时代教育 · 国外高校优秀教材精选

Pearson Education

（英文版·原书第8版）

应用数学

——经济、金融、生命科学及社会科学专业适用

Applied Mathematics

Raymond A.Barnett
(美) Michael R.Ziegler 著
Karl E.Byleen

机械工业出版社
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引进国外优秀原版教材，在有条件的学校推动开展英语授课或双语教学，自然也引进了先进的教学思想和教学方法，这对提高我国自编教材的水平，加强学生的英语实际应用能力，使我国的高等教育尽快与国际接轨，必将起到积极的推动作用。

为了做好教材的引进工作，机械工业出版社特别成立了由著名专家组成的国外高校优秀教材审定委员会。这些专家对实施双语教学做了深入细致的调查研究，对引进原版教材提出了许多建设性意见，并慎重地对每一本将要引进的原版教材一审再审，精选再精选，确认教材本身的质量水平，以及权威性和先进性，以期所引进的原版教材能适应我国学生的外语水平和学习特点。在引进工作中，审定委员会还结合我国高校教学课程体系的设置和要求，对原版教材的教学思想和方法的先进性、科学性严格把关。同时尽量考虑原版教材的系统性和经济性。

这套教材出版后，我们将根据各高校的双语教学计划，举办原版教材的教师培训，及时地将其推荐给各高校选用。希望高校师生在使用教材后及时反馈意见和建议，使我们更好地为教学改革服务。

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序

本书叙述了线性代数和概率论的基础知识，详细讲述了一元函数微积分的基本思想、概念和方法，介绍了多元函数微分学、二重积分及微分方程，还简单描述了线性规划的初步内容。

书中有大量实例。在详细分析解答实例的过程中，让学生逐步体会、理解所引入的数学概念、思想和方法。而在理解了数学概念、方法后，又提出了金融、社会生活等各方面的应用问题，使学习深入一步。这样引导学生学习研究数学的方法值得提倡。这会使学生对数学产生兴趣，易于接受。

在积分部分，作者主要对代数函数讲述相应内容，而把指数函数、对数函数的微分放在后面的章节中。这种由易到难、循序渐进的学习方式便于学生理解掌握复杂的计算方法。

本书有大量的例题、习题，应用题甚多，内容涉及经济、金融、生命科学及社会科学诸方面。有不少题目十分新颖、有趣。这些例题、习题值得我国教师借鉴。

因为原书第一部分(第 1 章和第 2 章)、附录 A 内容属于我国中学课程范围，故不影印。为读者阅读方便，章节未作调整。本书适合作为文科、生命科学经济类专业本科生、研究生的教材或参考书。

北京理工大学
张润琦

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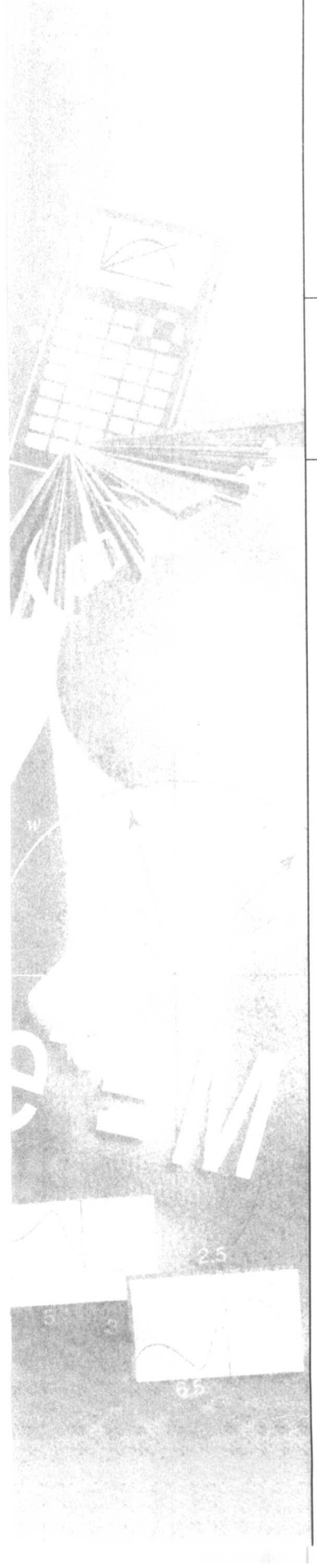
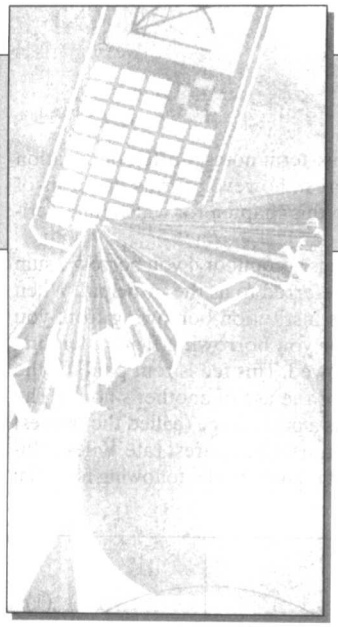


PART TWO

Finite Mathematics



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INTRODUCTION

This chapter is independent of the others; you can study it at any time. In particular, we do not assume that you have studied Chapter 2, where a few of the topics in this chapter were discussed briefly as applications of exponential and logarithmic functions.

The low cost and convenience of the calculators that are currently available make them excellent tools for solving problems on compound interest, annuities, amortization, and so on. Any calculator with logarithmic and exponentiation keys is sufficient for solving the problems in this chapter. A graphing utility offers the additional advantage of enabling us to visualize the rate at which an investment grows, or the rate at which the principal on a loan is amortized.

If time permits, you may wish to cover arithmetic and geometric sequences, discussed in Appendix B-2, before beginning this chapter. Although not necessary, these topics will provide additional insight into some of the topics covered.

To avoid repeating the statement many times, we now point out:

Throughout the chapter, interest rates are to be converted to decimal form before they are used in a formula.

Section 3-1

Simple Interest

Simple interest is generally used only on short-term notes—often of duration less than 1 year. The concept of simple interest, however, forms the basis of much of the rest of the material developed in this chapter, for which time periods may be much longer than a year.

If you deposit a sum of money P in a savings account or if you borrow a sum of money P from a lending agent, then P is referred to as the **principal.** When money is borrowed—whether it is a savings institution borrowing from you when you deposit money in your account or you borrowing from a lending agent—a fee is charged for the money borrowed. This fee is rent paid for the use of another's money, just as rent is paid for the use of another's house. The fee is called **interest.** It is usually computed as a percentage (called the **interest rate**)* of the principal over a given period of time. The interest rate, unless otherwise stated, is an annual rate. **Simple interest** is given by the following formula:

Simple Interest

$$I = Prt \tag{1}$$

where

P = principal
r = annual simple interest rate (written as a decimal)
t = time in years

For example, the interest on a loan of \$100 at 12% for 9 months would be

$$\begin{aligned} I &= Prt \\ &= (100)(0.12)(0.75) && \text{Convert 12\% to a decimal (0.12)} \\ &= \$9 && \text{and 9 months to years } (\tfrac{9}{12} = 0.75). \end{aligned}$$

At the end of 9 months, the borrower would repay the principal (\$100) plus the interest (\$9), or a total of \$109.

In general, if a principal P is borrowed at a rate r, then after t years the borrower will owe the lender an amount A that will include the principal P (the **face value** of the note) plus the interest I (the rent paid for the use of the money). Since P is the amount that is borrowed now and A is the amount that must be paid back in the future, P is often referred to as the **present value** and A as the **future value.** The formula relating A and P is as follows:

Amount: Simple Interest

$$\begin{aligned} A &= P + Prt \\ &= P(1 + rt) \end{aligned} \tag{2}$$

*If r is the interest rate written as a decimal, then $100r\%$ is the rate using %. For example, if $r = 0.12$, then using the percent symbol, %, we have $100r\% = 100(0.12)\% = 12\%$. The expressions 0.12 and 12% are equivalent.

where

P = principal, or present value
r = annual simple interest rate (written as a decimal)
t = time in years
A = amount, or future value

Given any three of the four variables A, P, r, and t in (2), we can solve for the fourth. The following examples illustrate several types of common problems that can be solved by using formula (2).

Example 1 **Total Amount Due on a Loan** Find the total amount due on a loan of \$800 at 9% simple interest at the end of 4 months.

SOLUTION To find the amount A (future value) due in 4 months, we use formula (2) with $P = 800$, $r = 0.09$, and $t = \frac{4}{12} = \frac{1}{3}$ year. Thus,

$$\begin{aligned} A &= P(1 + rt) \\ &= 800[1 + 0.09(\tfrac{1}{3})] \\ &= 800(1.03) \\ &= \$824 \end{aligned}$$

■

Matched Problem 1 Find the total amount due on a loan of \$500 at 12% simple interest at the end of 30 months.

■

Explore–Discuss 1

(A) Your dear sister has loaned you \$1,000 with the understanding that the principal plus 4% simple interest are to be repaid when you are able. How much would you owe her if you repaid the loan after 1 year? After 2 years? After 5 years? After 10 years?

(B) How is the interest after 10 years related to the interest after 1 year? After 2 years? After 5 years?

(C) Explain why your answers are consistent with the fact that for simple interest the graph of future value as a function of time is a straight line (see Fig. 1).

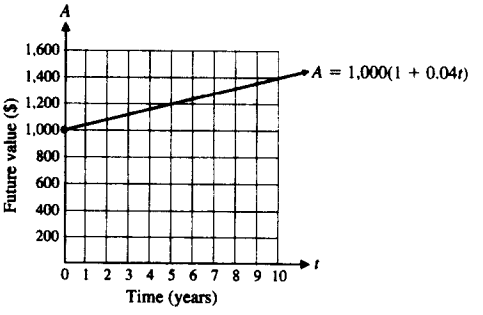

FIGURE 1

Example 2 **Present Value of an Investment** If you want to earn an annual rate of 10% on your investments, how much (to the nearest cent) should you pay for a note that will be worth \$5,000 in 9 months?

SOLUTION We again use formula (2), but now we are interested in finding the principal P (present value), given $A = \$5{,}000$, $r = 0.1$, and $t = \frac{9}{12} = 0.75$ year. Thus,

$$\begin{aligned} A &= P(1 + rt) \\ 5{,}000 &= P[1 + 0.1(0.75)] \quad \text{Replace } A, r, \text{ and } t \text{ with the given values,} \\ 5{,}000 &= (1.075)P \quad \text{and solve for } P. \\ P &= \$4{,}651.16 \end{aligned}$$

■

Matched Problem 2 Repeat Example 2 with a time period of 6 months. ■

Example 3 **Interest Rate Earned on a Note** T-bills (Treasury bills) are one of the instruments the U.S. Treasury Department uses to finance the public debt. If you buy a 180-day T-bill with a maturity value of \$10,000 for \$9,693.78, what annual simple interest rate will you earn? (Express the answer as a percentage, correct to three decimal places.)

WWW

SOLUTION Again we use formula (2), but this time we are interested in finding r, given $P = \$9{,}693.78$, $A = \$10{,}000$, and $t = 180/360 = 0.5$ year.*

$$\begin{aligned} A &= P(1 + rt) \quad \text{Replace } P, A, \text{ and } t \text{ with the} \\ 10{,}000 &= 9{,}693.78(1 + 0.5r) \quad \text{given values, and solve for } r. \\ 10{,}000 &= 9{,}693.78 + 4{,}846.89r \\ 306.22 &= 4{,}846.89r \\ r &= \frac{306.22}{4{,}846.89} \approx 0.06318 \quad \text{or} \quad 6.318\% \end{aligned}$$

■

Matched Problem 3 Repeat Example 3 assuming that you pay \$9,668.74 for the T-bill.

Example 4 **Interest Rate Earned on an Investment** Suppose that after buying a new car you decide to sell your old car to a friend. You accept a 270-day note for \$3,500 at 10% simple interest as payment. (Both principal and interest will be paid at the end of 270 days.) Sixty days later you find that you need the money and sell the note to a third party for \$3,550. What annual interest rate will the third party receive for the investment? (Express the answer as a percentage, correct to three decimal places.)

SOLUTION **Step 1.** Find the amount that will be paid at the end of 270 days to the holder of the note.

$$\begin{aligned} A &= P(1 + rt) \\ &= \$3{,}500[1 + (0.1)(\tfrac{270}{360})] \\ &= \$3{,}762.50 \end{aligned}$$

*It is common to find institutions using a 360-day year, a 364-day year, or a 365-day year. For simplicity, in this section we use a 360-day year. In other sections we will use a 365-day year. The choice will always be stated clearly.