Chapter 5
Discrete Probability Distributions

Chapter outline

- ✓ Random Variables
- ✓ Discrete Probability Distributions
- ✓ Expected Value and Variance
- ✓ The Binomial Probability Distribution
- ✓ The Poisson Probability Distribution
- ✓ The Hypergeometric Probability Distribution

Random Variables

- ✓ A _____ is a numerical description of the outcome of an experiment.
- ✓ A _____ may assume either a finite number of values or an infinite sequence of values.
- ✓ A _____ may assume any numerical value in an interval or collection of intervals.

Discrete Probability Distributions

- ✓ The probability distribution for a random variable describes how probabilities are distributed over the values of the random variable.
- ✓ The probability distribution is defined by a probability function, denoted by $f(x)$, which provides the probability for each value of the random variable.
- ✓ The required conditions for a discrete probability function are:
- ✓ $f(x) \geq 0$
- ✓ $\Sigma f(x) = 1$
- ✓ We can describe a discrete probability distribution with a table, graph, or equation.

Example: Shipwreck Subdivision

- ✓ Relative Frequency Method
  - $P(X=x_i) = rf_i = f_i/n$
  - The Shipwreck Subdivision has 40 homes.

Number of Bedrooms	Number of Houses	Notation	Probability	
1	4	P(x=1)	4/40 = 0.1	$=f(1)$
2	12	P(x=2)	12/40 = 0.3	$=f(2)$
3	12	P(x=3)	12/40 = 0.3	$=f(3)$
4	8	P(x=4)	8/40 = 0.2	$=f(4)$
5	4	P(x=5)	4/40 = 0.1	$=f(5)$
	40		1.0	

- ✓ The expected value, or mean, of a random variable is a measure of its central location.
  - Expected value of a discrete random variable:

$$E(x) = \mu = \Sigma x_i f(x_i)$$

- ✓ The variance summarizes the variability in the values of a random variable.
  - Variance of a discrete random variable:

$$\text{Var}(x) = \sigma^2 = \Sigma(x_i - \mu)^2 f(x_i)$$
$$= E(x^2) - E(x)^2$$

The standard deviation, σ, is defined as the positive square root of the variance.

Example: Shipwreck Subdivision

Expected Value: $E(x) = \Sigma x_i f(x_i)$

Number of Bedrooms (x)		$f(x_i)$	$x_i f(x_i)$
1	$f(1)=$	0.1	
2	$f(2)=$	0.3	
3	$f(3)=$	0.3	
4	$f(4)=$	0.2	
5	$f(5)=$	0.1	_____

The average number of bedrooms per house in this neighborhood is _____

Example: Shipwreck Subdivision

Variance: $\sigma^2 = E(x^2) - E(x)^2$

Number of Bedrooms (x)		$f(x_i)$	$x_i f(x_i)$	$x_i^2 f(x_i)$
1	$f(1)=$	0.1	0.1	0.1
2	$f(2)=$	0.3	0.6	1.2
3	$f(3)=$	0.3	0.9	2.7
4	$f(4)=$	0.2	0.8	3.2
5	$f(5)=$	0.1	0.5	2.5
			2.9	9.7

$\sigma^2 = 9.7 - (2.9)^2 =$ **1.29** $\quad \sigma =$ **1.1357**

The Binomial Probability Distribution

- ✓ Properties of a Binomial Experiment
  - The experiment consists of a sequence of *n* identical trials.
  - Two outcomes, _____ and_____, are possible on each trial.
  - The probability of a success, denoted by *p*, does not change from trial to trial.
  - The trials are_____.