THE ERINDALE ACADEMY
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Unit 4: Probability Distribution

Lesson 4.1: Probability distribution

Part I: Uniform Probability distributions

All the probability questions we've done in Unit 1 – 3 are the emphasis on the probability of individual outcomes.

From now, we are going to focus on models of distributions that show the probabilities of all possible outcomes. The distributions can involve outcomes with equal or different likelihoods.

Uniform probability distribution is the first probability distribution we are going to talk about which is with equal likelihood in any single trial, such that:

- The probability to roll a five facing up is _________.
- The probability to select a random student from a class of 10 is _________.
- The probability of each marble to be picked up from a bag of 3 has exactly same chance which is ___________.

And the sum of the probabilities in uniform probability distribution is always 1.

Probability in a Discrete Uniform Distribution

$P(x) = \frac{1}{n}$,

where n is the number of possible outcomes in the experiment.

An expectation or **expected value** *E(X)*, is the predicted average of all possible outcomes of a probability experiment. The expectation is equal to the sum of the products of each outcome with its probability.

Expectation for a Discrete Probability Distribution

$$E(X) = x_1P(x_1) + x_2P(x_2) + \dots + x_nP(x_n)$$
$$= \sum_{i=1}^{n} x_iP(x_i)$$

Definition: within 10mins, quickly scan textbook on pg144 – 151, write down the definition of following terms.

Discrete random variable:

Continuous random variable:

Probability histogram: A graph of a probability distribution in which equal intervals are marked on the horizontal axis and the probabilities associated with these intervals are indicate by the area of bars.

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Weighted mean:

Example 1: Consider a simple game in which you roll a single die. If you roll an even number, you gain that of points, and, if you roll an odd number, you lose that number of points.

a) Show the probability distribution of points in this game, using probability distribution table.
b) Construct a probability histogram.
c) What is the expected number of points per roll?
d) Is this a fair game? Why?

# on upper face	Points, *x*	Probability, *P(x)*

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Part II: Non-uniform probability distribution

Example 2: A summer camp has seven 4.6-m canoes, ten 5.0-m canoes, four 5.2-m canoes, and four 6.1-m canoes. Canoes are assigned randomly for campers going on a canoe trip.

a) Show the probability distribution for the length of an assigned canoe, using probability distribution table.
b) Construct a probability histogram. And describe the distribution.
c) What is the expected length of an assigned canoe? What does it represent?

Length of Canoe (m), x	Probability, *P(x)*

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Practice 1: The door prizes at a dance are gift certificates from local merchants. There are four $10 certificates, five $20 certificates, and three $50 certificates. The prize envelopes are mixed together in a bag and are drawn at random.

a) Create a probability distribution for the nubmer of $50 prizes drawn, n, on the first three draws.
b) What is the exepected nubmer of $50 certificates among the first three prizes drawn?

Practice 2: A game is designed in which you roll two dies and the sum is noted, if you roll doubles you win $100, if you roll a sum of 5 you win $25 and on all else you pay $5.

a) Complete a probability distribution table for the amount you win/lose if you play the game.
b) What is the amount that you would expect to win/lose if you played the game 10 times?