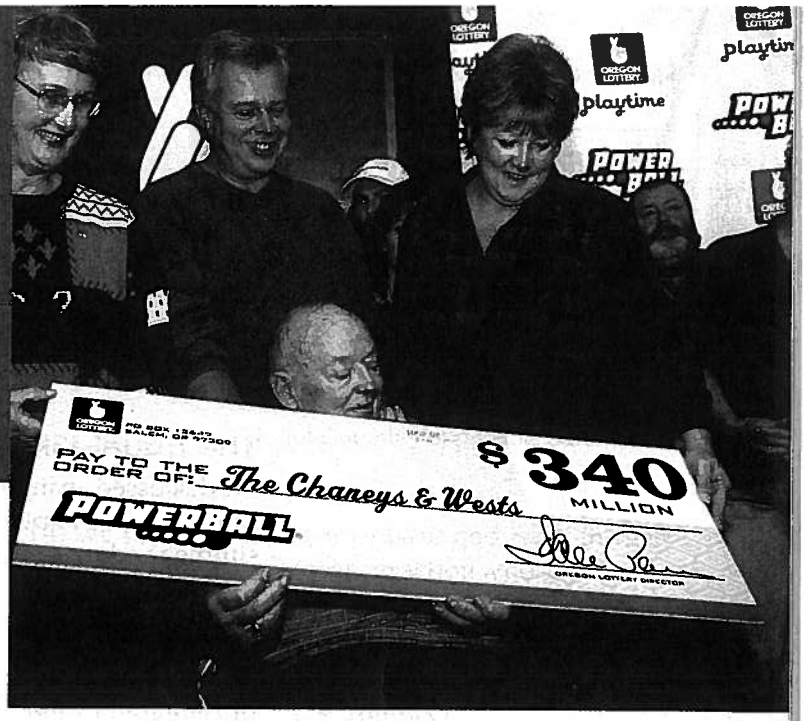
Case Study

The Powerball



The Powerball is a lottery that was introduced in 1992. It is now played in 27 states, Washington D.C., and the U.S. Virgin Islands. Profits from Powerball tickets stay in the state where the ticket is sold and each state uses its own computer system to issue and validate Powerball tickets.

Although the Powerball is a multistate lottery game, it isn't the first. That distinction goes to Lotto*America, which was created in 1987 when Iowa and six other states joined forces to offer a game with a large jackpot. The more people who play, the bigger the jackpots tend to be, so multistate lotteries offer larger prizes than those of individual states.

A Powerball jackpot grows if no one wins it. Because the chance of winning a jackpot is small, the jackpot often grows to huge amounts, sometimes more than $300 million. When there are multiple winners, the jackpot is divided equally among them. Drawings take place on Wednesday and Saturday evenings at 10:59 P.M. Eastern Time.

To play the basic Powerball, a player first selects five numbers from the numbers 1–55 and then chooses a PowerBall number, which can be any number between 1 and 42. A ticket costs $1. In the drawing, five white balls are drawn randomly from 55 white balls numbered 1–55; then one red PowerBall is drawn randomly from 42 red balls numbered 1–42.

To win the jackpot, a ticket must match all the balls drawn; smaller prizes are awarded for matching some but not all the balls drawn. What are the chances of winning the jackpot? What are the chances of winning any prize at all? After studying probability, you will be able to answer these and similar questions. You will be asked to do so when you revisit the Powerball at the end of this chapter.

TABLE 4.18
Powerball winning combinations, prizes, and probabilities

White matches	PowerBall match	Prize	Ways	Probability	1 in
5	yes	Jackpot	1	0.000000007	146,107,962
5	no	$200,000	41	0.000000281	3,563,609
4	yes	$10,000	250	0.000001711	584,432
4	no	$100	10250	0.000070154	14,254
3	yes	$100	12250	0.000083842	11,927
3	no	$7	502250	0.003437527	291
2	yes	$7	196000	0.001341474	745
1	yes	$4	1151500	0.007881158	127
0	yes	$3	2118760	0.014501332	69

Biography ANDREI KOLMOGOROV: Father of Modern Probability Theory

Andrei Nikolaevich Kolmogorov was born on April 25, 1903, in Tambov, Russia. At the age of 17, Kolmogorov entered Moscow State University, from which he graduated in 1925. His contributions to the world of mathematics, many of which appear in his numerous articles and books, encompass a formidable range of subjects.

Kolmogorov revolutionized probability theory with the introduction of the modern axiomatic approach to probability and by proving many of the fundamental theorems that are a consequence of that approach. He also developed two systems of partial differential equations, which bear his name. Those systems extended the development of probability theory and allowed its broader application to the fields of physics, chemistry, biology, and civil engineering.

In 1938, Kolmogorov published an extensive article entitled "Mathematics," which appeared in the first edition of the *Bolshaya Sovyetskaya Entsiklopediya* (Great Soviet Encyclopedia). In this article he discussed the development of mathematics from ancient to modern times and interpreted it in terms of dialectical materialism, the philosophy originated by Karl Marx and Friedrich Engels.

Kolmogorov became a member of the faculty at Moscow State University in 1925, at the age of 22. In 1931, he was promoted to professor; in 1933, he was appointed a director of the Institute of Mathematics of the university; and in 1937, he became Head of the University.

In addition to his work in higher mathematics, Kolmogorov was interested in the mathematical education of schoolchildren. He was chairman of the Commission for Mathematical Education under the Presidium of the Academy of Sciences of the U.S.S.R. During his tenure as chairman, he was instrumental in the development of a new mathematics training program that was introduced into Soviet schools.

Kolmogorov remained on the faculty at Moscow State University until his death in Moscow on October 20, 1987.

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