# Basic Probability Models

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- The **probability** of any outcome of a random phenomenon is the proportion of times the outcome would occur in a very long series of repetitions.
  - The **sample space** of a random phenomenon is the set of all possible outcomes.
  - An **event** is an outcome or a set of outcomes of a random phenomenon. It is a subset of the sample space. A **simple event** is an event consisting of exactly one outcome.
  - To compute the probability of some event *E* occurring, divide the number of ways that *E* can occur by the number of possible outcomes the sample space, S, can occur:

$$P(E) = \frac{n(E)}{n(S)}$$

Basic Rules of Probability

1. All events have a probability between zero and one. $0 \leq P(E) \leq 1$
2. All possible outcomes together must have a probability of one. P(S) = 1
3. Complement Rule: For any event *E,*

   $P(E^c) = 1 - P(E)$
4. Addition Rule: If E and F are disjoint events (mutually exclusive),

   then $P(E \cup F) = P(E) + P(F)$
5. If *E* and F are **any** events of an experiment,

   then $P(E \cup F) = P(E) + P(F) - P(E \cap F)$

# Example 1

- Suppose we draw a single card from a deck of 52 fair playing cards.

  n (S) = 52

  - What is the probability of drawing a heart?

    n *(* H) = 13 ,

    P(H) = *13 / 52 = 1 / 4*

  - What is the probability of drawing a queen?

    n(Q) = 4 ,

    P ( Q ) = 4 / 52 = 1 / 13

# Example 2

- If **5 marbles** are drawn at random **all at once** from a bag containing 8 white and 6 black marbles, **what is the probability that 2 will be white and 3 will be black** ?

1. $n(S) = {}_{14}C_5 = 2002$ (14!/9!.5!)
2. $n(\text{ 2 W \& 3 B}) = {}_{8}C_2 \,.\, {}_{6}C_3 = 560$ (8!/6!.2! . 6!/3!.3!)
3. $P(\text{ 2 W \& 3 B }) = 560 / 2002 = .28$

# Example 3

- The qualified applicant **pool for six management trainee positions** consists of **seven women and five men**. (n(S) = ${}_{12}C_6$ = 924)
  - What is the probability that a randomly selected trainee class will **consist entirely of women**?

  n(all women) = ${}_{7}C_6$ = 7

  P(all women) = 7 / 924

  - What is the probability that a randomly selected trainee class will **consist of an equal number of men and women**?

  n(3 men & 3 women) = ${}_{5}C_3$ . ${}_{7}C_3$ = 350

  P(3 men & 3 women) = 350/924 = 0.379

# Example 4

A sports survey taken at UH shows that 48% of the respondents liked soccer, 66% liked basketball, and 38% liked hockey. Also, 30% liked soccer and basketball, 22% liked basketball and hockey, and 28% liked soccer and hockey. Finally, 12% liked all three sports:

- What is the probability that a randomly selected student likes basketball or hockey? Solve this by also using an appropriate formula.

$P(\text{Basketball} \cup \text{Hockey}) = P(\text{Basketball}) + P(\text{Hockey}) - P(\text{Basketball} \cap \text{Hockey})$

$= .66 + .38 - .22 = .82$

- What is the probability that a randomly selected student does not like any of these sports?
  - Draw and then you can see !