

Probability Distributions

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Definitions

- **Random Variable:** a variable that has a single numerical value that is determined by the chance of an outcome of an experiment.
- **Probability Distribution:** A table, graph, or formula that shows all the possible outcomes and their probabilities.

Probability Distribution Example

500 tickets are sold for a raffle at **\$10** each. There will be one **\$1000** grand prize and two **\$200** other prizes given. Write down the probability distribution table.

Discrete vs. Continuous

- **Discrete:** A random variable is discrete if it has a finite number of outcomes or a countable number of outcomes.
- **Continuous:** A variable is continuous if it is not discrete.

Two Requirements

Let x be a discrete random variable. Then

1. $\sum P(x) = 1$

2. $0 \leq P(x) \leq 1$

Expected Value

- Expected Value: $\mu = \sum xP(x)$

If the experiment is run many many times, then it is very likely that the average value of x will be very close to the expected value.

Example of Expected Value

- A coin toss where **0** represents landing tails and **1** represents landing heads has expected value **0.5**. If I flip a coin many many times then the average outcome is likely to be **0.5** (half heads and half tails).

Standard Deviation

Standard Deviation: $\sigma = \sqrt{\sum (x - \mu)^2 P(x)}$

The standard deviation measures an average distance from the mean if the experiment is run many many times.

Insurance

- The insurance bet in 21 involves placing a bet, say **\$10**. If the dealer has a 10, Jack, Queen, or King, the dealer pays the player **\$20**. If not the dealer takes the **\$10**.
 - Suppose you have a 10 and a King and the dealer has an Ace showing. Should you buy insurance.
 - Suppose you have a 3 and a 7 and your friend has an 8 and an Ace and the dealer has an Ace showing.

Example

- Find and interpret the expected value and standard deviation for the random variable that represents the outcome of tossing a six-sided die.

1-Var Stats(L1,L2)

Example

- Find the expected value and standard deviation for the raffle example:

500 tickets are sold for a raffle at **\$10** each. There will be one **\$1000** grand prize and two **\$200** other prizes given. Write down the probability distribution table.

Example

- A contractor has figured that bidding on a contract costs her \$700. There is a 5% chance that she will win the contract and make a \$10,000 profit on the project and there is a 1% chance that she will win and establish a long term working relationship with the client resulting in a total of \$100,000 profit. Find and interpret the expected value and standard deviation.