Probability is of the study of calculating of the chances an event may occur (does not imply an event will occur)

For a die, it is common knowledge that it has six sides, and you are just as likely to roll each side of equal chance. So

$$P(1) = \frac{1}{6}, P(2) = \frac{1}{6}, \ldots, P(6) = \frac{1}{6}$$

Does that mean that when you roll a die 6 times you will roll all six numbers?

Experiment- Roll a die six times and record any numbers that were missing from the list you got.

Roll a die six times and record the results. Identify any number that did not show up in the set.

What is the actual probability of rolling a die and getting all six numbers in six rolls.

First Roll- Can be any of the 6 numbers

Second Roll- Can be any of the 5 numbers that did not occur in the 1^{st} roll

Third Roll- Can be any of the 4 numbers that had not occurred previously

…

Sixth Roll- can only be the roll of the left over number

What is the actually probability of this event.

Since the die are independent, there are 6^6 possible outcomes

The first roll can be 6 possible outcomes, second roll can be 5 possible outcomes, third roll 4, fourth 3,fifth 2, and sixth 1. All six numbers will appear in six rolls a total of 6! Possible ways.

Calculate, what is

$$\frac{6!}{6^6}$$

What was the percentage? So are you likely to roll all six numbers is six rolls?

Is a family of two always have a boy or a girl

Every time you flip a coin and get heads does that mean the second flip will be tails.

Probability doesn't say that you after 6 rolls you will get all six numbers, it says that for this one event, there is a 1/6 chance that the number may appear in one procedure.

Recap

Vocab-

An **event** is any collection of results or outcomes of a procedure

A **simple event** is an outcome or event that cannot be broken down further

A **sample space** for a procedure consists of all possible simple events. That is the sample space consists of all possible outcomes that cannot be broken down further.

Relative Frequency Approximation of Probability- Conduct or observe a procedure and count the number of times event A occurs

$$P(A) = \frac{number\ of\ times\ event\ A\ occured}{sumber\ of\ times\ procedure\ was\ repeated}$$

Classical Approach to Probability (Requires equally likely outcomes)- Assumes that a given procedure was n different possible outcomes with equal chance of occurring

$$P(A) = \frac{number\ of\ ways\ A\ occur}{number\ of\ simples\ events} = \frac{s}{n}$$

Subjective probability- P(A), the probability event A, is estimated by using knowledge of the relevant circumstances

Law of Large numbers- As a procedure is repeated many times, the relative frequency probability of an event tends to approach the actual probability

Unlikely- An event is unlikely if it's probability is very small, such as .05 or less.

Unusually high/low number- When the outcomes is far fomr what was expected (ch 5 will go more in-depth)

Compound Event- Any event combining two or more simples events. (or events)

$$P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)$$

A occurs

B occurs

A and B occurs

REMOVES any values counted 2X

Disjoint Events (mutually exclusive)- Event A and B can not occur at the same time

Complement- If A is an event, then not A is $\bar{A}$

Properties of Complements-

$$P(A) + P(\bar{A}) = 1$$

$$P(A) = 1 - P(\bar{A})$$

$$P(\bar{A}) = 1 - P(A)$$

"And" Events- Usually involve multiplication

$$P(A \; and \; B) = P(A)P(B|A)$$

A and B occurs

event B occurs given A has happened

Independent Events- When two event A and B are independent, then the occurrence of event A doesn't effect B and the occurrence of event B does not effect A. Below is the equation for independent events

$$P(A \; and \; B) = P(A)P(B)$$

For large population when finding the probability of a small portion of the population you may treat the events as independent.

At least one event- If an event occurs at least once in N trails. To calculate the P("at least once"), you would need to find the probability of P(1 or 2 or…. N), but it would take too long.

Instead use the complement rule. The complement is "not at least one time" or simply it never happens in N trials. It is easier to calculate and you get the following.

$$P(A) = 1 - P(\bar{A})$$

$$\downarrow$$

$$P(\text{"}event\ happnes\ at\ least\ onces\text{"}) = 1 - P\left(\text{"}\overline{event\ happnes\ at\ least\ onces}\text{"}\right)$$

$$\downarrow$$

$$P(\text{"}event\ happnes\ at\ least\ onces\text{"}) = 1 - P(\text{"}event\ never\ hapens\ in\ N\ trials\text{"})$$

Conditional Events- Event B taken into consideration that event A has already happened

$$P(B|A) = \frac{P(A\ and\ B)}{P(A)}$$

symbol means given

Fundamental Counting Rule- Number of ways two events can occur, given that the first event can happen m ways and the second event can happen n way, is calculated my mn.

Factorial Rule- n!= Number of different permutation (order matters!) that n different items can be selected n times (all items are selected.

Permutation Rule- $._n P_r = \frac{n!}{(n-r)!}$, when you have n different items and you only select r. (Order matters)

Combination Rule- $._n C_r = \frac{n!}{(n-r)!r!}$, Number of different combinations (order doesn't matter)