

MGSC 404—Midterm Case Study

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Introduction

American Office Systems, Inc. was established by the late R. J. Miller, Sr. in 1939. It began as an office supply store in Mountain View, California, and slowly expanded over the years into manufacturing small office equipment, overhead projectors, and bookkeeping machines. As computers started to erode the market for bookkeeping machines in the 1950s, the company diversified into the copier market. However, it struggled to capture a large market share due to the dominance of larger firms such as Xerox, Canon, Sharp, and A. B. Dick.

Innovation

A few years ago, American Office Systems' engineering staff developed an adapter that links a standard copier to personal computers, allowing the copier to function as a laser printer, scanner, and fax machine. The adapters showed great promise for both home and office use. However, the company is not well-known by the financial community or the copier market, mainly due to its small size and lackluster record. Consequently, it could only secure \$15 million in initial financial backing for the adapters. This capital was invested in constructing a small production facility and administrative offices in 1994, with production and sales commencing in 1995. There are two versions of the adapter: one for IBM-compatible computers priced at \$175 and another for Macintosh computers priced at \$200 per unit sales.

Executive Meeting

At the beginning of December 1995, Dr. R. J. Miller, II, President, convened a meeting to discuss the upcoming year's plans for the adapters. Rob Olsen, Vice President of Production, argued for expanding production facilities: "Until we have sufficient capacity to produce the adapters," he said, "there is no point in advertising." Sue Williams, Director of Marketing, countered, "On the contrary, without any demand for the adapters, there is no reason to produce them. We need to prioritize advertising." J.T. Howell, the Comptroller, highlighted that

Olsen and Williams were presenting the situation as a choice between production and marketing: “Indeed, funds must be allocated between production and advertising. However, the cash flow challenge the company faces is more pressing. Just yesterday, I secured a \$750,000 line of credit for the coming year from Citibank at a favorable interest rate of 15%. This will help our cash flow problems and influence both production and advertising decisions. Moreover, we must consider financial and accounting factors in any decision regarding the adapters.” Olsen added, “This is more complex than I initially thought. Before we decide, we should apply modern management science techniques to ensure all relevant factors are considered.” He mentioned hiring Carlos Garcia from Stanford, who has a Master’s in Operations Research, to examine the situation.

Williams, however, preferred a more straightforward approach: “Let’s not get lost in the quantitative complexities that Rob favors. His studies are often lengthy and too complex. We need a decision by the end of next week.” After the discussion, Miller formed an executive action team to study the issue and make a recommendation at the following week’s meeting. “Rob and Sue, document your arguments in more detail. J.T., provide more clarity on cash flow, accounting, and financial challenges. And Rob, have Carlos look into a model for potential insights.”

Infrastructure and Current Operations

The significant portion of the \$15 million initial funding was directed towards the construction of a five-story building in Mountain View, just south of San Francisco. Although construction is about 90% complete, the building is already operational. The first floor is dedicated to production and shipping facilities and includes a small storage area. Conveniently, another larger warehouse owned by the company is located just across the street. The engineering department occupies the second floor, a research lab takes up the third floor, and the administration is housed on the top two floors. The production facility operates over two shifts each day and boasts a production capacity of 30 IBM adapters and 10 Macintosh adapters per hour. In his planning, Olsen accounts for 20 production days each month, reserving additional days for maintenance and repairs. **The last stage of the initial construction will be finished by the beginning of the fourth quarter, making the building 100% complete. This will increase the production capacity rates by 10%.**

Howell typically handles the company’s financial planning on a monthly basis. He assumes that cash flows associated with all current operating expenses, sales revenues (taking collections into account), advertising costs, loans from the line of credit, investments of excess cash in short-term government securities, and so forth, occur at the end of the corresponding month. However, because he needs information for the meeting next week, he decides to do a rough plan on a quarterly basis. This means that all the aforementioned cash flows, and so on, will be assumed to occur at the end of the quarter. After

the meeting, when more time is available, the plan will be expanded to a monthly basis. To get started, one of his senior financial analysts prepares the list of quarterly fixed operating expenses shown in Table 4.16. Additionally, the accounting department calculates that the variable costs of the adapters are \$100 each for the IBM version and \$110 each for the Macintosh version.

The table below provides a summary of the quarterly fixed operating expenses:

Expense	Cost
Administrative Expense	\$1,500,000
Fixed Manufacturing Costs	\$750,000
Sales Agents' Salaries	\$750,000
Depreciation	\$100,000

Table 1: Quarterly Fixed Operating Expenses

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Cash Flow and Investment Strategy

American Office Systems is grappling with a cash flow crunch, largely due to the substantial initial investments required for the adapter production, advertising, and sales activities. Nevertheless, the company has a policy, as stated by Howell, to invest any surplus funds in short-term government securities like treasury bills, anticipated to yield a 6% return in the upcoming year.

Production and Inventory Analysis

Olsen has tasked Garcia with examining the production and inventory first, due to his expertise in these areas from Stanford. Later, Olsen expects Garcia to develop a programming model to encompass all facets of the issue—production, sales, advertising, inventory, accounting, and finance. Given the time constraints and Williams's apprehension about complicated solutions, a linear programming approach will be utilized as a preliminary measure, with plans to refine the model after the subsequent week's meeting.

Inventory Management Model

After discussions with Olsen and Williams, Garcia feels that something needs to be done to help the company handle the uncertainty surrounding future sales of the adapters. He points out that it is impossible to guarantee that

the company will never be out of stock. However, it is possible to decrease shortages so that any difficulties associated with them would be small and they would not cause major disruptions or additional management problems, such as excess time and cost spent expediting orders, and so forth. **Thus, Garcia formulates an inventory model. To be able to solve the model, he has to check the inventory levels of the adapters currently on hand in the warehouse. From these quantities, he calculates that there will be 10,000 IBM and 5,000 Macintosh adapters on hand at the beginning of 1996. Based on the results of the model, he recommends that a simple rule of thumb be used: production plus the end-of-period inventory for the adapters should be at least 10% larger than the estimated sales for the next period. This would be a safety cushion to help prevent shortages of the adapters. In addition, to provide a smooth transition to 1997, the inventory level plus production at the end of the fourth quarter of 1996 should be at least twice the maximum expected sales for that quarter. Garcia says that using these rules of thumb will minimize annual inventory costs. When explaining the inventory model to Olsen, Garcia emphasizes the importance of including inventory carrying costs as part of any analysis, even though such costs frequently are not out-of-pocket. He says that his analysis of data provided by the accounting department yielded a 1% per month inventory carry cost, and this is what he used in his model.**

Sales during the first year (1995) for the adapters are shown in Table 2. Next year's sales are uncertain. One reason for the uncertainty is that they depend on the advertising. To begin the analysis, Williams asks her marketing research analyst, Debra Lu, to estimate the maximum sales levels for the coming four quarters if no advertising is done. Since last year's sales of both models showed a steady increase throughout the year, Lu projects a continuation of the trend. She forecasts that the company will be able to sell any number of adapters up to the maximum expected sales amounts shown in Table 2.

Quarter	1995 Sales		1996 Maximum Expected Sales	
	IBM Adapters	Macintosh Adapters	IBM Adapters	Macintosh Adapters
1	5,000	1,000	9,000	1,800
2	6,000	1,200	10,000	2,000
3	7,000	1,400	11,000	2,200
4	8,000	1,600	12,000	2,400

Table 2: 1995 Adapter Sales and Maximum Expected 1996 Sales

Advertising Strategy

Miller has suggested that advertising in prominent magazines such as PC World and Home Office could significantly raise consumer awareness of the company's adapters. Williams met with a San Francisco advertising agency to discuss this approach. They provided her with options for advertisements tailored for the IBM and Macintosh adapters, including cost estimates and expected campaign effectiveness. Using this data, along with insights from Lu, Williams prepares a report for Miller, hypothesizing that every \$10 spent on advertising might yield one additional IBM adapter sale, a figure she expects to be similar for Macintosh adapters.

Account Receivables Analysis

The accounting department, after reviewing the 1995 sales and accounts receivable, provides the payment collection experience in Table 3. For instance, 75% of the IBM adapters sold within a quarter are paid for within that quarter, 20% in the subsequent quarter, and 3% in the third quarter. The remaining 2% are considered uncollectible and sold to a collection agency for fifty cents on the dollar.

Quarter		Collections	
		IBM Adapters	Macintosh Adapters
1	Current Quarter	0.75	0.80
2	Following Quarter	0.20	0.11
3	Third Quarter	0.03	0.05
4	Uncollectible	0.02	0.04

Table 3: Collection Experience for IBM and Macintosh Adapters

Questions

Suppose you are Garcia.

Question 1. Develop an LP model of the situation to help the executive action team make a decision about how to allocate funds between production and advertising, ensuring that all cash flow, financial, accounting, marketing, inventory, and production considerations are taken into account and American Office Systems' profits are maximized. Use the data collected and the estimates made by the members of the executive action team. (Please define decision variables, assumptions, objective function, and constraints clearly)

Question 2 Solve the LP model formulated in Question 1.

Analysis of Assumptions:

The executive action team has assembled to reconsider the plans for the adapters for the coming year. Garcia, who developed the LP model, concludes his presentation by saying, "As everyone can see, the model provides the optimal solution that maximizes profits. Since I have incorporated the estimates and assumptions that all of you made, it is clearly the best solution. No other alternative can deliver a higher profit." Even Williams, who initially was skeptical about using quantitative models for making executive-level decisions, is impressed and indicates that she will support the results.

Miller says, "Good work, Carlos! This is a complex problem, but your presentation made it all seem so simple. However, remember that those figures you used were based on estimates made by all of us. Some were little better than guesses. What happens if they are wrong? In other words, your presentation has helped me understand the problem we are facing, and I know that models are useful where hard, accurate data exists. However, with all the uncertainty in our situation and the many rough estimates made, it seems to me that I will still have to make a judgment call when it comes down to making a final decision. Also, there has been a new development. J.T. tells me that we might be able to secure another \$1 million line of credit from a Bahamian bank. It will take a while to work out the details, and maybe it will cost us a little. I am wondering if it is worth it. What would we do with the \$1 million if we got it?" T.J. responds, "We really need the \$1 million. But it is a drop in the bucket. My analysis shows that we really need another \$8 million line of credit."

Analyze, as Garcia is going to do, the effect of uncertainty and errors on the results of Questions 1 and 2 by answering the following questions. They should be attempted only after Questions 1 and 2 have been answered correctly.

Question 3. One area where assumptions were made is adapter price.

- (a) What happens if the prices for the adapters are a little weak and they decrease to \$173 for the IBM version and \$198 for the Macintosh version? Does this make any difference?
- (b) What about decreases to \$172 and \$197, respectively, for the IBM and Macintosh versions? Explain the answers in terms that Miller will understand.
- (c) Suppose that American Office Systems can increase the price of the adapters to \$179 and \$204. How would this affect the original solution?

Question 4. Another potential variable is adapter production cost.

- (a) Suppose that an error was made in determining the costs of the adapters and that they really should have been \$101 for the IBM version and \$111 for the Macintosh version. What is the effect of this error?
- (b) What about costs of \$103 and \$115? Explain the answers in terms that Miller will understand.

Question 5. Howell notes that one of the contributing factors to American Office Systems' cash squeeze is the slow collection of accounts receivable. He is considering adopting a new collection procedure recommended by a consulting company. It will cost \$100,000 and will change the collection rates to those given in Table 4.19.

- (a) Analyze the effect of this new collection policy and make a recommendation to Howell about whether to implement the new procedure. As before, any accounts receivable not collected by the end of the third quarter will be sold to a collection agency for \$0.50 on the dollar.
- (b) Howell wonders whether switching to selling adapters for all cash is worth the effort. This would ameliorate the cash squeeze because it would eliminate not only the slow collections but also the use of the collection agency for accounts that remain unpaid after 9 months. It would cost about \$90,000 more than at present to implement the all-cash policy because the accounting system would need to be modified, and personnel would have to be retrained. Analyze this possibility and make a recommendation to Howell.

Quarter	IBM Adapters	Macintosh Adapters
1	0.90	0.92
2	0.07	0.03
3	0.01	0.01

Table 4: New Collections

Question 6. Yet another variable is advertising effectiveness.

- (a) Suppose that Williams overestimated the effectiveness of advertising. It now appears that \$100 is needed to increase sales by one adapter. How will this affect the original solution? Explain the answer in terms that Miller will understand.
- (b) What happens if the required advertising outlay is \$12.50 per additional adapter sold?

Question 7. Suppose that the line of credit from Citibank that Howell thought he had arranged did not work out because of the poor financial situation of the company. The company can obtain one for the same amount from a small local bank; however, the interest rate is much higher, 24%. Analyze how this change affects American Office Systems.

Question 8. The safety cushion for inventory is subject to revision.

- (a) Suppose that Garcia finds a bug in his original inventory model. Correcting it results in a safety cushion of 15% instead of the 10% he suggested previously. Determine whether this is important.

- (b) What if the error is 20%? Explain the answers in terms that Miller will understand.

Question 9 Production capacity is scheduled to increase by 10% in the fourth quarter.

- (a) Production capacity is scheduled to increase by 10% in the fourth quarter. Suppose that Miller is advised by the construction company that the work will not be finished until the following year. How will this delay affect the company's plans?
- (b) In addition to the delay in part (a), suppose that an accident in the production facility damages some of the equipment so that the capacity is decreased by 10% in the fourth quarter. Analyze how this will affect the original solution.

Question 10. Williams is concerned about the accuracy of Lu's 1996 maximum expected sales forecasts. If errors in these forecasts have a significant impact on company profits, she is considering hiring a San Francisco marketing research firm for a more detailed analysis, which would charge \$50,000 for the study. Analyze the potential impact if Lu's forecasts are off by 1,000 for IBM adapters and 200 for Macintosh adapters each quarter. Should she hire the marketing research firm?

Question 11.

- (a) To determine whether the extra \$1 million line of credit is needed, analyze its effect on the original solution given in Question 2.
- (b) To fully understand the ramifications of the extra \$1,000,000 line of credit, redo: (i) Question 3b, (ii) Question 4b, (iii) Question 6a, and (iv) Question 8b. Summarize your results.
- (c) What about Howell's claim that an extra \$8,000,000 line of credit is necessary? Use that adjustment and redo Question 6a.