# Day 1: Chapter 6.1 Discrete Random Variables

Do Price is Right – Switcheroo

What is the probability of winning the car?

What is the probability of winning all 5 prizes? (change to 4 prizes and write out the sample space)

What is the probability of winning at least 1 prize?

Discuss discrete random variables

Make a probability distribution, graph the distribution and describe it

How can we measure the center and spread? Learn about mean and std dev later

Do hot tubs problem worksheet – same process as Switcheroo but not all outcomes are equally likely

# HW: page 359 (1, 6)

**AP Statistics**

**Unit 6 – Random Variables**

# Days 2/3: 6.1 Discrete Random Variables

Read 347–350

What is a random variable? Give some examples.

What is a probability distribution?

What is a discrete random variable? Give some examples.

Alternate Example: *How many languages?*

Imagine selecting a U.S. high school student at random. Define the random variable *X* = number of languages spoken by the randomly selected student. The table below gives the probability distribution of *X*, based on a sample of students from the U.S. Census at School database.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Languages:** | 1 | 2 | 3 | 4 | 5 |
| **Probability:** | 0.630 | 0.295 | 0.065 | 0.008 | 0.002 |

1. Show that the probability distribution for *X* is legitimate.
2. Make a histogram of the probability distribution. Describe what you see.
3. What is the probability that a randomly selected student speaks at least 3 languages? Interpret this probability.
4. What is the probability that a randomly selected student speaks more than 3 languages? How is this different than (c)?
5. Given that a student speaks more than one language, what is the probability the student speaks 3 languages?

Alternate Example: Roulette

One wager players can make in Roulette is called a “corner bet.” To make this bet, a player places his chips on the intersection of four numbered squares on the Roulette table. If one of these numbers comes up on the wheel and the player bet $1, the player gets his $1 back plus $8 more. Otherwise, the casino keeps the original $1 bet. If *X* = net gain from a single $1 corner bet, the possible outcomes are *x* = –1 or *x* = 8. Here is the probability distribution of *X*:

|  |  |  |
| --- | --- | --- |
| Value: | –$1 | $8 |
| Probability: | 34/38 | 4/38 |

If a player were to make this $1 bet over and over, what would be the player’s average gain?

Read 350–352

How do you calculate the mean (expected value) of a discrete random variable? Is the formula on the formula sheet?

How do you interpret the mean (expected value) of a discrete random variable?

Alternate Example: Calculate and interpret the mean of the random variable *X* in the languages example on the previous page.

Does the expected value of a random variable have to equal one of the possible values of the random variable? Should expected values be rounded?

Read 352–354

How do you calculate the variance and standard deviation of a discrete random variable? Are these formulas on the formula sheet?

How do you interpret the standard deviation of a discrete random variable?

The “red/black” and “corner” bets in Roulette both have the same expected value. How do you think their standard deviations compare? Calculate them both to confirm your answer.

Use your calculator to calculate and interpret the standard deviation of *X* in the languages example.

Are there any dangers to be aware of when using the calculator to find the mean and standard deviation of a discrete random variable?

# Day 2 HW: page 359 (3, 9, 11, 14)

# Day 3 HW: page 359 (18-20)

**Day 4: 6.1 Continuous Random Variables**

Read 355–358

What is a continuous random variable? Give some examples.

Is it possible to have a shoe size = 8? Is it possible to have a foot length = 8 inches?

How many possible foot lengths are there? How can we graph the distribution of foot length?

How do we find probabilities for continuous random variables?

For a continuous random variable *X*, how is *P*(*X* < a) related to *P*(*X* ≤ a)?

Alternate example: Weights of Three-Year-Old Females

The weights of three-year-old females closely follow a Normal distribution with a mean of µ = 30.7

pounds and a standard deviation of σ = 3.6 pounds. Randomly choose one three-year-old female and call her weight *X*.

1. Find the probability that the randomly selected three-year-old female weighs at least 30 pounds.
2. Find the probability that a randomly selected three-year-old female weighs between 25 and 35 pounds.
3. If *P*(*X* < *k*) = 0.8, find the value of *k*.

# HW: page 361 (23, 25, 27–30)

**Day 5: 6.2 Transforming Random Variables**

*Note: the following two pages of notes correspond to pages 363–369*

Alternate Example: El Dorado Community College

El Dorado Community College considers a student to be full-time if he or she is taking between 12 and 18 units. The number of units *X* that a randomly selected El Dorado Community College full-time student is taking in the fall semester has the following distribution.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Number of Units (*X*) | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Probability | 0.25 | 0.10 | 0.05 | 0.30 | 0.10 | 0.05 | 0.15 |

Calculate and interpret the mean and standard deviation of *X*.

At El Dorado Community College, the tuition for full-time students is $50 per unit. So, if *T* = tuition charge for a randomly selected full-time student, *T* = 50*X*. Here’s the probability distribution for *T*:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tuition Charge (*T*) | 600 | 650 | 700 | 750 | 800 | 850 | 900 |
| Probability | 0.25 | 0.10 | 0.05 | 0.30 | 0.10 | 0.05 | 0.15 |

Calculate the mean and standard deviation of *T*.

What is the effect of multiplying or dividing a random variable by a constant?

In addition to tuition charges, each full-time student at El Dorado Community College is assessed student fees of $100 per semester. If *C* = overall cost for a randomly selected full-time student, *C* = 100 + *T*. Here is the probability distribution for *C*:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Overall Cost (*C*) | 700 | 750 | 800 | 850 | 900 | 950 | 1000 |
| Probability | 0.25 | 0.10 | 0.05 | 0.30 | 0.10 | 0.05 | 0.15 |

Calculate the mean and standard deviation of *C*.

What is the effect of adding (or subtracting) a constant to a random variable?

What is a linear transformation? How does a linear transformation affect the mean and standard deviation of a random variable?

Alternate Example: Scaling a Test

In a large introductory statistics class, the distribution of *X* = raw scores on a test was approximately normally distributed with a mean of 17.2 and a standard deviation of 3.8. The professor decides to scale the scores by multiplying the raw scores by 4 and adding 10.

1. Define the variable *Y* to be the scaled score of a randomly selected student from this class. Find the mean and standard deviation of *Y*.
2. What is the probability that a randomly selected student has a scaled test score of at least 90?

# HW: page 382 (35, 37, 39, 40, 41, 43, 45)

**Day 6/7: 6.2 Combining Random Variables / Quiz**

*Note: the next 2 pages of notes correspond to pages 369–381*

Alternate Example: Speed Dating

Suppose that the height *M* of male speed daters follows a Normal distribution with a mean of 68.5 inches and a standard deviation of 4 inches and the height *F* of female speed daters follows a Normal distribution with a mean of 64 inches and a standard deviation of 3 inches. What is the probability that a randomly selected male speed dater is taller than the randomly selected female speed dater he is paired with?

Simulation approach:

Based on the simulation, what conclusions can we make about the shape, center, and spread of the distribution of a difference (and sum) of Normal RVs?

Non-simulation approach:

Alternate Example: Suppose that a certain variety of apples have weights that are approximately Normally distributed with a mean of 9 ounces and a standard deviation of 1.5 ounces. If bags of apples are filled by randomly selecting 12 apples, what is the probability that the sum of the 12 apples is less than 100 ounces?

Alternate Example: Let *B* = the amount spent on books in the fall semester for a randomly selected full- time student at El Dorado Community College. Suppose that µ*B* = 153 and σ *B* = 32 . Recall from earlier that *C* = overall cost for tuition and fees for a randomly selected full-time student at El Dorado

Community College and µ*C*

= 832.50 and σ *C*

= 103. Find the mean and standard deviation of the cost

of tuition, fees and books (*C* + *B*) for a randomly selected full-time student at El Dorado Community College. What is the shape of the distribution?

# HW: page 384 (47, 51, 57, 58, 59, 61, 63)

**Day 8: 6.3 Binomial Distributions**

Read 386–389

What are the conditions for a binomial setting?

What is a binomial random variable? What are the possible values of a binomial random variable?

What are the parameters of a binomial distribution?

What is the most common mistake students make on binomial distribution questions?

Alternate Example: Dice, Cars, and Hoops

Determine whether the random variables below have a binomial distribution. Justify your answer.

1. Roll a fair die 10 times and let *X* = the number of sixes.
2. Shoot a basketball 20 times from various distances on the court. Let *Y* = number of shots made.
3. Observe the next 100 cars that go by and let *C* = color.

*Note: The following 2 pages in the notes correspond to pages 390–393.*

Alternate Example: Rolling Sixes

In many games involving dice, rolling a 6 is desirable. The probability of rolling a six when rolling a fair die is 1/6. If *X* = the number of sixes in 4 rolls of a fair die, then *X* is binomial with *n* = 4 and *p* = 1/6.

What is *P*(*X* = 0)? That is, what is the probability that all 4 rolls are *not* sixes?

What is *P*(*X* = 1)?

What about *P*(*X* = 2), *P*(*X* = 3), *P*(*X* = 4)?

In general, how can we calculate binomial probabilities? Is the formula on the formula sheet?

Alternate Example: Roulette

In Roulette, 18 of the 38 spaces on the wheel are black. Suppose you observe the next 10 spins of a roulette wheel.

1. What is the probability that exactly 4 of the spins land on black?
2. What is the probability that at least 8 of the spins land on black?

# HW: page 410 (69–79 odd)

**Days 9/10: 6.3 Binomial and Geometric Distributions**

Read 394–396

How can you calculate binomial probabilities on the calculator?

Is it OK to use the binompdf and binomcdf commands on the AP exam?

*Note: The following page of notes corresponds to pages 397–400.*

How can you calculate the mean and SD of a binomial distribution? Are these on the formula sheet?

Alternate example: Roulette

Let *X* = the number of the next 10 spins of a roulette wheel that land on black.

1. Calculate and interpret the mean and standard deviation of *X*.
2. What is the probability that the number of spins that land on black be within one standard deviation of the mean?

Read 401–402 *Note: we are skipping the Normal approximation to the binomial distribution*

When is it OK to use the binomial distribution when sampling without replacement? Why is this an issue?

Alternate Example: In the NASCAR Cards and Cereal Boxes example from Section 5.1, we read about a cereal company that put one of 5 different cards into each box of cereal. Each card featured a different driver: Jeff Gordon, Dale Earnhardt, Jr., Tony Stewart, Danica Patrick, or Jimmie Johnson. Suppose that the company printed 20,000 of each card, so there were 100,000 total boxes of cereal with a card inside. If a person bought 6 boxes at random, what is the probability of getting 2 Danica Patrick cards?

What effect do *n* and *p* have on the shape of a binomial distribution?

Read 404–406

What are the conditions for a geometric setting?

What is a geometric random variable? What are the possible values of a geometric random variable?

What are the parameters of a geometric distribution?

Alternate Example: Monopoly

In the board game Monopoly, one way to get out of jail is to roll doubles. Suppose that a player has to stay in jail until he or she rolls doubles. The probability of rolling doubles is 1/6.

1. Explain why this is a geometric setting.
2. Define the geometric random variable and state its distribution.
3. Find the probability that it takes exactly three rolls to get out of jail. Exactly four rolls? 100 rolls?

In general, how can you calculate geometric probabilities? Is this formula on the formula sheet?

On average, how many rolls should it take to escape jail in Monopoly?

In general, how do you calculate the mean of a geometric distribution? Is the formula on the formula sheet?

What is the probability it takes longer than average to escape jail? What does this probability tell you about the shape of the distribution?

# HW: page 411 (81, 85, 87, 89, 93 | 95, 97, 101–104)

**Day 11: Binomial and Geometric distributions, continued**

**Day 12: Review / FRAPPY!**

**HW: page 416 Chapter Review Exercises (skip R6.8)**

**Day 13: Review Ch6**

# HW: Page 418 Chapter 6 AP Practice Test

**Day 14: CHAPTER 6 TEST**