Chapter 4

Discrete Probability Distributions

4.1
Probability Distributions

Random Variables

- The _____ associated with each _____of a _____ _____.

Two types of random variables

Discrete

The observations can take only a finite, countable number of values.

- The number of heads in four coin tosses
- The number of anorexics in a random sample of 500 people

Continuous

The observations can take on any of the countless number of values in an interval

- The average response time of a random sample of 200 depressed patients
- The average IQ of a random sample of 22 statistics students

Two Types of Random Variables:

- Discrete: When a random variable has a _____ or _____ of possible outcomes that can be _____
  - EX: The _____ of calls you make in a day.
  - Counted Data

- Continuous: When a random variable has an _____ of _____, represented by an _____ on a _____
  - EX: The _____ you spend making calls in a day.

  - Measured Data

EX: Determine whether the random variable is discrete or continuous. Explain.

- The number of Fortune 500 companies that lost money last year.
- The volume of gasoline in a 21-gallon tank.
- The speed of a rocket.
- The number of calves born on a farm in a year.

Discrete Probability Distributions

- The list of each _____ the _____ can be, together with its _____.
- Conditions:
- The _____ of each value id between _____.
- The _____ of all the _____ is _____.

Graphing a Discrete Probability Distribution

- You can graph a Discrete Probability Distribution with a _____ _____.
- Because _____ are the same as _____.

Steps to Graph a Discrete Probability Distribution:

- 1) Make a _____, if not given one.
- 2) Find the _____ of the _____.
- 3) Find each _____ by _____ each _____ by the _____ of the _____.
- 4) Make a _____ and _____ _____ of the _____.

EX: Construct a probability distribution and graph it using a histogram. Describe its shape.

Number of Pets (x)	Tally	Frequency (f)
0	IIII	4
1	𝍸 I	6
2	𝍸	5
3	III	3
4	II	2

EX: Verify that the distribution is a probability distribution.

Number of Orders per Week x_i	Probability p_i
41	.03
42	.10
43	.15
44	.17
45	.25
46	.15
47	.10
48	.05

Mean of a Probability Distribution

- Represents the _____/_____ of the probability distribution.
- To find it:
- _____ each value of _____ by its corresponding _____.
- _____ all these _____.

EX: Find the mean of the probability distribution and interpret its results.

Number of Cars	Probability
0	0.03
1	0.13
2	0.70
3	0.10
4 or more	0.04

Variance and Standard Deviation of a Probability Distribution

- Represents the _____/ _____ of the probability distribution.
- REMEMBER:

_____

_____

Steps to find Variance and SD by hand:

- Step 1: _____
- Step 2: _____ in Step 1
- Step 3: _____ each value in Step 2 by _____
- Step 4: _____ all values from Step 3
  - THIS IS THE _____
- Step 5: Take the _____ of Step 4
  - THIS IS THE _____

EX: Find the variance and standard deviation and interpret its results.

Number of Cars	Probability
0	0.03
1	0.13
2	0.70
3	0.10
4 or more	0.04

Expected Value

- What you would _____ to happen over _____ of trials.
- Expected value is _____ to the _____ of a probability distribution.

4.2 Binomial Distributions

Binomial Experiments

- Probability experiments in which the _____ can be reduced to _____ _____ - _____ or _____.
- EX: Shooting a Free Throw
  - You either _____ or _____

Conditions to be a Binomial Experiment:

- 1) The experiment has a _____ of trials. Each trial is _____ of the other trials.
- 2) Each trial has only _____ - _____ or _____
- 3) The probability of _____ is the _____ for each trial.
- 4) The _____ counts the number of _____.

Notation for Binomial Experiments

- n: the _____ of trials
- p: the _____ of _____ in a _____
- q: the _____ of _____ in a _____ (q = _____)
- x: the _____ that represents a _____ of the number of _____ in _____

EX:

- A coin is tossed 10 times. What is the probability that exactly 6 heads will occur.
- Success = "A head is flipped on a single coin"
- p =
- q =
- n =
- x =

EX:

- Determine whether the experiment is a binomial experiment. If it is, specify the values of n, p, and q, and list the possible values of the random variable x. If it is not, explain why.

- A certain surgical procedure has an 85% chance of success. A doctor performs the procedure on eight patients. The random variable represents the number of successful surgeries.

EX cont.

- A jar contains five red marbles, nine blue marbles, and six green marbles. You randomly select three marbles from the jar, without replacement. The random variable represents the number of red marbles.

Binomial Probability Formula

- Used to find the _____ of _____ in _____ in a binomial experiment.
- Formula:

EX:

- Rotator cuff surgery has a 90% chance of success. The surgery is performed on three patients. Find the probability of the surgery being successful on exactly two patients.

EX:

- A card is replaced from a standard deck and replaced. This experiments is repeated a total of five times. Find the probability of selecting exactly three clubs.

Binomial Probability Distribution

- A _____ of the possible _____ with the _____

Binomial with n = 5 and p = 0.716

x	P(X = x)
0	0.0018
1	0.0233
2	0.1174
3	0.2961
4	0.3732
5	0.1882

EX:

- In a survey, U.S. adults were asked to identify what devices they use to access social media. The results showed that 46% of adults use a cell phone to access social media. Four adults are randomly selected and asked whether they use a cell phone to access social media. Construct a binomial probability distribution for the number of adults who respond yes.

Finding Binomial Probabilities

- With a Calculator:
- DISTR
- Choose binompdf
- Enter values of n, p, and x
- Calculate the probability
- Add individual probabilities to get the total probability, in necessary

EX:

- A survey found that 34% of U.S adults have hidden purchases from their spouses. You randomly select 200 adults with spouses. What is the probability that exactly 68 of them have hidden purchases from their spouses? Use technology.

EX:

- A survey of U.S. adults found that 62% of women believe that there is a link between playing violent video games and teens exhibiting violent behavior. You randomly select four U.S. women and ask them whether they believe there is a link. Find the probability that
- A) exactly two of them respond yes
- B) at least two of them respond yes
- C) fewer than two of them respond yes

Graphing Binomial Distributions

- Make a _____ distribution – find the _____ for each _____.
- Graph the _____ using a _____.
  - Y-axis _____
  - X-axis_____

EX:

- About 60% of cancer survivors are ages 65 and older. You randomly select six cancer survivors and ask them whether they are 65 and older. Construct a probability distribution for the random variable x. Then graph the distribution and describe its shape. Identify any values of x that you would consider unusual.

Mean, Variance, and Standard Deviation of a Binomial Distribution

- Mean:
- Variation:
- Standard Deviation:

EX:

- In Pittsburgh, PA, about 56% of the days in a year are cloudy. Find the mean, variance, and standard deviation for the number of cloudy days during the month of June. Interpret the results.

4.3
More Discrete Probability Distributions

Geometric Distribution

- A situation in which an _____ is _____ until _____ _____.
- EX: You may need to send an email several times before it actually sends.

Conditions to be a Geometric Distribution:

- 1) A trial is _____ until _____ occurs.
- 2) The repeated trials are _____ of each other.
- 3) The _____ of _____ is the same for each trial.
- 4) The random variable _____ represents the _____ of the _____ in which the _____ occurs.

Geometric Distribution Formula

- The _____ that the _____ will occur on trial number _____ is:

- You may have to _____ individual probabilities to equal the total probability.

EX:

- Basketball player LeBron James makes a free throw about 75% of the time. Find the probability that the first free throw he makes occurs on the third or fourth attempt.

EX:

- Find the probability that LeBron makes his first free throw before his third attempt.

The Poisson Distribution

- Used to determine the _____ that a _____ of occurrences take place within a given unit of _____.
- EX: The probability that an employee will take 15 sick days within a year.

Conditions to be a Poisson Distribution:

- 1) Contains a _____ of the number of times a _____ occurs in a given _____.
- 2) The _____ of the event occurring is the _____ for each interval.
- 3) Each occurrence is _____ of other occurrences in other intervals.

Poisson Distribution Formula:

- The probability of _____ occurrences in an _____ is:

- e = 2.71828
- μ = the _____ number of occurrences per interval unit

EX:

- The mean number of accidents per month at a certain intersection is three. What is the probability that in any given month four accidents will occur at the intersection?

EX:

- What is the probability that more than four accidents will occur in any given month at the intersection?