AP Practice Simulations TEACHER

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?

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

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

BACK

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.

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.

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.

BACK

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.

BACK

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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(15) (a) There are 19 #'s Between 00 and 18, 19 #'s between 19 and 37 and three #'s between 38 + 40 This changes the proportions Between the 3 diff. outcomes.

(b) Don't skip #'s already encountered

(18) (a) not valid – you are not putting the card back in the deck after dealing

(b) Legitimate.
There is 95% chance of getting a # btwn 00+94
+ selections are independent using a table

(19) (a) Question: What is the probability that in a random selection of 10 passengers, none from first class were chosen

(b) First class 01 – 12
others 13–76
Ignore all other #'s → use table of random digits
Count # of two digit btwn 01 + 12 that occur in 10 selections

(c) 71, 48, 70, 29, (07), 63, 61, 68, 34, 52
one in 10

(d) 15% of the time no #'s selected rep. First class
Since this is a low percent, it seems plausable that the initial screening in question was actually random.

(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]

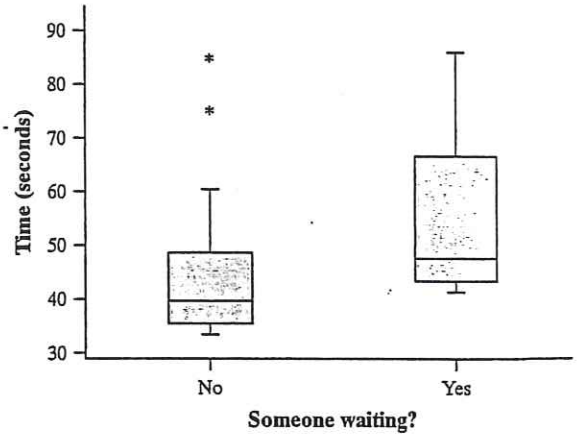
(a) Identify the population and the sample.

(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	M
Time	No	20	44.42	14.10	33.76	35.61	39.56	48.48	6
	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?

open ended

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

00-14 → gets strep 15-99 → no strep

Define a trial: Four pairs of digits = 1 trial (each # = one kid)
(read four pairs of digits, one for each child in the family)

What makes a successful trial: A trial is a success if at least one child of the four pairs gets strep (00-14)

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

6 - yes
14 - no
$> \frac{6}{20}$

Set up (Alternate)
01-15 Succ
00, 16-99 Fail
prob may be different for (c)

(c) Finding Probability of a successful trial: $\frac{6}{20} = 30\%$

(d) The correct probability that at least one child gets strep is .48. How does your answer/estimate from your simulation compare? my sim produced low results however - w/more trials I believe it would be higher

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

15

17 18 19

0 0 1 1

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.

one digit random #'s

0 ⇒ defective
1 - 9 not defective

one trial is 5 consec. digits from the table
perform 25 trials
success = 2+ that come up defective in a trial

b) Perform the simulation. Record results

2 trials of the 25 had 2 or more defective

2/25 = .08 or 8%

2

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

Simulation produced same results.

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

47169 (0)	80410 (2)	03333 (1)	73856 (0)	85627 (0)	54351 (0)
36653 (0)	55390 (1)	20439 (1)	48605 (1)	45513 (0)	05458 (1)
76361 (0)	47409 (1)	14914 (0)	55280 (1)	70533 (0)	52960 (1)
20579 (1)	87054 (1)	59998 (0)	90071 (2)	67554 (0)	91237 (0)
96994 (0)	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.

0–9 = correct ast not gnor rep

(a) Describe your simulation.

7, X, 3, 6, 4, 10, 2, 5, X, 4, 8, 7, 3, 8, 3, 10, 3, 9, 9, 2

0–9

(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

1	2	3	4	5	6	7	8
$\frac{2}{20}$	$\frac{2}{20}$	$\frac{4}{20}$	$\frac{2}{20}$	$\frac{1}{20}$	$\frac{1}{20}$	$\frac{2}{20}$	$\frac{2}{20}$

9	10
$\frac{2}{20}$	$\frac{2}{20}$

$1(\frac{2}{20}) + 2(\frac{2}{20}) + 3(\frac{4}{20}) + 4(\frac{2}{20}) + 5(\frac{1}{20}) + 6(\frac{1}{20}) + 7(\frac{2}{20}) + 8(\frac{2}{20}) + 9(\frac{2}{20}) + 10(\frac{2}{20})$

p. 397 #1, 3

#1 (a) 2 coin flip — 75%
HH, TT, HT, TH
↓ failure / success (variations of this)

(b) six sided dice
1, 2, 3, 4, 5, 6
use 4 / ignor/roll again
1-3 success
4 failure
} variations

(c) use 2 digits at a time
75% > 00-74 = success (75 #'s)
76-99 = failure

(d) 75% → 52 cards
26 R ♡ ◇ → success
26 B ♧ ♤ → failure
} of some variation

#3 (a) A list of All students at campus
use a random process to select 10 students at a time → (# generator, table, etc)

(b) once groups of 10 are selected, then use 2 digit series to Y or N
To get 84% → 84/100 #'s need to be "Yes"
00-83 = Yes
84-99 = No

(c) (36) (75), 95, 89, 84, (68), (28), (82), (29), (13) = 7 yes / 10 = 70%

(18) (63), 85, (43), (03), (00), (79), (50), 87, (27) = 8 yes 80%

(09) (05) (16) (48) (17) 87 (17) (40) 95 (17) = 8 yes

84, 53 40 64 89 87 20 19 72 45 = 7 yes

05 00 71 66 32 81 19 41 48 73 = 10 yes

1/5 = 20% chance that would happen

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#8 → to create 60% chance

6/10 0,1,2,3,4,5 = Win - Am. Team

6,7,8,9 = Loss Am. Team (or Nat'l Team Win)

- Single digits chosen at random until one team wins 4 Times (4-7 times)
- perform sim multiple times
- in long run 5-6 games should be played (Expected value)

game	4	5	6	7	4	5	6	7
Am. Wins	11	1	1	11	2/10	1/10	3/10	4/6
Nat. Wins			11	11				

E.V. = 5.9

6,9,3,3,5,6,9, = 7 games
1,4,7,7,1,7 = 6 games
5,9,9,1,2,8,2, = 7 game
9,8,1,2,7 = 6
1,8,6,3,0,0 4
0,3,4,2 4
7,1,5,1,9,5 5
4,3,1,8,9,9,7 4 7
2,8,8,4,4,9,3 7
3,0,5,1 4

(B) weather, injury status, pitchers, etc.

(b) +0 -Sam

Sam can be right 25% of time (potentially)

.4(2.5) + -1(1.5) = 2.5 (out of 10)

#12 1/4 Chance correct

1, 2, 3, 4 #1 = correct

Select rand # 10 times

Simulation 28/100 correct

+4 -1

25/100 75 = Exp. Score - 25 out of 100

(1) 3 3 2 4 (1) (1) 3 3 3 3/10 correct

+4 -1

3/10 7/10

4(3) - 1(7) = 5