12 Discuss the strengths and weaknesses of quality circles. Are they similar to student cohort work groups?
13 What are the ways to reduce the cost of detailing?
14 Explain what the House of Quality does and how it works.
15 Describe how QFD functions.
16 What prize competitions exist for quality and why are these prizes given?

Problems Section

Note: This section has various problems that can be formulated and solved using QuantMethods Production/Operations Management software (QMpom). The appropriate model categories are indicated for each problem.

1 The costs of quality are given by the following equations:

$$C_a = 100D + 1500$$
$$C_p = -50D + 6300$$
$$C_f = De^{0.5D}$$

where:

C_a is the cost of appraisal,
C_p is the cost of prevention, and
C_f is the cost of failure.

Note that D is the percent defectives and $0 \leq D \leq 100$.
Determine the total cost of quality when there are no defectives. $D = 0$ and product quality is perfect.
2 Given the information in Problem 1, determine the total cost of quality when $D = 90$. No company could stay in business with $D = 90$, as will be apparent from the calculations.
3 Given the information in Problem 1, determine the total cost of quality when $D = 0$, 10, and 15. Plot all of the points.
4 Using the information in Problem 1, comment on the shape and position of these cost of quality curves.
5 Using the information in Problem 1, is there a minimum total cost? What is it?
6 Assume that the cost of appraisal is the same no matter what the value of D.
Can this situation be explained in a rational way?
Calculate the minimum total cost of quality with appraisal costs removed.
7 Make a list of the variables that should be included in a model for a rational warranty policy for each of these four products. Develop a specific warranty policy.
Using the QMpom module called Quality Control Models (Pareto Analysis, Histograms, and Fishbone) will facilitate solving the following five situations.

a. Automobile (specify the type and cost)
b. Four-pack of regular lightbulbs (specify the type and cost)
c. Four-pack of CFL (compact flourescent lamps)
d. Something that breaks easily
e. Something that is highly unlikely to break down

8 How should responsibility for quality be positioned within and throughout the U.S. government? Should there be a Department of Quality? Relate this discussion to both products and services. Then, relate this discussion to the quality of safety and security.
9 Develop an HOQ-type matrix for the Computer Laptop Company, which manufactures and markets laptops for the mid- to low-price range market such as students in college. Label the rows with the customers' needs and label the columns with the properties of the product. Consider customer service to be an important requirement.
Using the QMpom module called Quality Control Models (Pareto Analysis, Histograms, and Fishbone) will facilitate solving the customer service goal.
10 The tolerance limits for the lead in the mechanical pencil are (0.5 ± 0.05). What tolerance limits should be specified for the tube in the pencil into which the lead is inserted? Discuss the quality problems that are related to this issue. Does it make sense to go back to the operations managers of the company that makes the lead to ask them what it would take to get tighter tolerances?

7 What purposes are served by control charts?
8 What would the blueprint look like for 2.54 centimeter (cm) nails to be tested by a go/no-go gauge that has (acceptable) tolerances of ±0.04 cm? Sketch this blueprint.
9 Explain why service systems are said to have higher levels of variability from chance causes than manufacturing systems.
10 A job shop that never produces lot sizes greater than 20 units cannot employ the x-bar and R-charts of SQC. Why is this so? What kind of quality management can be used?
11 Stylish Packaging is a flow shop with a high-volume, serial-production line making cardboard boxes. An important quality is impact resistance, which requires destructive testing. Can SQC methods be used with destructive testing? What quality control method(s) are recommended? Discuss.
12 Can the consumer tell when an organization employs SQC? Can the consumer tell when it does not employ SQC?
13 Differentiate between assignable and chance causes of variation. What other names are used for each type of cause? Give some examples of each kind of variation. How can one tell when an assignable cause of variation has arisen in a system?
14 Define a stable system. Why is the condition of stability relevant to P/OM activities?
15 Why is the use of statistical quality control by drug and food manufacturers imperative? Would you recommend two-sigma or three-sigma control limits for food and drug applications of SQC? Explain.
16 One of the major reasons statistical quality control is such a powerful method is its use of sequenced inspection. Explain why this is so.
17 How should the subgroup size and the interval between samples be chosen? Is the answer applicable to both high-volume, short-cycle time products (interval between start and finish) and low-volume, long-cycle time products?
18 Differentiate between the construction of the $\bar{x}$ -, R-, p- and c-charts. Also distinguish between the applications of these charts. Are the charts applicable to both high-volume, short-cycle time products (interval between start and finish) and low-volume, long-cycle time products?
19 What is meant by "between-group" and "within-group" variability? Explain how these two types of variability constitute the fundamental basis of SQC.
20 Use the concepts of "within-group" variability and "between-group" variability to answer the following questions:
   a. Are the designer's specifications realistic?
   b. Is the production process stable?
   c. Is the process able to deliver the required conformance specifications?

Problems Section

Note: This section has various problems that can be formulated and solved using QuantMethods Production/Operations Management software (QMpom). The appropriate model categories are indicated for each problem.

1 Draw a scatter diagram for the following data where it is suggested that *df* (defective fraction) is a function of temperature T. Note the following definition of T.

Sample No.	T	*df*
1	120	80
2	110	75
3	105	65
4	112	73
5	118	78

T is the temperature of the plating tank and *df* is the measure of defective parts per thousand, after plating. Does there seem to be a special relationship (correlation) between T and *df*?

Using the QMpom module called Forecasting Models (Linear Regression) will facilitate solving Problem 1. Include the correlation coefficient in the discussion.

2 After setup in the job shop, the first items made are likely to be defectives. If the order size calls for 125 units, and the expected percent defective for start-up is 7 percent, how many units should be made?

3 A subassembly of electronic components, called M1, consists of 5 parts that can fail. Three parts have failure probabilities of 0.03. The other two parts have failure probabilities of 0.02. Each M1 can only be tested after assembly into the parent VCR. It takes a week to get M1 units (the lead time is one week), and the company has orders for the next five days of 32, 44, 36, 54, and 41. How many M1 units should be on hand right now so that all orders can be filled?

Using the QMpom module called Forecasting Models (Linear Regression), analyze the effect of the day on the number of rejects in each sample. Also, use of the QMpom module called Quality Control Models (Statistical Quality Control [SQC]) will help create the *p*-chart.

10 A food processor specified that the contents of a jar of salsa should weigh 14 ± 0.10 ounces net. A statistical quality control operation is set up, and the following data are obtained for one week:

	Sample No.			
1 – Mon.	14.10	14.06	14.25	14.06
2 – Tues.	13.90	13.85	13.80	14.00
3 – Wed.	14.40	14.30	14.10	14.20
4 – Thurs.	13.95	14.10	14.00	14.15
5 – Fri.	14.05	13.90	13.95	14.60

Using the QMpom module called Forecasting Models (Linear Regression), analyze the effect of the day on the sample means for the weight of the contents of the salsa jars.

a. Construct an $\bar{x}$- chart based on these 5 samples.
b. Construct an *R*-chart based on these 5 samples.
c. What points, if any, have gone out of control?
d. Discuss the results.

Also, use of the QMpom module called Quality Control Models (Statistical Quality Control [SQC]) will help create the $\bar{x}$- chart and the *R*-chart.

11 Use a data check sheet to track the Dow Jones average, regularly reported on the financial pages of most newspapers. Record the Dow Jones closing index value on a data check sheet every day for one week. Do an Ishikawa analysis, trying to develop hypotheses concerning what causes the Dow Jones index to move the way it does. Draw scatter diagrams to see if the hypothesized causal factors are related to the Dow Jones.

Using the QMpom module called Quality Control Models (all models in this section) will help in the analysis.

12 A method for determining the number of subgroups that will be sampled each day will be developed. Apply it to the situation where the total number of units produced each day is 1,000. The subgroup sample size is 30 units, and the interval between subgroups is 200 units.

a. How many subgroups will be sampled each day?
b. How many units will be sampled each day?
c. What should be done if the sampling method damages one out of three units?

Method: Dividing the production rate per day by the subgroup sample size plus the interval between samples (given in units) determines the number of samples to be taken per day. If the subgroup sample size is $n = 3$ units, and the interval between sample subgroups is $t = 4$ units, and the total number of units produced each day is $P = 210$, then the calculation to determine the number of subgroups sampled each day, called *NS*, is as follows:

$$NS = P/(n + t) = 210/(3 + 4) = 30$$

The total number of units that are sampled and tested for quality is $n(NS) = 90$. This means that 90 units would be withdrawn from the production line and tested. If the quality-testing procedure damages the product in any way, the sample interval would be increased and the sample size might be reduced to two.

Practice Quiz

1. Embarking on a quest for better quality is an important P/OM quality assurance objective. Which of the following answers is incorrect?

a. Use Pareto analysis to create a chart of customer complaint frequencies. Starting with the most frequent complaint, analyze what can be done to rectify the situation. Proceed to the next most frequent complaint. Continue in this way to address all complaints.
b. The use of a control chart to determine if price-marking errors are stable could be beneficial in evaluating the price-marking process.
c. A fishbone analysis and chart might help management understand the causes of damaged packaging on the shelves. This work could even reduce the number of damaged packages.