Chapter 4

4.1 Sportsware Brands

- Annabel Gonzalez, chief retail analyst at marketing firm Longmeadow Consultants is tracking the sales of compression-gear produced by Under Armour, Inc., Nike, Inc, and Adidas Group.
- After collecting data from 600 recent purchases, Annabel wants to determine whether age influences brand choice.

	Brand Name		
Age Group	**Under Armour**	**Nike**	**Adidas**
Under 25 years	174	132	90
35 years and older	54	72	78

Table 4.1: Live Example for Chapter 4

4.2 Fundamental Probability Concepts

- A probability is a numerical value that ...
- An experiment

4.2.1 Assigning Probabilities

Subjective Probabilities

- Draws on personal and subjective judgment.

Objective Probabilities

- Empirical probability: a relative frequency of occurrence
- a priori probability: a logical analysis

4.2.2 Probabilities expressed as odds

Percentages and *odds* are an alternative approach to expressing probabilities include.

4.2.3 Converting an odds ratio to a probability

Given *odds* for event A occurring of "a to b", the probability of A is:

$$\frac{a}{a+b}$$

Given *odds* against event A occurring of "a to b", the probability of A is:

$$\frac{b}{a+b}$$

4.2.4 Converting probability to an odds ratio

4.3 Rules of Probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \tag{4.1}$$

4.3.1 Multiplication Rule

$$P(A \cap B) = P(A|B) \times P(B) = P(B|A) \times P(A) \tag{4.2}$$

4.4 Contingency Tables and Probabilities

4.4.1 Contingency Tables

- A contingency table generally shows frequencies for two qualitative ...

4.5 Bayes' Rule

$$\begin{aligned} P(B|A) &= \frac{P(A \cap B)}{P(A \cap B) + P(A \cap B^c)} \\ &= \frac{P(A|B)P(B)}{P(A|B)P(B) + P(A|B^c)P(B)^c} \end{aligned} \tag{4.3}$$

We find:

$$\begin{aligned} P(T|D) &= \frac{(0.005)(0.99)}{(0.005)(0.99) + (0.95)(0.01)} \\ &= \frac{0.00495}{0.00495 + 0.0095} \\ &= \frac{0.00495}{0.01445} \\ &= 0.342560554 \end{aligned}$$

Prior Probability	Conditional Probability	Joint Probability	Posterior Probability
$P(T) = 0.99$			
$P(T^c) = 0.01$			
$P(T) + P(T^c) = 1$			

Table 4.2: Bayes' Rule Example

4.6 Counting Rules

$$ {}_nC_x = \left(\begin{array}{c} n \\ x \end{array} \right) = \frac{n!}{(n-x)!x!} \tag{4.4} $$

$$ {}_nP_x = \ldots \tag{4.5} $$