AP Practice Simulations

heavily on black at the next spin. Asked why, he explains that black is "due by the law of averages." Explain to the gambler what is wrong with this reasoning.

(b) After hearing you explain why red and black are still equally likely after five reds on the roulette wheel, the gambler moves to a poker game. He is dealt five straight red cards. He remembers what you said and assumes that the next card dealt in the same hand is equally likely to be red or black. Is the gambler right or wrong, and why?

13. **Free throws** A basketball player has probability 0.75 of making a free throw. Explain how you would use each chance device to simulate one free throw by the player.

(a) A six-sided die

(b) Table D of random digits

(c) A standard deck of playing cards

14. **Stoplight** On her drive to work every day, Ilana passes through an intersection with a traffic light. The light has probability 1/3 of being green when she gets to the intersection. Explain how you would use each chance device to simulate whether the light is red or green on a given day.

(a) A six-sided die

(b) Table D of random digits

(c) A standard deck of playing cards

15. **Simulation blunders** Explain what's wrong with each of the following simulation designs.

(a) A roulette wheel has 38 colored slots—18 red, 18 black, and 2 green. To simulate one spin of the wheel, let numbers 00 to 18 represent red, 19 to 37 represent black, and 38 to 40 represent green.

(b) About 10% of U.S. adults are left-handed. To simulate randomly selecting one adult at a time until you find a left-hander, use two digits. Let 01 to 10 represent being left-handed and 11 to 00 represent being right-handed. Move across a row in Table D, two digits at a time, skipping any numbers that have already appeared, until you find a number between 01 and 10. Record the number of people selected.

16. **Simulation blunders** Explain what's wrong with each of the following simulation designs.

(a) According to the Centers for Disease Control and Prevention, about 26% of U.S. adults were obese in 2008. To simulate choosing 8 adults at random and seeing how many are obese, we could use two digits. Let 01 to 26 represent obese and 27 to 00 represent not obese. Move across a row in Table D, two digits at a time, until you find 8 distinct numbers (no repeats). Record the number of obese people selected.

(b) Assume that the probability of a newborn being a boy is 0.5. To simulate choosing a random sample of 9 babies who were born at a local hospital today and observing their gender, use one digit. Use `randInt(0,9)` on your calculator to determine how many babies in the sample are male.

17. **Is this valid?** Determine whether each of the following simulation designs is valid. Justify your answer.

(a) According to a recent poll, 75% of American adults regularly recycle. To simulate choosing a random sample of 100 U.S. adults and seeing how many of them recycle, roll a 4-sided die 100 times. A result of 1, 2, or 3 means the person recycles; a 4 means that the person doesn't recycle.

(b) An archer hits the center of the target with 60% of her shots. To simulate having her shoot 10 times, use a coin. Flip the coin once for each of the 10 shots. If it lands heads, then she hits the center of the target. If the coin lands tails, she doesn't.

18. **Is this valid?** Determine whether each of the following simulation designs is valid. Justify your answer.

(a) According to a recent survey, 50% of people aged 13 and older in the United States are addicted to email. To simulate choosing a random sample of 20 people in this population and seeing how many of them are addicted to email, use a deck of cards. Shuffle the deck well, and then draw one card at a time. A red card means that person is addicted to email; a black card means he isn't. Continue until you have drawn 20 cards (without replacement) for the sample.

(b) A tennis player gets 95% of his second serves in play during practice (that is, the ball doesn't go out of bounds). To simulate the player hitting 5 second serves, look at pairs of digits going across a row in Table D. If the number is between 00 and 94, the serve is in; numbers between 95 and 99 indicate that the serve is out.

19. **Airport security** The Transportation Security Administration (TSA) is responsible for airport safety. On some flights, TSA officers randomly select passengers for an extra security check prior to boarding. One such flight had 76 passengers—12 in first class and 64 in coach class. Some passengers were surprised when none of the 10 passengers chosen for screening were seated in first class. We can use a simulation to see if this result is likely to happen by chance.

(a) State the question of interest using the language of probability.

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(b) How would you use random digits to imitate one repetition of the process? What variable would you measure?

(c) Use the line of random digits below to perform one repetition. Copy these digits onto your paper. Mark directly on or above them to show how you determined the outcomes of the chance process.

71487 09984 29077 14863 61683 47052 62224 51025

(d) In 100 repetitions of the simulation, there were 15 times when none of the 10 passengers chosen was seated in first class. What conclusion would you draw?

20. **Scrabble** In the game of Scrabble, each player begins by drawing 7 tiles from a bag containing 100 tiles. There are 42 vowels, 56 consonants, and 2 blank tiles in the bag. Cait chooses her 7 tiles and is surprised to discover that all of them are vowels. We can use a simulation to see if this result is likely to happen by chance.

(a) State the question of interest using the language of probability.

(b) How would you use random digits to imitate one repetition of the process? What variable would you measure?

(c) Use the line of random digits below to perform one repetition. Copy these digits onto your paper. Mark directly on or above them to show how you determined the outcomes of the chance process.

00694 05977 19664 65441 20903 62371 22725 53340

(d) In 1000 repetitions of the simulation, there were 2 times when all 7 tiles were vowels. What conclusion would you draw?

21. **The birthday problem** What's the probability that in a randomly selected group of 30 unrelated people, at least two have the same birthday? Let's make two assumptions to simplify the problem. First, we'll ignore the possibility of a February 29 birthday. Second, we assume that a randomly chosen person is equally

22. **Monty Hall problem** In *Parade* magazi posed the following question to Marilyn and the "Ask Marilyn" column:

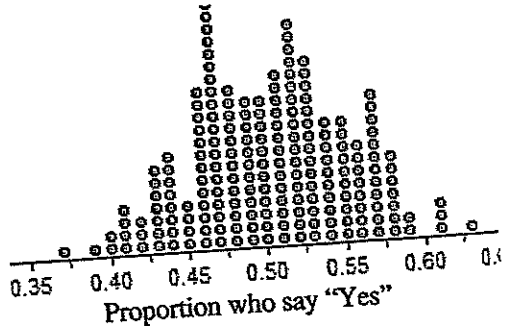
> Suppose you're on a game show, and the choice of three doors. Behind one car, behind the others, goats. You pic #1, and the host, who knows what's be doors, opens another door, say #3, wh goat. He says to you, "Do you want to #2?" Is it to your advantage to switch y of doors?

The game show in question was *Let's Make* and the host was Monty Hall. Here's the f of Marilyn's response: "Yes; you should The first door has a 1/3 chance of winni the second door has a 2/3 chance." Thous readers wrote to Marilyn to disagree with swer. But she held her ground.

(a) Use an online *Let's Make a Deal* apple form at least 50 repetitions of the simulatio whether you stay or switch (try to do each a the time) and the outcome of each repetitic

(b) Do you agree with Marilyn or her reader

23. **Recycling** Do most teens recycle? To fi out, an AP Statistics class asked an SRS students at their school whether they re recycle. How many students in the samp need to say "Yes" to provide convincing that more than half of the students at the recycle? The Fathom dotplot below show results of taking 200 SRSs of 100 student a population in which the true proportio recycle is 0.50.



(d) in a very large number of bridge deals, the average number of aces in a hand will be very close to 0.11.

(e) None of these

32. If I toss a fair coin five times and the outcomes are TTTTT, then the probability that tails appears on the next toss is

(a) 0.5. (c) greater than 0.5. (e) 1.

(b) less than 0.5. (d) 0.

Exercises 33 to 35 refer to the following setting. A basketball player makes 47% of her shots from the field during the season.

33. To simulate whether a shot hits or misses, you would assign random digits as follows:

(a) One digit simulates one shot; 4 and 7 are a hit; other digits are a miss.

(b) One digit simulates one shot; odd digits are a hit and even digits are a miss.

(c) Two digits simulate one shot; 00 to 47 are a hit and 48 to 99 are a miss.

(d) Two digits simulate one shot; 00 to 46 are a hit and 47 to 99 are a miss.

(e) Two digits simulate one shot; 00 to 45 are a hit and 46 to 99 are a miss.

34. Use the correct choice from the previous question and these random digits to simulate 10 shots:

82734 71490 20467 47511 81676 55300 94383 14893

How many of these 10 shots are hits?

(a) 2 (b) 3 (c) 4 (d) 5 (e) 6

35. You want to estimate the probability that the player makes 5 or more of 10 shots. You simulate 10 shots 25 times and get the following numbers of hits:

5 7 5 4 1 5 3 4 3 4 5 3 4 4 6 3 4 1 7 4 5 5 6 5 7

What is your estimate of the probability?

(a) 5/25, or 0.20 (d) 16/25, or 0.64

(b) 11/25, or 0.44 (e) 19/25, or 0.76

(c) 12/25, or 0.48

36. Ten percent of U.S. households contain 5 or more people. You want to simulate choosing a household at random and recording whether or not it contains 5 or more people. Which of these are correct assignments of digits for this simulation?

(a) Odd = Yes (5 or more people); Even = No (not 5 or more people)

(b) 0 = Yes; 1, 2, 3, 4, 5, 6, 7, 8, 9 = No

(c) 5 = Yes; 0, 1, 2, 3, 4, 6, 7, 8, 9 = No

(d) All three are correct.

(e) Choices (b) and (c) are correct, but (a) is not.

37. **Are you feeling stressed?** (4.1) A Gallup Poll asked whether people experienced stress "a lot of the day yesterday." Forty percent said they did. Gallup's report said, "Results are based on telephone interviews with 178,545 national adults, aged 18 and older, conducted Jan. 2–June 30, 2009."[4]

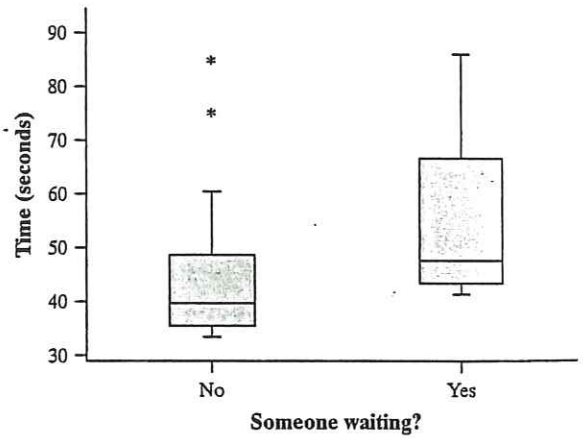
(a) Identify the population and the sample.

(b) Explain how undercoverage could lead to bias in this survey.

38. **Waiting to park** (1.3) Do drivers take longer to leave their parking spaces when someone is waiting? Researchers hung out in a parking lot and collected some data. The graphs and numerical summaries below display information about how long it took drivers to exit their spaces.

(a) Write a few sentences comparing these distributions.

(b) Can we conclude that having someone waiting causes drivers to leave their spaces more slowly? Why or why not?



Descriptive Statistics: Time

Variable	Waiting	N	Mean	StDev	Minimum	Q1	Median	Q3	Ma
Time	No	20	44.42	14.10	33.76	35.61	39.56	48.48	8
	Yes	20	54.11	14.39	41.61	43.41	47.14	66.44	8

Simulation Problems Worksheet
AP Statistics

1. The chance of contacting strep throat when coming into contact with an infected person is estimated as 0.15. Suppose the four children of a family come into contact with an infected person. Conduct a simulation to answer the following questions. Use the random number table below and conduct 20 trials. Clearly identify each trial on the table. What is the chance that at least one of the four children get strep?

(a) Choice of model: explain how you are setting up your simulation to get 0.15

Define a trial:
(read four pairs of digits, one for each child in the family)

What makes a successful trial:

(b) Conduct 20 trials. How many were successful out of the 20?
(show work)

(c) Finding Probability of a successful trial:

(d) The correct probability that at least one child gets strep is .48. How does your answer/estimate from your simulation compare?

31151	64727	88795	93736	2218947004
48304	774107887198387		44647	18072
65194	58586	78232	57097	0143000304
32036	2367165929	9761394452		56211

85446 13656 32155 84455 38125 50339

82178 19650 41283 13944 13736 02627

41929 60613 73840 53838 90804 94332

2. A camera manufacturer finds that 10% of the springs used in the shutters it manufactures are defective. Of the next 5 springs tested by the manufacturer, what is the probability of finding two or more defective. Design and execute a simulation.

a)Choose your model and explain it. This is where you define digits, number of trials and what defines a successful trial.

b) Perform the simulation. Record results

c) How many of your trials where successful? What is the probability that two or more will be defective?

d) The actual probability is .082. Compare this with your simulation results.

47169	80410	03333	73856	85627	54351
36653	55390	20439	48605	45513	05458
76361	47409	14914	55280	70533	52960
20579	87054	59998	90071	67554	91237
96994	65965	73235	49260	45309	24660

92048	08676	72653	87342	19084	33780
37592	96361	18246	36121	14888	23329
08032	20831	98314	93521	24035	43186

3. A certain professor has ten keys, but he never recalls which one fits his office door lock. He tries one key at a time, each time choosing one of the keys at random from his pocket. (All the keys look the same but he **does not** put a key back in his pocket once he has tried that key.) Conduct a simulation to answer the following question. Use the random number table below and conduct 20 trials. Clearly identify each trial on the table.

(a) Describe your simulation.

(b) (try this) What is the expected number of tries needed for him to find the correct key?

64831	78558	25961	07610	75464	85326
34336	39840	24371	53548	01485	57845
11792	38659	92620	48253	05370	80411
65985	43392	21100	08763	37469	66583
52822	48990	03648	34861	54680	64791
31645	45552	78255	64794	21228	69707
38804	45687	85320	54654	76156	01853
97115	91205	92396	97645	18911	76701