## Chapter 2

# Probability

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



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## 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)=N(A)/N.**



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## 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 $n_1 n_2$.**



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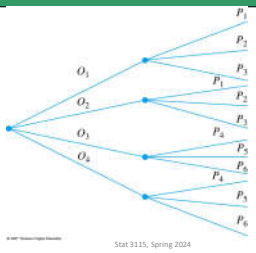
## Multiplication Rule





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## Example

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



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## 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 kth element. Then there are $n_1 n_2 \cdot \ldots \cdot n_k$ possible k-tuples.**



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## 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)?



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## 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**

$$P_{k,n} = n(n-1)(n-2)\cdot\ldots\cdot(n-k+1) = \frac{n!}{(n-k)!}$$



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## Example

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



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## Example

Assume there is a group with 20 people. Find the probability that at least two of the 20 people have birthday on the same day.



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## 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**

$$\binom{n}{k} = \frac{P_{k,n}}{k!} = \frac{n!}{k!(n-k)!}$$



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## Example

How many different teams of four people can be formed from a group of nine people?



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## 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?