Exam Prep

Chapter 5 – Cost Estimation In-Class Handout

1. Hagler's Toupees has the following machine hours and production costs for the last six months of last year:

Month	X Machine Hours	Y Production Cost
July	~~15,000~~	~~$12,075~~
August	~~13,500~~	~~10,800~~
September (low)	11,500	9,580
October (high)	15,500	12,080
November	~~14,800~~	~~11,692~~
December	~~12,100~~	~~9,922~~

If Hagler expects to incur 14,000 machine hours in January, what will be the estimated total production cost using the high-low method?

A. $8,750.00

B. $11,142.50

C. $22,400.00

D. $10,889.10

$Y = a + bX$

$b = \text{slope} = \frac{\Delta Y}{\Delta X} = \frac{12,080 - 9580}{15,500 - 11,500} = \frac{2500}{4000}$

$b = .625$

$Y = a + 0.625/MH\ (X)$

$\$9,580 = a + 0.625/MH\ (11,500)$ (low Y)

$a = \$2,392.5$

14,000

$Y = \$2,392.5 + 0.625/MH\ (X)$

$Y = \$11,142.50$

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C. $22,400.00.

D. $10,889.10.

VC per unit = ($12,080 - 9,580)/(15,500 - 11,500) = $.625; FC = $12,080 - $.625(15,500) = $2,392.50; TC = $2,392.50 + $.625(14,000) = $11,142.50

2. The Business School at Eastern College is accumulating data as a first step in the preparation of next year's budget development. One cost that is being looked at closely is administrative costs as a function of student credit hours. Data on administrative costs and credit hours for the past thirteen months are shown below:

Month	Administrative Costs (Y)	Credit Hours (X)
July	$129,301	250
August (Low)	82,613	115
September (High)	228,580	1,392
October	216,394	1,000
November	258,263	1,309
December	184,449	1,112
January	219,137	1,339
February	245,000	1,373
March	209,642	1,064
April	191,925	1,123
May	249,978	1,360
June	170,418	420
July	128,167	315
Total	$2,510,867	12,172
Average	$193,144	936

$Y = a + bx$

$b = \frac{228,580 - 82,613}{1,392 - 115} = \$114.30$ per hour

(Low): $82,613 = a + 114.30(115)$

$a = 69,467.97$

$Y = 69,467 + 114.30(X)$

The controller's office has analyzed the data and has given you the results from the regression analysis:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93346722
R Square	0.87136104
Adjusted R Square	0.85966659
Standard Error	19943.5805
Observations	13

ANOVA

	df	SS	MS	F	Significance F
Regression	1	29636340628	2.96363E+10	74.5106436	3.14788E-06
Residual	11	4375210454	397746405		
Total	12	34011551082			

	Coefficients	Standard Error	t-Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	$96,409.42	12521.26261	7.69965611	9.381E-06	68850.28899	123968.543	68850.289	123968.543
Credit Hours	$103.56	11.9974027	8.6319548	3.1479E-06	77.15491912	129.967156	77.1549191	129.967156

If the controller uses the high-low method to estimate costs, the cost equation for administrative salaries is:

A. Cost = $96,409.42 + $103.56 × Credit-hours.

B. Cost = $69,474.40 + $114 30 × Credit-hours. ← closest answer

C. Cost = $201.21 × Credit-hours.

D. Cost = $198,808.

A. Cost = $96,409.42 + $103.56 × Credit-hours.

B. Cost = $69,474.40 + $114 30 × Credit-hours.

C. Cost = $201.21 × Credit-hours.

D. Cost = $198,808.
VC = ($228,580 - 82,613)/(1,392 - 115) = $114.30; FC = $228,580 - (114.30 × 1,392) = 69,474.40

AACSB: Analytic
AICPA FN: Decision Making
Blooms: Apply
Difficulty: 3 Hard
Learning Objective: 05-04 Estimate costs using statistical analysis.
Topic Area: High-Low Cost Estimation

3. Thul Company is interested in establishing the relationship between electricity costs and machine hours. Data have been collected and a regression analysis prepared using Excel. The monthly data and the regression output follow:

Month	Machine Hours	Electricity Costs				
January	2,500	18,400				
February	2,900	21,000				
March	1,900	13,500				
April	3,100	23,000				
May	3,800	28,250				
June	3,300	22,000				
July	4,100	24,750				
August	3,500	22,750				
September	2,000	15,500				
October	3,700	26,000				
November	4,700	31,000				
December	4,200	27,750				
SUMMARY OUTPUT						
Regression Statistics						
Multiple R	.965					
R Square	.932					
Adjusted R Square	.925					
Standard Error	1,425.18					
Observations	12.00					
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	3,726.88	1,682.82	2.21	0.05	(22.69)	7,476.45
Machine Hours	5.77	0.49	11.7	0.00	4.67	6.87

If the controller uses regression analysis to estimate costs, the cost equation for electricity cost is:

A. Cost = $1,425.18 + $12.00 × Machine-hours.

B. Cost = $3,726.88 + $1,682.82 × Machine-hours.

C. Cost = $1,682.82 + $0.49 × Machine-hours.

D. Cost = $3,726.88 + $5.77 × Machine-hours.

A. Cost = $1,425.18 + $12.00 × Machine-hours.

B. Cost = $3,726.88 + $1,682.82 × Machine-hours.

C. Cost = $1,682.82 + $0.49 × Machine-hours.

D. Cost = $3,726.88 + $5.77 × Machine-hours.

Reading the correct values from the excel output.

AACSB: Analytic
AICPA FN: Decision Making
Blooms: Apply
Difficulty: 3 Hard
Learning Objective: 05-05 Interpret the results of regression output.
Topic Area: Statistical Cost Estimation Using Regression Analysis

E 5-39. Interpretation of Regression Results: Simple Regression (LO 5-5)

A local restaurant, Fred's Fish Fry, is estimating nonfood kitchen costs (labor, supervision, utilities, etc.) based on food cost. Data were gathered for the past 24 months and analyzed using a spreadsheet program. The following output was generated:

Equation		
Intercept	$14,000	FC
Coefficient on food cost	225%	VC rate
Statistical data		
Correlation coefficient	0.483	
R^2	0.233	

The company is planning to operate at a level of $15,000 of food costs per month for the coming year.

Required

a. Use the regression output to write the nonfood cost equation.

b. Based on the cost equation, compute the estimated nonfood kitchen costs (labor, supervision, utilities, etc.) per month for the coming year.

c. Fred has asked you for advice on whether he should rely on the estimate. What will you say?

a. Nonfood kitchen costs = $14,000 + 225% (Food cost)
FC VC Rate

b. Nonfood kitchen costs per month next year = $14,000 + 225%($15,000)
= $47,750

c. R^2 = 23.3% very low

76% of variation in Nonfood kitchen costs is not being explained. Explore other possible explanatory variables.

E 5-39 (30 min.) Interpretation of Regression Results—Simple Regression: Fred's Fish Fry.

a. Estimation equation for nonfood kitchen costs:

Nonfood kitchen costs	=	Fixed costs + Variable cost as a percentage of food cost
	=	$14,000 + 225% Food cost

b.

Nonfood kitchen costs	=	$14,000 + 225% Food cost
	=	$14,000 + 225% x $15,000
	=	$14,000 + $33,750
	=	$47,750

c.

The R^2 for the equation is only 23.3%, which is very low for this type of regression. Fred should consider identifying other cost drivers and using them to estimate other nonfood kitchen costs.

P 5-54. Methods of Cost Analysis: Account Analysis, Simple and Multiple Regression Using a Spreadsheet (Appendix A) (LO 5-3, 4, 5, 7, 8)

Caiman Distribution Partners is the Brazilian distribution company of a U.S. consumer products firm. Inflation in Brazil has made bidding and budgeting difficult for marketing managers trying to penetrate some of the country's rural regions. The company expects to distribute 450,000 cases of products in Brazil next month. The controller has classified operating costs (excluding costs of the distributed product) as follows:

Account	Operating Cost	Behavior
Supplies	$ 350,000	All variable
Supervision	215,000	$150,000 fixed
Truck expense	1,200,000	$190,000 fixed
Building leases	855,000	$550,000 fixed
Utilities	215,000	$125,000 fixed
Warehouse labor	860,000	$140,000 fixed
Equipment leases	760,000	$600,000 fixed
Data processing equipment	945,000	All fixed
Other	850,000	$400,000 fixed
Total	$6,250,000	

Although overhead costs were related to revenues throughout the company, the experience in Brazil suggested to the managers that they should incorporate information from a published index of Brazilian prices in the distribution sector to forecast overhead in a manner more likely to capture the economics of the business.

Following instructions from the corporate offices, the controller's office in Brazil collected the following information for monthly operations from last year:

Month	Cases	Price Index	Operating Costs
1	345,000	115	$5,699,139
2	362,000	117	5,806,638
3	358,000	118	5,849,905
4	380,000	122	5,927,617
5	374,000	124	5,939,135
6	395,000	125	6,043,364
7	367,000	128	5,918,495
8	412,000	133	6,133,868
9	398,000	133	6,126,130
10	421,000	132	6,186,625
11	417,000	136	6,208,799
12	432,000	139	6,362,255

These data are considered representative for both past and future operations in Brazil.

Required

a. Prepare an estimate of operating costs assuming that 450,000 cases will be shipped next month based on the controller's analysis of accounts.

b. Use the high-low method to prepare an estimate of operating costs assuming that 450,000 cases will be shipped next month.

c. Prepare an estimate of operating costs assuming that 450,000 cases will be shipped next month by using the results of a simple regression of operating costs on cases shipped.

d. Prepare an estimate of operating costs assuming that 450,000 cases will be shipped next month by using the results of a multiple regression of operating costs on cases shipped and the price level. Assume a price level of 145 for next month.

e. Make a recommendation to the managers about the most appropriate estimate given the circumstances.

P 5-54 (40 min.) Methods of Cost Analysis—Account Analysis, Simple and Multiple Regression Using a Spreadsheet (Appendix A): Caiman Distribution Partners.

a. Estimating equation based on account analysis:

Cost Item	Operating Cost	Fixed Cost	Variable
Supplies	$ 350,000	$ 0	$ 350,000
Supervision	215,000	150,000	65,000
Truck expense	1,200,000	190,000	1,010,000
Building leases	855,000	550,000	305,000
Utilities	215,000	125,000	90,000
Warehouse labor	860,000	140,000	720,000
Equipment leases	760,000	600,000	160,000
Data processing equipment	945,000	945,000	0
Other	850,000	400,000	450,000
Total	$6,250,000	$3,100,000	$3,150,000

Variable cost per case = Total variable cost/Cases produced
= $3,150,000 ÷ 450,000 cases
= $7.00 per case

Estimated overhead = Fixed overhead + Variable overhead per case x Number of cases
= $3,100,000 + $7.00 x Number of cases
= $3,100,000 + $7.00 × 450,000
= $6,250,000

P 5-54. (continued)

b. Cost estimate using high-low analysis.

	Cases	Operating Costs
Highest activity (month 12)	432,000	$6,362,255
Lowest activity (month 1)	345,000	$5,699,139

$$\text{Variable cost} = \frac{\text{Cost at highest activity} - \text{cost at lowest activity}}{\text{Highest activity} - \text{lowest activity}}$$

$$= \frac{\$6,362,255 - \$5,699,139}{432,000 - 345,000} = \$7.62202 \text{ per case}$$

Fixed costs = Total costs – variable costs
= $6,362,255 – $7.62202 x 432,000
= $3,069,542

or

Fixed costs = $5,699,139 – $7.62202 x 345,000
= $3,069,542

The cost equation then is:

Overhead costs = $3,069,542 + ($7.622 per case x Cases).

For 450,000 cases:

Operating costs = $3,069,542 + $7.622 x 450,000
= $6,499,442

P 5-54. (continued)

c. Simple regression based on cases:

Regression Statistics	
Multiple R	0.98034501
R Square	0.96107634
Standard Error	39850.1391
Observations	12

	Coefficients
Intercept	$3,411,468
Cases	$6.70765

Operating costs = $3,411,468 + $6.70765 x cases
= $3,411,468 + $6.70765 x 450,000
$3,411,468 + $3,018,443
= $6,429,911

d. Multiple regression based on cases and price level.

Regression Statistics	
Multiple R	0.9905
R Square	0.9810
Adjusted R Square	0.9768
Standard Error	29315.827
Observations	12

Improvement

	Coefficients
Intercept	$3,176,995
Cases	$4.41892
Price Index	$8,857.73

FC
VC rate (1)
VC rate (2)

Operating costs = $3,176,995 + $4.41892 x cases + $8,857.73 x Price level
= $3,176,995 + $4.41892 x 450,000 + $8,857.73 x 145
$3,176,995 + $1,988,514 + $1,284,371
= $6,449,880

P 5-54. (continued)

e. Recommendation.

The multiple regression appears to improve the "fit" (compare the adjusted R^2's), but the rationale for the inclusion of the price level as a cost driver is unclear. There is some possibility that the price index variable is a surrogate for some other factor correlated with the growth of the business. It might be better to adjust the cost figures to real (price-level adjusted) and forecast the adjusted operating costs.

Once the simple regression is complete, and it is relatively easy to do, there is no reason for the high-low estimate, because it ignores most of the information.

Therefore, some combination of the controller's account analysis estimate and the estimate from the simple regression seems most appropriate.

P 5-51. Interpretation of Regression Results: Simple Regression (LO 5-5)

Your company provides a variety of delivery services. Management wants to know the volume of a particular delivery that would generate $10,000 per month in operating profits before taxes. The company charges $20 per delivery.

The controller's office has estimated overhead costs at $9,000 per month for fixed costs and $12 per delivery for variable costs. You believe that the company should use regression analysis. Your analysis shows the results to be:

Monthly overhead = $26,501 + $10.70 per delivery

Your estimate was based on the following data:

Month	Overhead Costs	Number of Deliveries
1	$142,860	11,430
2	151,890	12,180
3	192,600	15,660
4	141,030	11,250
5	203,490	12,780
6	180,630	14,730
7	159,630	12,510
8	183,990	15,060
9	194,430	15,450
10	150,120	11,970
11	154,080	12,630
12	184,800	15,300
13	183,120	14,580

The company controller is somewhat surprised that the cost estimates are so different. You have been asked to recheck your work and see if you can figure out the difference between your results and the controller's results.

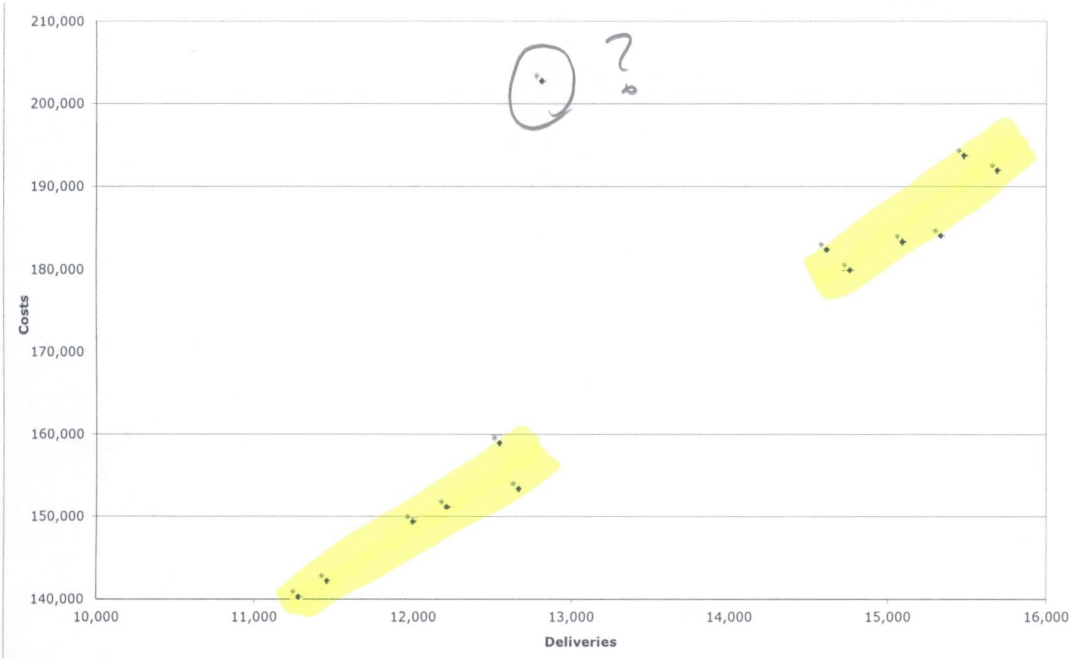
Required

a. Analyze the data and your results and state your reasons for supporting or rejecting your cost equation.

b. Write a report that informs management about the correct volume that will generate $10,000 per month in operating profits before taxes.

P 5-51 (30 Min.) Interpretation of Regression Results: Simple Regression.

a. The first step in understanding the difference is to prepare a scattergraph of the data:



Notice the one observation that appears to be unusual. (This is observation 5.) Without knowing more about the reasons for the high cost, we might want to treat it as an "outlier" meaning we would estimate the regression without this observation. The results of that regression are:

Regression Statistics	
Multiple R	0.9921
R Square	0.9843
Adjusted R Square	0.9827
Standard Error	2635.7
Observations	12
	Coefficients
Intercept	$9776.56
Number of deliveries	$11.69

These results are much closer to the controller's estimates.

5-51 (continued)

b. Using the results from the "improved" regression, the cost equation for overhead costs can be written as:

Monthly overhead = $9,777 + $11.69 x number of deliveries

This implies a contribution margin per delivery of $8.31 (= $20.00 – $11.69).

To earn operating profits of $10,000, the company needs approximately 2,380 (= [$10,000 + $9,777] ÷ $8.31) deliveries.

Note, however, that this level of deliveries is outside the range of the observations used to develop the regression estimates. Therefore, this estimate needs to be used with caution.

INTEGRATIVE CASE

Case 5-57. Cost Estimation, CVP Analysis, and Decision Making (LO 5-4, 5, 8)

Luke Corporation produces a variety of products, each within their own division. Last year, the managers at Luke developed and began marketing a new chewing gum, Bubbs, to sell in vending machines. The product, which sells for $5.25 per case, has not had the market success that managers expected and the company is considering dropping Bubbs.

The product-line income statement for the past twelve months follows:

Revenue		$14,682,150
Costs		
Manufacturing costs	$14,440,395	
Allocated corporate costs (@5%)	734,108	15,174,503
Product-line margin		$ (492,353)
Allowance for tax (@20%)		98,470
Product-line profit (loss)		$ (393,883)

All products at Luke receive an allocation of corporate overhead costs, which is computed as 5 percent of product revenue. The 5 percent rate is computed based on the most recent year's corporate cost as a percentage of revenue. Data on corporate costs and revenues for the past two years follow:

	Corporate Revenue	Corporate Overhead Costs
Most recent year	$106,750,000	$5,337,500
Previous year	$ 76,200,000	4,221,000

Roy O. Andre, the product manager for Bubbs, is concerned about whether the product will be dropped by the company and has employed you as a financial consultant to help with some analysis. In addition to the information given on the previous page, Mr. Andre provides you with the following data on product costs for Bubbs:

Month	Cases	Production Costs
1	207,000	$1,139,828
2	217,200	1,161,328
3	214,800	1,169,981
4	228,000	1,185,523
5	224,400	1,187,827
6	237,000	1,208,673
7	220,200	1,183,699
8	247,200	1,226,774
9	238,800	1,225,226
10	252,600	1,237,325
11	250,200	1,241,760
12	259,200	1,272,451

Required

a. Bunk Stores has requested a quote for a special order of Bubbs. This order would not be subject to any corporate allocation (and would not affect corporate costs). What is the minimum price Mr. Andre can offer Bunk without reducing profit any further?

b. How many cases of Bubbs does Luke have to sell in order to break even on the product?

c. Suppose Luke has a requirement that all products have to earn 5 percent of sales (after tax and corporate allocations) or they will be dropped. How many cases of Bubbs does Mr. Andre need to sell to avoid seeing Bubbs dropped?

d. Assume all costs and prices will be the same in the next year. If Luke drops Bubbs, how much will Luke's profits increase or decrease? Assume that fixed production costs can be avoided if Bubbs is dropped.

Case 5-57 (60 min.) Cost Estimation, CVP Analysis, and Decision Making: Luke Corporation.

This problem is more subtle than it might appear, because the student must consider the effect on Luke Corporation and the Product Manager, Mr. Andre separately. In other words, it anticipates in a small way the issues in management control systems.

a. $2.24 per case.

This is a special order question similar to those discussed in Chapter 4. The relevant cost is the variable production cost. (The problem states that no corporate overhead will be allocated or affected by the order.) To determine the variable production cost, a regression analysis on the production data can be run. The results follow:

	A	B	C	D	E	F	G
1	SUMMARY OUTPUT						
2							
3	*Regression Statistics*						
4	Multiple R	0.980345319					
5	R Square	0.961076945					
6	Adjusted R Square	0.957184639					
7	Standard Error	7969.964262					
8	Observations	12					
9							
10	ANOVA						
11		*df*	*SS*	*MS*	*F*	*Significance F*	
12	Regression	1	15684258323	1.5684E+10	246.9171	2.23512E-08	
13	Residual	10	635203303.4	63520330.3			
14	Total	11	16319461626				
15							
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
17	Intercept	682293.6573	33240.33583	20.5260759	1.66E-09	608229.5739	756357.7406
18	Cases	2.235883256	0.142289713	15.7135973	2.24E-08	1.918842019	2.552924493
19							

As shown, the estimated variable production cost is $2.24. This is the minumum that can be charged without reducing profit.

Case 5-57. (continued)

b. 242,120 cases.

To break even on the product, Luke has to sell a sufficient number of cases to cover fixed production costs on the product. The contribution margin, however, is lowered by the variable portion of the (truly) corporate costs. To determine these, we can use the High-Low method, because we only have two observations.

Corporate costs are assumed to variable with respect to revenues, so using data on coporate costs, variable costs are 3.65% of revenue.

$$\text{Variable cost} = \frac{\text{Cost at highest activity} - \text{cost at lowest activity}}{\text{Highest activity} - \text{lowest activity}}$$

$$= \frac{\$5,337,500 - \$4,221,000}{\$106,750,000 - \$76,200,000} = 3.65\% \text{ of Revenue}$$

Let Q be the number of cases sold. Then, profit for Q cases is (note that the fixed costs are from the analysis in part a):

Profit = Revenues – Variable product costs – Variable corporate costs – Fixed production costs

= ($5.25 x Q) – ($2.24 x Q) – (3.65% x $5.25 x Q) – $682,294

or $2.818 x Q = $682,294

or Q = 242,120 cases.

Case 5-57. (continued)

c. 274,565 cases.

This problem differs from requirement (c), because the the requirement that the revenue from the product covers the production costs and the full 5% corporate cost allocation makes the corporate cost allocation entirely variable. Therefore, the number of cases to provide a profit equal to 5% of revenue (= 5% x $5.25 x Q) can be determined as follows. Let Q be the number of cases sold. Then, profit for Q cases is:

Profit = Revenues – Variable product costs – Variable corporate costs – Fixed production costs

= $5.25 x Q – $2.24 x Q – 5% x $5.25 x Q – $682,294

(5% x $5.25 x Q) = ($5.25 x Q) – ($2.24 x Q) – (5% x $5.25 x Q) – $682,294

$2.485 x Q = $682,294

Q = 274,565 cases.

d. $235,314 increase.

Because fixed manufacturing costs can be avoided, Luke will save all the production costs plus the variable corporate overhead.

Lost revenue		$(14,682,150)
Production costs avoided		14,440,395
Loss before corporate overhead savings		$ (241,755)
Corporate costs avoided	(= 3.65% x $14,682,150)	535,898
Increase profits before tax		$ 294,143
Tax (@20%)		58,829
Increased profits		$ 235,314