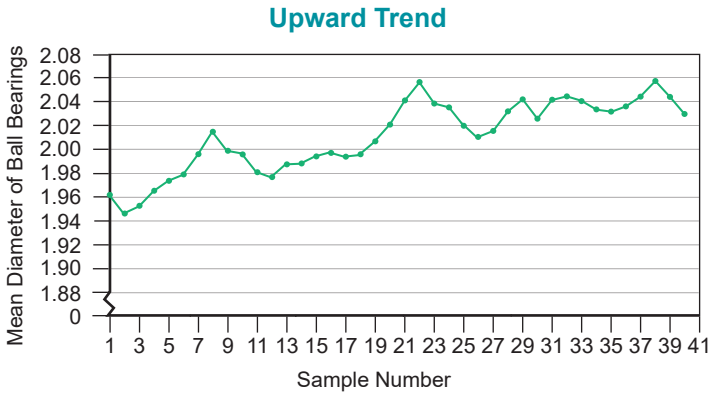


Figure 18.1.3

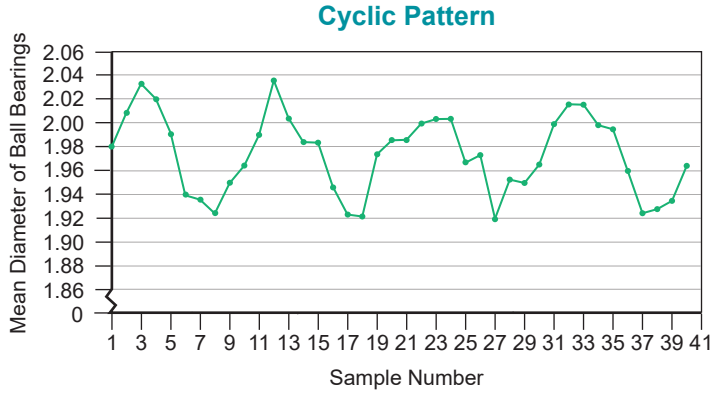


Figure 18.1.4

NOTE

Unstable patterns on a runs chart are often the result of special causes — perhaps a systematic environmental change (e.g. maintenance, employee fatigue, or equipment rotation).

Definition

Cycle

A **cycle** is a systematic repeating pattern observed in a run chart.

Notice how the data in the graph in Figure 18.1.4 move systematically up and down in a repeating pattern. This pattern (called a **cycle**) is also an indication of a process that is unstable.

18.1 Exercises

Basic Concepts

1. Describe the contributions made by Dr. Walter A. Shewhart in the field of quality control.
2. What contributions did W. Edwards Deming make in the field of quality control? Of Deming's 14 Points, give five that you believe are most important.
3. To which types of organizations do Deming's 14 Points apply?
4. What is the common philosophy of the fathers of modern quality control?
5. What is Six Sigma? Briefly describe the methodology behind Six Sigma.
6. What is a flowchart? Why are flowcharts important in quality control?
7. What is a Pareto chart? Explain how a Pareto chart can be used in the field of quality control.
8. What is a run chart? Is a run chart the same as a time series plot? Explain.
9. Explain how a run chart can be used in the field of quality control.

Exercises

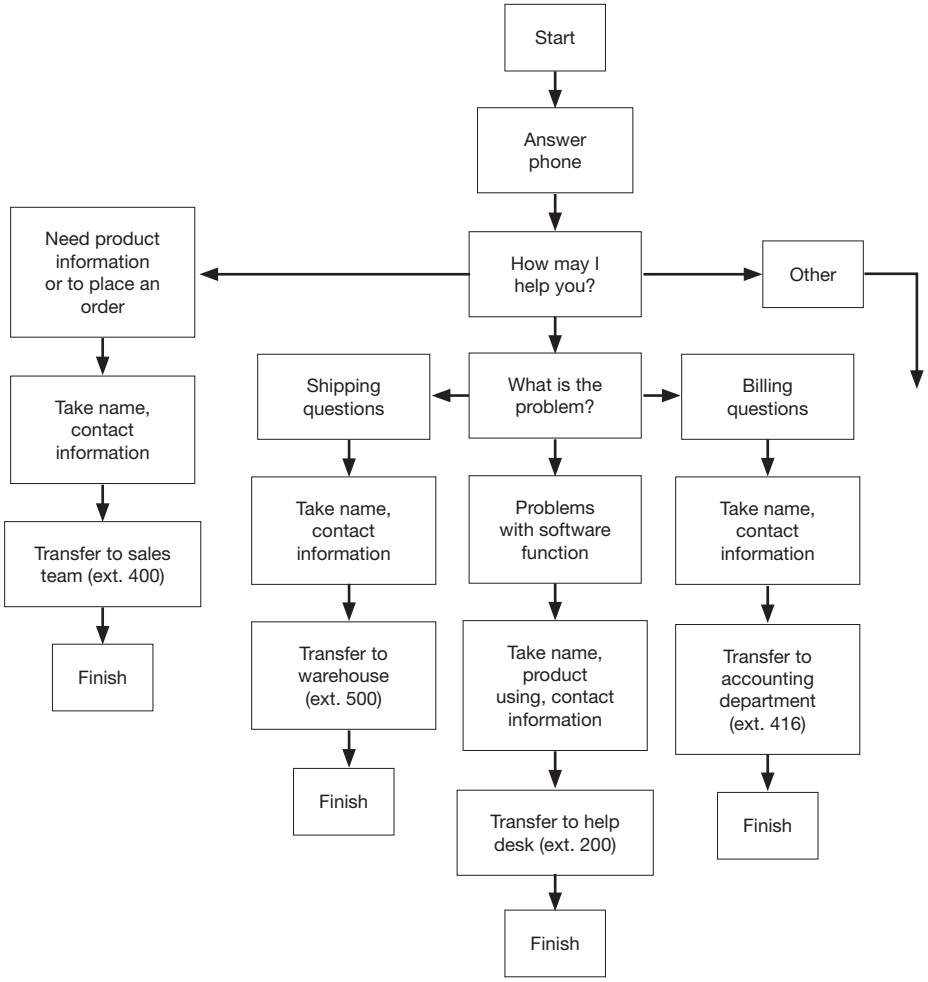
10. Create a flowchart for each of the following processes.
    a. Getting ready for work in the morning

b. Getting married

c. Going on a week-long vacation in Bermuda

d. Going to a job interview

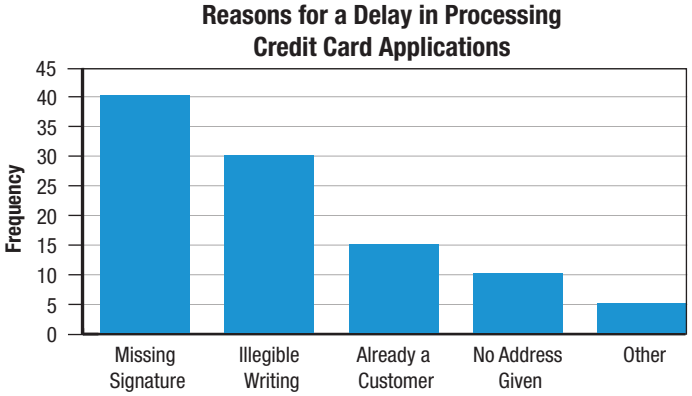
11. Consider the following flowchart regarding incoming call routing for a software company.



a. Explain why it is important for a new receptionist working at the company to understand this flowchart.

b. In what ways do you think this flowchart could be improved?

12. Consider the following Pareto chart regarding reasons for a delay in processing credit card applications.



a. What percentage of delays is caused by a missing signature on the application?

b. What percentage of delays is caused by a missing signature or illegible writing on the application?

c. From the chart, what would you identify as the "vital few" problems?

d. How do you think the credit card company could attempt to correct these problems?

e. Does the 80/20 notion seem to apply here? Explain.

13. Consider the following data regarding customer complaints for a clothing store.

Customer Complaints

Complaint	Frequency
Not Enough Parking	80
Rude Personnel	50
Poor Lighting	42
Confusing Store Layout	28
Limited Sizes	15
Clothing Unattractive	10

a. Compute the relative frequencies for the complaints listed in the table.

b. Create a Pareto chart for the data.

c. Which problem(s) would you identify as the "vital few"?

d. Does the 80/20 notion seem to apply here? Explain.

e. How should the clothing store proceed in attempting to improve customer satisfaction? In your opinion, what should be done first? Explain why.

14. Consider the following data regarding the number of returned products for a large online retailer, by month, for the years 2003 and 2011.

Number of Returned Products in 2003 and 2011

Month	2003	2011
January	79	100
February	81	105
March	92	96
April	101	84
May	111	72
June	120	80
July	119	64
August	125	60
September	137	55
October	120	59
November	140	42
December	145	56

a. Create a run chart for the number of returned items, by month, in 2003.

b. Analyze the run chart for returned items in 2003. Is there a downward or upward trend or is the pattern cyclic?

c. Would you consider the process to be stable or unstable? Explain why.

d. Create a run chart for the number of returned items, by month, in 2011.

e. Analyze the run chart for returned items in 2011. Is there a downward or upward trend or is the pattern cyclic? Does the process appear to be stable or unstable? Explain.

f. Does it appear that the retailer has improved the process from 2003 to 2011? Explain.

15. Consider the following data regarding revenues, by quarter, for a popular local restaurant.

Quarterly Revenues (Thousands of Dollars)

Year	Quarter	Revenue
2008	1	270
2008	2	369
2008	3	468
2008	4	306
2009	1	285
2009	2	354
2009	3	525
2009	4	330
2010	1	261
2010	2	288
2010	3	375
2010	4	366
2011	1	303
2011	2	420
2011	3	471
2011	4	414

a. Create a run chart for the quarterly revenues.

b. Analyze the run chart. Is there a downward trend or an upward trend? Do revenues appear to be cyclical? Explain.

c. Do you think restaurant sales depend on the time of year?

d. Can you think of any reasons why there would be this type of trend for restaurant sales?

e. Does this process appear to be unstable? If so, suggest ways that quality control could help the restaurant manager control the process.

18.2 Basic Concepts

The scientific method for attaining quality relies on two basic concepts.

1. No matter what the specifications are for a product, the process that produces the product will create output that has *variation*. (For example, suppose a manufacturer desires to produce ball bearings with a diameter of two inches. If a process is set up to produce ball bearings with a diameter of two inches, then each item, when actually measured, will show deviation from the *ideal* of two inches.)
2. Improving a process requires removing variation from it. (Though the ideal would be to remove all variation, this cannot be achieved. The goal then is to move towards the ideal. This notion is known as *continuous improvement*.)

With these two powerful ideas in mind, let's look at some important definitions.

Definition

Control Chart Terminology

A **control chart** for a process consists of values plotted over time. This chart has an upper bound and a lower bound called the **upper control limit (UCL)** and the **lower control limit (LCL)**, respectively. The process is **out of control** when a measurement falls either above the UCL or below the LCL. The control chart also contains a **centerline** that represents the average value of the quality characteristic corresponding to the in-control state.