86	33,475	0
Direct Labour	38,000	4%	39,520	100%	39,520	2.74	49,400	0
Office Support	12,000	0%	12,000	30%	3,600	0.25	4,500	8,400
Utilities	40,000	0%	40,000	20%	8,000	0.56	10,000	32,000
Rent	42,000	4%	43,680	0%	0	0	0	43,680
Amortization	32,600	5%	34,230	0%	0	0	0	34,230
					77,900	5.41	97,375	118,310

Variable Cost / unit = $5.41 per car wash
Total Fixed Cost = $ 118,310

Cost Equation
TC = $118,310 + $5.41 * number of car washes
= $118,310 + $5.41 * 18,000
= $ 215,690

2.23 Cost Object, Cost Function Estimation, Opportunity Cost

A. Production of a high-definition flat screen monitor.

B. If all of the parts for the monitor are currently used in the organization, all of the information is likely to be contained in the accounting records. But new parts are most likely needed, since the monitor is a high-definition flat screen and probably involves different technology. Thus, estimates of costs from suppliers will be needed. In addition, estimates for the amount of labour time will be needed. Although labour cost per hour can be found in the records, the amount of labour time is likely to be different for this monitor than for other monitors. If machines are used in production, an estimation of machine hours is necessary to determine whether maintenance and repair costs will increase.

C. Estimating the cost of parts and the time involved in production is part of the engineered estimate of cost method.

D. The opportunity cost of using idle capacity for one product is the contribution of other uses of the capacity. If another product could be manufactured and sold, that product’s contribution margin is the opportunity cost. If the capacity can be rented or leased out, the rent or lease payments are the opportunity cost. If there are no other uses for the capacity, the opportunity cost is zero.

2.24 Direct and Indirect Costs - Frida's Tax Practice

Cost	Cost Object		
	Tax Department	Personal Returns	Mr. Gruper's Personal Tax Return
A. Subscription to personal tax law updates publication	D	D	I
B. Ink supplies for tax department photocopy machine	D	I	I
C. Portion of total rent for tax department office space	I	I	I
D. Wages for tax department administrative assistant	D	I	I
E. Tax partner's salary	D	D/I	D/I
F. Charges for long distance call to Mr. Gruper about personal tax return questions	D	D	D
G. Tax partner lunch with Mr. Gruper(the tax partner has lunch with each client at least once per year)	D	D	D

Explanation for Parts D and E: Notice that the wages of the tax department administrative assistant are considered a direct cost when the cost object is the entire tax department but are considered indirect for the other two cost objects. The benefits of tracking the cost at that level do not exceed the benefits of the information that would be obtained. For the firm to make this cost direct for the personal returns cost object, the administrative assistant would have to maintain detailed time records as to time spent working on personal returns versus corporate returns. Now notice that the tax partner's salary is considered a direct cost for all three cost objects. CAs do keep detailed time records. In a service business such as this, the CA's time is the product being sold. The time records that the tax partner maintains support this cost as a direct cost. Of course, the tax partner probably spends some time in non-billable activities, so a portion of his or her salary is direct only to the tax department and indirect to the two other cost objects.

2.25 Global Car Rental

A. Plan 1: Fixed cost
Plan 2: Variable Cost
Plan 3: Mixed Cost

B. Plan 1: Total cost for 4 days: $49.95 x 4 days = $199.80;
Average cost per day: $199.80 ÷ 380 km = $0.53/km

Plan 2: Total cost for 4 days: $0.5 x 380 km = $190.00
Average cost per day: $190.00 ÷ 380 km = $0.50/km

Plan 3: Total cost for 4 days: $24.95 x 4 days+ ($0.25 x 380 km) = $194.80

Average cost per day:	\$194.80 ÷ 380 km = \$0.51/km

C. Plan 1: $49.95 x 1 day = $49.95 with unlimited mileage

Plan 2:
(1) \$0.5 x 50 km = \$ 25
(2) \$0.5 x 100 km = \$50
(3) \$0.5 x 250 km = \$125

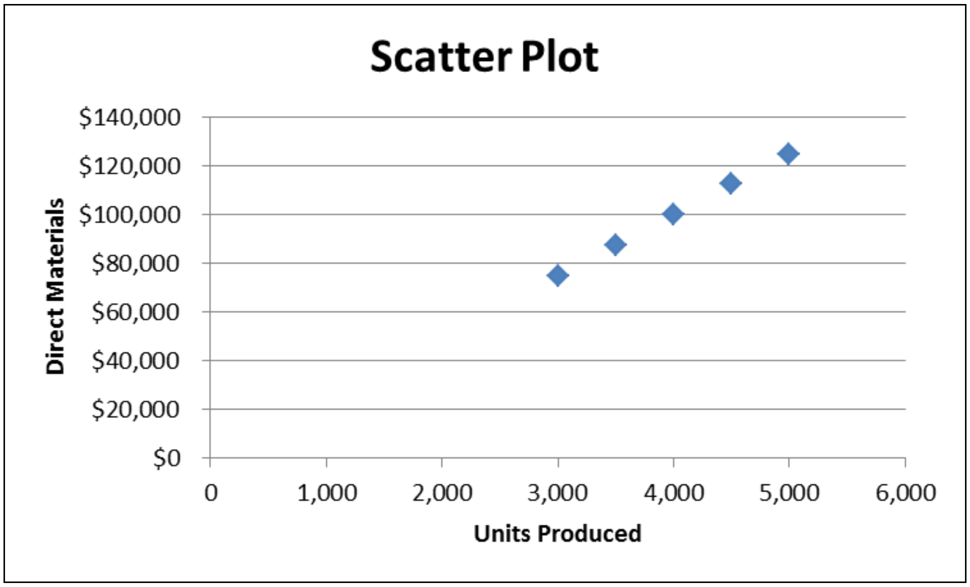
Plan 3:
(1) \$24.95 x 1 day + \$0.25 x 50 km = \$37.45
(2) \$24.95 x 1 day + \$0.25 x 100 km = \$49.95
(3) \$24.95 x 1 day + \$0.25 x 250 km = \$87.45

If she plans to drive 50 km, then she should choose Plan 2. If she plans to drive more than 99 km, then she should choose Plan 1.

2.26 Toyco

A. Direct labour appears to be a fixed cost; therefore, the cost function is TC = $95,000.

B. There are no apparent outliers; all of the observations appear to be close to or on the same slope line:



C. Using the high-low method:

(125,000 – 75,000)/(5,000 – 3,000) = 50,000/2,000 = $25 per unit

TC = F + VQ, so $125,000 = F + ($25×5,000)
$125,000 = F + $125,000
So F = 0; Direct materials are a variable cost.

The cost function is: TC = $0 + $25×Units Produced

The output from regression analysis is shown below. Because there is no variation (i.e., materials always cost $25 per unit), the statistics are not meaningful. Regression analysis indicates the same cost function as calculated above using the high-low method:
TC = $0 + $25×Units Produced

SUMMARY OUTPUT

Regression Statistics	
Multiple R	1
R Square	1
Adjusted R Square	1
Standard Error	0
Observations	5

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-2.91E-11	0	65535	#NUM!
Units Produced	25	0	65535	#NUM!

2.27 Barney's Pizza

A.

Fixed costs	
Rent	$ 400
Depreciation	80
Insurance	100
Advertising	60
Manager salary	1,400
Cleaning supplies	15
Utilities	110
Total	$ 2,165
Variable costs	
Wages	$ 2,340
Toppings	180
Dough	240
Paperware	75
Soft drinks	375
Total	$ 3,210
	/600 pizzas
Variable cost per pizza	$ 5.35

TC = $2,165 + $5.35×Number of pizzas

Students might have made different assumptions about the behavior of some of the costs. For example, at least some of the part-time help wages is likely to be fixed because a minimum number of workers is needed when the pizza parlor is open. Thus, it would be reasonable to classify wages as a fixed cost.

B. Total cost for 700 pizzas: TC = $2,165 + $5.35×700 pizzas = $5,910

C. Assumptions: Fixed costs remain fixed within the relevant range, and variable costs remain constant within the relevant range.

Factors that could cause the assumptions to be incorrect next month include the following. Students may think of other factors.

- Changes in any of the individual fixed costs, such as an increase in rent or insurance
- Changes in purchase price for variable costs such as the pizza dough, sauce, or soft drinks
- Change in the customer tastes leading to a change in the proportion of different types of pizzas sold, in turn changing the average cost of toppings or other ingredients

2.28 Cost function, rejection rate

A. Average wage per hour: ($28+$20+$16+$16+$12)/5 = $18.40 per hour.

Employees work 7 out of 8 hours or 87.5% of the time, so the effective rate wage rate for production time = $18.40/0.875 = $21.03 per hour.

Twenty units can be made per hour, but 10% (2 units) are defective, so 18 good units are made.

Direct labour cost per unit = $21.03/18 = $1.17 per good unit

B. Arguments can be made for either treatment:
- Including the cost of a temp worker as part of overhead would increase the accuracy of the cost function for direct labour cost. Illnesses cannot be predicted, so the number of absences (temp workers) cannot be predicted.
- If this cost is added to overhead, the total employee cost will always be underestimated by the amount paid to the temp workers, which could be a problem. This method would reduce the amount of bookkeeping because hours do not have to be tracked to individual batches or units.
- No matter how it is recorded, the cost of temp labour will be treated as product costs in inventory and cost of goods sold.

2.29 Equipment maintenance department

A. Following are the cost categorizations

	Fixed	Variable
Manager's salary	$3,200	
Supplies		$5.23
Insurance	250	
Electricity	62	
Property tax	100	
Repair manuals	90	
Total	$3,702	$5.23

Supplies: Monthly average cost per service call = $5.22, 5.25, $5.25, and $5.20. This cost appears to be variable. The average cost for the four months was $5.23.

Electricity: Varies with weather, so May's bill may best reflect costs in June

Property tax: Should be assigned monthly. The total cost is $1,200 for 12 months, or $100 per month.

Repair manuals: This is a fixed cost that varies slightly from month to month. The best estimate is the average cost over the four months, or $90 per month.

B. Overhead cost for June = $3,702 + $5.23×135 = $4,408.05

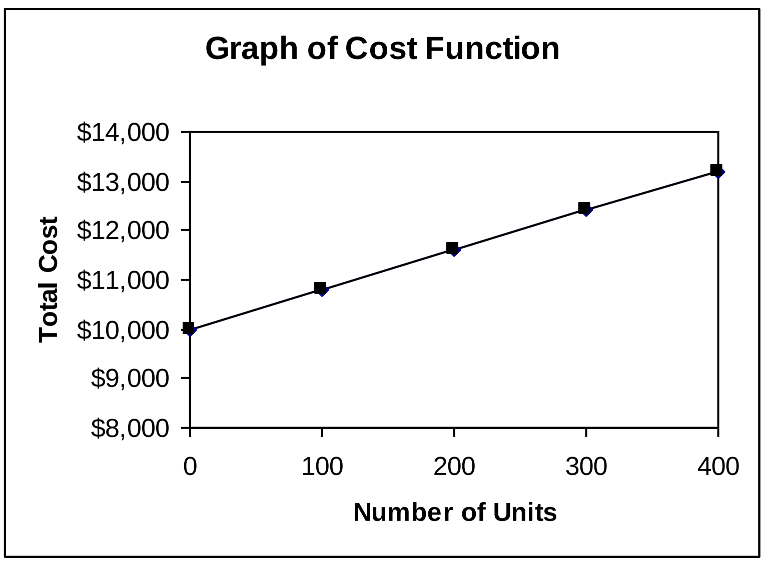
C. Average overhead cost = ($3,819+$3,939+$4,730+$4,252)/(90+110+140+125) = $36.00

Estimated cost for 135 units = $36.00×135 = $4,860.00
Note: This estimate is likely to overestimate cost because fixed costs in prior periods are spread over fewer units, on average.

D. Developing a cost function with fixed and variable costs is more accurate than using average costs. An average cost would only be accurate if the value of the numerator used to determine the average was the same number used in future predictions. If volume is greater than this amount, the cost estimate will be too high; and if the volume is less than this amount, the estimate will be too low.

2.30 Linear, Stepwise Linear, and Piecewise Linear Cost Functions

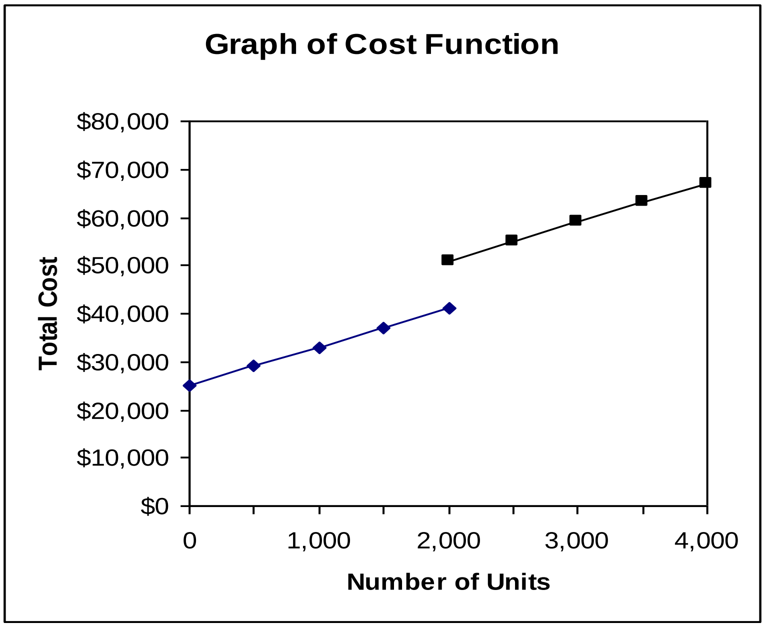
A. TC = $10,000 + $8.00*Q



The cost function includes the following assumptions:

- Operations are within a relevant range of activity
- Within the relevant range of activity:
    - Fixed costs will remain fixed
    - Variable cost per unit will remain constant

B. TC = $25,000 + $8.00*Q, for Q ≤ 2,000
TC = $35,000 + $8.00*Q, for Q > 2,000



C. To estimate the costs at another production level, it is first necessary to estimate the cost function.

Convert the average costs to total costs for each production level:

Total cost at 10,000 units = 10,000 * $45 = $450,000
Total cost at 12,000 units = 12,000 * $44 = $528,000

Calculate the variable cost per unit using the Two-Point method:

$$\frac{\text{Change in cost}}{\text{Change in volume}} = (\$528,000 - \$450,000)/(12,000 - 10,000)$$
$$= \$78,000/2,000 = \$39 \text{ per unit}$$

Use one data point in the total cost function and solve for F:

Using the data for 10,000 units:
$450,000 = F + $39*10,000
F = $450,000 - $390,000 = $60,000

Combining the fixed and variable costs to create the cost function:

TC = $60,000 + $39*Q

Estimated total cost at 15,000 units:

TC = $60,000 + $39*15,000 = $60,000 + $585,000 = $645,000

Estimated cost per unit = $645,000/15,000 = $43

D. Inserting $10,000 in revenues into the cost function, total cost is estimated as:

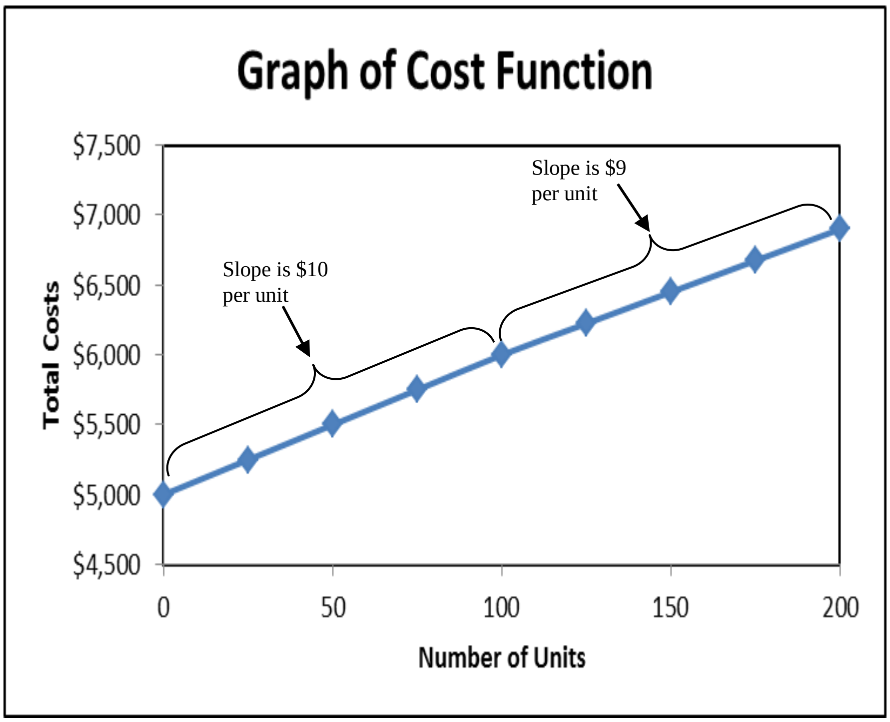
TC = $5,000 + 45%*$10,000 = $9,500

2.31 Piecewise Linear Cost Function, Regression Measurement Error

A. TC = $5,000 + $10.00*Q, for Q ≤100

For Q > 100:

TC = $5,000 + ($10.00 * 100) + ($9.00*(Q-100))
TC = $5,000 + $1,000 + $9.00*Q - $900
TC = $5,100 + $9.00*Q



B. If the accountant did not detect that there were two different relevant ranges, the cost function mismeasurement depends on the values of Q. There are three general situations:

1. If all of the data estimation points occurred when Q was ≤ 100 units, then the cost function would appear to be: TC = \$5000 + \$10.00*Q. This cost function would provide reasonable estimates for Q ≤ 100 units but would overestimate total cost for Q > 100 units.

2. If all of the data estimation points occurred when Q was > 100 units, then the cost function would appear to be: TC = \$5,100 + \$9.00*Q. This cost function would provide reasonable estimates for Q > 100 units but would underestimate total cost for Q ≤ 100 units.

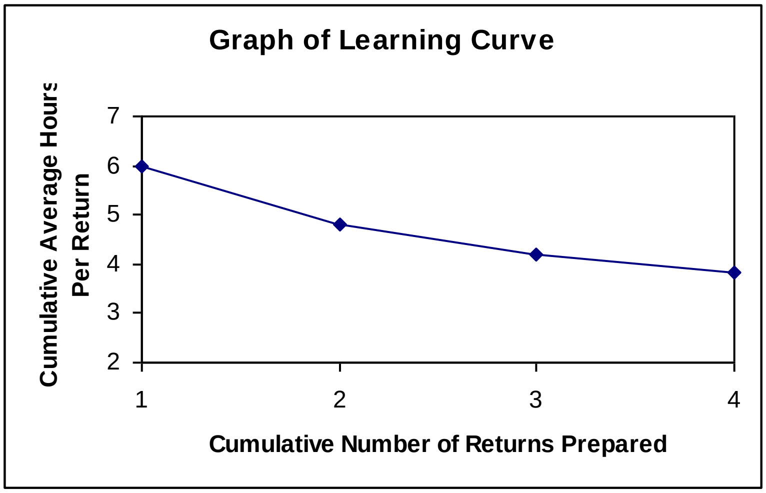
3. If the data estimation points occurred across the two relevant ranges, then the cost function would be some mixture of the functions for the two relevant ranges. This cost function will either overestimate or underestimate costs for almost any level of Q (see Exhibit 2A.3 and 2A.4.

2.32 Learning Curve, Graphing - Tax Plus

A. Hours for two returns would be determined as follows; using the learning curve equation $Y = \alpha X^r$

Learning rate = 80%
α = 6 hours
X (units produced) = 2
Learning rate = (ln 0.80/ln2) = –0.3219
$Y = 6 \text{ hours} * 2^{-0.3219}$
Y = 4.8 hours (average time for each of the next two returns)

B.



As the accounting graduates become more familiar with the tasks involved in preparing simple tax returns, their productivity increases. However, as their performance improves, it improves less quickly for the next return. Eventually their learning will plateau, and their productivity rate will remain stable.

2.33 Cost Function and Assumptions - Bison Sandwiches

A. If total variable costs were $8,000 on total sales of $32,000, then variable cost per dollar of revenue is calculated as follows:
$8,000/$32,000 = 0.25, or 25% of sales

Combining fixed and variable costs, the cost function is:
TC = $20,000 + 25%*Total sales

B. Assumptions: Fixed costs remain fixed in total within the relevant range, and variable costs/unitremain constant within the relevant range. In addition, this particular cost function assumes that variable costs are driven by sales. Chapter 3 will point out another assumption for this cost function: the sales mix (the proportion of sales of different products) remains constant within the relevant range.

2.34 Direct and Indirect Costs; Fixed, Variable, and Mixed Costs - Glazed Over

[*Note about problem complexity*: Items F and H are coded as “Extend” because judgment is needed for categorization.]

A. D or I, F Assuming that employee time can be traced to each bowl, wages are a direct cost. However, if time is not traced to individual bowls (for example, if the employee performs different types of tasks and records are not kept of the types of work performed) or if the employee does not work directly in production, then wages would be an indirect cost. Wages are fixed because they remain constant (the employee always works 40 hours).

B. D, V Assuming that the cost of clay can be traced to each bowl, it is a direct cost. Total clay cost will vary with the number of bowls made.

C. I, F Depreciation on the kilns is indirect because it cannot be directly traced to individual bowls, that is, it is a common cost of production for all of the bowls that are heat-treated in the kiln. The cost probably does not depend on production volume (assuming depreciation is not based on units produced), making it a fixed cost. Note: Depreciation using a method such as declining balance is not constant over time, but would still be considered fixed because it does not vary with production volume.

D. D or I, V If the glaze is expensive and therefore a relatively large cost, it is most likely traced to individual bowls, making it a direct and variable cost. If the cost of glaze is very small, it might not be traced to individual bowls, making it an indirect cost. Also, if the cost is small it might be grouped with overhead costs (variable).

E. I, V or F Brushes for the glaze are most likely used for multiple bowls, making them a common cost for multiple units and an indirect cost. They might be fixed or variable, depending on whether they are “used up” after a certain quantity of production.

F. I, F or M Electricity is an indirect cost because it cannot be traced to individual bowls. It might be fixed or mixed, depending on what causes the cost to vary. If the kiln is electric, part of the cost might vary proportionately with volume.

G. I, F The business license is not related to production, making it an indirect cost. It is mostly likely a flat fee or is calculated on a basis unrelated to production volume, making it a fixed cost.

H. I, F Advertising is not directly related to production, making it an indirect cost. This cost is also discretionary, so it is treated as fixed.

I. I, F or M Pottery studio maintenance is an indirect and fixed cost if it is the same payment every week. If it is an hourly charge, it is probably a mixed cost, because the production area may need more cleaning as volumes increase.

J. D or I, V Assuming that the cost of packing materials is traced to each bowl, this is a direct cost. If the packing materials are not traced (for example, if the cost is too small to justify tracing them), then this cost could be indirect. Packing costs are most likely variable because they will increase as production increases.

2.35 Cost Function, Opportunity Cost, Relevant Costs - Yummy Yogurt

[*Note about problem complexity*: Item A is coded as “Extend” because judgment is needed for categorization.]

A.

	Fixed	Variable
Cost of ingredients		$4,500
Rent	$1,000	
Store attendant salary	2,300	
Total costs at $9,000 in sales	$3,300	$4,500

B. In many organizations, costs vary with dollars of revenue. In this type of situation, total revenue (TR) instead of quantity (Q) can be used in the cost function:

Total variable cost/Total revenue = $4,500/$9,000 = 0.50, or 50% of revenue

Combining fixed and variable costs, the cost function is:

TC = $3,300 + 50%*Total revenue

C. The opportunity cost is the lost contribution margin from the products sold with the flavor that has been replaced.

D**.** The cost of rent is irrelevant because it will not change with either alternative.

2.36 Relevant Costs; Fixed, Variable, and Mixed Costs - Pizza Shop and Fishing Boat

[*Note about problem complexity*: Items C, E, F, and G require substantial business knowledge and/or ability to visualize cost behavior.]

A. B; F, V, or M
There would most likely be hourly wages in both types of businesses (assuming employees are hired). In the pizza shop, employees are likely scheduled in advance on a fixed schedule. Some may be sent home if business is very slow. Therefore, these costs would be mixed with a large proportion of the cost fixed. Hourly wages on the fishing boat most likely vary with the number of days or hours the boat is out fishing. While hourly wages may be related to number of fish caught, because of uncertainty in the success of each fishing expedition, they are more likely related to time on the boat than pounds of fish.

B. PS; V
Ingredients are used in making pizzas, and the cost would vary with number of pizzas produced. There most likely would not be any ingredients in a fishing boat business.

C. B; F or M
Employee benefits occur in any business in which employees are hired. Benefits might include mandated items such as Canada pension plan, workers' compensation, and employment insurance, as well as voluntary items such as health insurance and retirement benefits. Benefit costs often vary with level of wages or salaries, so they would tend to be fixed or mixed (see Item A above).

D. FB; F
There would be no reason to incur fishing equipment costs in a pizza business. In the fishing boat business, this cost would most likely be fixed because the cost would not vary within a relevant range of activity.

E. B; F
Some type of utility costs (such as water and electricity) would be incurred in both types of business, although the cost would probably be much higher for the pizza business because of the utilities needed to run the pizza shop. For the fishing boat business, there might be some utility costs for the fishing operation and for a business office. In general, the utility costs for these two businesses would tend to be fixed (would not vary with production).

F. PS; F
Most pizza shops incur advertising costs such as flyers, newspaper advertisements, and yellow pages advertisements. If the fishing boat is for tourists, advertising costs would be incurred, however it would be unusual for a commercial fishing boat business to incur

advertising costs because the customers are most likely canneries and distributors with whom the fishermen have an ongoing relationship. Because advertising costs tend to be discretionary, they are treated as fixed costs.

G. B; F or M
Any type of business will have insurance costs. The cost might be fixed or mixed, depending on how the insurance cost is calculated. It will be a fixed cost if it is a flat amount, but it might be mixed if a portion of the cost relates to levels of business activity.

2.37 Nursery Supply

A. Each cost function is written using the regression intercept term as the fixed cost and the slope as the variable cost:
   1. TC = $55,000 + $21.00 × assembly hours
   2. TC = $20,000 + $31.00 ×labour hours
   3. TC = $38.00 × machine hours (*Note:* Because the p-value for the t-statistic is 0.25, the intercept is not statistically different from zero. Therefore, the fixed cost is assumed to be zero.)

B. Assembly hours explain about 31% of the variation in overhead. The remaining 69% is unexplained.

C. The p-value for the intercept in the regression of overhead cost against machine hours is 0.25. This means that there is a 25% probability that the intercept (fixed cost) is zero instead of $10,000. If this cost is used in a cost function, it will be zero one out of four times, which means that it is not a very accurate reflection of the expected cost.

D. The p-value of the slope in the labourhours regression is 0.01, which means that there is a 1% probability that the variable cost for overhead related to labour hours could be zero instead of $31.00 per labour hour.

E. The highest adjusted R-Square is 70% for machine hours. The intercept coefficient has a high p-value, so if we assume there is a fixed cost portion in total cost, we have a 25% chance of being wrong. Therefore, we ignore the fixed cost and assume that the overhead cost is strictly variable. Because the adjusted R-Square is higher than the other two models, machine hours is the best cost driver.

F. Managers cannot know future costs. Nevertheless, they need to estimate these costs to make decisions. A cost function helps managers estimate future costs; it can also be updated to incorporate current estimates of future costs so that predictions are as precise as possible. Using a model such as the cost function also helps managers be more methodical in their approach to cost estimation, improving the quality of cost estimates. Higher quality estimation methods provide higher quality information for decision making.

2.38 Engineered Estimate of Cost, Cost-Based Price - Hamburger Haven

Following are calculations for the cost per unit of each ingredient and the cost of plain and cheeseburgers:

		Cost per Unit	Plain	Cheeseburger With Everything
1.	Hamburger patty ($1.69/7)	$0.2414	$0.2414	$0.2414
2.	Hamburger bun ($1.29/12)	0.1075	0.1075	0.1075
3.	Dill pickles [($8.95/2,000) * 4]	0.0179		0.0179
4.	Tomato ($.69/8)	0.0863		0.0863
5.	Lettuce ($.59/40)	0.0148		0.0148
6.	Mayonnaise [$1.49/(16 x 4)]	0.0233		0.0233
7.	Mustard ($.79/150)	0.0053		0.0053
8.	Catsup ($.99/50)	0.0198		0.0198
9.	Cheese ($2.59/16)	0.1619		0.1619
10.	Onions ($.15/45)	0.0033		0.0033
			$0.3489	$0.6815

A. Cost of plain burger = $0.3489 (calculated above)

B. Cost of burger with everything except cheese = ($0.6815 - $0.1619) = $0.5196

Suggested selling price: 300% * $0.5196 = $1.56

C. Selling price of cheeseburger with everything: 300% * $0.6815 = $2.04

Therefore, the price of the plain hamburger should be: $2.04 - $0.25 = $1.79

Some students will view this higher price as "unfair." However, there is no moral obligation to maintain a 300% markup on each item. It is just a general guideline. Market forces will dictate achievable prices.

D. In the current business environment, most organizations are price takers, that is, they set prices considering their competitors' prices. If Ms. Long's prices are too high, volumes will drop because customers will go to other fast food restaurants that sell hamburgers. Alternatively, if her prices are too low, she foregoes profits and people may believe there could be quality problems with her food. Therefore, she needs to know what competitors charge for a similar quality sandwich and price hers competitively. This means that her costs need to be below the competitive price. Alternatively, if Ms. Long is able to differentiate her hamburgers from others in the market, then she may be able to charge a price that is higher than competitors—as long as customers are willing to pay the higher price.

2.39 Fixed, Variable and Mixed Costs - Spencer and Church

[*Note about problem complexity:* These are difficult questions because students will need to first visualize the costs (with very little information) and then apply chapter concepts. The Step 2 questions (A, B, and F) are the ones requiring significant assumptions to generate an answer.]

A. Staff wages – Could be variable or mixed (salary + overtime) for regular staff. If there is part time help, that cost would be variable; However staff are often salaried, in which case the total cost would be primarily fixed.

B. Clerical wages – Fixed unless overtime is regularly scheduled, and then mixed

C. Rent - Fixed

D. Licenses- Fixed

E. Insurance- Fixed

F. Office supplies - Mixed, mostly variable

G. Professional dues- Fixed

H. Professional subscriptions- Fixed

I. Canada Pension Plan – Mixed – assuming most employees are paid the same amount each pay period the CPP would be fixed each period until employees reach the maximum CPP per year and then their CPP will decline and become zero. Other employees may never reach the maximum so their CPP will remain. If employees are paid overtime their CPP will be adjusted accordingly with their pay. CPP is mostly fixed but may vary from pay period to pay period.

J. Property taxes- Fixed

K. Advertising – Fixed

2.40 Cost Function Using Regression, Other Potential Cost Drivers

A. TC = $222.35*units sold. (Notice that the T-statistics on the fixed costs indicate that it is not likely to be different from zero. Therefore, the fixed cost is set at zero.)

B. The adjusted R-Square indicates how much of the variation in the marketing department cost can be explained by variation in units sold. In this problem, the variation in units sold explains about 61% of the variation in marketing department cost.

C. Other possible cost drivers for marketing department costs could be revenue, number of advertisements placed, or profits. In addition, it is possible that marketing costs are discretionary. The cost analyst needs to gather information about how marketing costs are set each year. For example, the analyst could ask the CFO whether the marketing department budgets its costs through a negotiation process with top management. If this is the case, the cost is discretionary and will be set through the negotiating process.

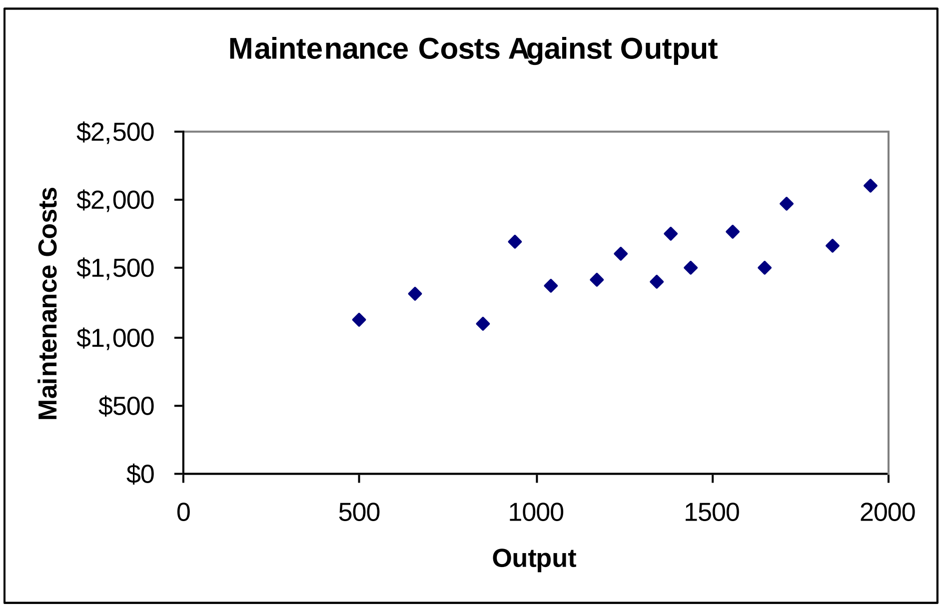
2.41 Scatter Plot, Cost Function Using Regression, Three Potential Cost Drivers - Central Industries

The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available at www.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A.

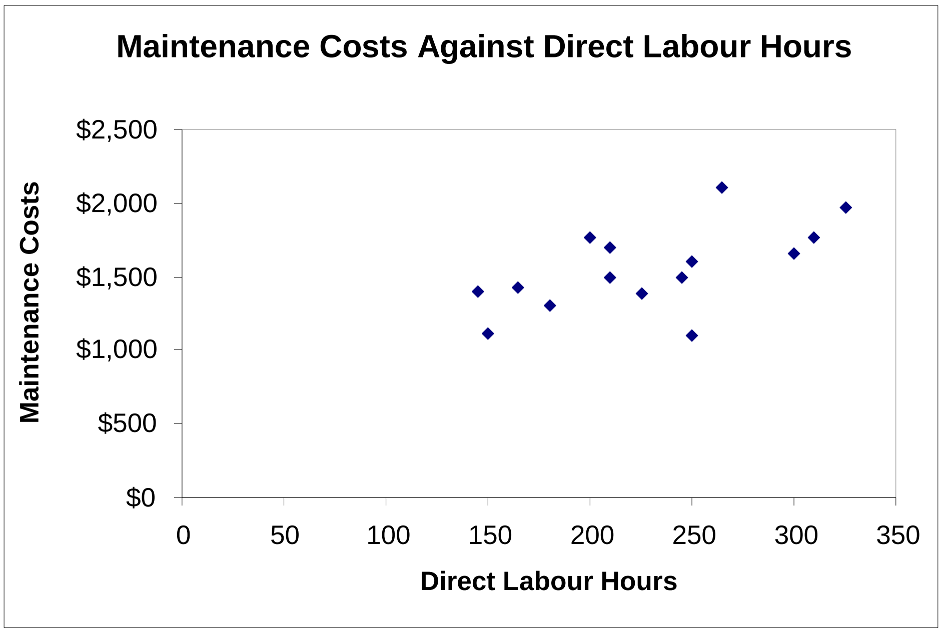
Potential Cost Driver: Output



Regression Statistics	
Multiple R	0.78591283
R Square	0.61765897
Adjusted R Square	0.58824812
Standard Error	182.119724
Observations	15

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	884.026826	153.4342166	5.761602	6.58E-05
Output	0.52099624	0.113687834	4.582691	0.000514

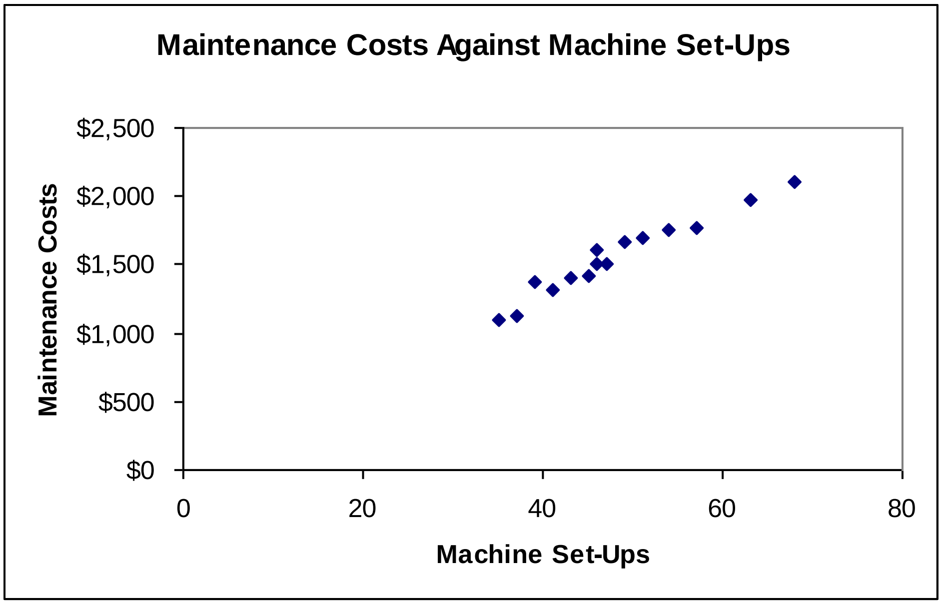
Potential Cost Driver: Direct Labour Hours



Regression Statistics	
Multiple R	0.60187065
R Square	0.36224828
Adjusted R Square	0.31319046
Standard Error	235.210849
Observations	15

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	861.457384	261.7549386	3.291084	0.005847
Direct Labour Hours	3.02569657	1.113464425	2.717372	0.017601

Potential Cost Driver: Machine Setups



Regression Statistics	
Multiple R	0.97410583
R Square	0.94888217
Adjusted R Square	0.94495003
Standard Error	66.5913391
Observations	15

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	126.815737	93.42597461	1.357393	0.197755
Machine Setups	29.6778973	1.910475729	15.5343	8.96E-10

B. In a scatter plot, a good cost driver would presenta linear or football-shaped positive slope or trend. If the observations are widely scattered, the cost driver does not explain the variation in cost and either it is the wrong driver, or the cost is mostly fixed. In Part A, all three potential cost drivers appear to be positively related to maintenance costs. However, machine setups appears to be the most likely cost driver and direct labour appears to be the least likely cost driver. Sometimes a cost that is mostly variable can be identified from a scatter plot. For example, the trend line for machine setups looks as if the intercept could be zero or very close to zero. This indicates that the cost could be totally variable.

C. The regression results and cost function for the three potential cost drivers are:

Potential Cost Driver	Adj. R-Square	Cost Function
Output	0.588	TC = $884 + $0.521*Output
Direct labour hours	0.313	TC = $861 +$3.026*Direct Labour Hours
Machine setups	0.945	TC = $29.68* Machine Setups

The machine setups intercept coefficient is not significant, so it is excluded from the cost function.

The regression using machine setups has the highest adjusted R-Square of 0.945. This means that variation in setups explains about 95% of the variation in cost.

D. In the machine setups regression, the t-statistic is significant for the independent variable but not for the intercept. This provides confidence that the variable cost part of the cost function is not zero, but does not provide confidence that the intercept (fixed cost) part of the cost function is different from zero. Therefore, the cost is likely to be totally variable. The cost function is in C above.

E. The use of past cost data to predict the future assumes that future resource costs and volumes of activities will remain the same as in the past. Changes in many factors such as resource prices, business processes, the economic environment, and technology can cause future costs to be different than estimated.

PROBLEMS

2.42 Cost Function Using High-Low and Regression, Quality of Cost Estimates - Big Jack Burgers

A. Total revenue (TR) instead of quantity (Q) in the cost function because sales is a potential cost driver. Under the high-low method, the cost function is calculated using the highest and lowest values of the cost driver. First, the variable cost is calculated:

($68,333 – $43,333)/($1,132,100 – $632,100)
= $25,000/$500,000
= 0.05, or 5% of sales

The fixed cost is determined by substituting the variable cost into one of the high-low data points:

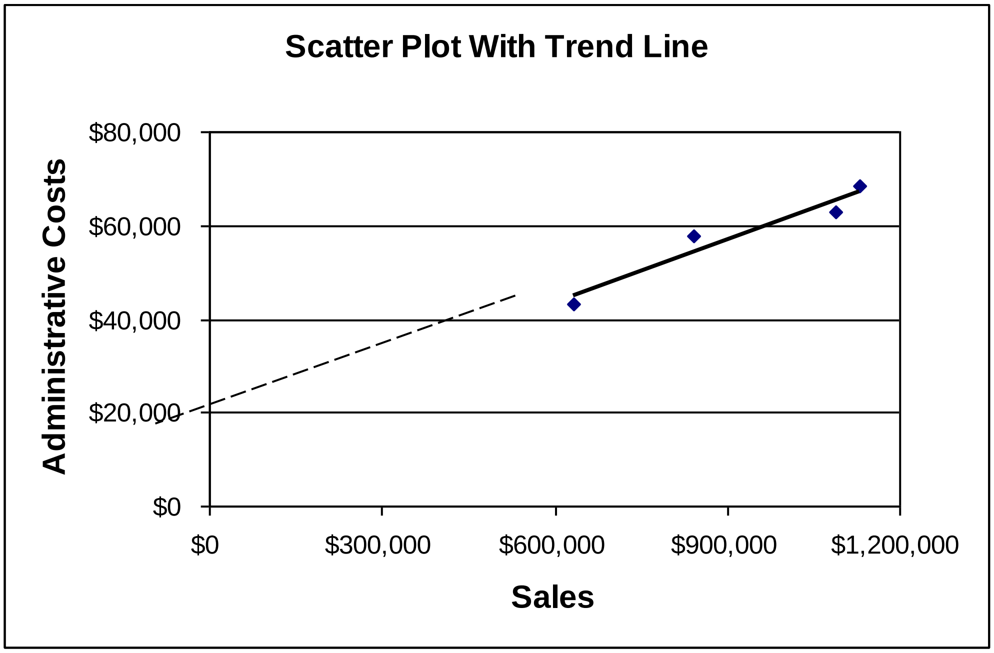
$68,333 = F + 5%*$1,132,100
F = $68,333 - $56,605 = $11,728

Thus, the total cost function is:

TC = $11,728 + 5%*Sales

B. The high low method uses the most extreme cost driver values, which could be outliers, that is, not represent the cost most of the time. That means that the cost function might not represent the actual cost, on average. Therefore, this cost function might provide poor estimates of future costs.

C. Chart of data with trend line added by Excel; trend line extended to Y-axis (dashed line) using Word:



It appears that the cost is most likely mixed. There is a general downward slope (variable cost) that appears to meet the intercept enough above zero to suggest a fixed cost. The upward slope of the line indicates that there are variable costs.

D. Following is the regression output. A t-statistic greater than 2 is often interpreted as meaning that the coefficient is significantly different from zero. Notice that the t-statistic for the intercept coefficient is 2.172, but the p-value is greater than 10% at 0.162. Based on the p-value, there is a 16% probability that the intercept (fixed cost) is not different from zero.Because this regression has few observations, the p-value result for the t-statistic is atypical. Additional judgment is requiredto decide whether it is appropriate to include a fixed cost in the cost function.

Analysis at the account level can be used to increase the understanding of this cost. If this cost pool includes items such as salaries and other fixed costs (insurance, etc), the regression intercept can be used as an estimate of the fixed costs. Then, the cost function would be **TC = $16,800 + 4.5% x sales**. Alternatively, analysis at the account level might indicate that there are few fixed costs. In that case, fixed costs are likely to be zero and would be excluded from the cost function. Then, the cost function would be: **TC = 4.5% x sales**

Regression Statistics	
Multiple R	0.9680477
R Square	0.93711636
Adjusted R Square	0.90567454
Standard Error	3293.4038
Observations	4

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	16800.2444	7734.73545	2.17205158	0.16197623
X Variable 1	0.04466925	0.00818212	5.45937486	0.0319523

E. Because of unforeseen changes in cost behavior, a cost function may not provide a good estimate for the next month's costs. The past costs used for estimation might not be representative, especially because so few observations were used in the estimation. Sales might not be the activity that drives administrative costs. There might be a change in business operations or in the economy that would cause future costs to be different than in the past. There might be a large discretionary component in administrative costs, causing fluctuations in cost that are unrelated to any cost driver.

F. There is a positive or upward sloping trend line indicating that sales is an economically plausible cost driver for administrative costs.

2.43 Scatter Plot, Cost Function Using Regression

A. The plot shows costs that are widely scattered. However, there does appear to be a general upward trend. Sales does not appear to explain much of the variation in research and development costs.

B. Using the regression results, the cost function is:

TC = $50,365 + 0.82%*Sales

C. The adjusted R-Square statistic is very low at 0.186. This means that variation in sales explains only about 18% of the variation in research and development cost. Future costs are not likely to be estimated accurately if the cost driver explains only a small part of the variation in the cost.

D. Several very general assumptions apply to a linear cost function. First, the cost is assumed to be linear within the relevant range. Therefore, fixed costs would remain fixed and variable costs would remain constant within that range. When regression analysis is used to specify a cost function, the underlying cost function is assumed to be linear and that the cost driver is assumed to be economically plausible as a cost driver, that is, the relation makes sense from an economic standpoint. In this problem, assuming that the cost function is linear may not be appropriate. The scatter plot shows little evidence of linearity. In addition, research and development cost is often discretionary. These costs are set by decision, usually annually. Managers set the costs depending on the organization's strategies and funds available for research and development. Better cost estimates for discretionary costs can be obtained by gathering information about planned expenditures from the department head or from the managers who are responsible for costs.

2.44 Cost Driver, Cost Categories, Appropriateness of Regression, Relevant Information - Susan's Telephone Service

A. The cost driver for long distance calls is the number of minutes on the telephone.

B. The fixed cost is the $20 flat fee. The variable cost is 10 cents per minute for those minutes over 500 per month.

C. Regression is useful for estimating a cost function when fixed and variable costs are unknown. In this problem, Susan already knows the cost function, so she does not need to estimate the cost function using regression or any other estimation technique.

D. Yes, to make a decision she needs to compare her costs under the old plan to what costs would be under the new plan.

E. She cannot be certain that she will use the same amount of time, on average, as she has in the past. Since her consulting work varies, the number of calls and whether they are long distance or local calls will vary.

F. Additional information could include the location of Susan's future consulting work, the amount of traveling she will be doing since she cannot call from home when she is traveling, the cost of alternatives such as cellular service or any other types of telephone or communication service.

G. It is likely that Susan has to call people to conduct business, although she could use email. Since she probably can cut back on calls when her consulting work is not providing enough income, a portion of the cost is likely to be discretionary. Since she has to have telephone service to stay in business, part of the cost is committed and cannot be reduced.

H. The classification as direct or indirect depends on whether Susan's calls are directly related to specific projects she works on or are indirect activities such as business promotion. It also depends on whether she can trace telephone calls to individual consulting jobs. Many cellular telephone bills do not list the calls made, so Susan may need to maintain her own records if she wishes to trace telephone usage. In most businesses, telephone costs are viewed as an indirect cost.

I. Pros:

- Susan might prefer the convenience of not switching telephone companies

- If Susan is happy with her current quality of service she might prefer to stay with the same company and not investigate other companies' plans
- Susan may be able to predict her cost better, especially if she usually calls less than 500 minutes a month
- Below is Susan's average cost per minute at different levels of calls per month.

Minutes	Total Cost	Average Cost
300	$20.00	$0.067
400	$20.00	$0.05
500	$20.00	$0.04
600	$20.00 + (600-500)*$0.10 = $30.00	$0.05
700	$20.00 + (700-500)*$0.10 = $40.00	$0.057

The average cost is lowest at exactly 500 minutes per month. If her calls are over 400 minutes or under 600 minutes, her phone bill will be less than it would be at a rate of 5 cents per minute, which appears to be the other alternative (although the 5 cents per minute rate might not be available for daytime week day calls).

Cons

- If Susan has a number of projects in her local area or will be traveling a lot, she may be paying for 500 minutes of service that she does not use
- If Susan's calling volume exceeds 500 minutes per month, she will pay a very high rate of 10 cents per minute

2.45 Learning Curve, Uncertainty, Regression Measurement Error - Fancy Furniture

A. Hours per batch would be determined as follows; using the learning curve equation $Y = \alpha X^r$

α = 10 hours
X (units produced) = 6
Learning rate = (ln 0.90/ln2) = –0.152
$Y = 10 \text{ hours} * 4^{-0.152}$
Y = 8.1 hours (average time for the first four batches)

B. There are many different reasons that the time could be different from the amount determined above. Here are some of the reasons; students may think of others. It is possible that the managers under- or overestimated the amount of hand work performed. In this case the learning rate would be wrong and so the time would also be wrong. In addition, it is possible that different types of wood affect the rate at which chairs can be produced. If a worker is absent one day, the rate will change if the replacement employee has never worked on this machine, or has a great deal of experience on the machine.

C. The chart suggests that a 90% learning curve is likely to occur if 25% of the work is hand assembly and 75% of the work is done by machine. Thus, if managers believe that 25%

of the work is done by hand, then the chart suggests that the learning rate estimate is reasonable. However, if managers believe that more than 25% of the work is done by hand, then this chart suggests that the learning curve will be slower than the 90% estimate.

D. The observations of labour costs over the first few weeks would not be representative of the labour costs once productivity has stabilized; they would be higher than the labour costs in later periods. If these values are used in a regression to estimate a cost function, then the cost would be overestimated.

2.46 Cost Categories, Cost Function, Opportunity Cost - Wildcat Lair

A. and B.

Wildcat Lair costs:	Fixed	Variable
Purchases of prepared food	$	$21,000
Serving personnel	30,000	
Cashier	5,500	
Administration	10,000	
University surcharge		7,000
Utilities	1,500	
Totals	$47,000	$28,000

Total revenue is the most likely cost driver for both variable costs. Food costs are likely to vary proportionately with sales, and the University surcharge is specifically based on sales.

C. Because revenue is the cost driver for both variable costs, total revenue (TR) instead of quantity (Q) can be used in the cost function:

Variable cost = $28,000/$70,000 = 0.40, or 40% of revenue

Combining fixed and variable costs, the cost function is:

TC = $47,000 + 40%*Total revenue

D. The estimate of total costs given revenues of $80,000 using the cost function is:

TC = $47,000 + 40%*80,000 = $79,000

Profit = Revenues – Total costs = $80,000 - $79,000 = $1,000

E. Lair's fixed costs are assumed to be unchanged with the $10,000 increase in revenues. Only total variable costs are expected to increase, and the increase is estimated to be 40% of the increase in revenues. So, total variable costs are expected to increase by $4,000 ($10,000*40%). So, the additional profit from a $10,000 increase in revenues is expected to be $6,000 ($10,000 - $4,000). In July there was a loss of $5,000, so the estimated profit in August is $1,000 (-$5,000+$6,000).

F. If the university were to close the Lair, it would lose the revenues, less the fixed costs and the variable food costs. Because the university surcharge is an allocation within the university, this surcharge should be ignored when computing the university's opportunity cost (assuming that the charge does not relate to any variable costs for the university that arise because of the Lair). Thus, for July the opportunity cost would have been $2,000 - the operating loss of $(5,000)+the university surcharge of $7,000.

To estimate the opportunity cost for August, the variable cost part of the cost function can be adjusted. Variable food costs are estimated to be 30% ($21,000/$70,000) of revenues. (This is the same as the previous 40% variable cost rate less the university surcharge of 10% of revenues.) The adjusted cost function is:

TC = $47,000 + 30%*Total revenue

During August, the opportunity cost is estimated to be:

Revenue	$80,000
Fixed costs	(47,000)
Variable costs (30%*$80,000)	(24,000)
Net	$ 9,000

2.47 Cost Behaviour, Scatter Plot - Polar Bear Ski Wear

[*Notes about problem complexity:* Item D will be VERY difficult for most students.]

A. In a retail business, electricity usually varies with hours of operation and possibly with the season (because of heating and air conditioning). A shop located near a ski area is likely to incur high heating costs during the winter. Electricity costs also vary with changes in electricity rates, but this is not considered a *cost driver* (a business activity that causes variations in total variable cost).

B. The shop is most likely a seasonal business, generating most of its sales around the ski season (fall and winter). During the spring and summer months, the shop might experience very little business activity; it might even close when the ski area shuts down.

C. Assuming the highest electricity cost is during the winter when fewest bathing suits are sold, costs would be higher when there were fewer sales, so the trend would be the opposite of this plot. However, if the bathing suit shop is located in a geographic region where the highest electricity costs occur during the summer because of air conditioning, then the highest sales might coincide with the highest electricity costs.

D. Many costs can be related to volume of activity. For example, higher profits generally occur during periods when activity is high. Higher profits, in turn, generally mean there is more money available to spend on administrative travel, special promotions, employee training, and new office furniture or equipment. Although these expenditures are made because more money is available, they are discretionary expenditures and not *caused* by the level of activity. A correlation may appear ina scatter plot or regression analysis. However, correlation does not necessarily mean causation.

2.48 Learning Curve, Cost-Based Prices, Financial Statements - Firm A and Firm B

Costs for Firm A in the first year would be determined as follows; using the learning curve equation $Y = \alpha X^r$

α = $300 instead of hours
X (units produced) = 5
Learning rate = (ln 0.85/ln2) = 0.2345
$Y = \$300*5^{-0.2345}$
Y = $205.69 (average cost for each of the 5 units)
Total cost = $205.69 x 5 = $1,028.45

Although each customer paid a different price, a 50% markup on total cost will cause sales to be:

$1,028.45 x 1.50 = $1,542.67

Firm A's income for last year was:

Sales	$1,542.67
Costs	1,028.45
Income	$ 514.22

Firm B set its selling price based on the average cost, given a 100 unit production level:

$Y = \alpha X^r$
$Y = \$300*100^{-0.2345}$
Y = $101.89 (average cost for each of the 100 units produced)
Given a 50% markup on cost,firm B's selling price is:
$101.89 x 1.5 = $152.84

Firm B's costs, assuming an 85% learning effect would be:

$Y = \$300*150^{-0.2345}$
Y = $92.65 (average cost for each of the 150 units produced)

Firm B's income statement for last year was:

Sales (150 x $152.84)	$22,926.00
Costs (150 x $ 92.65)	13,897.50
Income	$ 9,028.50

Firm A's revenues for this year are:

(10 x $152.84) = $1,528.40

Firm A's costs may be computed as follows:

Y = $300*15$^{-0.2345}$ (notice that the cumulative units produced is 15)
Y = $158.97 (average cost for each of the 15 units produced)

Total cost to produce the first 15 units (15 x $158.97)	$2,384.55
Less costs from last year's income statement for first five units	1,028.45
Cost to produce the 10 units for this year	$1,356.10

Thus Firm A's income statement for this year is

Sales	$1,528.40
Costs	1,356.10
Income	$ 172.30

Firm B's calculation for its selling price is as follows:

Y = $300*300$^{-0.2345}$
Y= $78.75 (average cost for each of the 300 units)

Note that the cumulative production for Firm B through this year is 300 units.

Total cumulative production cost (300 x $78.75)	$23,625.00
Total costs to produce the first 150 (from last year's income statement)	13,897.50
Total costs of this year's production (150 units)	$ 9,727.50

Average cost per unit = $9,727.50/150 units = $64.85

Thus Firm B's selling price this year was

$64.85 x 1.50 = $97.28

Firm B's income statement for this year is

Sales (150 x $97.28)	$14,592.00
Costs (150 x $64.85)	9,727.50
Income	$ 4,864.50

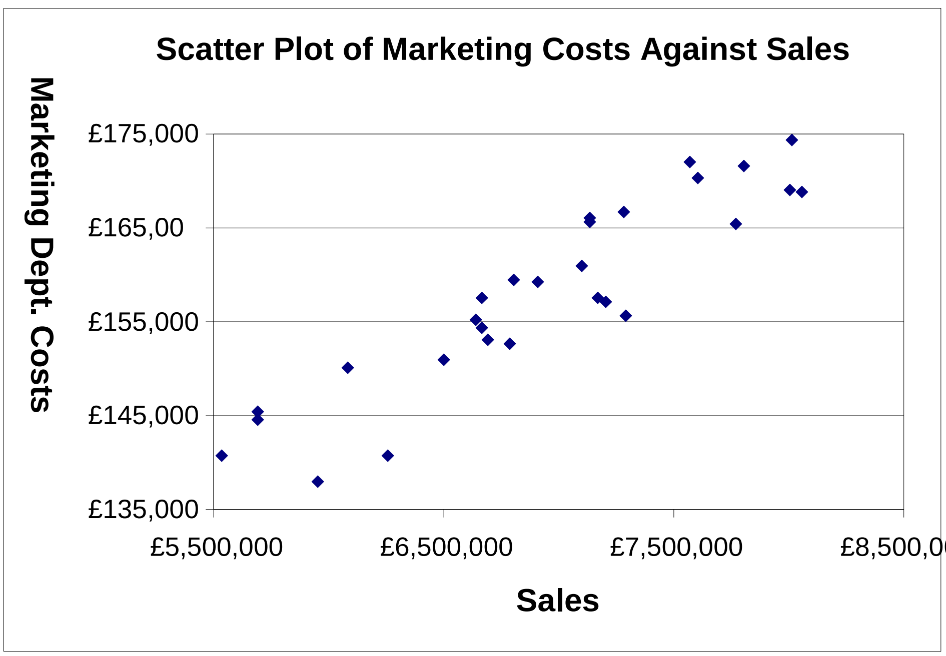
Note that Firm B's selling price for this year of $97.28 is lower than Firm A's average cost per unit: $1,356.10/10 = $135.61. Such results often lead to charges of "unfair dumping" but with large differences in cumulative production volumes, such extreme differences in cost can occur.

2.49 Cost Function Using Regression, Scatter Plot, Discretionary Cost - Belford's

The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available atwww.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A.



B. Sales seems to be a potential cost driver because there appears to be a positive correlation between the marketing department costs and sales. There is a positive slope, and most of the observations appear to have a fairly linear trend.

C. Here is the regression output.

Regression Statistics	
Multiple R	0.93336396
R Square	0.87116829
Adjusted R Square	0.86656716
Standard Error	4015.08144
Observations	30

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	65584.2608	6844.63816	9.58184484	2.4501E-10
X Variable 1	0.01335108	0.00097028	13.7600071	5.5289E-14

Based on the regression results, the cost function is:

TC = £65,584 + 1.34%*Sales

D. If the variable portion of the marketing cost is sales commissions, it is economically plausible for sales to be a cost driver.

E. Even if marketing department costs are discretionary, they may be positively correlated with sales. When more money is spent on marketing, sales may go up. In addition, discretionary costs such as marketing are often increased when profits increase. Assuming that profits are more likely to increase when sales increase, there would be a positive correlation between marketing department costs and sales.

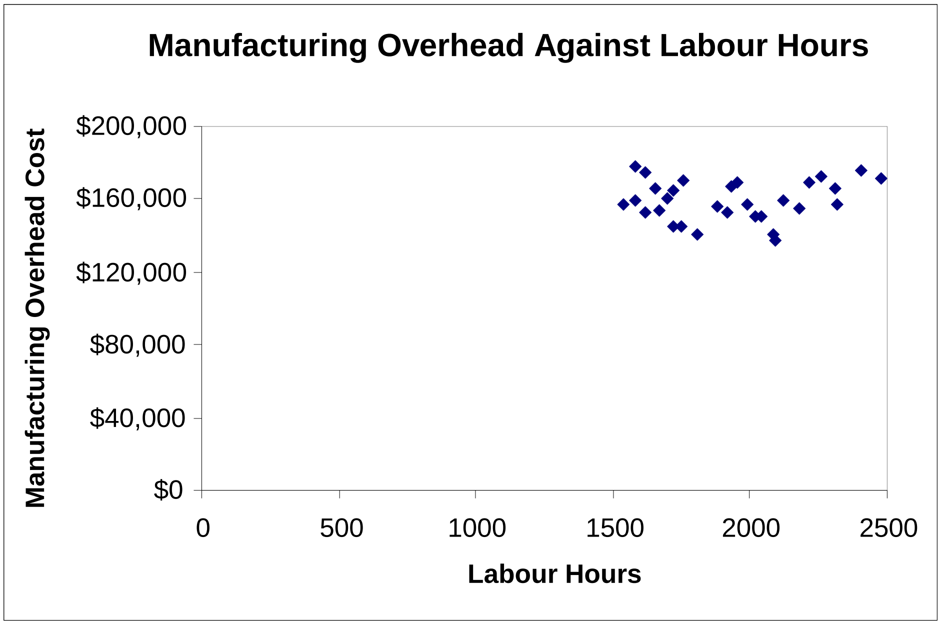
F. Discretionary costs are set by decision, usually annually. Therefore, the cost estimate should not be based on past costs, using regression or any other technique. Instead, the decision maker(s) should be asked what next year's cost will be.

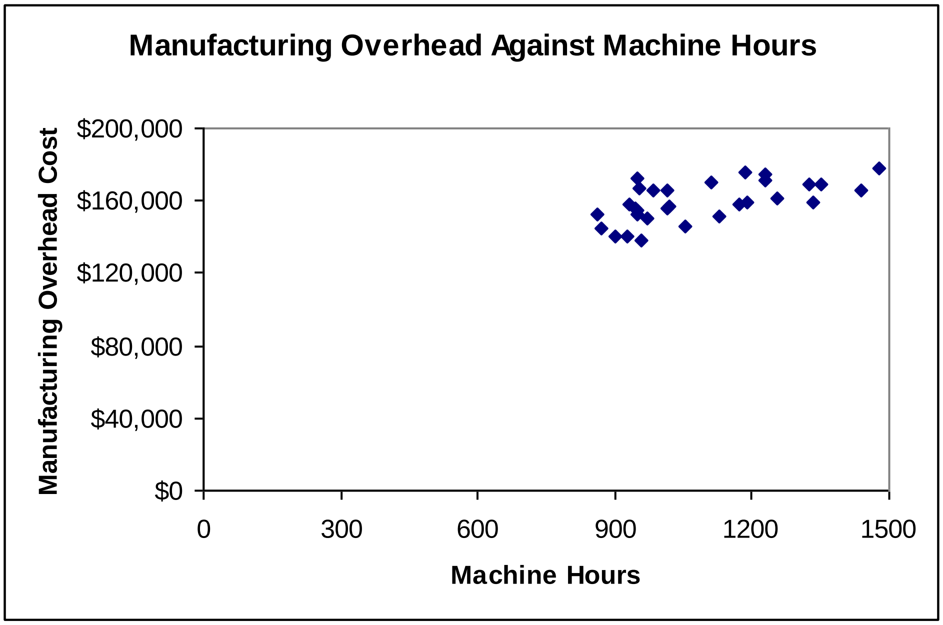
2.50 Cost Function Using Regression, Scatter Plots, Three Potential Cost Drivers - Peer Jets International

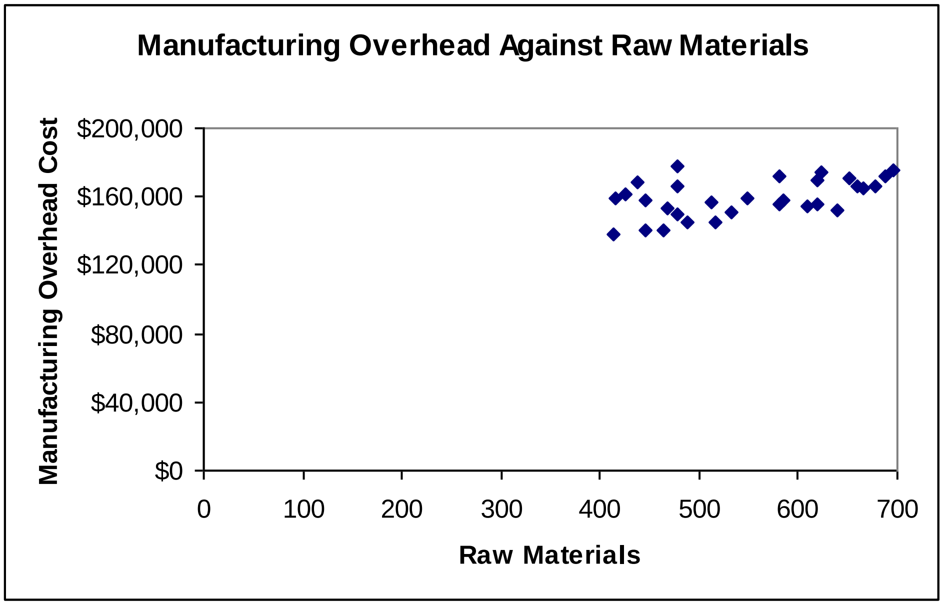
The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available at www.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A.







B. None of the plots show a definite trend, but the plot for labour hours appears to have the least trend. Based only on the cost plots, labour hours could be deleted as a potential cost driver.

C. Costs and potential cost driver data are plotted to determine whether further analysis is necessary. Analysis of the plots involves looking for a linear or football-shaped positive slope or trend. If the observations are widely scattered, the cost driver does not explain the variation in cost;either the driver is wrong or the cost is mostly fixed. Sometimes a cost that is mostly variable. The plots help determine whether regression analysis should be performed using any of the potential drivers.

D.

Labour Hours Regression:

Regression Statistics	
Multiple R	0.11279932
R Square	0.01272369
Adjusted R Square	-0.02253618
Standard Error	11114.8173
Observations	30

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	150410.682	14812.50852	10.1543	6.86E-11
Labour Hours	4.56597156	7.600936029	0.600712	0.552864

Only the intercept term is significantly different from zero, so the cost function is estimated as:

TC = $150,411

Machine Hours Regression:

Regression Statistics	
Multiple R	0.612063
R Square	0.3746211
Adjusted R Square	0.3522862
Standard Error	8846.1555
Observations	30

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	117598.67	10291.47803	11.4268	4.68E-12
Machine Hours	38.217192	9.331580777	4.095468	0.000325

Both the intercept and slope coefficients are significant, so the cost function is estimated as:

TC = $117,599 + $38.22*Machine hours

Raw Materials Regression:

Regression Statistics	
Multiple R	0.5033241
R Square	0.2533351
Adjusted R Square	0.2266685
Standard Error	9665.9786
Observations	30

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	126216.91	10853.56778	11.62907	3.11E-12
Raw Materials	60.215128	19.53627459	3.082222	0.004579

Both the intercept and slope coefficients are significant, so the cost function is estimated as:

TC = $126,217 + $60.22* Raw materials

E. Labour hours can be eliminated as a potential driver because its coefficient is not significantly different from zero (see Part D). The coefficients for each of the other potential cost drivers are significantly different from zero, and the adjusted R-Squares from the regressions are:

Machine Hours	0.352
Raw Materials	0.226

Based on the simple regression results, machine hours appears to do the best job of explaining manufacturing overhead costs; however, this driver explains only 35% of the variation in cost.

F. Yes, the direct labour hours was not significantly related to manufacturing overhead costs using simple regression.

2.51 Cost Function Using Multiple Regression - Peer Jets International (continued from Problem 2.50)

The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available at www.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A. Multiple regression with all three potential cost drivers:

Regression Statistics	
Multiple R	0.9092294
R Square	0.8266982
Adjusted R Square	0.8067018
Standard Error	4832.5558
Observations	30

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	60988.489	10361.2349	5.886218	3.3E-06
Labour Hours	-0.1959303	3.333162437	-0.05878	0.953575
Machine Hours	48.778501	5.291558412	9.218173	1.12E-09
Raw Materials	82.976635	10.10654585	8.210187	1.08E-08

Comparison of simple and multiple regression results:

	Adj. R^2	Intercept t-stat (p-value)	Independent Variables t-stat (p-value)		
			Labour Hours	Machine Hours	Raw Materials
Simple Regressions:					
Labour Hours	-0.022	$150,411 (<0.001)	$4.57 (0.55)		
Machine Hours	0.352	$117,599 (<0.001)		$38.22 (<0.001)	
Raw Materials	0.226	$126,217 (<0.001)			$60.22 (0.005)
Multiple Regression	0.806	$60,988 (<0,001)	$-0.20 (0.954)	$48.78 (<0.001)	$82.98 (<0.001)

B. Labour hours does not appear to be a cost driver when using either simple regression or multiple regression; its coefficient is not significantly different from zero in either regression. Also, its coefficient is negative rather than positive in the multiple regression. Thus, labour hours can be eliminated as a potential cost driver.

Both machine hours and raw materials are positive and significantly different from zero when using simple regression and also when using multiple regression. The adjusted R-Square is far higher in the multiple regression (0.806) than in either of the simple regressions (0.352 and 0.226) for these two cost drivers. A combination of cost drivers does a much better job of explaining the variation in manufacturing overhead costs than either cost driver alone.

C. Multiple regression using machine hours and raw materials as cost drivers:

Regression Statistics	
Multiple R	0.90921678
R Square	0.82667515
Adjusted R Square	0.81383627
Standard Error	4742.5348
Observations	30

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	60677.5902	8743.664851	6.939606	1.86E-07
Machine Hours	48.7422519	5.157604083	9.450561	4.71E-10
Raw Materials	82.925842	9.881964042	8.391636	5.29E-09

The cost function is: TC = $60,678 + $48.74*Machine hours + $82.93*Raw materials

D. Manufacturing can be a complex activity requiring a number of different tasks. Each task includes different activities. Costs for these activities are likely related to specific cost drivers. In this example, machine hours and raw materials explain different activity costs, such as machining work on units, and materials handling for the units. A better understanding of the manufacturing process improves the ability to determine the types and number of cost drivers that can be used in a more complete cost function.

2.52 Use of Prior Year Costs, Quality of Information - Software Solutions

A. Regina has at least two choices in this situation. She can tell the Director of Finance that she cannot produce a very accurate budget within two days or she can pull together something that may not be very accurate. She may believe that her reputation as a diligent employee would suffer if she cannot produce something. However, if she submits a budget based on last year's budget and she knows that this is likely to be inaccurate, her reputation would also suffer. This is a potential ethical dilemma for Regina because the Director of Finance believes that he can rely on Regina's work when he presents the budget to the board. If Regina uses last period's budget, the department amounts and total budget may be quite inaccurate, and the Director of Finance will present the board with information that is unreliable. When the budget is complete the board will likely see it again and notice the discrepancies between the preliminary and actual budgets and wonder why the first budget was so inaccurate, and that could reflect negatively on the Finance Director. More importantly, the board may make inappropriate decisions based on faulty data.

B. The board of directors monitors the performance of the CEO and top management. If they have outdated information and inaccurate information, they will draw erroneous conclusions about the performance of the organization and the top management. They may either praise or criticize top management when the situation may not warrant it. They may also use the inaccurate information to help them approve decisions, such as a business expansion.

C. Although the board is not directly involved in day-to-day operations, in their role of oversight, they need the most current information available and explanations for information that is not available. The relationship between the CEO and the board should be one of trust and confidence. If Regina submits unrealistically low budgets this month and then more accurate budgets next month, but with large increases in department costs, the board may begin to lose trust in the CEO's ability to manage operations. Regina should submit the most current information she has, and use last year's budgets for departments that have not turned theirs in, with a flag indicating that the information quality is low for the budgets in those departments and an explanation that the budget is currently based on last year's information.

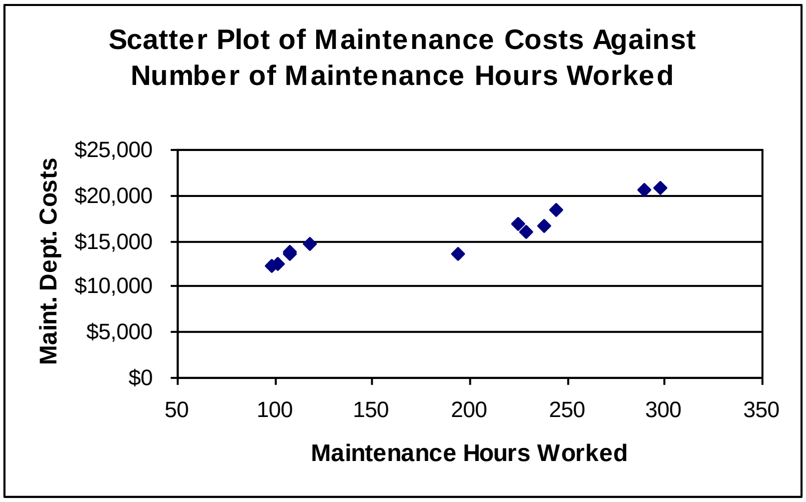
2.53 Scatter Plots, Cost Function Using Regression, Two Potential Cost Drivers - Brush Prairie High School

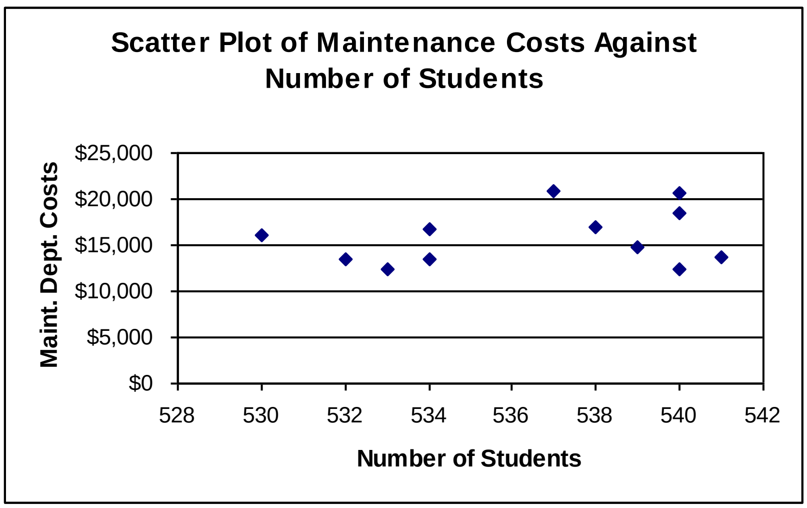
The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available at www.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A. Other cost drivers for total maintenance cost could be number of rooms cleaned, square feet cleaned, number of hours students attend school, number of hours the building is open, or number of classes and activities per period. Students may have thought of other drivers that could be logically related to cleaning maintenance costs.

B.





C. I would eliminate number of students because there does not seem to be a positive linear relationship between maintenance cost and number of students.

D.

Regression results for maintenance cost and number of maintenance hours worked:

Regression Statistics	
Multiple R	0.920565237
R Square	0.847440356
Adjusted R Square	0.832184392
Standard Error	1217.06772
Observations	12

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9134.875134	965.5045837	9.461245	2.63E-06
X Variable 1	35.74733262	4.796328319	7.453062	2.18E-05

Regression output for maintenance cost and number of students:

Regression Statistics	
Multiple R	0.247329
R Square	0.061172
Adjusted R Square	-0.03271
Standard Error	3019.173
Observations	12

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-89867	130954.9	-0.68624	0.508157
X Variable 1	197.0261	244.0857	0.807201	0.438328

According to the R Square statistics, changes in maintenance hours worked explains more than 80% of the changes in maintenance cost while number of students explains none. Therefore,maintenance hours isa reasonable cost driver. The p-values on the T-statistics are very small, providing high confidence that both the intercept and slope are different from zero. The total cost function is:

TC = $9,135 + $35.75*maintenance hours worked.

E. It cannot be known for certain whether the number of maintenance hours is the best cost driver because every single possible cost driver cannot be identified. An unidentified cost driver could have a higher R-Square. However, it is logical to expect a strong relation between hours worked and cost. From the analyses performed, it is rational to conclude that hours worked will provide a reasonable estimate of future costs.

2.54 Personal Cost Function, Information System, Two-Point and High-Low Methods

A, B, C, and D. The answers to these questions depend on the individual student's data and cost behavior.

E. In some ways, a personal budget estimation problem is similar to the cost estimation problem for a business. Some future costs can be estimated with high accuracy based on prior commitments (e.g., rent). Some costs are discretionary. Other costs are highly uncertain and subject to external factors that cannot be controlled.

2.55 Cost function Judgment and Methodology

A. The cost object is the help line. Accounting records could be accessed to determine the wage rates and time worked for help support staff and supervisors. Analysis of general ledger entries could be used to determine past costs for phone service, supplies, and other miscellaneous costs. If the help line is housed in its own building, depreciation schedules, prepaid insurance schedules, etc. could be used to identify costs for building and occupancy costs. If the service is housed in a common building, cost allocation records could be used to identify past costs. The choice of information sources depends on how the past cost information is to be used.

B. Possible cost drivers include number of calls handled, number of hours worked, number of work stations, number of employees, or total number of Internet customers. Information about number of employees and hours worked is found in the payroll accounting system. Number of calls might have to be tracked by employees or by the telephone system. Number of customers is part of the revenue accounting records. Number of work stations might come from the department head.

C. It would be useful to obtain several years of monthly data from which to prepare scatter plots and run regression analysis. This data could be found in the accounting system, or it might need to be estimated if it has not been tracked in the past. Vendors, department heads, and others could be interviewed to identify any potential cost increases or other expected changes in cost behavior from prior periods.

D. If enough data points are available, regression analysis would probably be the best choice. Regression analysis makes use of all data points and is more accurate than two-point methods, assuming a linear cost function. If not, a two point method might be best, with representative points selected from a scatter plot. Alternatively, analysis at the account level could be used to develop a cost function using information from the general ledger.

MINI-CASES

2.56 Cost Function Using Account Analysis and High-Low Method - The Little Beaver Daycare Centres

A and B

Salaries are always fixed, and rent for this type of facility is usually fixed. Utilities cost varies with season not number of children, it is considered fixed. The most current value is used to predict next period's utilities. Daycare supplies vary with number of children; each child requires a certain number of supplies, such as crayons, books, paper, and so on. These would be variable. Some supplies, such as stuffed animals and other toys, must be kept on hand whether or not they are used. These would be fixed. Therefore, daycare supplies is a mixed cost. Other expenses appear to increase and decrease with number of children, but not proportionately. This analysis suggests that some of the other expenses are variable costs and some are fixed, so this cost is classified as a mixed cost.

Category	Fixed	Variable	Cost Driver	Mixed
Daycare staff salaries*	$14,115			
Daycare supplies used**	219	$3.49	Number of Children	X
Administrative salaries	3,412			
Rent	1,100			
Utilities	226			
Other expenses***	664	2.58	Number of Children	X
Total Expenses	$19,736	$6.07		

* The value in June is used for fixed costs because the increase in salaries will hold into the future.

**Using high-low, variable cost is $3.49 ($3,182 - $2,934)/(849 – 778).
Use March, high point of daycare supplies cost and children data, to find fixed: $3,182 = F + $3.49*849.

***Using high-low, variable cost is $2.58 ($2,854 - $2,671)/(849 - 778).
Use March, high point of daycare other expenses cost and children data, to find fixed: $2.854 = F + $2.58 * 849.

Given the preceding computations and cost summary, the cost function is:

TC = $19,736 + $6.07*number of children

C. At 940 children, July expenses are estimated to be:

TC = $19,736 + $6.07*940 = $25,441.80

D. There are many possible reasons that could be listed. Here are some of the reasons:

- The managers will not know how many children they will service, and costs go up as the number of childrenincrease. The number of children attending is affected by season (vacations), weather, current illnesses that are circulating in the area, and so on. Also, other facilities may open or close, affecting the number of children at this daycare.
- Prices of all inputs could change (usually increase).

E. Answers will vary for students but some sample pros and cons are given:

Pros:

- Costs tend to appear relatively consistent for the four months data given and therefore they should be representative of a typical months operation results.
- The High-Low method is relatively simple and easy to use.

Cons:

- The High-Low method uses the two extreme points in the data which may lie outside normal activity ranges and therefore may distort the cost function causing the managers to over or underestimate the costs for July.
- The estimate does not account for the expected increase in costs for July that typically result from the increased amount of outdoor activities in that month.
- This method relies on past results and may not accurately predict or estimate the future costs.

F. There is no one answer to this part. Sample solutions and a discussion of typical student responses will be included in assessment guidance on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

2.57 Adjusting Data for Use with Regression, Outlier - Smeyer Industries

The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available at www.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A. Adjustments to more accurately reflect overhead costs incurred:

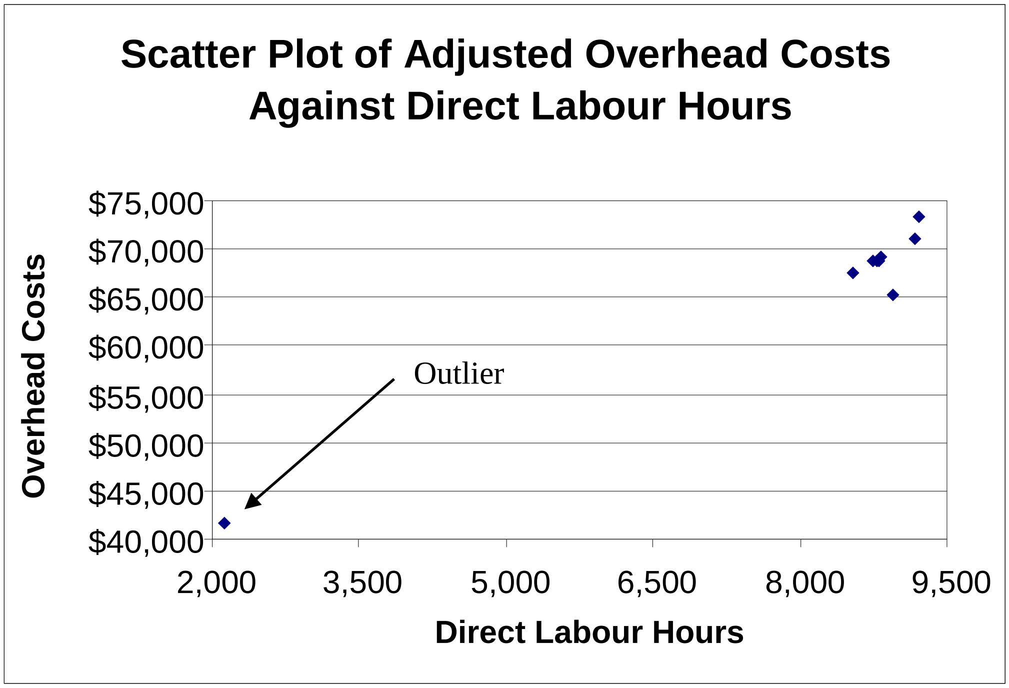
	Unadjusted Overhead	Property Tax(a)	Depreci-ation(b)	Other	Payroll[3]	Adjusted Cost
Mar	$68,200	+$500	+$36 [1]			$68,736
Apr	71,250	+ 500	+ 36			
		-4,300			67,486	
May	68,150	+ 500	+ 36			68,686
June	73,500	+ 500	+ 36			
	-3,000				71,036	
July	38,310	+ 500	+ 36		+$2,750	41,596
Aug	70,790	+ 500	+ 36		- 2,750	
				+ 4,800	73,376	
Sept	80,350	+ 500	+ 36	- 10,850 [2]	- 4,800	65,236
Oct	68,750	+ 500	+ 36			69,286
Nov	68,200	+ 500	+ 36			68,736

[1]To predict future overhead, the first month is adjusted even though it is not an actual cost: 4,300/10 x 12 = 35.83/mo. (rounded to $36)
[2] Note IB-4's power added to Dept. IP-14
[3] Payroll paid every two weeks; 1/2 of August 5 payroll goes to July: 5,500 x 1/2 = 2,750. Similarly, 80% of September 2 payroll to August: .8 x 6,000 = 4,800.

No adjustments are needed for items (c) and (d); these are correctly handled.

The miscellaneous supplies account also looks suspicious, but there is insufficient information to make an adjustment.

B. Operations in the month of July are not typical of the rest of the time period, as shown in the scatter plot below. If these observations are included in the regression analysis, the trend line is likely to distort costs. Because of the large difference between these values and the values in other months, July's result is an outlier and should be removed from the data.



C. Here are the regression results:

Regression Statistics	
Multiple R	0.641981
R Square	0.412139
Adjusted R Square	0.314163
Standard Error	1980.47
Observations	8

Outlier

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	8777.818	29406.26	0.298502	0.775388
X Variable 1	6.789722	3.310484	2.050976	0.086126

Based on the t-statistic and p-value for the intercept, the fixed cost does not appear to be different from zero. Therefore, the cost function is estimated as:

Overhead cost = $6.79 * direct labour hours

This cost function might not provide a very accurate estimate for future costs because the direct labour hours explain only about 31% of the variation in overhead costs (based on the adjusted R-square). Thus, considerable future variation in overhead costs is likely to occur due to factors other than changes in direct labour hours.

D. According to the details provided for August and September, supplies were a large proportion of overhead cost. Based on the variation in dates at which supplies are recorded, they are most likely recorded at the time of purchase rather than at the time of use. Monthly overhead costs for supplies may be significantly overstated or understated if the amount of supplies inventory varies significantly from month to month. Thus, adjustments could be made to adjust the balance in supplies inventory each month. In addition, there could be seasonal variation in costs such as overtime pay and utilities. If the cost function is for annual costs, this may not be a problem, but if the company would like information about predicted monthly costs, these variations would need to be considered. Additional adjustments include any expected changes in costs from prior periods. For example, power costs could be adjusted upward if utility rates in the future are expected to be higher than in the past.

E. Following are three reasons for making adjustments when estimating cost functions. First, the accounting records might not accurately reflect the costs incurred during each time period. The process of preparing financial statements often includes adjustments so that costs are recorded in the correct time period. However, financial statements may be prepared less frequently than data is collected for cost estimation. Second, small adjustments that may be material when estimating a cost might not be sufficiently material to the financial statements for adjustments in the accounting records. Third, sometimes known changes have occurred in prices or cost behavior. Prior cost data should be adjusted for these changes before the data are used to estimate future costs.

BUILD YOUR PROFESSIONAL COMPETENCIES

2.58 Integrating Across the Curriculum Statistics

[*Note about problem complexity*: This homework problem was written with adequate instructions so that students should be able to perform the various regression analyses that are called for. However, students are likely to struggle interpreting and choosing a method (Parts E and F).]

The data for this problem can be found on the datasets file for chapter 2, available on both the Instructor and Student web sites for the textbook (available at www.wiley.com/canada/eldenburg).

A spreadsheet showing the solutions for this problem is available on the Instructor's web site for the textbook (available at www.wiley.com/canada/eldenburg).

A. In prior years, the cost function was estimated by regressing actual labour costs on number of chairs produced, using monthly data for the prior 4 years. Here are the simple regression results:

Regression Statistics	
Multiple R	0.7748991
R Square	0.6004687
Adjusted R Square	0.5917832
Standard Error	6216.7995
Observations	48

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	133194.04	6710.609693	19.848277	3.437E-24
X Variable 1	13.957296	1.678620854	8.3147402	1.02E-10

Based on the regression results, the fixed cost and the variable cost per unit are each positive and statistically different from zero. The cost function is estimated as:

Labour cost = $133,194 + $13.96 x number of chairs produced

However, the regression explains only about 59% of the variation in labour costs. Considerable variation in labour costs is not explained by changes in the volume of production.

B. Because of the annual pay increases, the prior labour costs are biased downward—future labour costs are expected to be higher than past labour costs. Also, the degree of downward bias is higher for older data than for more recent data.

C. Here are a couple of months' data for double-checkingthe calculation of adjusted labour costs:

Month	Original Labour Cost	Calculation	Adjusted Labour Cost
Jan 2006	$203,533	$\$203,533 \times (1.02)^4$	$220,311
Dec 2009	196,347	$196,347 x 1.02	200,274

Using the adjusted labour cost data, here are the regression results:

Regression Statistics	
Multiple R	0.864722
R Square	0.747745
Adjusted R Square	0.742261
Standard Error	5148.905
Observations	48

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	133736	5557.891	24.06236	1.05E-27
X	16.23439	1.390275	11.67711	2.35E-

Variable 1	15

Based on the regression results, the fixed cost and the variable cost per unit are each positive and statistically different from zero. The cost function is estimated as:

Labour cost = $133,736 + $16.23 x number of chairs produced

This regression provides a more reasonable cost function than the previous version because it explains a higher proportion of the variation in labour costs (adjusted R-square of 0.74). Also, this cost function would result in a higher estimate for future costs. The fixed cost is nearly the same, but the variable cost increased from $13.96 to $16.23 per chair, which is reasonable given the increase in wage rates over time. Nevertheless, approximately 26% of the variation in labour costs is still unexplained.

D. Here are the multiple regression results:

Regression Statistics	
Multiple R	0.932541
R Square	0.869633
Adjusted R Square	0.863839
Standard Error	3742.411
Observations	48

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	107748.8	5689.492	18.93821	4.57E-23
X Variable 1	16.26499	1.010513	16.09577	2.73E-20
X Variable 2	6.54295	1.00872	6.486389	5.91E-08

Based on the regression results, the fixed cost and the variable cost per unit for each cost driver are all positive and statistically different from zero. The cost function is estimated as:

Labour cost = $107,749 + $16.26 x current month number of chairs produced
+ $6.54 x prior month number of chairs produced

The statistics suggest that this is a more reasonable cost function than the previous version because all coefficients are positive, statistically different from zero, and this regression explains more of the variation in labour costs (86%).

E. The first slope coefficient ($16.26) is interpreted in a straight-forward way; each month's labour costs are expected to increase by $16.l6 for each chair produced during the month.

The second slope coefficient requires more thought. As explained in the problem, the company's policy is to increase the number of workers when production volumes increase, and to decrease the number of workers when production volumes decrease. However, it often takes time for the company to hire qualified new workers, and the managers often delay laying off employees when volumes decline. Thus, there may be some lag between the time that production volumes change and labour costs change. According to the multiple regression results, each month's labour costs are expected to increase by $6.54 for each chair produced during the *prior* month. If the prior month's production was higher than this month's production, then this month's labour costs will reflect the higher level of labour cost. Conversely, if the prior month's production was lower than this month's production, then this month's labour costs will reflect a lower level of labour cost.

F. There is no one single answer to this question. On one hand, it appears that both independent variables should be included in the cost function because they both have a logical cause-and-effect relationship with labour costs, and they both have positive and statistically significant coefficients. In addition, the two cost drivers together explain a very high proportion (86%) of the variation in past labour costs.

   On the other hand, it could be argued that some other cost driver might do a better job of predicting future labour costs.