Welcome

STATISTICAL METHODS FOR ECONOMISTS
A PRIORI PROBABILITY

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CONTENTS

PROBABILITY

- Probability refers to the measure of the likelihood that an event will occur.
- It is expressed as a number between 0 and 1,where 0 indicates an impossible event,1 represents a certain event ,and values in between signify varying degrees of likelihood.
- Its providing a framework for quantyfing , analyzing and making prediction about the likelihood of different outcomes in various situations.

A PRIORI PROBABILITY

- A priori Probability also known as classical probability, is a probability that is deduced from formal reasoning.
- In other words, A priori probability is derived from logically examining an event.
- A priori probability doesn't vary from person to person (As would a subjective probability) and is an objective probability.

FORMULA

$$\text{A Priori Probability} = \frac{F}{N}$$

WHERE:

- F refers to the Number of desirable outcomes.
- N refers to the total number of outcomes.

EXAMPLE 1 (FAIR DICE ROLL)

- A six – sided fair dice is rolled. What is the priori probability of rolling a 2,4, or 6, in a dice roll?
- The number of desired outcomes if 3 (rolling a 2,4,or 6) and there are 6 outcomes in total. The priori probability for this example is calculated as follows:
- A priori probability = 3 /6 = 50%. Therefore the priori probability of rolling a 2, 4, or 6 is 50 %.

EXAMPLE 2 (DECK OF CARDS)

- In a standard deck of card, is the priori probability of drawing an ace of spades?
- The number of desired outcomes is 1 (An ace of spades) and there are 52 outcomes in total. The priori probability for this example is calculated for as follows:
- A priori probability =1/52 = 1.92%. Therefore the priori probability of drawing ace of spades is 1.92%.

EXAMPLE 3 (COIN TOSS)

- Subaash is looking to determine the priori probability of landing a head. He conducts a single coin toss, shown below:

EXPERIMENT:

RESULT: HEAD

- What is the priori probability of landing a head ?
- The above is a trick example- the priori coin toss has no impact on the priori probability of landing a head, its calculated as follows:
- A priori probability =1 / 2 = 50 %. Therefore the priori probability of landing a head is 50 %.

ADVANTAGES

- Flexibility
- Customization
- Transparency
- Handling Uncertainty
- Decision Support

LIMITATIONS

- Lack of Updating
- Variability
- Limited Applicability
- Limited Predictive Power
- Complexity in Combination with Data
- Time Sensitivity

REAL-WORLD APPLICATION

- One real – world application of a priori probability is in weather forecasting.
- Meteorologists use their expertise and priori knowledge of weather patterns, climate data, and atmospheric conditions to make probabilistic predictions about future weather.

- Finance and Investment
- Insurance Underwriting
- Legal Decision Making
- Environmental Risk Assessment
- Project Management
- Product Development
- Marketing and Sales
- Political Predictions
- Quality Control

CONCLUSION

- A priori probability, also known as subjective probability, plays a significant role in decision-making, forecasting, and risk assessment in various real-world applications.
- While a priori probabilities offer flexibility and customization to specific situations, they come with inherent subjectivity and the potential for bias.
- Therefore, their use should be approached with caution and in awareness of their limitations, but they remain a valuable tool for addressing uncertainty and making informed decisions when objective data is lacking or insu

thank you

Statistics

ADDITION THEOREM OF PROBABILITY

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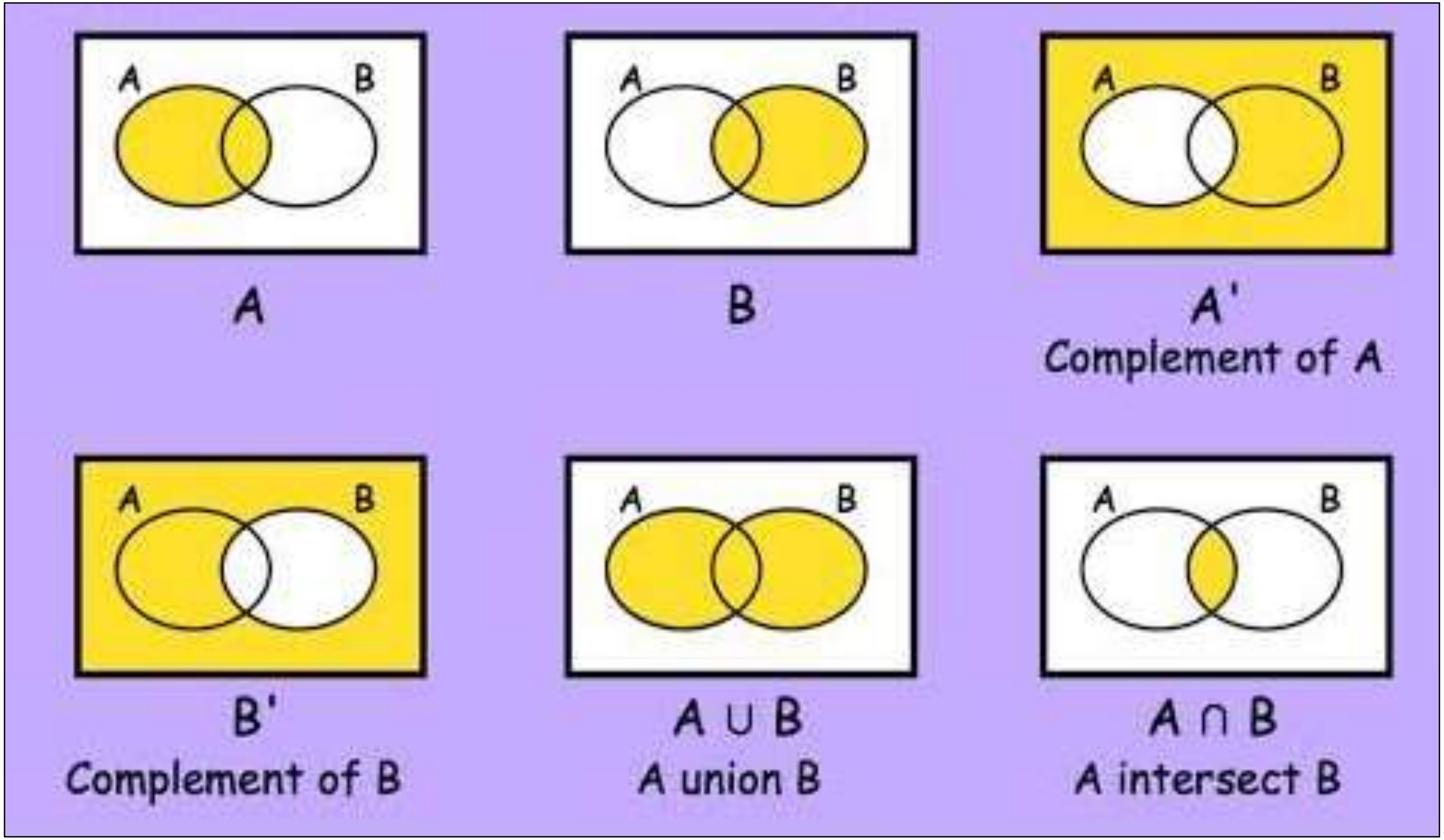
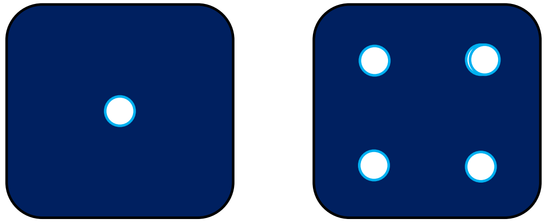
VENN DIAGRAMS



Mutually Exclusive Events

Two or more events $E_1, E_2, \ldots E_n$ in a sample space are mutually exclusive if if they have no point in common i.e if $E_1 \cap E_2 \cap \ldots \cap E_n = \phi$.

Example: getting an odd number and getting an even number while rolling a die

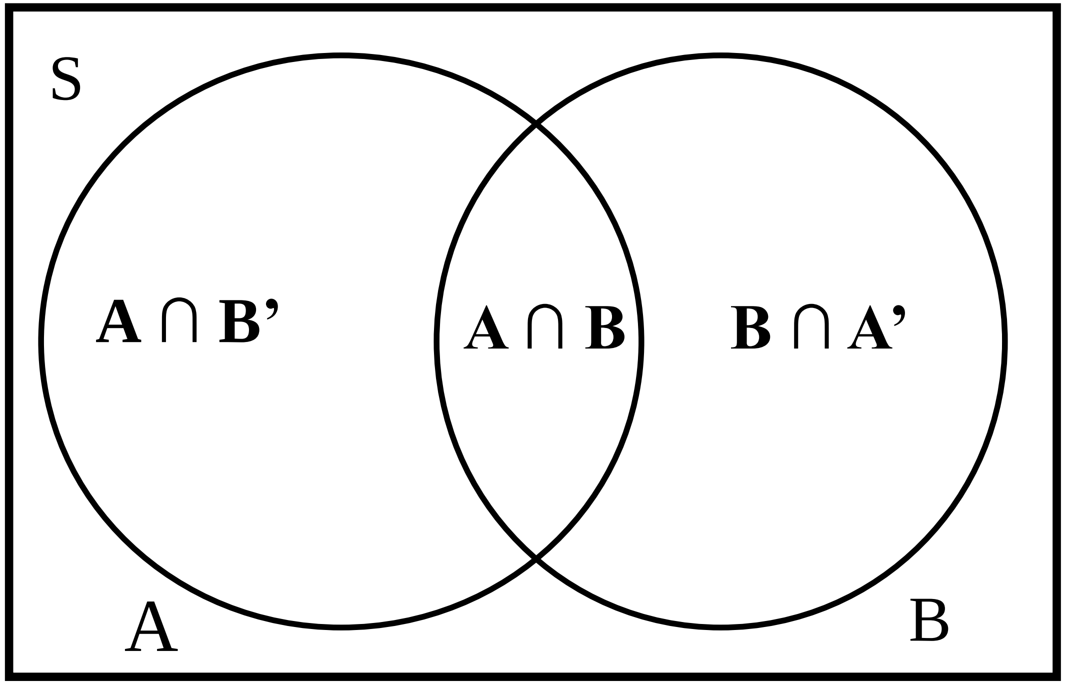


Addition Theorem of Probability for Non- Mutually Exclusive Events

Statement 1: If A and B are any two Non-Mutually exclusive events, then

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Proof:



$$A \cup B = A \cup (B \cap A')$$

$$\Rightarrow P(A \cup B) = P(A \cup (B \cap A'))$$

$$= P(A) + P(B \cap A')$$

($\because$ Both A and $B \cap A'$ are disjoint)

$$= P(A) + [P(B \cap A') + P(A \cap B)] - P(A \cap B)$$

$$= P(A) + P[(B \cap A') \cup (A \cap B)] - P(A \cap B)$$

$$= P(A) + P(B) - P(A \cap B)$$

$\because (B \cap A') \cup (A \cap B) = B$

Hence proved

Statement 2: If A,B and C are three Non-Mutually Exclusive Events, then

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) – P(A \cap B) – P(B \cap C) – P(C \cap A) + P(A \cap B \cap C)$$

Addition theorem for Mutually Exclusive events

Statement 3: If A and B are mutually exclusive events,

$A \cap B = \phi$ and so

$$P(A \cup B) = P(A) + P(B)$$

Statement 4: If A,B and C are mutually exclusive events,

$A \cap B \cap C = \phi$ and thus

$$P(A \cup B \cup C) = P(A) + P(B) + P(C)$$

➢ SOME EXAMPLES REGARDING THE ADDITION THEOREM OF PROBABILITY

Q1) Find the probability of getting a spade or an ace when a card is drawn from a well shuffled pack of 52 cards.

Q2) Find the probability of getting neither heart nor king when a card is drawn from a well shuffled pack of 52 cards.

Q3)Three newspapers A, B, C are published in a city and a survey on readers reveals the following information:

25% read A, 30% read B, 20% read C, 10% read both A and B, 5% read both A and C, 8% read both B and C, 3% read all three newspapers.

For a person chosen at random, find the probability that he reads none of the newspapers.

Q4) Discuss and comment on following:

$P(A) = \frac{1}{3}$, $P(B) = \frac{3}{5}$, $P(C) = \frac{2}{3}$ are probabilities of three mutually exclusive events A, B and C.

Conclusion

- The addition theorem for probabilities is comprised of separate rules or formulas.
- The first two takes into account the occurrence of two or three events that are incompatible with one another (NME).
- The next two takes into account the occurrence of two or three events that are compatible with one another (ME).

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2. BOOKS

- Ncert class IX Textbook

THANK YOU ALL

Welcome

Statistical methods for Economists

Calculation of Probability

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Contents

1.Probability:

- *Probability* is a measure of likelihood of the occurrence of some event.
- The probability is the measure of the likelihood of an event to happen. It measures the certainty of the event.
- **Probability** in Statistics expresses the chance of an incident occurring. The value of probability ranges from zero to one.
- Probability refers to possibility.

$$\text{Probability(Event)} = \frac{\text{Favourable outcomes}}{\text{Total number of outcomes}}$$

2. Calculation of probability:

- The calculation of probability involves determining the likelihood of an event occurring.
- The calculation of probability depends on the type of probability distribution being used.

$$p(A) = \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$$

Example:

Calculate the probability of a company meeting its quarterly profit target.

(to calculate this, we need historical data on the company's past quarterly performances. We take out, in the last 20 quarters, the company met its profit target in 14 quarters.)

$$P(A) = \frac{a}{n} \quad \begin{matrix}\text{(number of favourable outcomes)} \\ \text{(total number of outcomes)}\end{matrix}$$

$$= \frac{14}{20} = 0.7 .$$

So, the probability of the company meeting its quarterly profit target is 0.7 or 70%. This means there is a 70% chance that the company will achieve or exceed its profit goal in a given quarter based historical data.

3.Events:

- Mutually exclusive events
- Simple events
- Compound events
- Complementary events
- Exhaustive events
- Equally likely events
- Independent and dependent events

Mutually exclusive events:

- Two or more events are said to be mutually exclusive if the events do not have any outcomes in common.

Complementary events:

- Occur when two events are exhaustive and mutually exclusive, as a result when one event occurs, the other cannot occurs.

Exhaustive events:

- A set of events that collectively cover all possible outcomes of an experiment.

Independent and dependent events

- Two or more events are said to be independent when the outcome of one does not affect, and is not affected by other.
- Dependent events are those in which occurrence of one event affects the probability of other events.

Equally likey events

- Events are said to be equally likely when one does not occur more often than the others.

AN EVENT IS A SUBSET OF THE SAMPLE SPACE CONSISTING OF AT LEAST ONE OUTCOME FROM THE SAMPLE SPACE.

If in an experiment all possible outcomes are known in advance and none of the outcomes can be predicted with certainty, the outcomes as **Events** or chance events.

1. Sure event – occurrence in inevitable.
2. Impossible event – which can never occur
3. Random event – may or may not occur.

4. Simple events:

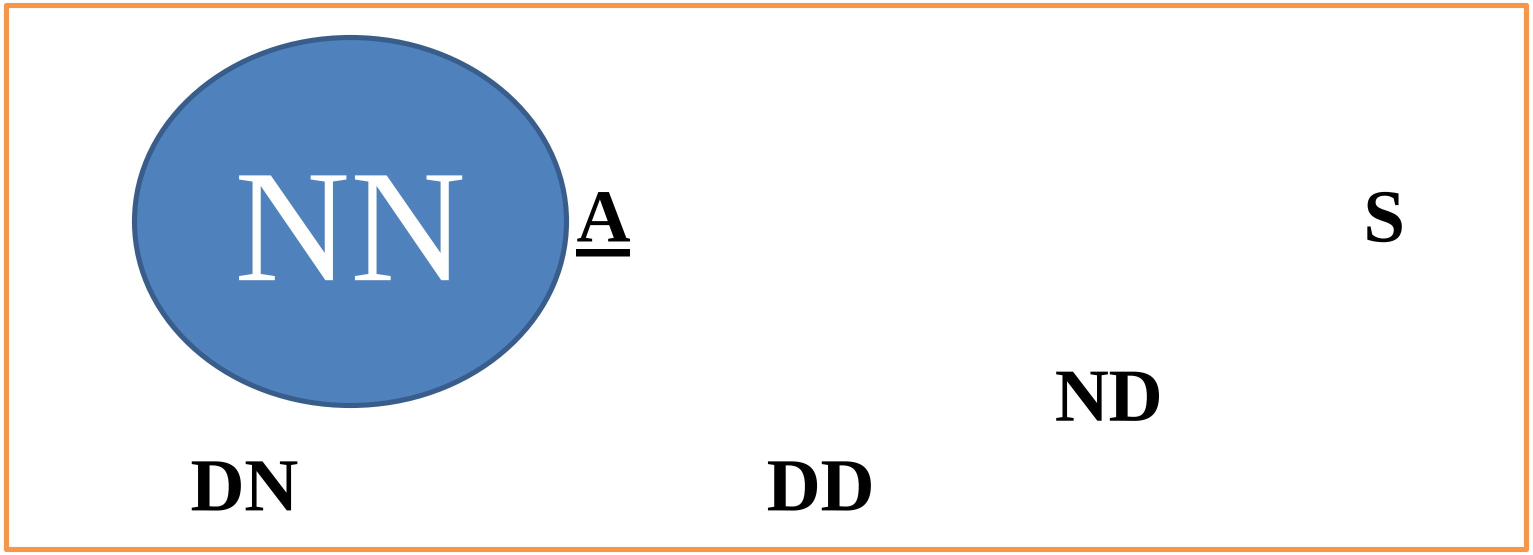
If the event consists of exactly one outcome, it is called a simple event.

It refers to the most basic and elementary outcomes of a random experiment or event.

Example:

A quality control technician selects two computer mother boards and classifies each as defective or nondefective. The sample space may be represented as S={NN,ND,DN,DD}, where D represents a defective unit N represents a nondefective unit. Let A represent the event unit is defective.

A={NN} is a simple event. The Venn diagram represents the sample space S and the event A. In a Venn diagram, the sample space is usually represented by a rectangle and events are represented by circles within the rectangle.



5. Compound events:

If an event consists of more than one outcome, it is called Compound events.

It refers to events that are composed of two or more events.

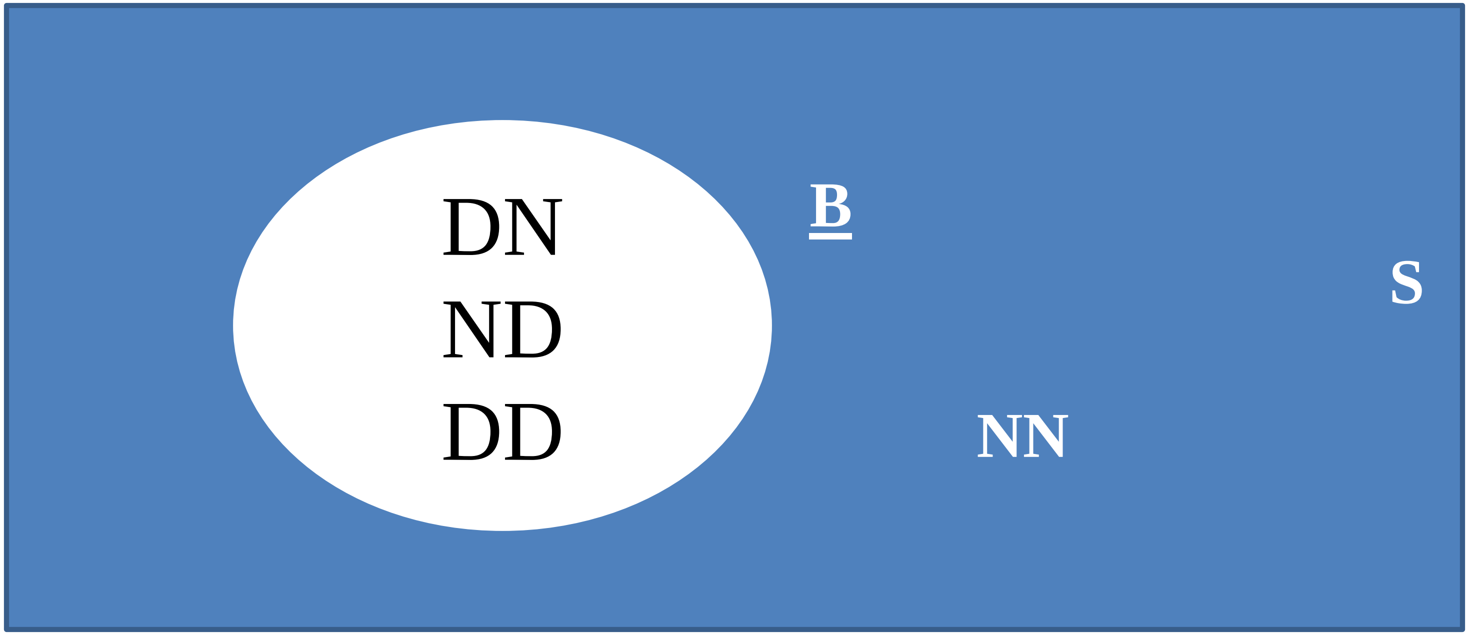
Compound events are formed by combining the simple events in various ways.

In simple terms, compound events involve multiple possibilities or outcome that can occur together or independently.

Example:

we can take the above example, A quality control technician selects two computer mother boards and classifies each as defective or nondefective. The sample space may be represented as S={NN,ND,DN,DD}, where D represents a defective unit N represents a nondefective unit. Let B represents the event unit is nondefective.

B={DN,ND,DD} is a simple event. The Venn diagram represents the sample space S and the event A. In a Venn diagram, the sample space is usually represented by a rectangle and events are represented by circles within the rectangle.



6. Conclusion:

These were the calculation of probability, Events in probabilities. Simple and compound events were explained.


Thank you

Any Questions


welcome!

STATISTICS

Topic: Importance of probability

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CONTENTS

1. importance of probability.
2. about of probability
3. uses of probabili
4. Applications of probabilit
5. Types of probabili
6. What is probability
7. Classicalt probability

IMPORTANCE OF PROBABILITY

- Modeling randomness and measuring uncertainty.
- Describing the distributions of populations.
- Obtaining descriptive measures of populations.
- Assessing uncertainty in the sampling process.
- Interence from sample to population.

ABOUT PROBABILITY

- **The term "probability" has many definitions, making it difficult to create a definition. It can be used as a Noun or an Adjective depending on the context.**
- **Probability is often confused with statistics and sometimes related to statistics by both laymen and scholars.**
- **Statistics often describe random phenomena, and probability is often used with random variables; therefore, it is easy to confuse the two concepts.**
- **However, probability has not been well-developed compared with statistics.**

USES OF PROBABILITY

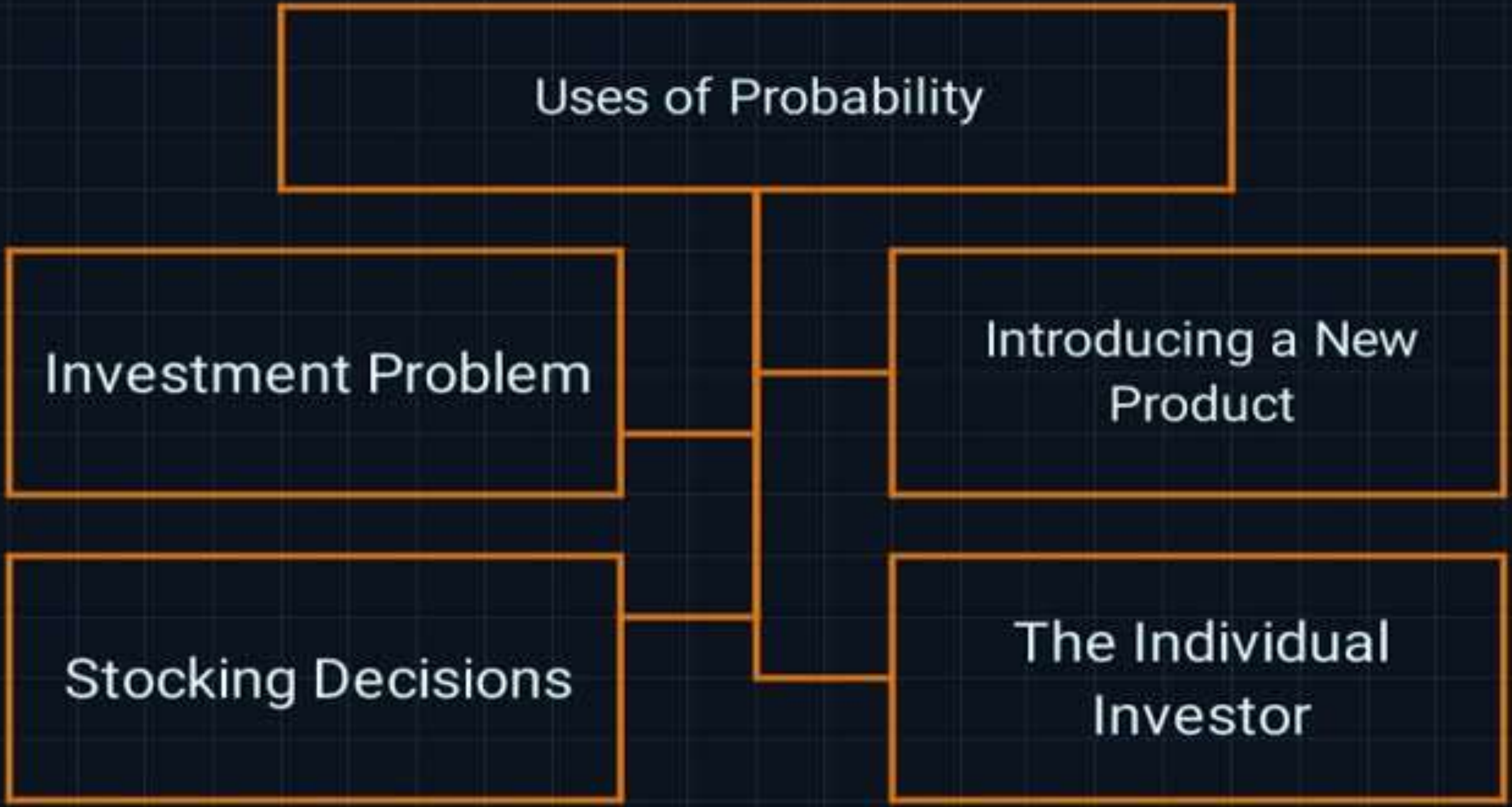
- **Probability theory originated in the study of games of chance .**

  Tossing dice dealing shuffled cards ,and spinning a roulette wheel

  Are examples of deliberate randomisation.

- **Probabilityis used in astronomy math surveying economics, generics in probaility .**

  Although we are interested probability usefulness in statistics.


Uses of Probability
Investment Problem
Introducing a New Product
Stocking Decisions
The Individual Investor

APPLICATIONS OF PROBABILITY

- **Probability theory has been applied in many fields.**
- **It is commonly used in games of chance, such as the lottery and gaming. In the lottery, it is important to make sure the probabilities of winning are as high as possible.**
- **A larger number of tickets are sold, which will increase the number of people who have won, increasing the chances that someone win.**
- **Probability theory is also commonly used in gambling.**

TYPES OF PROBABILITY

- **Probability is of 4 major types and they are .**

  1.classical probability

  2.Empirical Probability

  3.subjective probability

  4.Axiomatic probability

- **The probability of an occurrence is the chance that it will happen.**


Types of Probability
Objective Probability
Subjective Probability Theory
Classical Probability
Empirical Probability

WHAT IS PROBABILITY

- **Probability is the chance that something will happen _ how likely**

  Likely It is that some event will happen.

  sometime you can measure a Probability.

  1 . Impossible

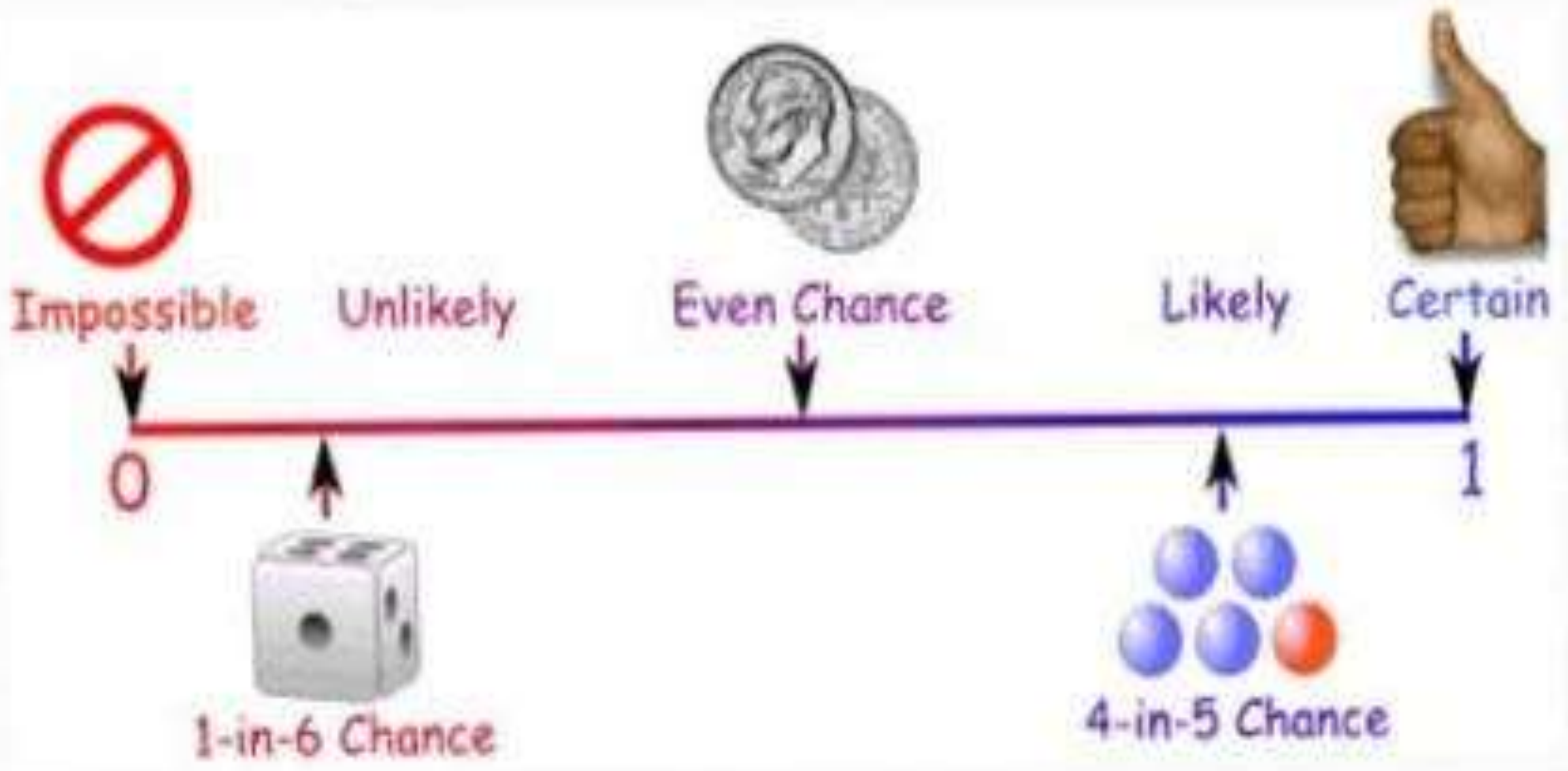
  2.unlikely

  3. evenchance

  . 4. likely and certain

EXAMPLE

: "It is unlikely to rain tomorrow".



CLASSICAL OF PROBABILITY

- **C**lassical probability **also known as classical or prequentist**

  probability is based on the relative frequencies of events

  In the long run.

- **It assumes that in a well defined repeatable random experiment**

  The probability of an event is the ration of the number of favorable

  Outcomes to the total number outcomes.

“Thank You”

WELCOME

STATISTICAL METHODS FOR ECONOMISTS

MULTIPLICATION THEOREMS OF PROBABILITY

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CONTENTS

-
- INTRODUCTION OF MULTIPLICATION THEOREM OF PROBABILITY
- EXAMPLE OF MULTIPLICATION THEOREM OF PROBABILITY
- PROOF OF MULTIPLICATION THEOREM OF PROBABILITY.
- USE OF MULTIPLICATION THEOREM OF PROBABILITY

Multiplication Theorem of Probability

- **Multiplication Theorem**: This theorem states that if two events A and B are independent the probability that they both will occur is equal to product of probability of their individual probabilities. Symbolically, if A and B are independent, then

  P(A and B) = P(A) × P(B).

  The theorem can be extended to three or more independent events. Thus,

  P(A and B) = P(A) × P(B) × P(B).

Multiplication Theorem of Probability

- **Example**: A bag contains 5 white and 3 black balls. Two balls are drawn at random one after another without replacement. Find the probability that (i) both are black; (ii) one black and one white.

- **Solution**:

(i) Probability of drawing a black ball in the first attempt $= \frac{3}{3+5} = \frac{3}{8}$

Probability of drawing a black ball in the second attempt $= \frac{2}{2+5} = \frac{2}{7}$

Probability that both balls drawn are black

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

$$= \frac{3}{8} \times \frac{2}{7} = \frac{3}{28}\ Ans$$

Multiplication Theorem of Probability

- **Proof of the Theorem**:
- If an event A can happen in n_1 of which a_1 are successful ways and event B can happen in n_2 of which a_2 are successful ways, we can combine each successful event in the first with each successful event in the second case. Thus the total number of successful events in the both the cases is $a_1 \times a_2$. Similarly total number of possible cases is $n_1 \times n_2$.

Multiplication Theorem of Probability

- Then by definition, the probability of bot independent events happening is

$$\frac{a_1 \times a_2}{n_1 \times n_2} = \frac{a_1}{n_1} \times \frac{a_2}{n_2}$$

But, $\frac{a_1}{n_1}$ = P(A), and

$\frac{a_2}{n_2}$ = P(B).

$$\therefore \quad P(A \text{ } and \text{ } B) = P(A) \times P(B) = \frac{a_1}{n_1} \times \frac{a_2}{n_2}$$

In similar way, theorem can be extended to three or more events.

USE OF THE MULTIPLICATION THEOREM

- Whenever we find an intersection between to events, then we use the multiplication theorem
- Suppose we have two events A and B. Then the intersection of these two events is denoted by A ^ B, only if these two events occur simultaneously.

THANK YOU


Welcome !

Probability of Complementary Events

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Contents

Introduction

Probability

- Probability is a branch of mathematics that deals with numerical representations of how likely an event or statement is to occur.
- In probability, complementary occurrences occur when two events are exhaustive and mutually exclusive.
- As a result, when one event occurs, the other cannot occur.

Complementary events

- Complementary events are two occurrences that occur only if and only if the other does not occur.
- Two events must be mutually exclusive and exhaustive in order to be characterised as complimentary.
- The sum of complimentary occurrences' probabilities must equal one.
- Only when there are exactly two outcomes can complementary events occur.
- If one occurrence can only happen if the other does not, the two events are said to be complimentary.

- A complement of an event can also be described as the set of outcomes that it does not produce.
- Allow A to be an occasion.
- A’ or Ac stands for the complement of A.
- The events such as A and A’ are mutually exclusive here.
- When only two possibilities are feasible, complementary events occur in probability.
- Take, for example, passing or failing a test.
- An experiment’s set of outcomes is referred to as an event.
- As a result, the sample space will always be a subset of events.

Complementary Events Properties

- Complementary events are incompatible.
- This indicates that two complementing occurrences cannot happen at the same moment.
- Complementary events, in other words, are disjointed.
- Complementary activities are numerous.
- This means that an event must entirely fill the sample area, as well as its complement.
- Thus, $S = A \cup A'$.

Rule Of Complementary Events

- The rule of complementary events asserts that the sum of an event's probability of occurrence and its complement's probability of occurrence is always 1.
- Let A represent an occurrence, and P(A) represent the probability of A occurring.
- As a result, P(A') reflects the likelihood that A will not occur.
- This rule can then be stated numerically as follows.
- $P(A) + P(A') = 1$
- $P(A) = 1 – P(A')$
- $P(A') = 1 – P(A)$
- These three mathematical statements are interchangeable.

Example

1) Suppose two dice are rolled. Let B be the event of getting two unique digits. Find P(B).

Let B' be the event that the digits on both dice are the same or not unique.

The sample space for B' is S' = {(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (6, 6)}

Total number of outcomes when two dice are rolled = 36

Number of favorable outcomes = 6

P(B') = 6 / 36 = 1 / 6

Using the rule of complementary events, P(A) = 1 - P(A')

P(B) = 1 - (1 / 6) = 5 / 6

Thus, the probability of getting two unique digits on rolling two dice is 5 / 6.

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Thank you

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CONTENT

- Exhaustive event
- Equally likely event

EXHAUSTIVE EVENT

- An Exhaustive Event refers to a set of all possible outcomes in a sample space where at least one event must occur.
- When we deal with probability, the sum of the probabilities of all exhaustive events must equal 1.

Problem 1:

In a box, there are 3 black balls, 2 magenta balls, and 1grey ball. One ball in drawn at random. What is the probability of drawing a black, magenta, or grey?

Explanation:

1. Identify the events:

Event A: Drawing a black ball

Event B: Drawing a magenta ball

Event C: Drawing a grey ball

These events are from an exhaustive set because no other outcome is possible(only black, magenta, or grey can be drawn).

2. Calculate the probability of each event:

Total balls= 3 black + 2 magenta+ 1 grey= 6 balls

- The Probability of drawing a black ball
  $P(A)=3/6=0.5$

- The Probability of drawing a magenta ball
  $P(B)=2/6=0.333$

- The Probability of drawing a grey ball
  $P(C)=1/6=0.167$

3. Sum of the probabilities(since these are exhaustive events):

$P(A)+P(B)+P(C) = 0.5+0.333+0.167 = 1$

since the sum of the probabilities is 1, these events are exhaustive.

4. Conclusion:

The probability of drawing either a black, magenta, or grey ball is 1, confirming that these events cover all possible outcomes and are exhaustive.

Problem 2:

A dice is rolled. What is the probability of rolling an odd number or an even number?

Explanation:

1. Identify the events:

Event A: Rolling an odd number 1,3,5

Event B: Rolling an even number 2,4,6

These events are exhaustive because no other outcome is possible roll will either result in an odd or an even number.

2. Calculate the probability of each event:

- Total outcomes when rolling a die=6 (since the die has 6 faces: 1,2,3,4,5,6)
- Probability of rolling an odd number P(A)=3/6=0.5
- Probability of rolling an even number P(B)=3/6=0.5

3. Sum of the probabilities

P(A)+P(B)=0.5+0.5=1

The sum is 1, confirming that these events are exhaustive.

4. Conclusion:

The probability of rolling either an odd or an even number is 1, indicating that these events cover all possible outcomes and are exhaustive.

EQUALLY LIKELY EVENTS

- Equally likely events are events that have the same probability of occurring. When flipping a coin or rolling a fair die, the outcomes are equally likely because each has the same chance of happening.

Problem 1: Coin Toss

A fair coin is tossed. What is the probability of getting heads or tails?

Explanation:

1. Identify the events:

Event A: Getting heads

Event B: Getting tails

2. Determine the total possible outcomes:

when a coin is tossed, there are 2 equally likely outcomes: Heads(H) and Tails (T).

3. Probability of each event:

Probability of getting heads

P(A)=1/2=0.5

P(B)=1/2=0.5

4. Conclusion:

Since the coin is fair, the events are equally likely, and each outcomes has a probability of 0.5 or 50%. So, the probability of getting heads or tails is 0.5 for each.

Problem 2:

A fair six-sided die is rolled. What is the probability of getting any one number 1,2,3,4,5,6?

Explanation:

1. Identify the events:

Event A: Getting a 1

Event B: Getting a 2

Event C: Getting a 3

Event D: Getting a 4

Event E: Getting a 5

Event F: Getting a 6

2. Determine the total possible outcomes:

The die has 6 faces, and the possible outcomes are 1,2,3,4,5,or 6.

3. Probability of each event:

Since the die is fair, each number has an equal chance of being rolled:

P(A)=P(B)=P(C)=P(D)=P(E)=P(F)=1/6

4.conclusion:

Each number (1 to 6) has an equal probability of 1/6, or about16.67%, because the die is fair, and the events are equally likely.

THANK YOU

Understanding probability

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Means :

Probability is the measure of the likelihood or chance of a particular event occurring. It quantifies uncertainty and is used to predict outcomes in situations where the exact result is not known beforehand. Probability ranges from 0 to 1:

0 means the event is impossible (it will never happen).

1 means the event is certain (it will definitely happen).

Values between 0 and 1 represent the likelihood of the event, with higher values indicating greater likelihood.

Formula for Probability:

For a given event , the probability of that event, denoted as , is calculated as:

P(A) = Number of favorable outcomes / Total number of possible outcomes

Key Concepts of Probability:

1. Experiment: A process that produces a random outcome, such as flipping a coin or rolling a. die .

2. Outcome: A possible result of an experiment.

For example, when rolling a die, getting a "3" is one possible outcome.

3. Sample Space : The set of all possible outcomes of an experiment.

Example: For a coin toss, the sample space is .

4. Event : A subset of the sample space. It is one or more outcomes that we are interested in.

Example: In a die roll, an event might be rolling an even number, which includes the outcomes .

Types of Probability:

1. Theoretical Probability:

Based on reasoning or known facts about the system.

Example: The probability of rolling a 6 on a fair six-sided die is , because there is one favorable outcome (rolling a 6) and six possible outcomes.

2. Experimental (Empirical) Probability:

Based on actual experiments or observations.

Formula:P(A) = Number of times event A occurs\Total number of trials conducted

3. Subjective Probability:

Based on personal judgment, intuition, or experience rather than concrete data or theoretical models.

Example: A weather forecast might say there is a 70% chance of rain, which is based on meteorological analysis and experience, not a direct calculation of outcomes

4.Axiomatic Approach (Advanced):

The axiomatic approach is more formal and was introduced by the mathematician Andrey Kolmogorov in 1933. It provides a rigorous, logical framework for probability theory. It is based on three fundamental axioms that define probability as a function over a set of events in a sample space.

Axioms:

1. The probability of any event is a non-negative number:

2. The probability of the sample space (the set of all possible outcomes) is 1: .

3. If two events are mutually exclusive (cannot both occur at the same time), the probability of their union is the sum of their individual probabilities:

Formula :

$$P(A \cup B) = P(A) + P(B)$$

Example:

Suppose and , where and are mutually exclusive events (they cannot happen together). The probability that either or occurs is:

$$P(A \cup B) = 0.4 + 0.6 = 1.0$$

This approach is foundational in modern probability theory and serves as the basis for both theoretical and applied probability.

Thank you ☺