**Instructor's Manual – OMSC2 – Collier/Evans – C2 Measuring Performance in Operations and Value Chains**

This chapter introduces students to the basic concepts performance measurement in both goods-producing and service-providing value chains. We describe different types of measures used for decision making; explain the use of analytics in OM, which includes an example of basic statistical analysis and a summary of the business analytics supplements at the end of this book, interlinking, and the value of a loyal customer; discuss how to design good performance measurement systems, and introduce four models of organizational performance – The Malcolm Baldrige Performance Excellence Framework, the balanced scorecard, the value chain model, and the service-profit chain.

Instructors may wish to assign *Supplement A: Probability and Statistics* to review basic concepts of descriptive statistics, frequency distributions and histograms, and probability distributions (which will be used in later chapters).

Questions and problems are provided in four categories:
1. Review questions
2. Discussion questions and experiential activities
3. Computational problems and exercises that are intended to be solved manually, and
4. Excel-based problems that may be solved using spreadsheets or the supplied spreadsheet templates.

Two Excel spreadsheet templates – *Statistical Analysis* and *VLC* (Value of a Loyal Customer), available in MindTap, are illustrated in solved problems.

The chapter has three cases:

1. ***Greyhound Bank: Credit Card Division*** focuses on business analytics and interlinking key internal (operations) and external (marketing) performance measures.

2. ***Rapido Burrito*** requires students to evaluate customer feedback in a quick service restaurant using basic statistics and graphs.

3. The integrative case study, ***Hudson Jewelers***, with case assignment questions in all chapters, requires the student to compute the value of a loyal customer and develop a service plan for a "super A" customer.

**KEY TERMS**

**Actionable measures** provide the basis for decisions at the level at which they are applied—the value chain, organization, process, department, workstation, job, and service encounter.

A **customer-satisfaction measurement system** provides a company with customer ratings of specific goods and service features and indicates the relationship between those ratings and the customer's likely future buying behavior.

**Descriptive statistics** refers to methods of describing and summarizing data using tabular, visual, and quantitative techniques.

**Flexibility** is the ability to adapt quickly and effectively to changing requirements.

**Goods and service design flexibility** is the ability to develop a wide range of customized goods or services to meet different or changing customer needs.

**Goods quality** relates to the physical performance and characteristics of a good.

**Innovation** refers to the ability to create new and unique goods and services that delight customers and create competitive advantage.

The quantitative modeling of cause-and-effect relationships between external and internal performance criteria is called **interlinking**.

**Learning** refers to creating, acquiring, and transferring knowledge, and modifying the behavior of employees in response to internal and external change.

**Measurement** is the act of quantifying the performance of organizational units, goods and services, processes, people, and other business activities.

**Operational efficiency** is the ability to provide goods and services to customers with minimum waste and maximum utilization of resources.

**Processing time** is the time it takes to perform some task.

**Productivity** is the ratio of the output of a process to the input.

**Quality** measures the degree to which the output of a process meets customer requirements.

**Queue time** is a fancy word for wait time—the time spent waiting in a queue.

**Service quality** is consistently meeting or exceeding customer expectations (external focus) and service-delivery system performance (internal focus) for all service encounters.

Errors in service creation and delivery are sometimes called **service upsets or service failures.**

**Statistics** involves collecting, organizing, analyzing, interpreting, and presenting data. A statistic is a summary measure of data.

The **triple bottom line (TBL or 3BL)** refers to the measurement of environmental, social, and economic sustainability.

The **value of a loyal customer (VLC)** quantifies the total revenue or profit each target market customer generates over the buyer's life cycle.

**Volume flexibility** is the ability to respond quickly to changes in the volume and type of demand.

**Wait time** is the time spent waiting in a queue.

**REVIEW QUESTIONS**

1. Define measurement.

   **Measurement** is the act of quantifying the performance criteria (metrics) of organizational units, goods and services, processes, people, and other business activities.

2. What are the eight performance measure categories for organizations?

   As described in the chapter, these are:
   - Financial
   - Customer and market
   - Quality
   - Time
   - Flexibility
   - Innovation and Learning
   - Productivity and operational efficiency
   - Sustainability

3. What is a customer-satisfaction system?

A **customer-satisfaction measurement system** provides a company with customer ratings of specific goods and service features and indicates the relationship between those ratings and the customer's likely future buying behavior.

4. Define goods quality and service quality.

    **Goods quality** relates to the physical performance and characteristics of a good.

    **Service quality** is consistently meeting or exceeding customer expectations (external focus) and service delivery system performance (internal focus) for all service encounters.

5. What are five dimensions of service quality?

    - *Tangibles* -- physical facilities, uniforms, equipment, vehicles, and appearance of employees (i.e., the physical evidence).
    - *Reliability* -- ability to perform the promised service dependably and accurately.
    - *Responsiveness* -- willingness to help customers and provide prompt recovery to service upsets.
    - *Assurance* -- knowledge and courtesy of the service-providers, and their ability to inspire trust and confidence in customers.
    - *Empathy* – caring attitude and individualized attention provided to its customers.

6. Define service upsets and give an example from personal experience.

    Errors in service creation and delivery are sometimes called **service upsets** or **service failures**. Students may describe service upset experiences such as university registration, online ordering, movies, banking, dorm move-in process, pizza delivery, vacations, hotel and airline experiences, traffic situations, and bookstore service upsets.

7. The performance measure "time" relates to what two performance dimensions?

    **Time** relates to two types of performance measures—the *speed* of doing something (such as the time to process a customer's mortgage application) and the *reliability* of doing something (such as meeting promised delivery dates for electronic component parts).

8. Define goods and service design flexibility and volume flexibility.

    **Goods and service design flexibility** is the ability to develop a wide range of customized goods or services to meet different or changing customer needs.

**Volume flexibility** is the ability to respond quickly to changes in the volume and type of demand.

9.  Define innovation and learning.

    **Innovation** refers to the ability to create new and unique goods and services that delight customers and create competitive advantage.

    **Learning** refers to creating, acquiring, and transferring knowledge and modifying the behavior of employees in response to internal and external change.

10. Define productivity and operational efficiency.

    ***Productivity** is the ratio of output of a process to the input:*

    Productivity = Quantity of Output/Quantity of Input

    As output increases for a constant level of input, or as the amount of input decreases for a constant level of output, productivity increases. Thus, a productivity measure describes how well the resources of an organization are being used to produce output.

    Productivity is often confused with efficiency or effectiveness.

    ***Efficiency** is the ability to provide goods and services to customers with minimum waste and maximum utilization of resources.*

    Students might ask about the difference between efficiency and effectiveness; the following may provide additional insight. ***Effectiveness** is achieving the organization's objective, mission, or goal through the eyes of the customer; that is, doing the <u>right things</u> efficiently.* When all of your customers are consistently happy and willing to repurchase your good or service, then you are being effective. People now realize that doing unnecessary or non- value-added work efficiently is not productive. Hence, productivity is more closely related to effectiveness than efficiency.

11. Define interlinking. Why is it important?

    *The quantitative modeling of cause-and-effect relationships between external and internal performance criteria is called **interlinking**.*

    Interlinking tries to quantify the performance relationships between all parts of the value chain—the processes ("how"), goods and services outputs ("what"), and customer experiences and outcomes ("why"). With interlinking models, managers can objectively make internal decisions that impact external outcomes, for example, determining the

effects of adding resources or changing the operating system to reduce waiting time, and thereby increase customer satisfaction (see Exhibit 2.3). *Basically, interlinking asks and tries to answer the question: How are internal and external performance measures related? What internal metrics drive (improve) external metrics?*

12. Define the value of a loyal customer. Why is it important?

    The **value of a loyal customer (VLC)**, *quantifies the total revenue or profit each target market customer generates over the buyer's life cycle.*

    VLC analysis can be used to set continuous improvement performance goals (targets). Job design, process changes, equipment changes, facility design, and labor and capacity additions all benefit from knowing the economic value of a loyal customer. OM practices can impact the customer defection and retention rates, the contribution margin, and the repurchase frequency.

13. How are the customer defection and customer retention rate related?

    *Customer defection rate = (1 − customer retention rate).*

14. What are some of the questions IBM uses to evaluate performance measures?

    - Does the measurement support our mission?
    - Will the measurement be used to manage change?
    - Is it important to our customers?
    - Is it effective in measuring performance?
    - Is it effective in forecasting results?
    - Is it easy to understand/simple?
    - Are the data easy/cost-efficient to collect?
    - Does the measurement have validity, integrity, and timeliness?
    - Does the measure have an owner?

15. Define actionable measures.

    ***Actionable measures*** *provide the basis for decisions at the level at which they are applied-the value chain, organization, process, department, workstation, job, and service encounter.* They should be meaningful to the user, timely, and reflect how the organization generates value to customers. Good performance measures are actionable.

16. Explain the Baldrige Model of Organizational Performance.

See Exhibit 2.5. The underlying concept is that "leadership drives the system that creates results."

17. What are the four performance categories of the balanced scorecard approach to performance measurement?

- **Financial Perspective**: Measures the ultimate value that the business provides to its shareholders. This includes profitability, revenue growth, stock price, cash flows, return on investment, economic value added (EVA), and shareholder value.
- **Customer Perspective**: Focuses on customer wants and needs and satisfaction as well as market share and growth in market share. This includes safety, service levels, satisfaction ratings, delivery reliability, number of cooperative customer-company design initiatives, value of a loyal customer, customer retention, per- cent of sales from new goods and services, and frequency of repeat business.
- **Innovation and Learning Perspective**: Directs attention to the basis of a future success – the organization's people and infrastructure. Key measures might include intellectual and research assets, time to develop new goods and services, number of improvement suggestions employee, employee satisfaction, market innovation, training hours per employee, hiring process effectiveness, revenue per employee, and skills development.
- **Internal Perspective**: Focuses attention on the performance of the key internal processes that drive the business. This includes such measures as goods and service quality levels, productivity, flow time, design and demand flexibility, asset utilization, safety, environmental quality, rework, and cost.

18. What are example performance metrics for suppliers, value-creation processes, and customers in the value chain model of organizational performance?

Students will cite performance measures from Exhibit 2.7 such as:

- Suppliers – on-time delivery, accuracy, quantity, conformance to specifications
- Value-creation processes – productivity, cost per unit, reliability, amount of rework
- Customers – customer satisfaction, service quality, goods quality, timeliness, price

19. What is the primary theory of the service-profit chain model of organizational performance?

The primary theory is that "internal performance creates value and drives external performance."

20. What are the implications of Marriott's quote "Happy employees create happy customers"? What does this mean for human resource management?

This relates to the Service-Profit Chain. Employees create customer value, which in turn, drives profitability. Human resource managers, therefore, must focus on hiring the best people, recognizing and rewarding them, and creating effective training programs and processes.

**DISCUSSION QUESTIONS AND EXPERIENTAL ACTIVITIES**

21. What types of performance measurements might be used to evaluate a fraternity or student organization?

    Metrics might include attendance at key events, total membership each academic term, gains and losses in membership, fundraising amounts, operations costs, number of professional or social events held each term, grade point average of members, number of intramural sporting events participated in, number of guest speakers, student (member) satisfaction, projects completed on time and on budget, and so on.

22. Select an organization you are familiar with or have an interest in and write a short two-page paper describing key performance metrics in that industry and firm using the format of Exhibit 2.1.

    Students will develop some interesting tables for different industries and firms of interest to them. A few questions you might pose during discussion of this question are as follows:

    - What criteria are missing? Explain
    - Does the measurement support our mission?
    - Will the measurement be used to manage change?
    - Is it important to our customers?
    - Is it effective in measuring performance? (Is it actionable?) **Actionable measures** *provide the basis for decisions at the level at which they are applied*—the value chain, organization, process, department, workstation, job, and service encounter. They should be meaningful to the user, timely, and reflect how the organization generates value to customers.)
    - Is it effective in forecasting results?
    - Is it easy to understand/simple?
    - Is the data easy/cost-efficient to collect? (How would the data be collected? Who would do it? How long would it take? What would the cost be?)
    - Does the measurement have validity, integrity, and timeliness?
    - Does the measurement have an owner? (Who will ensure that the data do get collected, analyzed, and disseminated as needed?)

    Good performance measures are actionable. **Actionable measures** *provide the basis for decisions at the level at which they are applied*—the value chain, organization, process,

department, workstation, job, and service encounter. They should be meaningful to the user, timely, and reflect how the organization generates value to customers.

23. Interview managers at a local company to identify the key business measures (financial, market, supplier, employee, process, information, innovation, etc.) for that company. What quality indicators does that company measure? What cause-and-effect (interlinking) performance relationships would be of interest to the organization?

    It is always interesting to see what organizations really measure. In many cases, don't be surprised to see simply a heavy emphasis on financial results without a "balanced scorecard" as such. Quality indicators are often the traditional ones (defects, yield). Many smaller companies don't measure the cost of quality or customer satisfaction. Does the firm measure time, product and service quality, or what? Highlight OM metrics and issues. This question can be used to generate discussion on what *should* be measured and why (a good lead in to ideas of strategy in the next chapter). For small firms all performance measurement is sometimes done by observation of the owner(s). So make sure the size of the firm is identified upfront.

24. Research and write a short paper on how some organization applies the five dimensions of service quality.

    SERVQUAL was originally measured on 10 aspects of service quality: reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding the customer and tangibles (background -- using factor analysis). It measures the gap between customer expectations and experience. By the early nineties the authors had refined (combined) the SERVQUAL model to the useful acronym RATER (these five dimensions are in the chapter):

    - Reliability
    - Assurance
    - Tangibles
    - Empathy, and
    - Responsiveness

    If students search SEVQUAL and/or the GAP model (in C16) they will find many applications. The SERVQUAL has been tested in banking, credit cards, repair and maintenance, and long distance telephone service. Hospitals, for example, (see web reference below) have also used these five measures of service quality to measure their performance.

    http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1069855/pdf/hsresearch00075-0070.pdf

25. Discuss some analytical or graphical approaches that organizations can use for analyzing performance data based on your experience and previous coursework.

These methods might include simple charts that you would find in Microsoft Excel, such as bar charts, scatter plots, pie charts, and line charts for time series data. Other approaches would be basic statistical techniques such as frequency distributions and histograms, basic statistical measures such as means and standard deviations, statistical process control charts, Pareto (ABC) analysis, regression and correlation analysis, and so on.

26. Revenue or costs per passenger mile are two key performance measures in the airline industry. Research their use in this industry and prepare a one-page paper summarizing how they are used and why they are so important.

The two-metrics drive profitability in the airline industry. Few industries have so few and simple summary metrics yet they are very powerful. Southwest Airlines, for example, normally has the widest gap between these two metrics, and therefore, generates profits, while older airlines such as United often have costs per passenger mile equal to or higher than revenue per passenger mile. Your students will find many interesting ways to use these productivity metrics for this industry. Your students will also discover energy and labor costs are huge components of total airline costs.

27. Under which perspective of the balanced scorecard would you classify each of the following measurements?

   a.    On-time delivery to customers (customer perspective)
   b.    Time to develop the next generation of products (innovation and learning
              perspective)
   c.    Manufacturing yield (internal perspective)
   d.    Engineering efficiency (internal perspective)
   e.    Quarterly sales growth (customer perspective if units; financial perspective if
              dollars)
   f.    Percent of products that equal 70 percent of sales (innovation and learning
              perspective)
   g.    Cash flow (financial perspective)
   h.    Number of customer partnerships (customer, perspective)
   i.    Increase in market share (customer perspective)
   j.    Unit cost of products (financial perspective)

Arguments can be made for other perspectives. Some measures may not clearly fall into a particular category; however, what is more important is that the organization takes a broad view of the most important measures across the enterprise, rather than just focusing on financial results.

28. When the value of a loyal customer (VLC) market segment is high, should these customers be given premium goods and services for premium prices? If the VLC is low, should they be given less service? Explain.

This question can trigger significant differences in student opinions.  For example, should banking customers with average bank deposits of over $100,000 have to stand in the same teller line as a bank customer with average bank deposits of $1,000?  That is, should the bank set up a premium service channel for premium customers?  In the early 1990s when a New York bank set up a separate bank teller window (and line) for customers with bank deposits over $100,000, the outcry from other bank customers resulted in the bank closing the premium teller window for premium customers three days after it opened. Yet, hotels have VIP and loyal customer suites and floors, airlines give premium customers first choice at airline seats and flights plus VIP lounges and first-class services, some automobile dealerships give free loaner cars to their top customers while not offering these extra services to less valuable customers, and so on.  *The reality is that when a small percentage of customers (say 20%) account for a large percentage of total revenue (say 65%) it is profitable to segment markets based on the value of a loyal customer or customers and provide premium service for A customers.*

**COMPUTATIONAL PROBLEMS AND EXERCISES**
*These exercises require students to apply the formulas and methods described in the chapter. These problems should be solved manually.*

29. Each day, a FedEx competitor processes approximately 70,000 shipments.  Suppose that they use the same Service Quality Index as FedEx and identified the following numbers of errors during a 5-day week (see the "FedEx: Measuring Service Performance" box).  These values are hypothetical and do not reflect any real company's actual performance.

Complaints reopened: 125
Damaged packages:  18
International: 102
Invoice adjustments: 282
Late pickup stops: 209
Lost packages:  2
Missed proof of delivery:  26
Right date late:  751
Traces:  115
Wrong day late:  15

Compute the Service Quality Indicator by finding the weighted sum of errors as a percentage of total shipments.  How might such an index be used in other organizations such as a hotel or automobile service facility?

| | Weight | Percent of Total Weight | Number of Errors | Weighted Average Errors |
|---|---|---|---|---|
| Number of Shipments/Day | 70,000 | | | |
| Total Number of Shipments Over 5 Days | 350,000 | | | |
| Complaints Reopen | 3 | 0.079 | 125 | 9.87 |
| Damaged Packages | 10 | 0.263 | 18 | 4.74 |
| International | 1 | 0.026 | 102 | 2.68 |
| Invoice Adjustments | 1 | 0.026 | 282 | 7.42 |
| Late Pickup Stops | 3 | 0.079 | 209 | 16.50 |
| Lost Packages | 10 | 0.263 | 2 | 0.53 |
| Missed Proof of Delivery | 1 | 0.026 | 26 | 0.68 |
| Right Date Late | 1 | 0.026 | 751 | 19.76 |
| Traces | 3 | 0.079 | 115 | 9.08 |
| Wrong Day Late | 5 | 0.132 | 15 | 1.97 |
| | | | | |
| Total | 38 | 1 | 1645 | 73.24 |

Weighted Average % of Total Shipments        0.000209248*   0.020924812+

**Service Quality Indicator (SQI)**                        **99.979^**

*73.24/350,000 = 0.000209248
+0.000209248*100 = 0.020924812
^100-0.020924812 = 99.979

Over this 5-day period FE delivery performance was almost perfect on a percent basis, yet 1,645 customers experienced some type of service upset. You might point out that the U.S. Postal Service has good performance too (not as good as above) and that the huge volumes hide the number of impacts on individual customers. *Students may make different assumptions on this more open-ended problem so expect different solutions.*

30. Productivity measures for a manufacturing plant over a six-month period follow:

| Month | Jan. | Feb. | Mar. | Apr. | May | June |
|---|---|---|---|---|---|---|
| Productivity | 1.46 | 1.42 | 1.49 | 1.50 | 1.30 | 1.25 |

Using January as the base period, compute a productivity index for February to June, and comment on what those productivity indexes tell about the productivity trend.

Productivity Indexes:

   February: 1.42/1.46 = 0.97
   March: 1.49/1.46 = 1.02
   April: 1.50/1.46 = 1.03
   May: 1.30/1.46 = 0.89
   June: 1.25/1.46 = 0.86

Remember that January is the base year with an index of 1.46. While relatively stable through April, the productivity index appears to have taken a sharp decline in May and June; not good. Management should investigate why.

31. A major airline is attempting to evaluate the effect of recent changes it has made in scheduling flights between New York City and Los Angeles. Data available are shown below.

| | Number of Flights | Number of Passengers |
|---|---|---|
| Month prior to schedule change (January) | 16 | 8,795 |
| Month after schedule change (June) | 27 | 15,653 |

Using passengers per flight as a productivity indicator, comment on the apparent effect of the schedule change.

Computing passengers per flight, we obtain (after rounding)

   Month prior to schedule change:    8,795/16 = 550
   Month after schedule change:       15,563/27 = 576

Productivity increased by 4.73 percent (26/550) after the schedule change. This could be due to more convenient flight times, better schedules or some other intervening variable. Here the productivity metric is output per flight. Other possible productivity indicators for airlines might include flights/labor dollar, passengers/labor dollar, total passenger revenue/total cost of all flights, total number of passengers/total cost of all flights.

32. A hamburger factory produces 60,000 hamburgers each week. The equipment used costs $10,000 and will remain productive for four years. The labor cost per year is $13,500.

   a. What is the productivity measure of "units of output per dollar of input" averaged over the four-year period?

Productivity = total units produced divided by the total labor cost plus total equipment cost = 60,000(52)(4)/[13,500(4)+10,000] = 195 hamburgers/dollar

b. We have the option of $13,000 equipment, with an operating life of 5 years. It would reduce labor costs to $11,000 per year. Should we consider purchasing this equipment (using productivity arguments alone)?

For the expensive machine, productivity = 60,000(52)(5)/[11,000(5) + 13,000] = 229.4 hamburgers/dollar input. Because the productivity of the expensive machine is higher, it would be a good investment based on this single criterion.

33. A computer software firm provides a 20' x 30' office for its six systems analysts and plans to hire two additional analysts. To maintain a 100-square-foot working space per analyst, the firm's owner-manager is considering expansion. The cost of expansion is $40 per square foot with annual maintenance costs of $4 per square foot. The useful life of floor space is 20 years. By how much should employee productivity increase to justify the additional expenditure? The current salary of the systems analysts is $25,000.

Additional floor space requirement = 30(20)(2)/6 = 200 sq. ft. Annual cost of depreciation is $40(200)/20 years = $400; maintenance = $4(200) = $800. Total annual costs = $1,200. Thus, the productivity of the systems analysts has to increase 1200/25,000(8 analysts) = 0.006. There are, of course, other ways of arriving at the same result.

34. A factory produces 10,000 desk staplers each week. The equipment used costs $50,000 and will remain productive for three years. The labor cost per year is $180,000.

a. What is the productivity measure of "units of output per dollar of input" averaged over the three-year period?

Productivity = total units produced divided by the total labor cost plus total equipment cost =10,000(52)(3)/[180,000(3)+50,000]=1,560,000/590,000 = 2.65 units of output per dollar input

b. We have the option of buying $80,000 of new equipment, with an operating life of six years. It would reduce labor costs to $104,000 per year. Should we consider purchasing this equipment (using productivity arguments alone)?

For the newer and more expensive machine, productivity = 10,000(52)(6)/[104,000(6) + 80,000] = 3,120,000/704,000 = 4.43 units of output per dollar input. Because the productivity of the new machine is much higher, it would be a good investment.

35. A fast-food restaurant has a drive-through window and during peak lunch times can handle a maximum of 50 cars per hour with one person taking orders, assembling them, and

acting as cashier. The average sale per order is $9.00. A proposal has been made to add two workers and divide the tasks among the three. One will take orders, the second will assemble them, and the third will act as cashier. With this system it is estimated that 70 cars per hour can be serviced. Use productivity arguments to recommend whether or not to change the current system.

Productivity = revenue/labor dollar

For system 1, productivity = 50($9.00)/x = 450/x
For system 2, productivity = 70($9.00)/3x = 210/x

where x is the prevailing minimum wage.  With the additional two workers, productivity drops by more than on-half (i.e., too much labor for system 2).  Thus, it is not advisable to change the current system (i.e., keep system 1).  System 2 uses too much labor.

36. The data shown below apply to the first two quarters of the current year. Using total-dollar measures of input and output, compare the total profit and productivity achieved for the two quarters. How does second-quarter productivity compare with the first-quarter productivity? Use partial-factor productivity to identify what might be done to improve productivity and profitability during the third quarter.

| | First Quarter | Second Quarter |
|---|---|---|
| Unit selling price | $20.00 | $21.00 |
| Total units sold | 10,000 | 8,500 |
| Labor hours | 9,000 | 7,750 |
| Labor cost/hour | $10.00 | $10.00 |
| Material usage (lb) | 5,000 | 4,500 |
| Material cost/pound | $15.00 | $15.50 |
| Other costs | $20,000 | $18,000 |

First Quarter:

Output = $20(10,000) = $200,000
Input = $10(9000) + $15(5000) + $20,000 = $185,000
Profit = $200,000 - $185,000 = $15,000
Productivity = 200,000/185,000 = 1.081

Second Quarter:

Output = $21(8500) = $178,500
Input = $10(7750) + $15.50(4500) + $18,000 = $165,250
Profit = $178,500 - $165,250 = $13,250

Productivity = 178,500/162,250 = 1.080

Profit has decreased $1,750 during the second quarter; however, overall productivity has remained about the same.

|  | First quarter | Second quarter |
|---|---|---|
| Labor productivity | 200,000/90,000 = 2.22 | 178,500/77,500 = 2.303 |
| Material Productivity | 200,000/75,000 = 2.667 | 178,500/69,750 = 2.559 |

Labor productivity increased slightly during the second quarter while material usage productivity declined slightly. Perhaps material productivity should be examined more closely.

37.  A manufacturing firm uses two measures of productivity:

   a. Total sales/Total inputs
   b. Total sales/Total labor inputs

Given the data for the last three years below, calculate the productivity ratios. How would you interpret the results? All figures are in dollars.

|  | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Sales | $110 | $129 | $124 |
| Materials | 62 | 73 | 71 |
| Labor | 28 | 33 | 28 |
| Overhead | 8 | 12 | 10 |

The results are:

|  | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Total sales/total inputs | 1.1224 | 1.0932 | 1.1376 |
| Total sales/labor dollars | 3.9286 | 3.9091 | 4.4286 |

Total productivity decreased in year 2 but improved in year 3. This might be a result of the improvement in labor productivity.

38.  If the customer defection rate is 17.5 percent, what is the customer retention rate?

customer defection rate = 1 −  customer retention rate
0.175 = 1 − customer retention rate
customer retention rate = 1 − customer defection rate = 1.000 − 0.175 = 0.825

39. Estimate the value of a loyal customer of a loyal Volvo automobile owner? Assume the contribution margin is 0.32, the purchase price is $70,000, the repurchase frequency is every four years, and the customer defection rate is 30 percent.

    VLC = P*CM*RF*BLC = ($70,000)(0.32)(0.25)(3.33) = $18,667

    where      P = the revenue per unit = $70,000
             CM = contribution margin to profit and overhead = 0.32.
              RF = repurchase frequency = 1/4 years = 0.25 purchases per year.
             BLC = buyer's life cycle = (1/0.3 = 3.33 years).

40. What is the average value of a loyal customer (VLC) in a target market segment if the average purchase price is $70 per visit, the frequency of repurchase is every month, the contribution margin is 20%, and the average customer defection rate is 25%?  If a continuous improvement goal is set of a 20% defection rate next year and 15% two years from now, what are the revised VLCs over their average buying life?

    We can use the logic of the equation: VLC = P*CM*RF*BLC, where  P = the revenue per unit, CM = contribution margin to profit and overhead expressed as a fraction (i.e., 0.45, 0.5, and so on), RF = repurchase frequency = 1/(years or fraction of years between purchases); that is, 1/0.5 = 2 if repurchased every 6 months, 1/2 if every 2 years, and so on, BLC = buyer's life cycle, computed as 1/defection rate, expressed as a fraction (1/0.2 = 5 years, 1/0.1 = 10 years, and so on).  Applying this to the data, we have

             VLC = P*CM*RF*BLC = ($70)(0.20)(12)(4) = $672
             VLC = P*CM*RF*BLC = ($70)(0.20)(12)(5) = $840
             VLC = P*CM*RF*BLC = ($70)(0.20)(12)(6.67) = $1,121

    The economic advantage of reducing the customer defection rate from 25% to 20% to 15% is evident, and when multiplied by the number of customers in the market segment can be substantial.  Also, the instructor should point out the importance of the high repurchase frequency – every month.

41. What is the average defection rate for grocery store shoppers in a local area of a large city if they spend $50 per visit, shop 52 weeks per year, the grocery store has a 16% gross contribution margin, and the value of a loyal customer is estimated at $2,000 per year?

    VLC = P*CM*RF*BLC = ($50)(.16)(52)(1/DR) = $2,000
    $416 = $2000(DR)
    DR = .208

42. What is the value of a loyal customer (VLC ) in the small contractor target market segment who buys an electric drill on average every four years (or every 0.25 year) for $100, when

the gross margin on the drill averages 50 percent, and the customer retention rate is 60 percent? What if the customer retention rate increases to 80 percent? What is a 1 percent change in market share worth to the manufacturer if it represents 100,000 customers? What do you conclude?

If customer retention rate is 60 percent, the average customer defection rate is (1= customer retention rate). Thus, the customer defection rate is 40 percent, or 0.4. The average buyer's life cycle is 1/ 0.4 = 2.5 years. The repurchase frequency is every four years, or 0.25 (1/4) year. Therefore, using Equation (2.2): VLC = P*RF*CM*BLC = ($100)(0.25)(0.50)(1/ 0.4) = $31.25

The value of a 1 percent change in market share = (100,000 customers)($31.25/ customer year) = $3,125,000

If the customer retention rate is 80 percent, the average customer defection rate is 0.2, and the average buyer's life cycle is 1/0.2 or 5 years. Then, VLC = P*RF*CM*BLC = ($100)(0.25)(0.50)(5) = $62.50. Thus, the value of a 1 percent change in market share = (100,000 customers)($62.50/customer/year) = $6,250,000

The economics are clear. If customer retention can be increased from 60 to 80 percent through better value chain performance, the economic payoff is doubled.

43. If a coffee shops average transaction price is $4.00, their gross margin is 60 percent, the typical customer makes a purchase once a week or 52 weeks per year, and management estimates the value of a loyal customer over their buying life cycle as $520, what is the customer defection rate?

VLC = P*CM*RF*BLC = ($4)(0.6)(52)(1/DR) = $520
$520*DR = $124.8
DR = 0.24


**EXCEL-BASED PROBLEMS**
*For these problems, you may use Excel or the spreadsheet templates in MindTap to assist in your analysis.*

*Note to instructors:* You might want to review how to generate charts using Excel.

44.  A key hospital outcome measure of clinical performance is length of stay (LOS); that is, the number of days a patient is hospitalized.  For patients at one hospital with acute myocardial infarction (heart attack), the length of stay over the past four years has consistently decreased.  The hospital also has data for various treatment options such as

the percentage of patients who received aspirin upon arrival and cardiac medication for Left Ventricular Systolic Dysfunction (*LVSD*). The data are shown below:

| Year | Average LOS | Aspirin on arrival | LVSD medication |
|------|-------------|--------------------|-----------------|
| 2007 | 4.35 days | 95% | 89% |
| 2008 | 4.33 days | 98% | 93% |
| 2009 | 4.12 days | 99% | 96% |
| 2010 | 4.15 days | 100% | 98% |

Illustrate the interlinking relationships by constructing scatter charts using Excel showing the LOS as a function of the other variables.   What do these models tell you?

Students can chart these performance measures using Excel; then interpret the graphs. The charts below show that as the percentage of aspirin on arrival and LVSD medications increase, the average LOS decreases, suggesting that these interventions reduce hospitalization which is good.  Instructors might wish to illustrate how to add a trendline to a scatter chart (right click the data series and choose Add Trendline).



LOS vs Aspirin on Arrival



LOS vs. LVSD Medication
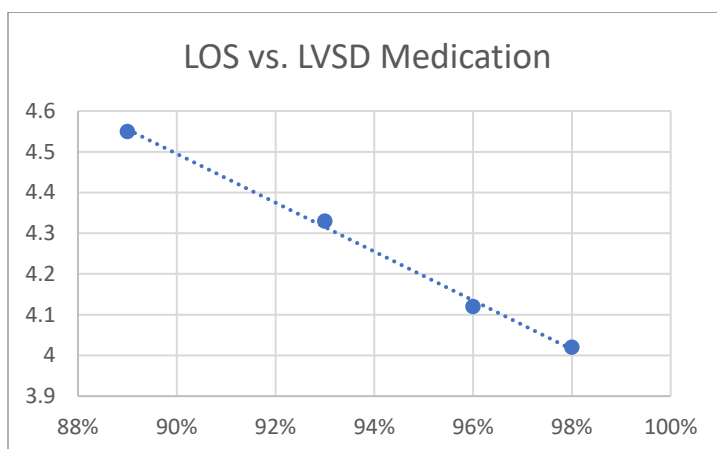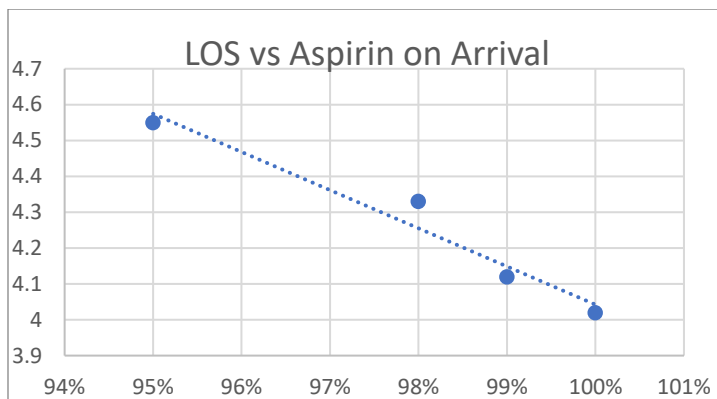
45. Customers call a call center to make room reservations for a small chain of 42 motels located throughout the southwestern part of the United States. Business analytics is used to determine how and if the following performance metrics are related: time by quarter, average time on hold (seconds) before a customer reaches a company customer service representative, percent of time the customer inquiry is solved the first time (called first pass quality) and customer satisfaction with the overall call center experience.

| Quarter | Average Hold Time | Percent Solved First Time | Overall Customer Satisfaction Percent |
|---|---|---|---|
| Q1 | 22 seconds | 89% | 96% |
| Q2 | 34 seconds | 80% | 92% |
| Q3 | 44 seconds | 78% | 82% |
| Q5 | 67 seconds | 85% | 84% |
| Q6 | 38 seconds | 87% | 90% |
| Q7 | 70 seconds | 76% | 80% |
| Q8 | 86 seconds | 67% | 74% |

Develop a graphical interlinking model by constructing scatter charts using Excel showing the relationships between each pair of variables. What do results tell you?

The charts below suggest that as the average hold time increases, both the percent solved the first time and customer satisfaction decreases (suggesting that service reps are probably rushing due to high call volumes). Instructors might wish to illustrate how to add a trendline to a scatter chart (right click the data series and choose Add Trendline).



20

**Customer Satisfaction vs Hold TIme**
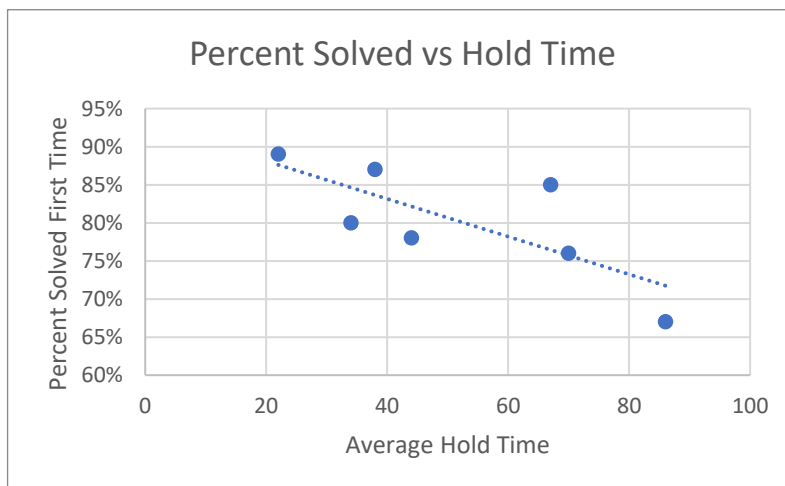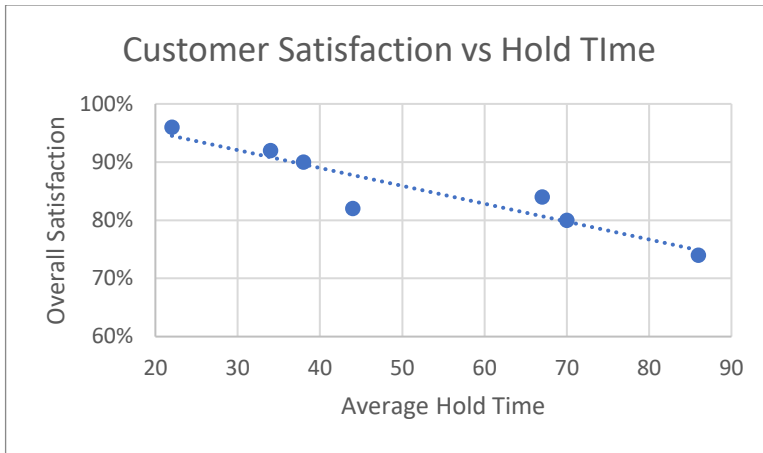


There also appears to be a positive relationship between Percent Solved the First Time and Customer Satisfaction.

**Customer Satisfaction vs Percent Solved First TIme**
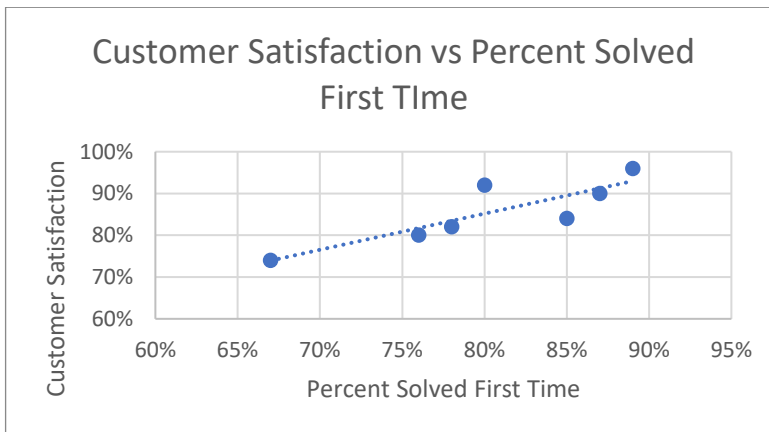


46. Use the Excel template *VLC* to find the average value of a loyal customer (VLC) in a target market segment if the average purchase price is $75 per visit, the frequency of repurchase is six times per year, the contribution margin is 10 percent, and the average customer defection rate is 25 percent?

VLC = P x CM x RF x BLC, where P = the revenue per unit, CM = contribution margin to profit and overhead expressed as a fraction (i.e., 0.45, 0.5, and so on), RF = repurchase frequency = 6 times/year, BLC = buyer's life cycle, computed as 1/defection rate, expressed as a fraction (1/0.25 = 4 years)

VLC = P x CM x RF x BLC = ($75)(0.10)(6)(4) = $180

We may also use the spreadsheet template *VLC*:

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $75.00 | | |
| 5 | Percent contribution margin to profit and overhead | 10% | | |
| 6 | Repurchase frequency (purchases/year) | 6 | | |
| 7 | Defection rate | 0.25 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 4.00 | | |
| 10 | VLC | $180.00 | | |

47. Using the base case data in question 46, use the Excel template *VLC* to analyze how the value of a loyal customer (VLC) will change if the average customer defection rate varies between 15 and 40 percent (in increments of 5 percent) and the frequency of repurchase varies between 3 and 9 times per year (in increments of 1 year). Sketch graphs (or use Excel charts) to illustrate the impact of these assumptions on the VLC.

An example using Excel line charts is shown below.

| Defection Rate | Repurchase Frequency | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0.15 | $150.00 | $200.00 | $250.00 | $300.00 | $350.00 | $400.00 | $450.00 |
| 0.20 | $112.50 | $150.00 | $187.50 | $225.00 | $262.50 | $300.00 | $337.50 |
| 0.25 | $90.00 | $120.00 | $150.00 | $180.00 | $210.00 | $240.00 | $270.00 |
| 0.30 | $75.00 | $100.00 | $125.00 | $150.00 | $175.00 | $200.00 | $225.00 |
| 0.35 | $64.29 | $85.71 | $107.14 | $128.57 | $150.00 | $171.43 | $192.86 |
| 0.40 | $56.25 | $75.00 | $93.75 | $112.50 | $131.25 | $150.00 | $168.75 |
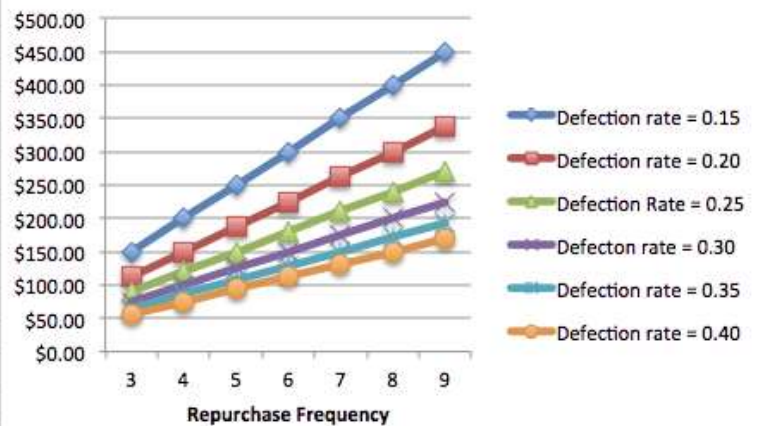


48. What is the average defection rate for grocery store shoppers in a local area of a large city if they spend $45 per visit, shop 52 weeks per year, the grocery store has a 4 percent gross margin, and the value of a loyal customer is estimated at $3,500 per year? Use a trial-and-error approach with the Excel template *VLC* to find your answer.

VLC = P x CM x RF x BLC = ($45)(0.04)(52)(1/DR)
$3,500 = $93.6/DR
$3,500 DR = $93.6

DR = 0.0267  (The average customer defection rate is 2.7%.)

The *VLC* spreadsheet template may be used using a trial and error approach.  A more accurate approach is to use Excel's Goal Seek tool; however, students may not be familiar with it. It will be introduced in Chapter 4 for break-even analysis applications and in Supplement C.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $45.00 | | |
| 5 | Percent contribution margin to profit and overhead | 4% | | |
| 6 | Repurchase frequency (purchases/year) | 52 | | |
| 7 | Defection rate | 0.02674 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 37.40 | | |
| 10 | VLC | $3,500.37 | | |

49. What is a grocery store's contribution margin (CM) if the average purchase price is $86.55 per visit, the customer defection rate is 0.10, the VLC is $1,800, and 52 purchases are made per year? Use a trial-and-error approach with the Excel template *VLC* to find your answer.

VLC = P x CM x RF x BLC = ($86.55)(CM)(0.52)(10) = $1,800

where  P = the revenue per unit = $86.55

CM = contribution margin to profit and overhead = ?

RF = repurchase frequency = 52

BLC = buyer's life cycle = (1/0.1 = 10 years).

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $86.55 | | |
| 5 | Percent contribution margin to profit and overhead | 4% | | |
| 6 | Repurchase frequency (purchases/year) | 52 | | |
| 7 | Defection rate | 0.1 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 10.00 | | |
| 10 | VLC | $1,800.24 | | |

50. Use the Excel template *VLC* to estimate the value of a loyal customer for a loyal Craftsman tool buyer? Assume the contribution margin is 0.25, the purchase price is $300 for a certain set of tools, and the repurchase frequency is every 5 years, and the customer defection rate is 10 percent. If the target market segment for this tool set is one million customers and this firm has a 27 percent market share, what is the VLC for this firm's target market.

VLC = P x CM x RF x BLC = ($300)(0.25)(0.2)(10) = $150

where  P = the revenue per unit = $300
        CM = contribution margin to profit and overhead = 0.25.
        RF = repurchase frequency = 1/5 = 0.2 years
        BLC = buyer's life cycle = (1/0.1 = 10 years).

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $300.00 | | |
| 5 | Percent contribution margin to profit and overhead | 25% | | |
| 6 | Repurchase frequency (purchases/year) | 0.2 | | |
| 7 | Defection rate | 0.1 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 10.00 | | |
| 10 | VLC | $150.00 | | |

Total VLC for this firm's target market = (1,000,000)(0.27)($150) = $40,500,000

51.    A retail store sells a popular cosmetic called *Devine* and the store manager was given $100,000 by the corporate office to improve store performance any way she thinks best. The "base case" information is a price of $30 per bottle, a contribution margin of 0.50, a customer defection rate of 17%, and a repurchase frequency of 3 times a year.   If these improvement funds could be used to either (a) increase the contribution margin to 0.58 or

(b) reduce the customer defection rate to 15% or (c) increase the repurchase frequency to 4 times per year, what is the best way to spend these improvement funds by answering the next two multiple choice questions? (Assume all other variables *remain at the base case level for each of the three improvement options.*)   $VLC = P*CM*RF*BLC$

Use the Excel template *VLC* to answer these questions and summarize your answers using the table below.

| Price | Contribution Margin | Repurchase Frequency | Defection Rate | VLC in $ |
|---|---|---|---|---|
| $30 | 0.50 | 3 | 17% | |
| $30 | 0.58 | 3 | 17% | |
| $30 | 0.50 | 3 | 15% | |
| $30 | 0.50 | 4 | 17% | |

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $30.00 | | |
| 5 | Percent contribution margin to profit and overhead | 50% | | |
| 6 | Repurchase frequency (purchases/year) | 3 | | |
| 7 | Defection rate | 0.17 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 5.88 | | |
| 10 | VLC | $264.71 | | |

Option (a)

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $30.00 | | |
| 5 | Percent contribution margin to profit and overhead | 58% | | |
| 6 | Repurchase frequency (purchases/year) | 3 | | |
| 7 | Defection rate | 0.17 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 5.88 | | |
| 10 | VLC | $307.06 | | |

Option (b)

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $30.00 | | |
| 5 | Percent contribution margin to profit and overhead | 50% | | |
| 6 | Repurchase frequency (purchases/year) | 3 | | |
| 7 | Defection rate | 0.15 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 6.67 | | |
| 10 | VLC | $300.00 | | |

Option (c)

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $30.00 | | |
| 5 | Percent contribution margin to profit and overhead | 50% | | |
| 6 | Repurchase frequency (purchases/year) | 4 | | |
| 7 | Defection rate | 0.17 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 5.88 | | |
| 10 | VLC | $352.94 | | |

a. The value of a loyal customer (VLC) for improvement option (a) is _____?

BLC = 1/0.17 = 6.67 years; VLC = $307

b. The best way to use the $100,000 in improvement funds is Option _____?

Option c: VLC = $353

52. The manager at Raphael's Four-Star Italian Restaurant wants to set the price of their premiere entrée. He estimates a loyal customer is worth $1,000. Based on survey data, the customer defection rate is 0.22, the repurchase frequency is once a month, and the restaurant's contribution margin is 18.5 percent. What is the price he should charge for the premiere entrée? Use the Excel template *VLC* to search for the solution.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $99.00 | | |
| 5 | Percent contribution margin to profit and overhead | 18.5% | | |
| 6 | Repurchase frequency (purchases/year) | 12 | | |
| 7 | Defection rate | 0.22 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 4.55 | | |
| 10 | VLC | $999.00 | | |

After the student uses the Excel template to search for a solution, a price of $99 for the premiere entrée fits the restaurant cost structure and customer behavior.

53. A computer manufacturer currently has a 20 percent customer defection rate. Their accounting department estimates the incremental contribution to profit and overhead as 35 percent. Customers purchase computers every four years at an average cost of $1,200.00. In an effort to reduce the defection rate, the company is improving both the quality of its computers and its post-sale service. Use the Excel template *VLC* to determine the increase in the average value of a loyal customer if the defection rate drops to 5 percent.

Current VLC = P × CM × RF × BLC
VLC = (1200)(0.35)(1/4)(1/0.2) = $525

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $1,200.00 | | |
| 5 | Percent contribution margin to profit and overhead | 35% | | |
| 6 | Repurchase frequency (purchases/year) | 0.25 | | |
| 7 | Defection rate | 0.2 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 5.00 | | |
| 10 | VLC | $525.00 | | |

If the defection rate drops to 5%, VLC = (1200)(0.35)(1/4)(1/0.05) = $2,100

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $1,200.00 | | |
| 5 | Percent contribution margin to profit and overhead | 35% | | |
| 6 | Repurchase frequency (purchases/year) | 0.25 | | |
| 7 | Defection rate | 0.05 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 20.00 | | |
| 10 | VLC | $2,100.00 | | |

The value of a loyal customer more than triples. A continuous improvement goal could be established by management to reduce the customer defection rate by better goods and service quality, better process design, and better human resource management (hiring, training, and recognition and reward).


## Teaching Note: Rapido Burrito

**Overview**

Rapido Burrito is a small regional chain of quick service restaurants. Rather than wait in a cafeteria style line, customers check boxes for their choice of ingredients, sauce, and so on paper menus at their table. The food is prepared quickly and then delivered to the tables. Lately, one of the store managers has been hearing customer complaints, such as: "The tortillas are too thin"; "The food is not hot"; "Every time I get a burrito it seems to be a different size"; and "I got the wrong ingredients on my burrito." Many complaints were submitted through the corporate website. The district manager was most concerned with the comments about the consistency of size. One of the staff designed a customer survey using the questions in Exhibit 2.109, based on a 5-point Likert scale [5 = excellent, or strongly agree; 1 = poor or strongly disagree] for the first 10 questions. The last two questions were coded as a 1, 2, 3, or 4. They administered the questionnaire to 25 random customers. The restaurant also gathered data on the weights of 50 samples of 3 burritos (a total of 150). (Both the survey data and weight data are available on spreadsheet *Rapido Burrito Case Data* in MindTap.)

EXHIBIT 2.10   Customer Survey Questions

1. Was the menu easy to read?
2. Was the order prepared correctly?
3. Was the food tasty?
4. Was the food served hot?
5. Were employees courteous and polite?
6. Was the restaurant clean?
7. In your opinion, did you receive a good value for the price you paid?
8. What was your level of satisfaction?
9. How likely are you to dine with us again?
10. How likely are you to recommend us to your friends/family?
11. How often do you eat at Rapido Burrito? First time, less than once/month, one to three times a month, weekly?
12. What was the main ingredient in your burrito: chicken, beef, pork, or beans?

**Case Questions for Discussion:**

1. **What conclusions do you reach when you calculate descriptive statistics for the answers to each of the survey questions in the database?**

Portions of the spreadsheet Rapido Burrito Case Soln.xlsx are shown below. A frequency count of the 25 customers who were surveyed is evenly divided, from first timers to those who eat there weekly.

| Customer survey responses | Avg | Std. dev. |
|---|---|---|
| Menu was easy to read | 4.64 | 0.70 |
| Order was prepared correctly | 4.32 | 0.75 |
| Food was tasty | 4.00 | 0.87 |
| Food was served hot | 3.72 | 1.37 |
| Employees were courteous and polite | 4.16 | 0.55 |
| Restaurant was clean | 4.16 | 0.75 |
| Value for price paid | 4.08 | 1.08 |
| Overall satisfaction | 3.96 | 0.79 |
| Likely to dine with us again? | 3.64 | 0.99 |
| Likely to recommend us to friends? | 3.56 | 1.08 |

- ✓ The survey averages show that customers were most satisfied with the menu and order preparation.
- ✓ Averages for tasty food, courtesy of employees, restaurant cleanliness, and value for price were between 4 and 4.16.
- ✓ Overall satisfaction averaged close to 4.
- ✓ Respondents were less enthusiastic about the food being served hot at an average of

3.72.
- ✓ The average likelihood of the customer dining again is only 3.64; likely to recommend is a bit lower at 3.65.
- ✓ The standard deviations for all of the questions for the menu, order preparation, employee courtesy, restaurant cleanliness, and overall satisfaction are similar.
- ✓ There was more variation in the responses to the questions about tastiness of food, food served hot, value vs. price, and likelihood to dine again, and likely to recommend. Hot food had a much larger standard deviation, indicating that there may be a problem in the kitchen or order delivery process.

2. **If you average the responses to the first seven questions by customer, how closely are those averages correlated to the satisfaction score? Include a scatter chart in your analysis.**

The first chart is overall satisfaction versus the average score on the first seven survey questions. The second graph is the survey question scores (a) likely to dine with us again versus (b) the overall satisfaction score. The second graph is for your information only and was not asked in the case assignment questions.

The average responses to the first seven questions by customers, are well correlated with their satisfaction scores. The $R^2$ = 0.7 which indicates a fairly good linear fit [correlation coefficient = 0.84] between the average scores and the overall satisfaction scores, can be visualized on the scatter chart, below.
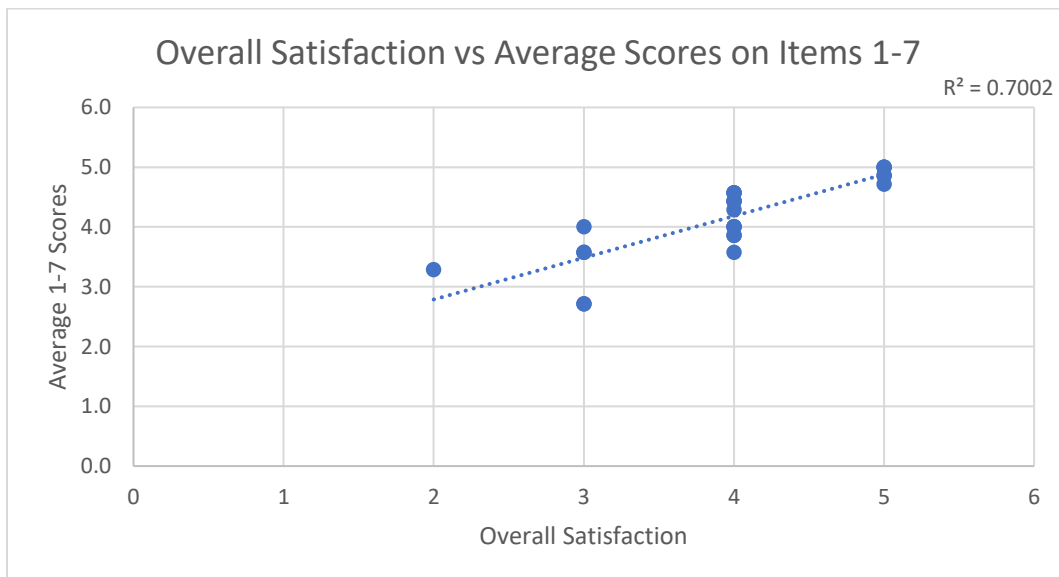


Comparing the likelihood of the customer dining again at Rapido Burrito with the satisfaction score, we also see a fairly strong correlation. The $R^2$ = 0.78, and the correlation coefficient is

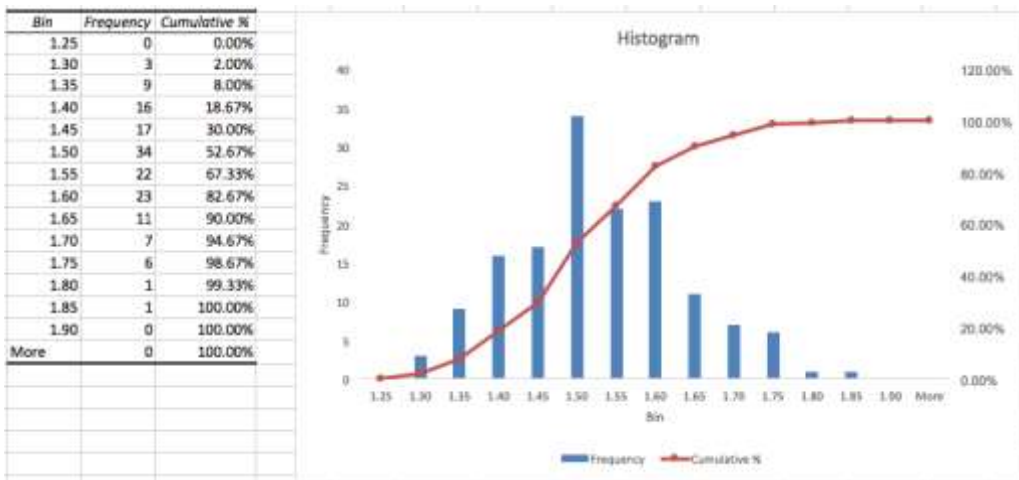0.88 as shown below. The lower the overall satisfaction, the customer will be less likely to dine again.



Likelihood to Dine Again vs Overall Satisfaction    R² = 0.779
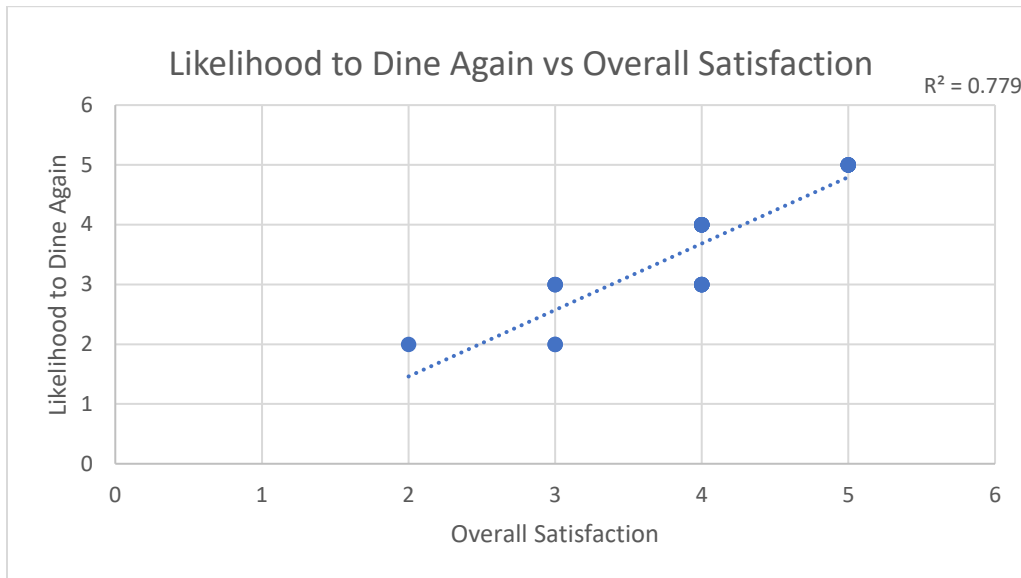
3. **Analyze the data on burrito weights using descriptive statistical measures such as the mean and standard deviation, and tools such as a frequency distribution and histogram. What do your results tell you about the consistency of the food servings?**

For all samples, descriptive statistics are

| | |
|---|---|
| Mean | 1.51 |
| Standard Deviation | 0.108375105 |
| Minimum | 1.29 |
| Maximum | 1.84 |

A frequency distribution and histogram are shown below:

| Bin | Frequency | Cumulative % |
|---|---|---|
| 1.25 | 0 | 0.00% |
| 1.30 | 3 | 2.00% |
| 1.35 | 9 | 8.00% |
| 1.40 | 16 | 18.67% |
| 1.45 | 17 | 30.00% |
| 1.50 | 34 | 52.67% |
| 1.55 | 22 | 67.33% |
| 1.60 | 23 | 82.67% |
| 1.65 | 11 | 90.00% |
| 1.70 | 7 | 94.67% |
| 1.75 | 6 | 98.67% |
| 1.80 | 1 | 99.33% |
| 1.85 | 1 | 100.00% |
| 1.90 | 0 | 100.00% |
| More | 0 | 100.00% |

The frequency distribution and histogram show that the sample is generally symmetric around the mean and somewhat normal in shape. The burrito weights vary from 1.29 lbs. to 1.84 lbs. This could be due to the nature of the burrito product, where the customer specifies ingredients, which add more or less weight to the burrito. More data would be needed to understand this.

If we plot the sample averages on a line chart, assuming that they were taken over consistent intervals of time, we see good consistency, although it appears that the averages seem to showing a downward trend toward the end. Again, this may be due to the type of product being ordered at that time, or might possibly be a result of fatigue and inattention after a long work shift.
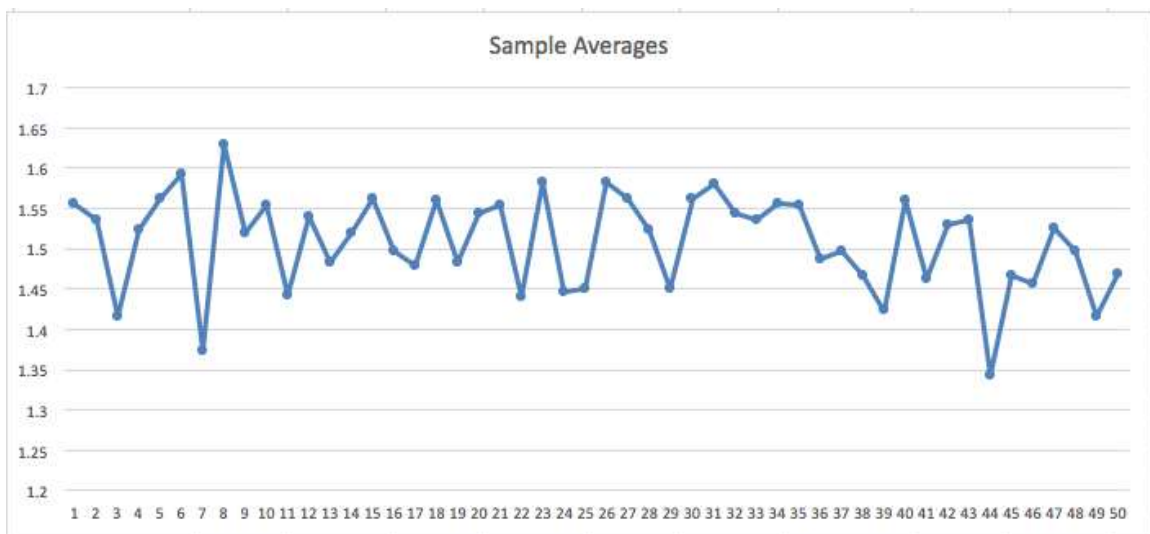


**4. What recommendations for decision making and improvement can you make to the store manager?**

a. Work to ensure that food is served hot (low average score of 3.60)
b. Develop a panel to do taste testing of various existing and new products (average scores are 3.84 for food was tasty and 3.92 for value for price paid).
c. Provide incentives for repeat customers, such as discounts for people who eat there three times, six times, nine times, etc. (since likely to dine with us again average score is 3.56 and likely to recommend us to friends average score is 3.44).
d. Consider job design and work method ways to ensure that exact weighs of ingredients can be measured and assembled in the burritos. That is, how can we continuously improve our job, equipment, and process designs to reduce variability?

Any average customer survey score below 4.0 is an opportunity for improvement and should be investigated!

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**Teaching Note: Greyhound Bank: Credit Card Division**

**Overview**

The case confronts the student with four variables that may or may not be related. Using only charts and basic statistics, the student is introduced to the ideal of internal and external performance metrics and their importance for management decision making. Key lessons learned from this case study are as follows, and the instructor should summarize these at the end of the case discussion.

1. Business analytics searches for performance relationships that help managers make internal and external decisions. In this case, does internal performance drive external performance?
2. Ideally, internal and external performance should be related but in the real world there are many intervening variables not accounted for in our data analysis.
3. There are four possible graphs that might provide management insights here (students seldom see all four).
4. There is evidence of continuous improvement (as the months increase, customer satisfaction increases).
5. Coordinating marketing and operations functional silos is difficult.

The case assignment asks only for basic statistics such as the mean, standard deviation, and three or four charts. If your students can do correlations and regressions then add this requirement to the assignment if you want.

| EXHIBIT 2.11 | Sample Internal and External Greyhound Credit Card Performance Data* | | |
|---|---|---|---|
| Month | Customer Satisfaction Percent (%) | New Applicant Processing Time (Days) | Plastic Production Turnaround Time (Days) |
| 1 | 86.4 | 1.7 | 1.005 |
| 2 | 81.8 | 1.0 | 1.007 |
| 3 | 81.6 | 1.4 | 1.208 |
| 4 | 83.7 | 1.8 | 0.906 |
| 5 | 83.3 | 1.6 | 1.057 |
| 6 | 81.7 | 1.5 | 1.099 |
| 7 | 84.0 | 1.2 | 0.755 |
| 8 | 84.5 | 1.3 | 1.208 |
| 9 | 83.3 | 1.7 | 0.906 |
| 10 | 82.6 | 1.1 | 1.087 |
| 11 | 84.2 | 1.3 | 0.884 |
| 12 | 85.0 | 1.1 | 0.987 |
| 13 | 85.6 | 0.9 | 0.755 |
| 14 | 85.8 | 1.0 | 1.102 |
| 15 | 84.1 | 0.9 | 0.782 |

**Case Questions for Discussion:**

1.  **What are the major problems facing the credit card division?**

    *   A possible mismatch between internal operations-focused performance measures and external customer-focused satisfaction scores.
    *   Quality of information is dependent on other players in financial value chain (other domestic and international banks, U.S. federal reserve, airborne couriers, UPS, etc.) and BankUSA does not have control over them.
    *   The existence of functional silos where marketing design and implements customer surveys without input from operations (poor functional communication).
    *   Do not understand cause and effect in their business and processes.
    *   A focus on average service.
    *   Too many services
    *   Too many sites
    *   The complexities of the customer benefit package and value chain operation.

2.  **What steps are required to develop a good internal and external performance and information system?**

Good operational planning, design, and management are keys to developing good internal performance systems, and require all of the topics in this textbook. Where some organizations fail on this issue is not having interdisciplinary teams plan, design the external performance measurement system. Operations is not always included in engineering design, marketing survey design, and field service studies. Functional silos and associated mentality still dominate organization performance. The instructor has to lead this class discussion for undergraduate students (sort of a tutorial). Typical steps might include

    *   Ensure top-level management support and champions.
    *   Clearly define job and process designs and workflows.
    *   Clearly define performance criteria and standards.
    *   Require frequent meetings between functional areas.
    *   Redo the survey with input from marketing and operations via a team effort.

Some clever students use the MBNQA or Service-Profit-Chain frameworks to define these steps.

3.  **How should internal and external performance be related? Are these data related? What do charts and/or statistical data analysis tell you, if anything? (Use the data in Exhibit 2.11 to help answer these questions).**

Depending on the capabilities of your students, they can draw simple charts of the data to discover performance relationships between (a) time (months) and customer satisfaction, (b)

customer satisfaction and either internal metric, (c) time and customer satisfaction or either internal metric.

## Descriptive statistics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mean | 83.84 | Mean | 1.3 | Mean | 0.9832 |
| Standard Error | 0.386658456 | Standard Error | 0.078679579 | Standard Error | 0.03856117 |
| Median | 84 | Median | 1.3 | Median | 1.005 |
| Mode | 83.3 | Mode | 1.7 | Mode | 1.208 |
| Standard Deviation | 1.497521762 | Standard Deviation | 0.3047247 | Standard Deviation | 0.149346768 |
| Sample Variance | 2.242571429 | Sample Variance | 0.092857143 | Sample Variance | 0.022304457 |
| Kurtosis | -0.812220772 | Kurtosis | -1.29421939 | Kurtosis | -0.927889441 |
| Skewness | -0.001926014 | Skewness | 0.262143688 | Skewness | -0.156222557 |
| Range | 4.8 | Range | 0.9 | Range | 0.453 |
| Minimum | 81.6 | Minimum | 0.9 | Minimum | 0.755 |
| Maximum | 86.4 | Maximum | 1.8 | Maximum | 1.208 |
| Sum | 1257.6 | Sum | 19.5 | Sum | 14.748 |
| Count | 15 | Count | 15 | Count | 15 |

## Correlations

| | Customer Satisfaction (%) | New Applicant Processing Time (Days) | Plastic Production Turnaround Time (Day) |
|---|---|---|---|
| Customer Satisfaction (%) | 1 | | |
| New Applicant Processing Time (Days) | -0.13461381 | 1 | |
| Plastic Production Turnaround Time (Days) | -0.319606478 | 0.215495901 | 1 |

## Scatter charts



Customer Satisfaction versus Month   $R^2 = 0.1549$
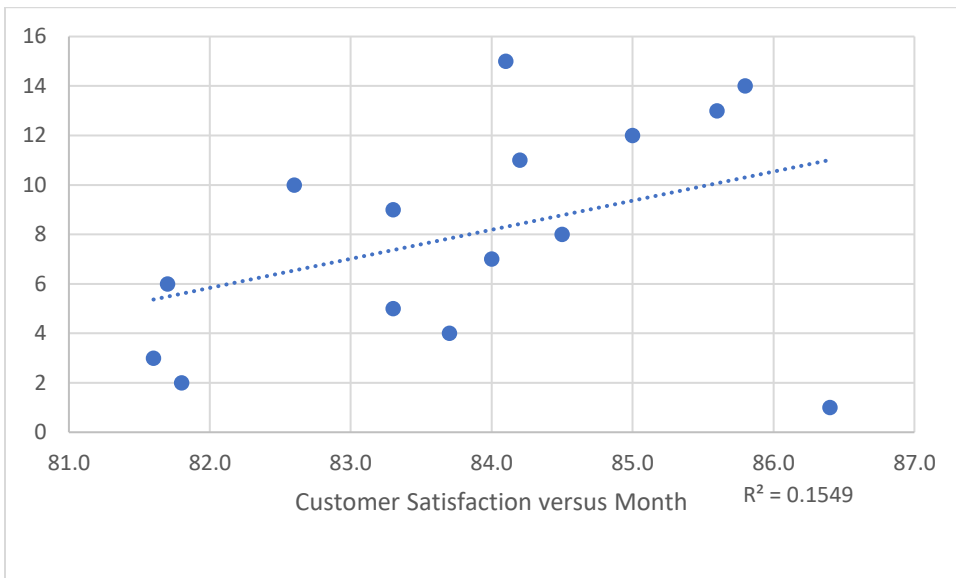
The CS% versus Month graph provides evidence of continuous improvement and a positive trend. As months increase so does customer satisfaction.
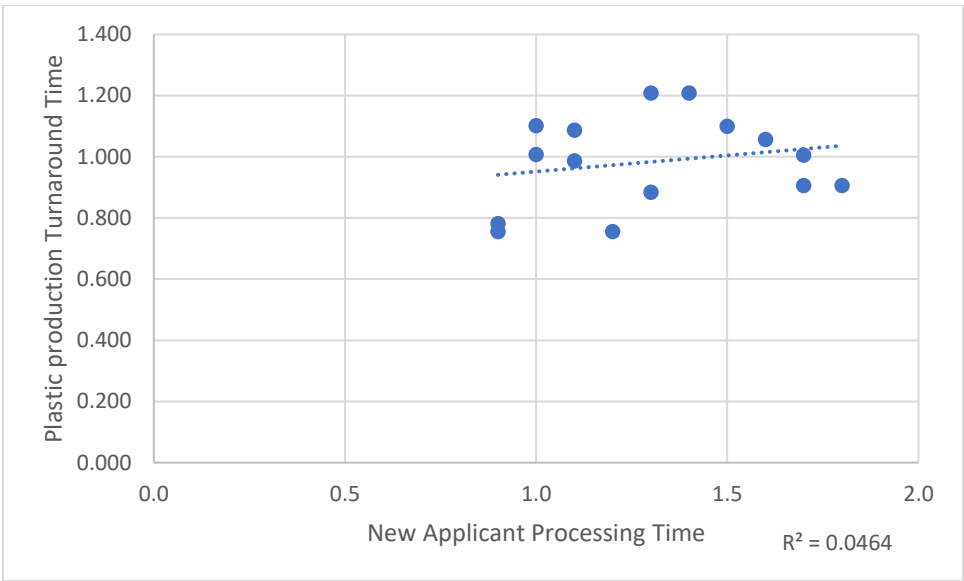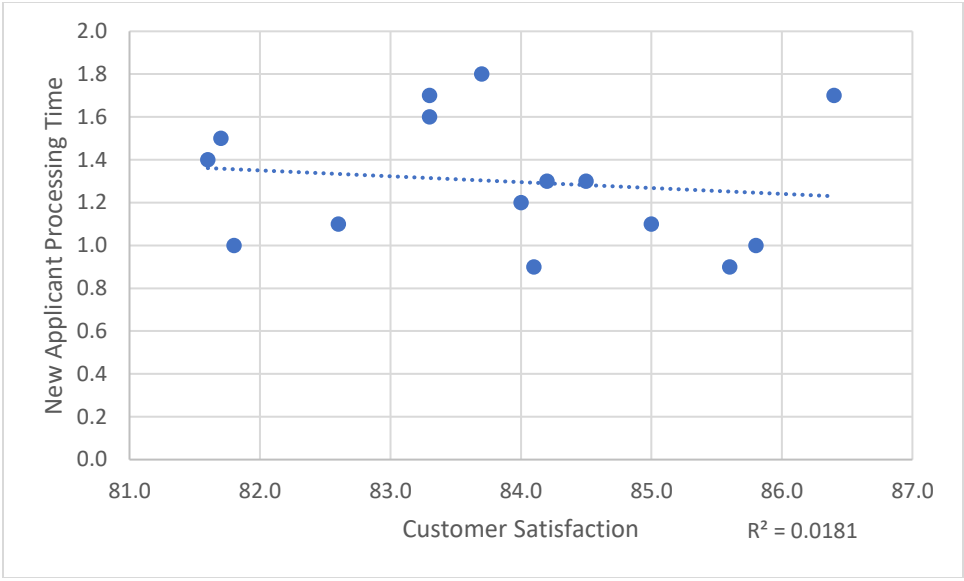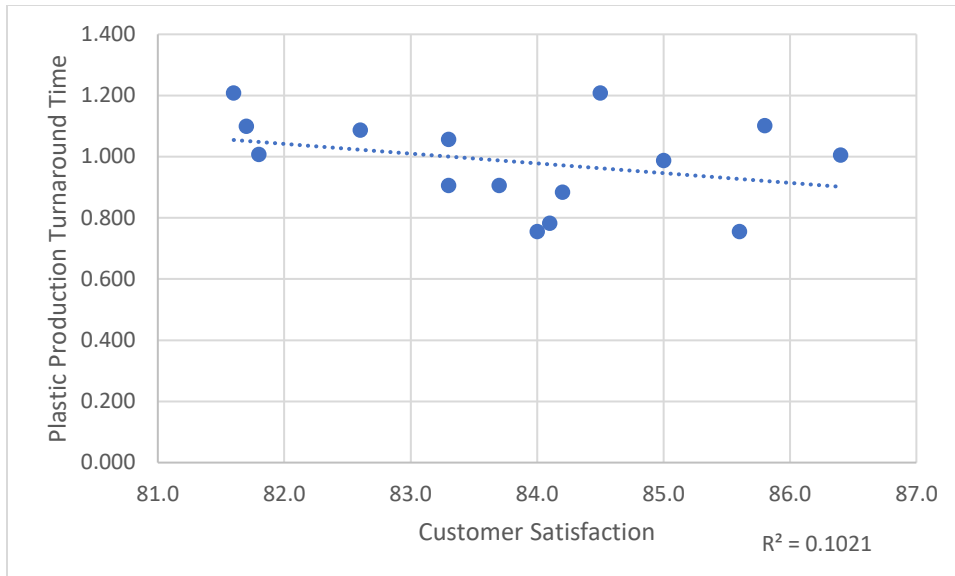
Students are not required to compute correlations or develop trendlines, so if they conclude there is a weak relationship between these internal and external variables, they are correct based on the graphs.

The charts that depict the external measure (customer satisfaction) versus the two internal measures (new applicant processing time and plastic production turnaround time) show a slight (weak) relationship that is not statistically significant. The correlations with customer satisfaction are -0.01346 for new applicant processing time and -0.3196 for plastic production turnaround time. As both internal measures decrease, customer satisfaction increases. (Also, point out that the signs of the correlation coefficients are correct).

If you assign your students to do correlations and regression analysis, none of the results are statistically significant (an advantage of statistical analyses). The scatter charts and $R^2$ values show little relationship between the variables, making it difficult to draw conclusions. The conclusion is the data collection and analysis should be redone with a larger sample size (current sample size is 15 observations).

**4. Is the real service level what is measured internally or externally? Explain your reasoning.**

This can trigger an interesting discussion. The answer to this question is: *the real service level is "what the customer perceives."* That's right, if process (operational) performance metrics indicate the process is doing an almost perfect job yet customer perception is lower based on statistical evidence then customer perception scores is actual (real) performance. Historically, many service systems have had this problem at one time or another including the U.S. Postal Service. The same could be said of goods-producing firms such as Ford and GM versus their Japanese competitors. Ford and GM internal quality measures may document highly reliable cars and trucks but the customer's perception is that American built cars are not as reliable.

Please note the dependent variable in this discussion is only customer satisfaction, not cost, timeliness, or profit.

**5. What are your final recommendations?**

A good student answer focuses on short- and long-term recommendations.  A short-term recommendation might be to immediately begin weekly meetings between marketing and operations to more closely understand the interdisciplinary issues and coordinate improvement efforts. Long-term recommendations might include redesigning the entire value chain in a coordinated process improvement effort and jointly designing surveys and value chain performance metrics. Also, larger sample sizes are required for a more meaningful analysis of performance relationships. For this bank, you are trying to change the culture and work habits – not an easy task.

**Teaching Plan**

Address the questions posed by Sutherland:

1. What are the major problems facing the credit card division?

2. What steps are required to develop a good internal and external performance and information system?

3. How should internal and external performance data be related? Are these data related? What do graphs and/or statistical data analysis tell you, if anything? (Use the data in case exhibit to help answer these questions.)

4. Is the real service level what is measured internally or externally? Explain your reasoning.
5. What are your final recommendations?

# Teaching Note: Hudson Jewelers

*A complete teaching note for all chapters is available in the Instructor Resources online. Instructors should read the entire case and most of the case assignments at the end of each chapter. Then decide if you want to assign all or part of the case questions.*

**Chapter 2 Case Questions for Discussion:**

1. **What is the value of a loyal customer to Hudson Jewelers for a wealthy individual who visits Naples, Florida every February and buys jewelry for her extended family every other year? Assume the following:**
   - **Customer retention rate = 80 percent**
   - **Contribution margin = 0.55**
   - **Price per purchase = $200,000**

Repurchase frequency = 0.5

Customer defection rate = 1 – retention rate = 1 – 0.8 = 0.2

Buyer's life cycle = 1/defection rate = 1/0.2 = 5 years

Value of this Loyal Customer = $200,000*0.55*.5*5 = $275,000

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Value of a Loyal Customer | Copyright © 2017 Cengage Learning | | |
| 2 | Enter data only in yellow cells. | Not for commercial use. | | |
| 3 | | | | |
| 4 | Revenue per unit | $200,000.00 | | |
| 5 | Percent contribution margin to profit and overhead | 55% | | |
| 6 | Repurchase frequency (purchases/year) | 0.5 | | |
| 7 | Defection rate | 0.2 | | |
| 8 | | | | |
| 9 | Buyer's life cycle | 5.00 | | |
| 10 | VLC | $275,000.00 | | |

## 2. Design an individual "service plan" for this "AAAA" customer.

A service plan for a "super A" customer might include:

- mailing or e-mailing to this customer upcoming jewelry pieces displayed at the store in November to March every year,
- train all employees to know this person and their family by name,
- build a family profile of wants, needs, names, and behavior that all employees can access in a backroom file,
- train all store employees on this persons loyalty and need for super duper service,
- query this customer for private appointments either at their seaside home or at the store including CAD co-designed pieces of jewelry
- if they come to the store to pick up the jewelry, give them their favorite wine ($1,000 plus), have all Hudson family attend and celebrate, etc.

The Ritz-Carlton and other high-end service systems maintain "customer profiles" for their "A" customers.  Formal customer profiles for A customers is a good idea for HJ.