2.1 Sample Spaces and Events
2.2 Axioms, Interpretations, and Properties of Probability
2.3 Counting Techniques
2.4 Conditional Probability
2.5 Independence

Equally likely Outcomes
When the various outcomes of an experiment are equally likely, the task of computing probabilities reduces to counting. If \( N(A) \) denotes the number of outcomes contained in the event \( A \) and if \( N \) denotes the number of outcomes in the sample space, then \( P(A) = \frac{N(A)}{N} \).

Ordered Pairs
If the first element of an ordered pair can be selected in \( n_1 \) ways, and for each of these \( n_1 \) ways the second element of the pair can be selected in \( n_2 \) ways, then the number of pairs is \( n_1n_2 \).

Example
How many strings with one letter followed by one number are there?

k-Tuples
If a set consists of ordered collections of \( k \) elements and there are \( n_1 \) possible choices for the first element, for each choice of the first element there are \( n_2 \) possible choices for the second element, ..., for each possible choice for the first \( k-1 \) elements there are \( n_k \) choices of the \( k \)th element. Then there are \( n_1n_2 \ldots n_k \) possible \( k \)-tuples.
Example
A restaurant offers 10 different soups, 5 different main dishes, 8 different desserts and 25 different drinks. How many different menus are there (consisting of one soup, one main dish, one dessert, and one drink)?

Permutations
An ordered subset is called a permutation.
The number of permutations of size $k$ that can be formed from the $n$ objects in a group is
$$P_{k,n} = n(n-1)(n-2) \cdots (n-k+1) = \frac{n!}{(n-k)!}$$

Example
How many 8-letter strings with all different letters are there?

Example
Assume there is a group with $n$ people. Find the probability that at least two of the $n$ people have birthday on the same day.

Combinations
An unordered subset is called a combination.
The number of combinations of size $k$ that can be formed from the $n$ objects in a group is
$$\binom{n}{k} = \frac{P_{k,n}}{k!} = \frac{n!}{k!(n-k)!}$$

Example
How many different teams of three people can be formed from a group of seven people?
Example

A university warehouse has received a shipment of 20 printers, of which 12 are laser printers and 8 are inkjet models. If 6 of these 20 printers are selected at random to be checked by a technician, what is the probability that

(a) exactly 3 of the selected ones are laser printers?
(b) at least 3 of the selected ones are laser printers?
(c) less than 3 of the selected ones are laser printers?