

## ECON 360, Socioeconomics of Gambling

**Homework 1 - Due at 4:00pm, in class, Wednesday, September 30**

You may work with up to two other people in the class.

Late work is not accepted; see the syllabus.

**Instructions:** Provide answers in the spaces provided, using your normal handwriting. For mathematical questions, show your work. Many questions come from material we've covered in class; others might require you to look for an answer, online or elsewhere. On p. 4, you'll find some information that might help you.

1. Read Walker's book review (provided on OAKS) of Cohen's *For a Dollar and a Dream*.

a. Write a concise description of the spread of lotteries throughout the United States.

New Hampshire introduced it in 1964, but most of the discussion follows other states, esp. NJ. There's a lot of issues, but the motivation seems to be: politicians want more revenues, and they don't want to ~~raise taxes~~ raise taxes.

b. In what year and state were scratch-off lottery first tickets sold in the U.S.? Briefly comment on the recent performance of that state's lottery. (There's one really interesting fact.)

Mass., 1974. They have the best performing (i.e., sales) lottery in the U.S.

c. Walker comments that Cohen doesn't seem to consider that governments could cut spending as a response to budget shortfalls.

For the following questions about roulette, suppose we're discussing the American (double-zero) game.

2. Are the numbers' colors on the U.S. roulette wheel standardized or random? For example, is 21 always a red number, as in the layout below? If it is standardized, what are the "rules"? Yep, 21 is always red.

Look at the layout below: 1-10 even: black odd: red 11-17 odd-black etc.

3. Casinos typically have minimum bets on "inside" and "outside" roulette bets. In the layout below, "outside" includes all bets shown on green felt (except 0 and 00). The minimum on these bets is always  $\geq \$5$ . The "inside" includes individual or adjacent numbers (e.g., 21, or on the border between 8 and 11). The minimum for these is usually \$1. There are 38 numbers on the table. What is the probability of winning...

a. "black" bet

$$18/38 = 47.3\%$$

b. a bet on the number 12

$$1/38 = 2.63\%$$

c. a split bet on 8 and 11

$$2/38 = 5.26\%$$

d. a bet on the "2nd 12"

$$12/38 = 31.6\%$$

e. a bet on the top row (3, 6, 9, ..., 36)

$$12/38 = 31.6\%$$

Probability of an event, where  $x$  is the event and  $y$  is the number of possible outcomes =  $x/y$

|    |        |      |   |        |    |    |        |     |       |    |    |    |        |
|----|--------|------|---|--------|----|----|--------|-----|-------|----|----|----|--------|
| 00 | 3      | 6    | 9 | 12     | 15 | 18 | 21     | 24  | 27    | 30 | 33 | 36 | 2 to 1 |
| 0  | 2      | 5    | 8 | 11     | 14 | 17 | 20     | 23  | 26    | 29 | 32 | 35 | 2 to 1 |
|    | 1      | 4    | 7 | 10     | 13 | 16 | 19     | 22  | 25    | 28 | 31 | 34 | 2 to 1 |
|    | 1st 12 |      |   | 2nd 12 |    |    | 3rd 12 |     |       |    |    |    |        |
|    | 1-18   | EVEN |   |        |    |    |        | ODD | 19-36 |    |    |    |        |

4. What are the odds against winning...

a. "black" bet  $(38-18)$  to 18, or  
20 to 18 (20:18)

b. a bet on the number 12  
 $(38-1)$  to 1, so 37:1

c. a split bet on 8 and 11  
 $(38-2)$  to 2, 36:2, or 18:1

d. a bet on the "2<sup>nd</sup> 12"  
 $(38-12)$  to 12, or 26 to 12, 13:6

e. a bet on the top row (3, 6, 9, ..., 36)  
 $(38-12)$  to 12, or 13 to 6

5. How much do you win if the bets listed in questions 3 and 4 win? Hint: This can be calculated easily if you just assume, for  $y$  in the equation above, that 0, 00 do not exist. For example, a bet on "odd" pays 1:1 because there are equal number of odd and even numbers. So if you bet \$10 on odd, and 23 is the point, you'll win \$10. You'll also get to keep your \$10 bet. In your answers, only include what you win from the casino; do not include your bet in the amount won.

a. \$10 "black" bet  $(36-18)$  to 18, or 18:18, 1:1, so you win \$10

b. \$5 bet 12 assuming 0, 00 don't exist, then we have  $(36-1)$  to 1, or 35:1. For a \$5 bet, it's  
 $\$5 \times 35 = \$175$

c. \$10 split bet on 8 and 11  $(36-2)$  to 2,  $\rightarrow = 17:1$ ,  
or 34 to 2, so you'd win \$170.

d. \$10 bet on the "2<sup>nd</sup> 12"  
 $(36-18)$  to 18, or 1:1, so you'd win \$10 on your \$10 bet.

e. \$10 bet on the top row (3, 6, 9, ..., 36) assuming 0, 00 don't exist, then we have  $(36-12)$  to 12, or 2:1.  
For a \$10 bet, it's a win of  $2 \times \$10$ , or \$20.

6. All bets in American, or double-zero (0, 00), roulette have the same house advantage of 5.26 %. This can be calculated simply as the number of green numbers divided by the total number of numbers on the wheel.  $2/38 = 5.26\%$

a. What is the house advantage on European, or single-zero (0) roulette?

There's only 1 zero, so it's  $1/37 = 2.7\%$ , half that for American. (see 3c)

b. What is the house advantage on triple-zero (0, 00, 000) roulette? This game is becoming more common in U.S. casinos, particularly in Las Vegas. — 39 total numbers.

$$3/39 = 1/13, \text{ or } 7.69\%$$

c. If you have a choice at an online casino, which version of roulette should you choose to play? Why?

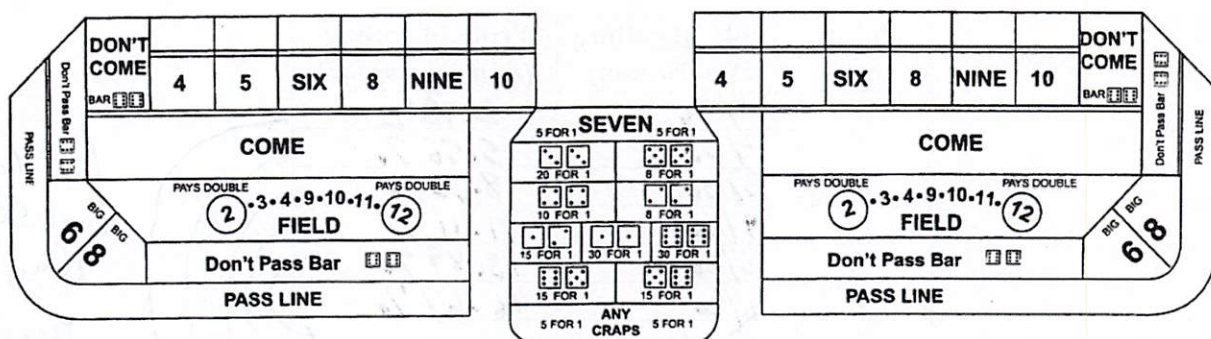
Play European! It has the lowest house advantage, which means you won't lose money as fast (as you would playing the other versions).

Odds against an event, where  $x$  is the event and  $y$  is the number of possible outcomes =  $(y - x)$  to  $x$

|        |   |   |   |        |    |    |    |        |    |    |    |       |      |
|--------|---|---|---|--------|----|----|----|--------|----|----|----|-------|------|
| 00     | 3 | 6 | 9 | 12     | 15 | 18 | 21 | 24     | 27 | 30 | 33 | 36    | to 1 |
| 0      | 2 | 5 | 8 | 11     | 14 | 17 | 20 | 23     | 26 | 29 | 32 | 35    | to 1 |
| 0      | 1 | 4 | 7 | 10     | 13 | 16 | 19 | 22     | 25 | 28 | 31 | 34    | to 1 |
| 1st 12 |   |   |   | 2nd 12 |    |    |    | 3rd 12 |    |    |    |       |      |
| 1-18   |   |   |   | EVEN   |    |    |    | ODD    |    |    |    | 19-36 |      |

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Like roulette, craps games can vary. But most of the bets we'll discuss are standard. What makes craps complicated is that there are many different casino payouts. These questions focus on probability of and odds against rolling particular numbers



**Note:** You don't really need this layout to answer the questions below, but I'm showing it to you so you can visualize the different bets discussed below.

7. Complete the table below by writing in all the "ways to roll" each point total. Then count the number of ways to roll each point total, and enter that number in the far-right column: As an example, I have completed the point total 10 for you.

| Point total | Ways to Roll                   | # ways to roll |
|-------------|--------------------------------|----------------|
| 2           | (1,1)                          | 1              |
| 3           | (2,1)(1,2)                     | 2              |
| 4           | (1,3)(3,1)(2,2)                | 3              |
| 5           | (1,4)(4,1)(2,3)(3,2)           | 4              |
| 6           | (1,5)(5,1)(2,4)(4,2)(3,3)      | 5              |
| 7           | (1,6)(6,1)(2,5)(5,2)(3,4)(4,3) | 6              |
| 8           | (2,6)(6,2)(3,5)(5,3)(4,4)      | 5              |
| 9           | (3,6)(6,3)(4,5)(5,4)           | 4              |
| 10          | (4,6)(6,4)(5,5)                | 3              |
| 11          | (5,6)(6,5)                     | 2              |
| 12          | (6,6)                          | 1              |
| Total       |                                | 36             |

- a. Which number(s) have the same number of ways to roll as...

Point total 4: 10 Point total 5: 9 Point total 6: 8

- b. How many different combinations can be rolled with two dice? Enter the total in the shaded cell of the table. (Hint: Just sum the number of ways to roll column. This number is critical for problems below.)

36

- c. "Craps" means rolling a total of 2, 3, or 12. How many ways are there to roll craps? 6

- d. How many ways are there to roll a 7? 6 How many ways are there to roll 7 or 11? 8

8. Now calculate the **probability of rolling a particular point total**. Hint: You could write and solve the formula on p. 1. But it's just the "# ways to roll" in the table above divided by 36, which is your answer for question 7(b). Complete the table below.

| Point total | Prob. of rolling (as a fraction) | Prob. of rolling as a percentage |
|-------------|----------------------------------|----------------------------------|
| 2           | $1/36$                           | $2.78\%$                         |
| 3           | $2/36$                           | $5.56\%$                         |
| 4           | $3/36$                           | $8.33\%$                         |
| 5           | $4/36$                           | $11.11\%$                        |
| 6           | $5/36$                           | $13.89\%$                        |
| 7           | $6/36$                           | $16.67\%$                        |
| 8           | $5/36$                           |                                  |
| 9           | $4/36$                           |                                  |
| 10          | $3/36$                           |                                  |
| 11          | $2/36$                           |                                  |
| 12          | $1/36$                           |                                  |
| "craps"     | $4/36$                           | $11.11\%$                        |

I'm lazy.  
But see?  
They'll be  
the same

9. Next, use the information from question 8 to calculate the **odds against rolling a particular point total**. Recall from the formula on p. 1, that if  $x$  is the roll we want, and there are  $y$  possible rolls, then the odds against rolling a particular number are  $(y-x)$  to  $x$ . Complete the table below.

| Point total | Calculation   | Odds against rolling | Odds, as a ratio |
|-------------|---------------|----------------------|------------------|
| 2           | $(36-1)$ to 1 | 35 to 1              | 35:1             |
| 3           | $(36-2)$ to 2 | 34 to 2              | 17:1             |
| 4           | $(36-3)$ to 3 | 33 to 3              | 11:1             |
| 5           | $32$ to 4     | 32 to 4              | 8:1              |
| 6           | $31$ to 5     | 31 to 5              | 6.2:1            |
| 7           | $30$ to 6     | 30 to 6              | 5:1              |
| 8           | $29$ to 7     |                      | 4.25:1           |
| 9           | $28$ to 8     |                      | 3.5:1            |
| 10          | $27$ to 9     |                      | 3:1              |
| 11          | $26$ to 10    |                      | 2.6:1            |
| 12          | $25$ to 11    |                      | 2.25:1           |
| "craps"     | $(36-4)$ to 4 | 32 to 4              | 8:1              |

← simplify these

← These (6, 8) are strange

10. If you did your work correctly in the questions above, you should find the same probability of rolling (and the same odds against rolling) three different pairs of point totals. One of the pairs is (6, 8). What are the other two?

(5, 9) and (4, 10)

11. If you bet \$5 on the number 4 and then the player rolls a 4, the casino will pay you \$9. Based on the probability against rolling a 4, is the casino's payout isn't "fair." How much should they pay you if craps bets were fair?

The casino should pay me \$ 10 on my winning \$5 bet on the number 4.

(Do not include your \$5 bet in your winning total; only indicate how much the casino pays your bet.)

any double  
p.