812 Section # 2

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1 Sample Spaces and Events

Experiment: Any process in which the possible outcomes can be identified ahead of time.

Sample space (Ω): The set of all possible outcomes or results. The sample space is **discrete** when it contains a finite or countably infinite number of outcomes.

Event: Any collection of possible outcomes of an experiment (i.e., any subset of Ω, including Ω).

Exercise 1 What is the sample space for the following experiments?

a. Rolling a single die where you record the number rolled
b. Flipping three coins where you record whether each coin came up H or T
c. Rolling two dice where you record the sum of the two dice
d. Pulling out three random cards from a standard deck where you record the suits drawn

Exercise 2 Consider the experiment where we flip three coins. List the simple events that make up each of the events below. Assuming all of the coins are fair (i.e., $P(H) = P(T) = .5$), what is the probability of these events?

a. All of the coins come up heads
b. All coins match (either all heads or all tails)
c. The second coin flipped comes up tails

Permutations

$$P_k^n = \frac{n!}{(n-k)!}$$

Combinations: Order does not matter

$$C_k^n = \binom{n}{k} = \frac{n!}{k!(n-k)!}$$

Exercise 3 There are 20 numbered balls in an urn. A game show host will randomly draw four balls out of the urn. As part of a lottery game, people fill out tickets guessing the sequence of balls that will be drawn.

a. How many possible tickets are there if the balls are not put back each time (i.e. balls are drawn without replacement)?
b. What is the probability that a contestant will correctly guess the sequence of balls?

2 Axioms of Probability

Axioms of Probability:

a. $P(A) \geq 0$
b. $P(\Omega) = 1$
c. If $A_1, A_2...$ is a sequence of disjoint sets (pairwise exclusive events), $Pr(A_1 \cup A_2 \cup ...) = \sum_{i=1}^{\infty} Pr(A_i)$

Exercise 4 Show using the Axioms of Probability, show that:

a. $P(A) \leq 1$
b. $P(A^C) = 1 - P(A)$
c. $P(B \cap A^C) = P(B) - P(B \cap A)$

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