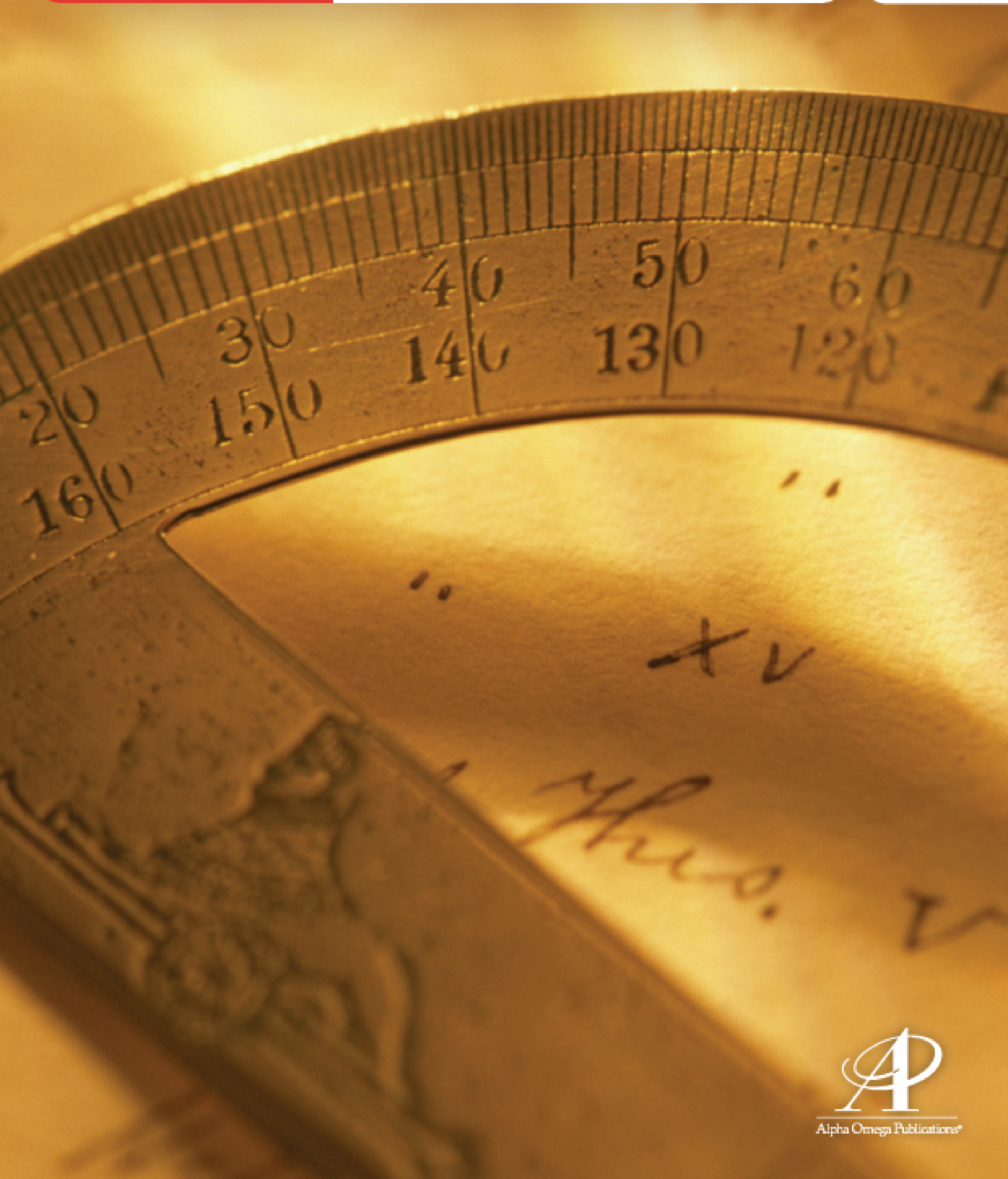
LIFEPAC® Math



Alpha Omega Publications®

MATHEMATICS 1209
PROBABILITY

CONTENTS

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PROBABILITY

Did you know that

- modern theory of mathematical probability is a little over 300 years old?
- during the eighteenth century much attention was given to the studies of population statistics, life insurance business, and the use of probability in the analysis of errors in physical and astronomical measurements?
- these studies included such fields as economics, genetics, physical science, biology, and engineering?
- concepts of probability are used in a person's life every day?
- permutations and combinations form an integral part in solving problems of probability?
- the probability of an event happening lies from 0 (it will not happen) to 1 inclusive (it will happen): thus, $0 \le P(x) \le 1$?

In everyday examples, what is the probability that

- you will get to school on time tomorrow?
- you will pass your next test?
- you will be involved in an automobile accident within the next three days?
- you will receive a pay raise at your job?
- you will buy a car in your senior year?
- you will be selected for the school play or the football team, or elected to a class office?

List five other everyday examples where you see the concept of probability can be used:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

Permutations, combinations, and theory of probability can easily become difficult, confusing, and frustrating. Therefore, every attempt has been made to make the material and problems in this LIFEPAC clear and precise. The topics presented in this LIFEPAC will usually refer to a finite sample space that will furnish models for experiments resulting in finite outcomes. These concepts of permutations, combinations, and probability will be sufficient for a major introduction to this unique branch of mathematics.

OBJECTIVES

Read these objectives. The objectives tell you what you should be able to do when you have successfully completed this LIFEPAC.

When you have completed this LIFEPAC, you should be able to:

1. Apply the basic concepts of probability.
2. Solve problems using permutations, combinations, and probability.
3. Solve problems using the concepts of random variable, probability distribution, and binomial distribution.

Survey the LIFEPAC. Ask yourself some questions about this study. Write your questions here.

I. RANDOM EXPERIMENTS AND PROBABILITY

OBJECTIVE

1. Apply the basic concepts of probability.

This section will introduce some general definitions of probability, show how to determine sample spaces for random experiments, and show the relationships between sample spaces and probability.

A wide variety of problems will be given. Each problem is unique: please read the problem carefully and thoroughly, set up the desired sample space, and use that information to find the probability requested in the problem.

DEFINITIONS, SAMPLE SPACES, AND PROBABILITY

This section explains some key terms, shows how to determine sample spaces, and shows some ways to use probability.

DEFINITIONS

A *sample space* is the set of all possible outcomes of a random experiment.

A subset of a sample space is called an *event*.

Equally likely events are events equally probable of happening; the probability of each of them occurring is $\frac{1}{n}$.

If an event results in one of n equally likely ways, and if s of these ways are considered successes, then the probability $P(A)$ of a successful result is the ratio of the number of successful ways to the total number of ways.

$$P(A) = \frac{\text{number of successes}}{\text{total number of possibilities}} = \frac{s}{n}.$$

The probability of an event happening will be a positive number from 0 to 1 inclusive. If the probability is 0, then the event will not occur. If the probability is one, then the event will certainly occur. If the probability is not 0 or 1, it will lie between 0 and 1.

$$0 \leq P(A) \leq 1$$

The *sum of probabilities* assigned to all the elements of a sample space equals 1.

$P(A)$ is the probability that event A will occur.

$P(A')$, read "the probability of A prime," is the probability that the event will not occur.

$P(A) + P(A') = 1$

Also, $P(A) = 1 - P(A')$, and $P(A') = 1 - P(A)$.

Model 1: The probability that an event will happen is $\frac{1}{4}$. What is the probability that it will not happen?

$$P(A) + P(A') = 1$$
$$\frac{1}{4} + P(A') = 1$$
$$P(A') = 1 - \frac{1}{4} = \frac{3}{4}$$
$$\therefore P(A') = \frac{3}{4}$$

Model 2: A coin is tossed one time. List the sample space and determine the probability of each event in the sample space.

The sample space consists of 2 elements, heads and tails. The probability of getting a head on one flip of the coin will be

$$P(A) = \frac{\text{number of successes}}{\text{total number of elements}}$$

$$= \frac{1}{2}$$

By using the same reasoning, the probability of getting a tail will be $P(B) = \frac{1}{2}$.

Also, the sum of the probabilities in the sample space is $P(A) + P(B) = \frac{1}{2} + \frac{1}{2} = 1$.

NOTE: To determine the number of elements in the sample space of flipped coins, use the formula 2^n (where n is the number of times the coin is flipped, and 2 is the number of possibilities of heads or tails).

Model 3: A coin is tossed two times. List the sample space of this event.

From the formula 2^n, where $n = 2$, 4 elements are in the sample space.

First Coin	Second Coin
H	H
H	T
T	H
T	T

Therefore, sample space $A = \{(H, H), (H, T), (T, H), (T, T)\}$.

Model 4: A coin is tossed three times. List the sample space A of this event.

$2^3 = 8$ elements are in the sample space.