CASE 5

NATIONAL COTTON FABRIC ASSOCIATION

Prediction of Quantity Demanded

5.1 INTRODUCTION AND BACKGROUND

George Castro, executive director of the National Cotton Fabric Association (NCFA), was asked to investigate the recent history of the industry. This action was prompted by a decline in production and sales of domestic cotton fabric. Some members of the board of directors claimed that the problem resulted from large increases in the volume of imported fabric on the market. Another group of board members suggested that price increases in recent years had encouraged clothing manufacturers to use other fabrics. The popularity of fabrics that require little or no ironing and involve easier care has also reduced sales of cotton fabric. George had observed both of these trends and believed that both were important. However, he also knew that he needed to present results from a rigorous study, in contrast to the general impressions he had gained from his casual observations. George asked the association's board of directors for authority to grant a contract to study the recent history and provide recommendations. The NCFA board approved George's request and named a subcommittee to meet with him to prepare a list of questions for the consultant to investigate.

A subcommittee from the board met with George to prepare specific questions in response to the concerns expressed at the board meeting. After considerable discussion, the group agreed that answers to the following questions should be obtained:

1. What has been the pattern of prices, production quantity, imported fabric quantity, and exported fabric quantity over the recent past?
2. What is the effect of price on the quantity of fabric produced?
3. Given the relationship of quantity versus price, what additional changes in production quantity are related to imports and to exports?
4. Given the NCFA's interest in maximizing total revenue, and working from recent experience, what price should be used?

TABLE 5.1 VARIABLE NAMES IN THE COTTON DATA FILE

VARIABLE NAME	NUMBER OF OBSERVATIONS	VARIABLE DESCRIPTION
Year	28	Year for the observation
Quarter	28	Quarter for the observation
Cotprod	28	Total cotton production (in million lb)
Whoprice	28	Wholesale price for cotton (in 1967 $ per lb)
Import	28	Quantity of cotton fabric imported (in million lb)
Export	28	Quantity of cotton fabric exported (in million lb)

The subcommittee asked George to include these questions in the specifications for the study contract.

You have been awarded the contract to conduct the study for the NCFA. At an initial meeting, George reviewed the concerns and provided the list of questions prepared by the subcommittee. In addition, he gave you a data file named Cotton that contained important industry data.

After receiving the contract, you discussed the objectives with George and reviewed the questions. You concluded that the study should begin by establishing descriptive statistics for the variables, followed by developing a demand function (quantity versus price) using regression analysis. First, however, you must examine the data file description and identify the variables in Table 5.1.

The data file contains seasonally adjusted quarterly data obtained from industry sources. You also decide to review the economic background for demand functions. The results of that review are contained in the following section.

5.2 ECONOMIC BACKGROUND FOR DEMAND FUNCTIONS

Microeconomics develops the concept of demand curves and presents numerous applications for them. You have considered the theoretical derivation. It is possible to solve a number of economic problems qualitatively by using theoretically derived demand functions. In many applied business and economic problems, however, a specific mathematical relationship (equation) is desired. It is difficult to derive exact equations on the basis of economic theory alone. Therefore, demand functions are often derived empirically from historical data by using regression analysis. The purpose of this exercise is to introduce you to the process of empirical estimation.

METHODOLOGICAL NOTE

It is usually a bad idea to predict the quantity of demand by using independent variable values that lie outside the range of those given in the original data. The regression represents a "best fit" for the data used to derive the equation, but it does not necessarily fit the data outside of the range. Using the equation to predict values outside the range of the independent variables is called extrapolation. Extrapolation should only be done when you can safely assume that the relationship is the same outside the range of the independent variables as inside.

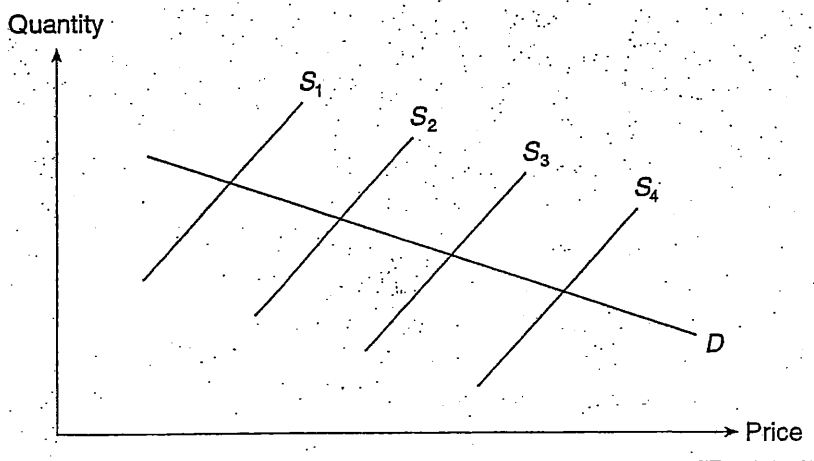
THEORETICAL PROBLEM

From microeconomic theory we know that a quantity sold—and hence purchased—is in equilibrium at the intersection of the supply and demand curves. If the curves did not shift, all points would have the same price and quantity, and it would be impossible to estimate a demand curve. Ideally, the estimation of a demand function would be performed under conditions where the demand curve (D) remained fixed and the supply curve (S) shifted as shown in Figure 5.1.

5.3 PROJECT REQUIREMENTS

After completing your analysis of the study goals and your review of the related background on demand functions, you believe that you are ready to proceed. Your final objective is to prepare a report to George Castro and the

FIGURE 5.1 DEMAND CURVE WITH SUPPLY CURVE SHIFTS



NCFA board that will respond to their concerns. They are particularly concerned about the effects of price and imports on cotton sales and production. In addition, they want you to use the demand models you develop to determine the price—within the range of observed prices—that will maximize total revenue in the industry. You must perform the following steps.

5.1 Load the data from the Cotton file into your local computer system, and name the variables.

5.2 Prepare time series plots of the four variables—cotton production, wholesale price, imported fabric, and exported fabric. Discuss the patterns of the variables over time.

5.3 Prepare a scatter plot for the observed values of cotton production and wholesale price, using your computer's statistical package. Discuss the relationship based on the observed plot pattern. Does the quantity demanded increase or decrease with increases in price?

5.4 Use simple least squares regression to estimate the relationship between quantity and price.

* **5.5** Plot the residuals from the least squares regression versus the predicted cotton production. Describe any unusual patterns in the data.

5.6 Determine the price that will yield the highest total revenue. [*Hint:* The regression equation computes quantity of cotton production as a function of price, and total revenue is price times quantity. Use your computer program to compute total revenue for each price, and plot total revenue versus price.]

* **5.7** Develop a mathematical function for total revenue as a function of price. Then use differential calculus to find the price that yields the "global maximum" total revenue. Explain why this price differs from the price you obtained in the previous question. Which price should you use in your report to George?

† **5.8** Estimate a model that predicts new production quantity as a function of imports and exports in addition to price. Use that function to answer the following questions.

a. How much does the quantity produced increase for each unit of exported cotton fabric?

b. How much does the quantity produced decrease for each unit of imported cotton fabric?

c. What is the effect on cotton production when trade is balanced—that is when the quantity imported is equal to the quantity exported?

d. Use the answers to the preceding questions to recommend a strategy for a trade policy that would benefit the cotton fabric industry

*These questions may require special material not covered in your course work to date.
†This question requires advanced understanding of multiple regression.

5.9 Prepare a two-page written report addressed to the NCFA Board, beginning with a short executive summary. This report should discuss your analysis and present the results requested for you study. You may attach additional graphs and tables to support your conclusions.