

COST AND OPTIMIZATION IN GOVERNMENT: An Introduction to Cost Accounting,
Operations Management and Quality Control
2nd Edition
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Chapter 1: Cost Concepts
Review Questions

1.1 Define cost. How would you distinguish between (a) direct and indirect costs, (b) fixed and variable costs, (c) sunk and future costs, (d) implicit and explicit costs, and (e) controllable and uncontrollable costs? Give an example of each.

1.2 How does a cost differ from expense and expenditure? How would you reconcile their differences? Explain with an example.

1.3 A state highway patrol department spent \$1,500,000 last year on patrol, which included, among others, the purchase of a new vehicle in the amount \$65,000 with a salvage value of \$7,500. It also spent \$28,000 on materials and supplies, but used only 65% for the year, the rest it spent on wages and salaries. The vehicle has a life span of six years. What was the actual cost providing the service to the department, assuming a straight-line depreciation, with and without the salvage value?

1.4 A local public library has recently purchased a multi-purpose copying machine at a cost of \$4,500. It has a standard life span of five years and a salvage value of \$1,250. What would be the annual depreciation expense for the machine under (a) straight-line depreciation, (b) declining balance depreciation, and (c) the sum-of-the years'-digits depreciation, with and without the salvage value?

1.5 A local United Way has recently purchased a mini-van at a cost of \$45,000 to provide free transportation services to elderly people who could not otherwise move around. The organization plans to trade it in for \$10,000 after it has gone 80,000 miles. The following information is available on the vehicle for miles traveled over a five-year period: 15,000 miles in year 1, 17,000 miles in year 2, 20,000 miles in year 3, 15,000 miles in year 4, and 13,000 miles in year 5. Calculate the depreciation expense for each of the five years using the units of production method.

1.6 Suppose that the electric utility department of a large metropolitan government experienced the following rate changes in the past 10 years, based on monthly average rate per kilowatt hour (kWh) of electricity with corresponding costs, as follows:

Year	Rate Per kWh (\$)	Departmental Cost (\$ Million)
1	0.085	10.5
2	0.087	10.5
3	0.088	11.4
4	0.089	11.6
5	0.090	12.0
6	0.093	12.6
7	0.095	12.9
8	0.096	13.3
9	0.098	13.5
10	0.100	13.7

Using the information above, do the following:

- (a) calculate the index value for each of the ten years

(b) determine the adjusted cost of electricity for each of the ten years

(c) Interpret the results

[Hint: Adjusted (Real) cost, $Yr1 = \text{Index Value} \times \text{Cost in a given year}$, e.g., $\text{Index value} \times \text{Cost in}$

$\text{Year 1} = (\$0.10/\$0.085) \times \$10.5 \text{ million} = 1.1765 \times \$10.5 \text{ million} = \$12.35 \text{ million}$]

1.7 Define price. Why is it difficult to determine the price of public goods? What pricing method would you use for (a) public utilities, (b) recreation facilities, and (3) a toll road? Why?

1.8 The cost of heart procedures for a county-run hospital is \$125,000, with a fixed cost of \$50,000 and a variable cost of \$75,000. The hospital completed 250 procedures last year.

[A] Assuming no changes in the number of procedures the hospital will perform next year, calculate the cost of surgery for next year, if (a) a 2% increase in variable and 1.5% increase in fixed costs, and (b) it wants to maintain 3.5% safety margin.

[B] What would be the cost if the number of procedures (1) will increase by 2%, and (2) will decrease by 4%, with and without safety margin, assuming no changes in cost conditions next year?

Chapter 2: Cost Behavior

Review Questions

2.1 What is the difference between a short-run and a long-run cost? Why in the long-run all costs are variable?

2.2 What is the difference between a linear and non-linear cost function, and what are their advantages and disadvantages? How can one linearize a non-linear cost function? Give an example of a linear and a non-linear cost function.

2.3 What are the advantages and disadvantages of using a graphical, the high-low, and the regression method for estimating the cost behavior of an organization? Under what circumstances would one use the high-low method over the regression method?

2.4 What are the steps in constructing a regression model? What specific tests would one conduct to establish the significance of the regression coefficients and the estimated regression line?

2.5 What is the difference between first and second-order tests? Why is it necessary to do both sets of tests to establish the significance of an estimated regression model?

2.6 Define elasticity. What is the difference between a point and an arc elasticity? Give an example of each.

2.7 The state fishing license department recently conducted a study of the demand for fishing licenses. It found that the average daily demand for licenses, Q , based on the licensing fee (P) is given by the equation

$$Q = 250 - 5P$$

(a) How many licenses the department can issue a day, if the fee for the license is \$30?

(b) Assuming the state wants to issue 150 licenses a day, how much should it charge for a license?

(c) How many licenses the department should issue, if it decided not to charge a fee?

2.8 The water department of a large metropolitan government noticed that demand, Q , for water consumption (in gallons) for a family per year is affected by changes in per capita family income, INC , in such a way that

$$Q = 2,500 + 0.5INC$$

(a) Determine the quantity demanded for water for a family for the year at each \$1,000 of per capita family income from \$15,000 to \$20,000

(b) Find the income elasticity of demand if per capita family income changes from \$10,000 to

\$15,000 and from \$20,000 to \$25,000

(c) Interpret the results

2.9 Suppose that a local homeless shelter wants to know the costs of running the facility, in particular fixed and variable costs that include, among others, providing shelter and free meals throughout the year. It has the following information on the number of individuals served and the corresponding costs, by month:

Month	Number of Individuals Served (Q)	Cost of Operation (\$)
January	350	140,000
February	400	150,000
March	300	120,000
April	250	120,000
May	200	100,000
June	150	70,000
July	150	80,000
August	150	80,000
September	200	90,000
October	200	100,000
November	250	110,000
December	300	120,000

Using the high-low method, do the following:

- estimate the fixed and variable costs of running the shelter
- determine the total cost of running the shelter for next year, assuming the shelter expects a 10% increase in homeless population but no changes in fixed and variable costs
- determine the total cost of running the shelter, assuming there will be no change in homeless population, but the variable cost will increase by 2.5% to keep up with the inflation rate next year
- determine the total cost of running the shelter, assuming there will be no change in homeless population, but the fixed cost will increase by 5%
- interpret the results

2.10 Repeat questions (a) through (d) in problem 2.9, using the regression method and show the estimated model with associated t-values, R^2 , and the F-Value. What do the results indicate as to the soundness of the estimated coefficients and the model?

Chapter 3: Cost Analysis

Review Questions

3.1 What is break-even analysis? What is the difference between a linear and non-linear break-even analysis? Discuss the assumptions that underlie a break-even analysis, especially a linear break-even analysis, and explain what happens if the assumptions are relaxed?

3.2 What is contribution margin? How does it differ from an operating leverage? Discuss, with an example, how contribution margin is used to determine a break-even quantity?

3.3 A city operates a downtown parking garage throughout the year, including holidays. The fixed cost of operating the garage is \$750,000 with a variable cost of \$2.50 per vehicle. The garage charges \$8.50

each time a vehicle is parked.

- (a) Calculate the number of vehicles that must be parked a year for the city to break-even
- (b) Determine the break-even cost of operating the garage for the city for the year
- (c) Find the break-even revenue from operation of the garage for the year
- (d) Interpret the results

[A] Assume that the revenue from the operation of the garage will increase by 5% next year, what would be the net gain for the City next year?

[B] Assume further that revenue as well as fixed and variable costs of operation will also increase by 5, 3, and 4 percents, respectively, next year. What would be the net gain for the City next year?

3.4 The Parking Meter Department of a local government gives on average 700,000 tickets a year, with a variable cost of \$15 per ticket and a fixed cost of \$700,000. The department charges \$85 per ticket.

- (a) What will be the break-even quantity for the department?
- (b) What will be the break-even revenue and break-even cost?
- (c) What will be the net revenue at the current level of tickets issued?
- (d) What will be the net revenue at the break-even level?

3.5 Suppose that the department in 3.4 wants to increase its revenue by 10 percent next year. For the department to achieve its goal, determine (1) the number of tickets it must issue, assuming no change in price, (2) the price it must charge per ticket without changing the current quantity

3.6 What is differential-cost analysis and how does it differ from break-even analysis? What are some of its advantages and disadvantages?

3.7 Suppose that a large metropolitan government wants to upgrade its convention center so it can hold more activities and attract more visitors to the city. The government projects its revenue from upgrade to increase by \$1.5 million. The city will incur the following costs to upgrade the center: 1. Direct Labor: \$225,000, 2. Direct Materials: \$150,000, 3. Overhead: \$50,000, 4. Promotion: \$25,000, 5. Miscellaneous other expenses: \$50,000. What would be the differential cost/revenue for the government?

3.8 What is payback period? What are some of its strengths and weaknesses? Why is it important to consider cumulative net flow as opposed to simple net flow, when using the payback period?

3.9 Suppose that the Central Printing Office of a small community college wants to buy a multi-purpose high speed copying machine at a cost of \$5,000. It hopes to recover the cost of the machine from the copying service it will provide to various departments of the college. The following presents the cash inflows for the office over a six-year period: Year 1 - \$1,000, Year 2 - \$1,500, Year 3 - \$2,000, Year 4 - \$1,700, Year 5 - \$1,200, Year 6 - \$1,000, Year 7-\$800, and Year 8-\$500. Calculate the payback period for the machine. Assume now that the college decides to borrow the fund at 8 percent rate of interest. What would be payback period for the investment?

3.10 Why is it important for a government to weigh the pros and cons of a cost decision before purchasing or acquiring an item? What are the advantages of leasing, as opposed to buying? What role does time value of money plays in these decisions?

3.10 A local community hospital needs a state-of-the art X-Ray machine to replace the one it has been using for several years. The hospital has the option to buy or lease the equipment. If the hospital decides to buy the equipment, it will cost \$125,000; if it decides to lease, the rental cost will be \$15,000 per year. If purchased, there is a salvage value of \$25,000 at the end of the asset's productive life. There is also a maintenance cost of \$3,000 if the equipment is purchased. The equipment has a useful life of seven years. Calculate the PV of ownership and indicate if the hospital should buy or lease. (Use a discount rate of 5 percent)

3.11 What is a discount rate? What role does it play in benefit-cost analysis? What are the differences between benefit-cost ratio, net present value, and internal rate of return? Under what circumstances would you use one, as opposed to the others? What are some of the limitations of Benefit-cost analysis?

3.12 A government is evaluating two investment projects, each with one-time cost of \$1 million and a life span of six years. The estimated benefits for the projects are as follows:

Project A	Project B
Cost: \$1,000,000 (one time)	Cost: \$1,000,000 (one time)
Benefit stream:	Benefit stream:
Year 1: \$350,000	Year 1: \$375,000
Year 2: \$425,000	Year 2: \$425,000
Year 3: \$575,000	Year 3: \$530,000
Year 4: \$925,000	Year 4: \$750,000
Year 5: \$850,000	Year 5: \$825,000
Year 6: \$750,000	Year 6: \$950,000

Assuming it will use net present value, which project should the government select? Why? Would the decision be different if it were using a discounted benefit-cost ratio? (Use a discount rate of 6.0 percent)

3.13 Suppose that the Public Works Department of a local government is planning to buy an electric motor and receives bids from three vendors. The following provides summary information about the motor features and the bids:

Parameters	Vendor A (Motor A)	Vendor B (Motor B)	Vendor C (Motor C)
Bid Price (Cost)	\$1,000	\$1,500	\$1,200
Duty Cycle/Year	1,000 Hours	1,000 Hours	1,000 Hours
Life Cycle	10 years	10 Years	10 Years
Energy Consumption/KWh	20 KWh	12 KWh	15 KWh
Cost Per KWh	\$0.10	\$0.10	\$0.10

[A] Given the information above and assuming no resale value, do the following:

- Determine the energy cost of each motor
- Determine the life-cycle cost of each motor
- Determine the vendor the government should accept the bid from and explain, why?

[B] Would the decision be different if the motors have the following resale values? Motor A = \$100, Motor B = \$200, and Motor C = \$150? [Hint: the energy cost can be computed in the following way: Energy Consumption/kWh x Energy Cost/kWh x Duty Cycle over the Useful Life = $20 \times \$0.10 \times (1,000 \times 10) = \$20,000_A$; Life-Cycle Cost = Bid Cost + Energy Cost]

Chapter 4: Cost Accounting

Review Questions

4.1 Define accounting. What are the differences between cost, managerial, and financial accounting? What is GAAP and what role does GAAP play in the accounting process?

4.2. Define and distinguish between job-order and process costing. What are the strengths and weaknesses of each? Discuss the steps one would use in carrying out job and process costing.

4.3 A county government has recently renovated one of its correctional facilities that is largely supported by state funding. It cost the government approximately \$375,000 in direct materials, \$1,210,000 in direct labor, and \$350,000 in overhead, of which \$215,000 went to labor and the rest to

materials. Assume the project used a total of 10,144 hours in direct labor. Assume further that direct materials were issued by the central warehouse on the day the job started, direct labor was accrued at the time of the journal entry, and overhead was applied at a predetermined rate. The job, which took approximately seven months, from September 1 through March 31, to complete, was assigned the number 057-PB for Plant and Building.

Given the information above,

- (a) prepare the source document
- (b) journalize the information
- (c) determine the overhead rate

4.4 The IT department of a large metropolitan government processes data that pass through two operating units of the government; we will call them A and B. Unit A collects all the necessary information at the beginning of the process, analyzes them, and prepares the results, while Unit B disburses the information to respective agencies of the government. Both departments use weighted average method. The work is done uniformly, although the tasks involved are not identical. The following information pertains to Unit A for the month of January:

- (1) Beginning work in process (WIP), January 1: 100,000 pieces of information; 100 percent completed with respect to materials and 40 percent completed with respect to conversion. The costs assigned to the work are as follows:

Materials	\$20,000
Labor	10,000
Overhead	30,000

- (2) Ending work in process (WIP), January 31: 50,000 pieces of information; 100 percent completed with respect to materials and 60 percent completed with respect to conversion.

Using the information above, do the following:

- (a) prepare a schedule of equivalent units
- (b) calculate the cost per equivalent unit

4.5 A local hospital has been treating 325 trauma patients last year; 200 of those patients have been completely treated and 125 remain under treatment. Of those who are under treatment, 80 percent were completed with respect to materials (hospital stay) and 40 percent with respect to conversion (direct labor such as nursing care, and overhead) by the time the year ended. Let us suppose that of the 200 patients who were completely treated, 50 were in queue from the previous year (i.e., beginning inventory, meaning that they were already there when the year started).

- (a) Prepare a schedule of equivalent units (patients, in our case), using both the weighted average and FIFO methods
- (b) Prepare a schedule of cost analysis
- (c) prepare a schedule of cost summary
- (d) interpret the results

[Hint: Use cost data of your choice]

4.6 Define cost allocation. What are some of the important underlying considerations in cost allocation? What would happen if you relax some of these considerations? Why is cost allocation base important in the cost allocation process? What criteria are commonly used to determine this base? Explain.

4.7 Suppose that we have the following information on the services a city-operated electric utility enterprise provided electricity to three departments of the city last year, other than itself: Public Works

(D2), Public Safety (D3), and General Administration (D4). We will call the departments user departments and the utility enterprise the service department, D1. The amount of service provided by D1 to D2, D3, and D4 for the year, respectively, were 1.2 million units, 1.3 million, and 0.75 million units. It cost the utility company \$100,000 in fixed cost and \$0.05 in variable cost per unit to provide the service. What was the total cost of service provision to D1? What would be the cost share (total, fixed, and variable) for the recipient departments? [Hint: Use the direct method.]

4.8 Suppose now that, for the problem above, we selected the four departments at random, three of which (D1,D2, and D3) are service/user departments and one (D4) is purely user a department. The following shows the amount of service provided by the service departments and their corresponding cost:

Departments	D1 (Units of Service)	D2 (Units of Service)	D3 (Units of Service)	Total cost (\$)
D1	--	1,500	25	350,000
D2	150	--	50	50,000
D3	100	2,000	--	450,000
D4	200	2,500	75	650,000
Total:	400	6,000	150	1,500,000

Given the information above, do the following:

- Calculate costs to the user departments using the direct method
 - Calculate costs to the user departments using the step-down (sequential) method
 - Calculate costs to the user departments using the reciprocal method
 - Interpret the results
- [Hint: Use the substitution method for (c)]

4.9 What is activity-based costing? How does it differ from the conventional costing method? What are the steps in an activity-based costing; more important, what specific measures would you take to implement an activity-based costing system in government? Explain.

4.10 Suppose that you are working as an intern for ABC City and have been asked by the city administration to estimate the cost of street cleaning for the year.

You have the following information for the service:

- Activities: vehicle maintenance, vehicle insurance, utility usage, facility maintenance, and payroll processing
- Total cost for the year for the city (by activity): Vehicle maintenance – \$375,000; Vehicle insurance - \$225,000; Utility usage - \$8,500; Facility maintenance - \$25,600; Payroll processing – \$83,500
- Cost driver for the city (by activity): Vehicle maintenance - Garage labor hours; Vehicle insurance - Mileage/year; Utility usage - Square feet occupied; Facility maintenance - Square feet occupied; and Payroll processing - Number of employees
- Cost driver level for the city (by activity): Vehicle maintenance – 1,500 hours; Vehicle insurance - 1,215,000 miles; Utility usage – 4,500 sq. ft.; Facility maintenance – 4,500 sq. ft.; and Payroll processing – 350 employees
- Cost driver level for street cleaning (by activity): Vehicle maintenance – 25 hours; Vehicle insurance - 121,500 miles; Utility usage – 375 sq. ft.; Facility maintenance – 375 sq. ft.; and Payroll processing – 5 employees;

In addition to the above, you also have information on direct labor and material costs for street cleaning, as follows:

- Labor (Driver) – 1,750 hours @ \$10.50 an hour

2. Material (Fuel) – 3,000 gallons @ \$3.50 a gallon

Using the information above, do the following:

- (a) calculate the cost of direct labor
- (b) calculate the cost of direct material
- (c) calculate the cost driver rate
- (d) calculate the indirect (support) cost for each activity, and
- (e) calculate the total cost of street cleaning (using activity-based costing)
- (f) calculate the total cost of the service for the government

Chapter 5: Cost Control

Review Questions

5.1 What is cost control? Why is cost control necessary in an organization, including government? What are some of the measures commonly used in cost control?

5.2 What is standard costing? What are the steps commonly used in standard costing? Discuss, with example, some of the commonly used standards in cost control.

5.3 What is variance analysis? Define and give an example of each of the following variances: [1] price variance, [2] usage variance, [3] efficiency variance, [4] overhead variance, and [5] budget variance.

5.4 Suppose that local community hospital does 315 X-rays a week. The standard costs per unit of material, labor, and overhead for X-rays are as follows:

- (1) Direct materials: 315 films (assuming an average of 2.5 X-rays per patient) x \$12 (per film) = \$3,780
- (2) Direct labor: 5 minutes (per X-ray) x \$35 (per hour) = \$2.92
- (3) Indirect labor: 2 minutes of labor time (per X-ray) x \$20 (per hour) = \$0.67, and
- (4) Indirect materials: 2 minutes of machine time (per X-ray) x \$10 (per hour) = \$0.33

The hospital costs for material, labor, and overhead (variable as well as fixed) for the year were as follows:

- (1) Direct materials: \$235,872
- (2) Direct labor: \$78,275
- (3) Variable overhead (labor): \$15,340, and
- (4) Variable overhead (materials): \$6,875

Using the information above, do the following:

- (a) find the material variance
- (b) find the labor variance
- (c) find the overhead variance
- (d) find the total variance
- (e) interpret the results

5.5 What is ratio analysis? Discuss, with example, the following ratios: [1] efficiency ratio, [2] capacity ratio, [3] activity ratio.

5.6 What is cost internal control? What are some of the commonly used cost internal control measures? Discuss, with an example of each.

5.7 What is a flexible budget? Why is it important to have a flexible budget for government? Construct a flexible budget for a local water department. Make sure the budget includes information on the following: [a] direct labor, [b] direct materials, [c] variable overhead, [d] fixed overhead, and [e] total cost of supplying water for the budgeted year.

Chapter 6: Classical Optimization

Review Questions

6.1 Why is optimization important in government? What are the key elements of classical optimization? What is the difference between a constrained and an unconstrained optimization? What is the purpose of using the Lagrangian multiplier? Explain.

6.2 A program is proposed to the state correctional agency to reduce gun violence across the state. The program claims that, if adopted, it will substantially reduce the cost of crime prevention due to gun-related violence. The agency carried out a preliminary study of the program and obtained the cost of running the program (C), the savings in the cost of crime prevention (S), based on the number of individuals who participated in the program - mostly inmates convicted of gun-related violence (N), given by the following functions:

$$S = 0.75N^2 + 1500N + 3500$$

$$C = 2.5N^2 - 6000N - 8000$$

Determine if the net return (π) from the program is positive and if it is maximum.

6.3 A local school district recently introduced a program to prevent the use of drugs, alcohol and smoking by its high school students. The district expects the program, if adopted, will reduce juvenile crime and healthcare costs, given by the following function:

$$C = R^2 + H^2 - 4HR + 12H + 30$$

where C is the cost of running the program, R is the reduction in cost related to juvenile crime, and H is the reduction in healthcare cost.

Determine, if the cost of running the program is efficient (optimum). [Hint: Use partial differentiation]

6.4 The cost function of a county-run hospital, specializing in children and elderly diseases, is given by the expression

$$C = 3.5x^2 - xy + 5y^2$$

where C is the cost which increases with the number of beds, x is the number of beds for children, and y is the number of beds for the elderly. Assume that there is a cost function that increases with the number of beds, given by the expression

$$1.5x + 0.75y = 1200$$

Determine the number of beds the hospital needs to maintain for the children and the elderly that will minimize the cost function and the total cost incurred by the hospital from the addition. [Hint: Use the Lagrangian multiplier]

6.5 The Central Purchasing Office of the Defense Department needs a certain number of items a quarter to carry out its repair jobs. The following data are obtained for the department:

- C = Cost of the item (\$15/piece)
- H = Carrying cost (12% of the average inventory)
- O = Ordering cost (\$16/order)
- D = Total demand for the item (800/quarter)

Using the information above,

- (a) determine the economic order quantity (EOQ) and the total cost (TC) of inventory
- (b) determine the economic order quantity (EOQ) and the total cost (TC) of inventory, assuming the average inventory is given by the expression $Q/3$, where Q is the order quantity.[Hint: Use the identity equation 6.11]
- (c) interpret the results

6.6 What is a queue? What are the key elements of a queuing system? What is the difference between queuing with a single channel and queuing with multiple channels? What role does simulation play in queuing? Discuss the advantages and disadvantages of using simulations such as Monte Carlo simulation.

6.7 The arrival time is constant at a local government-run, walk-in, healthcare clinic at five patients per hour. The cost of providing and maintaining the clinic is \$300 an hour and it can serve six patients an hour operating full time. If a patient has to wait an extra two hours, it represents a cost \$500. Find the optimum time to serve a patient, the total cost (TC) per period, and the minimum variable cost per patient. [Hint: Use Equation 6.29 for the optimum (minimum) time and Equation 6.30 for the total cost per period]

Chapter 7: Mathematical Programming

Review Questions

7.1 What role do mathematical programming methods serve in optimization? In what ways do these methods provide a better alternative to using the traditional optimization methods based on calculus?

7.2 What are the advantages of using a linear, as opposed to a non-linear programming method? What are the typical assumptions underlying a linear programming method?

7.3 What are the advantages of using a simplex, as opposed to a graphical method of solution? Discuss the steps used in a typical simplex method.

7.4 What is the difference between a primal and a dual solution to a linear programming problem? What rules are commonly used in converting a standard linear programming problem into its corresponding dual?

7.5 What is a shadow price? How would one interpret the shadow prices for a maximization and a minimization problem?

7.6 Graph the following linear programming problem and determine the optimal solution:

$$\begin{array}{ll}\text{Maximize } Z = & 5X + 3Y \\ \text{Subject to } & 3X + 2Y \leq 250 \\ & 3X + 4Y \leq 500 \\ & X, Y \geq 0\end{array}$$

7.7 Solve the problem in 7.6 using the simplex method and compare the solution obtained with the graphical method.

7.8 What is post-optimality analysis? Why are they necessary in optimization problems; in particular, mathematical programming? What changes would you make in a linear programming model if you are doing a post-optimality analysis?

7.9 For the problem in 7.6, what will be the optimal solution

- (a) if the objective function coefficients are changed to $4X+3Y$?
- (b) if the right-hand side constraints (resource constraints) are changed to 200 and 350, respectively?
- (c) if the technical coefficients are changed to $2X+Y$ and $3X+2Y$, respectively?