b. If at most 4000 MWs of power can be supplied by any one of the power plants, what is the optimal solution? What is the annual increase in power distribution cost that results from adding these constraints to the original formulation?

19. The Calhoun Textile Mill is in the process of deciding on a production schedule. It wishes to know how to weave the various fabrics it will produce during the coming quarter. The sales department has confirmed orders for each of the 15 fabrics produced by Calhoun. These demands are given in the following table. Also given in this table is the variable cost for each fabric. The mill operates continuously during the quarter: 13 weeks, 7 days a week, and 24 hours a day.

There are two types of looms: dobbie and regular. Dobbie looms can be used to make all fabrics and are the only looms that can weave certain fabrics, such as plaids. The rate of production for each fabric on each type of loom is also given in the table. Note that if the production rate is zero, the fabric cannot be woven on that type of loom. Also, if a fabric can be woven on each type of loom, then the production rates are equal. Calhoun has 90 regular looms and 15 dobbie looms. For this problem, assume the time requirement to change over a loom from one fabric to another is negligible.

Management would like to know how to allocate the looms to the fabrics and which fabrics to buy on the market so as to minimize the cost of meeting demand.

WEB file
Calhoun

Fabric	Demand (yd)	Dobbie (yd/hr)	Regular (yd/hr)	Mill Cost ($/yd)	Sub. Cost ($/yd)
1	16,500	4.653	0.00	0.6573	0.80
2	52,000	4.653	0.00	0.5550	0.70
3	45,000	4.653	0.00	0.6550	0.85
4	22,000	4.653	0.00	0.5542	0.70
5	76,500	5.194	5.194	0.6097	0.75
6	110,000	3.809	3.809	0.6153	0.75
7	122,000	4.185	4.185	0.6477	0.80
8	62,000	5.232	5.232	0.4880	0.60
9	7,500	5.232	5.232	0.5029	0.70
10	69,000	5.232	5.232	0.4351	0.60
11	70,000	3.733	3.733	0.6417	0.80
12	82,000	4.185	4.185	0.5675	0.75
13	10,000	4.439	4.439	0.4952	0.65
14	380,000	5.232	5.232	0.3128	0.45
15	62,000	4.185	4.185	0.5029	0.70

20. Refer to the Calhoun Mills make versus buy problem described in Problem 19. Use the procedure described in Section 8.7 to try to find an alternative optimal solution. If you are successful, discuss the differences in the solution you found versus that found in Problem 19.

Case Problem Investment Strategy

J. D. Williams, Inc. is an investment advisory firm that manages more than $120 million in funds for its numerous clients. The company uses an asset allocation model that recommends the portion of each client's portfolio to be invested in a growth stock fund, an income fund, and a money market fund. To maintain diversity in each client's portfolio, the firm places limits on the percentage of each portfolio that may be invested in each of the three funds. General guidelines indicate that the amount invested in the growth fund must be between 20 and 40 percent of the total portfolio value. Similar percentages for the other two funds stipulate that between 20 and 50 percent of the total portfolio value must

be in the income fund and that at least 30 percent of the total portfolio value must be in the money market fund.

In addition, the company attempts to assess the risk tolerance of each client and adjust the portfolio to meet the needs of the individual investor. For example, Williams just contracted with a new client who has $800,000 to invest. Based on an evaluation of the client's risk tolerance, Williams assigned a maximum risk index of 0.05 for the client. The firm's risk indicators show the risk of the growth fund at 0.10, the income fund at 0.07, and the money market fund at 0.01. An overall portfolio risk index is computed as a weighted average of the risk rating for the three funds, where the weights are the fraction of the client's portfolio invested in each of the funds.

Additionally, Williams is currently forecasting annual yields of 18 percent for the growth fund, 12.5 percent for the income fund, and 7.5 percent for the money market fund. Based on the information provided, how should the new client be advised to allocate the $800,000 among the growth, income, and money market funds? Develop a linear programming model that will provide the maximum yield for the portfolio. Use your model to develop a managerial report.

Managerial Report

1. Recommend how much of the $800,000 should be invested in each of the three funds. What is the annual yield you anticipate for the investment recommendation?
2. Assume that the client's risk index could be increased to 0.055. How much would the yield increase, and how would the investment recommendation change?
3. Refer again to the original situation where the client's risk index was assessed to be 0.05. How would your investment recommendation change if the annual yield for the growth fund were revised downward to 16 percent or even to 14 percent?
4. Assume that the client expressed some concern about having too much money in the growth fund. How would the original recommendation change if the amount invested in the growth fund is not allowed to exceed the amount invested in the income fund?
5. The asset allocation model you developed may be useful in modifying the portfolios for all of the firm's clients whenever the anticipated yields for the three funds are periodically revised. What is your recommendation as to whether use of this model is possible?

Appendix Solving Linear Optimization Models Using Analytic Solver Platform

In this appendix, we illustrate how to use Analytic Solver Platform (ASP) to solve linear programs in Excel. We assume that ASP has been installed.

Recall the M&D Chemicals problem. The linear optimization model we developed is

A = number of gallons of product A

B = number of gallons of product B

$$\begin{aligned}
\text{Min} \quad & 2A + 3B \\
\text{s.t.} \quad & \\
& 1A \geq 125 && \text{Demand for product A} \\
& 1A + 1B \geq 350 && \text{Total production} \\
& 2A + 1B \leq 600 && \text{Processing time} \\
& A, B \geq 0
\end{aligned}$$

The spreadsheet model is as shown in Figure 8.17.