Important Formulas of Probability PDF

Formulas
Examples
with Units

List of 21
Important Formulas of Probability

1) Empirical Probability Formula ↗

Formula
$$P_{Empirical} = \frac{n_{Event\ Occurs}}{n_{Total\ Trials}}$$

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

Evaluate Formula ↗

2) Odds against Formula ↗

Formula
$$O_A = \frac{n_L}{n_W}$$

Example
$$0.6667 = \frac{8}{12}$$

Evaluate Formula ↗

3) Odds in Favor Formula ↗

Formula
$$O_F = \frac{n_W}{n_L}$$

Example
$$1.5 = \frac{12}{8}$$

Evaluate Formula ↗

4) Probability of Event Formula ↗

Formula
$$P_{Event} = \frac{n_{Favorable}}{n_{Total}}$$

Example
$$0.3 = \frac{3}{10}$$

Evaluate Formula ↗

5) Probability of Failure Formula ↗

Formula
$$q = \frac{n_L}{n_W + n_L}$$

Example
$$0.4 = \frac{8}{12 + 8}$$

Evaluate Formula ↗

6) Probability of Success Formula ↗

Formula
$$p_{BD} = \frac{n_W}{n_W + n_L}$$

Example
$$0.6 = \frac{12}{12 + 8}$$

Evaluate Formula ↗

7) Probability of Two or More Events Formulas 📤

7.1) Probability of All Independent Events Occurring Formula 📤

Evaluate Formula 📤

Formula

$$P_{(A \cap B \cap C)} = P_{(A)} \cdot P_{(B)} \cdot P_{(C)}$$

Example

$$0.08 = 0.5 \cdot 0.2 \cdot 0.8$$

7.2) Probability of Atleast One Event Occurring Formula 📤

Evaluate Formula 📤

Formula

$$P_{(A \cup B \cup C)} = P_{(A)} + P_{(B)} + P_{(C)} - P_{(A \cap B)} - P_{(B \cap C)} - P_{(A \cap C)} + P_{(A \cap B \cap C)}$$

Example

$$0.92 = 0.5 + 0.2 + 0.8 - 0.1 - 0.16 - 0.4 + 0.08$$

7.3) Probability of Atleast Two Events Occurring Formula 📤

Evaluate Formula 📤

Formula

$$P_{(Atleast\ Two)} = \left(P_{(A)} \cdot P_{(B)} \right) + \left(P_{(A')} \cdot P_{(B)} \cdot P_{(C)} \right) + \left(P_{(A)} \cdot P_{(B')} \cdot P_{(C)} \right)$$

Example

$$0.5 = \left(0.5 \cdot 0.2 \right) + \left(0.5 \cdot 0.2 \cdot 0.8 \right) + \left(0.5 \cdot 0.8 \cdot 0.8 \right)$$

7.4) Probability of Dependent Events A and B Occurring Together Formula 📤

Evaluate Formula 📤

Formula

$$P_{(A \cap B)} = P_{(A)} \cdot P_{(B|A)}$$

Example

$$0.1 = 0.5 \cdot 0.2$$

7.5) Probability of Event A Not Occurring Formula 📤

Evaluate Formula 📤

Formula

$$P_{(A')} = 1 - P_{(A)}$$

Example

$$0.5 = 1 - 0.5$$

7.6) Probability of Event A Occurring given Event B occurs Formula 📤

Evaluate Formula 📤

Formula

$$P_{(A|B)} = \frac{P_{(A \cap B)}}{P_{(B)}}$$

Example

$$0.5 = \frac{0.1}{0.2}$$

7.7) Probability of Event A Occurring given Event B occurs using Baye's Theorem Formula 📤

Evaluate Formula 📤

Formula

$$P_{(A|B)} = \frac{P_{(B|A)} \cdot P_{(A)}}{P_{(B)}}$$

Example

$$0.5 = \frac{0.2 \cdot 0.5}{0.2}$$

7.8) Probability of Event A or B Occurring Formula

Formula

$$P_{(A \cup B)} = P_{(A)} + P_{(B)} - P_{(A \cap B)}$$

Example

$$0.6 = 0.5 + 0.2 - 0.1$$

7.9) Probability of Event A or B Occurring but Not Together Formula

Formula

$$P_{(A \Delta B)} = P_{(A)} + P_{(B)} - \left(2 \cdot P_{(A \cap B)} \right)$$

Example

$$0.5 = 0.5 + 0.2 - \left(2 \cdot 0.1 \right)$$

7.10) Probability of Exactly One Event Occurring Formula

Formula

$$P_{(\text{Exactly One})} = \left(P_{(A)} \cdot P_{(B')} \cdot P_{(C')} \right) + \left(P_{(A')} \cdot P_{(B)} \cdot P_{(C')} \right) + \left(P_{(A')} \cdot P_{(B')} \cdot P_{(C)} \right)$$

Example

$$0.42 = \left(0.5 \cdot 0.8 \cdot 0.2 \right) + \left(0.5 \cdot 0.2 \cdot 0.2 \right) + \left(0.5 \cdot 0.8 \cdot 0.8 \right)$$

7.11) Probability of Exactly Two Events Occurring Formula

Formula

$$P_{(\text{Exactly Two})} = \left(P_{(A')} \cdot P_{(B)} \cdot P_{(C)} \right) + \left(P_{(A)} \cdot P_{(B')} \cdot P_{(C)} \right) + \left(P_{(A)} \cdot P_{(B)} \cdot P_{(C')} \right)$$

Example

$$0.42 = \left(0.5 \cdot 0.2 \cdot 0.8 \right) + \left(0.5 \cdot 0.8 \cdot 0.8 \right) + \left(0.5 \cdot 0.2 \cdot 0.2 \right)$$

7.12) Probability of Independent Events A and B Occurring Together Formula

Formula

$$P_{(A \cap B)} = P_{(A)} \cdot P_{(B)}$$

Example

$$0.1 = 0.5 \cdot 0.2$$

7.13) Probability of Mutually Exclusive Events A or B Occurring Formula

Formula

$$P_{(A \cup B)} = P_{(A)} + P_{(B)}$$

Example

$$0.7 = 0.5 + 0.2$$

7.14) Probability of Neither of Events A or B Occurring Formula

Formula

$$P_{((A \cup B)')} = 1 - \left(P_{(A)} + P_{(B)} - P_{(A \cap B)} \right)$$

Example

$$0.4 = 1 - \left(0.5 + 0.2 - 0.1 \right)$$

Formula

$$P_{((A \cup B \cup C)')} = 1 - \left(P_{(A)} + P_{(B)} + P_{(C)} - \left(P_{(A)} \cdot P_{(B)} \right) - \left(P_{(B)} \cdot P_{(C)} \right) - \left(P_{(C)} \cdot P_{(A)} \right) + \left(P_{(A)} \cdot P_{(B)} \cdot P_{(C)} \right) \right)$$

Example

$$0.08 = 1 - \left(0.5 + 0.2 + 0.8 - \left(0.5 \cdot 0.2 \right) - \left(0.2 \cdot 0.8 \right) - \left(0.8 \cdot 0.5 \right) + \left(0.5 \cdot 0.2 \cdot 0.8 \right) \right)$$

Variables used in list of Important Formulas of Probability above

- $n_{\text{Event Occurs}}$ Number of Times Event Occurs
- $n_{\text{Favorable}}$ Number of Favorable Outcomes
- n_L Number of Losses
- $n_{\text{Total Trials}}$ Total Number of Trials
- n_{Total} Total Number of Outcomes
- n_W Number of Wins
- O_A Odds Against
- O_F Odds in Favor
- $P_{((A \cup B)')}$ Probability of Non-Occurrence of Event A and B
- $P_{((A \cup B \cup C)')}$ Probability of Non Occurrence of Any Event
- $P_{(A)}$ Probability of Event A
- $P_{(A')}$ Probability of Non-Occurrence of Event A
- $P_{(A|B)}$ Probability of Event A given Event B Occurs
- $P_{(A \cap B)}$ Probability of Occurrence of Event A and Event B
- $P_{(A \cap B \cap C)}$ Probability of Occurrence of All Three Events
- $P_{(A \cap C)}$ Probability of Occurrence of Event A and Event C
- $P_{(A \cup B)}$ Probability of Occurrence of Event A or Event B
- $P_{(A \cup B \cup C)}$ Probability of Occurrence of Atleast One Event
- $P_{(\text{Atleast Two})}$ Probability of Occurrence of Atleast Two Events
- $P_{(A \Delta B)}$ Probability of Event A or B but Not Together
- $P_{(B)}$ Probability of Event B
- $P_{(B')}$ Probability of Non-Occurrence of Event B
- $P_{(B|A)}$ Probability of Event B given Event A Occurs
- $P_{(B \cap C)}$ Probability of Occurrence of Event B and Event C
- $P_{(C)}$ Probability of Event C
- $P_{(C')}$ Probability of Non-Occurrence of Event C
- $P_{(\text{Exactly One})}$ Probability of Occurrence of Exactly One Event
- $P_{(\text{Exactly Two})}$ Probability of Occurrence of Exactly Two Events
- p_{BD} Probability of Success in Binomial Distribution
- $P_{\text{Empirical}}$ Empirical Probability
- P_{Event} Probability of Event
- q Probability of Failure

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