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## Repeated Experiments

### Part 1

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- Hello and welcome back.  
So far we talked about single experiments  
and now we're going to move from one experiment to multiple experiments and we'll start by talking about composite experiments and then we'll converge on a special but important case of repeated experiments, and then we'll see what



### Part 2

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- Welcome to the second part of repeated experiments.

So in the first part, we talked about

compound or composite experiments,

and we talked about what happens

when you repeat things,

and we said you can repeat either



#### 5.4a Probability Repeated Experiments

#### 5.4b Probability Repeated Experiments

### POLL

Which of the following are independent repetitive experiments?

### RESULTS

- |   |            |
|---|------------|
| <input checked="" type="radio"/> <b>card draws with replacement</b> | <b>91%</b> |
| <input type="radio"/> <b>card draws without replacement</b>         | <b>8%</b>  |
| <input type="radio"/> <b>neither</b>                                | <b>2%</b>  |

Submit

Results gathered from 311 respondents.

### FEEDBACK

Card draws with replacement will be independent repetitive experiments.

1

0 points possible (ungraded)

You have two fair coins. If you flip a head with the first coin, what is the probability of flipping a head with the second?

☐ 1

☐ 0

☒  $\frac{1}{2}$  ✓

☐  $\frac{1}{4}$

### Explanation

Flipping the first and the second coin are independent.

Submit

You have used 2 of 2 attempts

**i** Answers are displayed within the problem

2

1/1 point (graded)

A bag has 3 red and 3 green apples. You start by randomly selecting one red apple from the bag. Which of the following has the highest probability?

☐ Select another red apple after replacing the first.

☐ Select another red apple without replacing the first.

☐ Select a green apple after replacing the first red apple.

- ☒ Select a green apple without replacing the first red apple. ✓

### Explanation

- After replacement, there are 3 green and 3 red apples. The probability to select a red one is  $\frac{1}{2}$ .
- Without replacement, there are 3 green and 2 red apples. The probability to select a red one is  $\frac{2}{5}$ .
- After replacement, there are 3 green and 3 red apples. The probability to select a red one is  $\frac{1}{2}$ .
- Without replacement, there are 3 green and 2 red apples. The probability to select a red one is  $\frac{3}{5}$ .

Submit

You have used 1 of 2 attempts

**i** Answers are displayed within the problem

3

0 points possible (ungraded)

Roll two fair and distinguishable six-sided dice. What is the probability that the outcome of the second die is strictly greater than the the first?

0.5

✗ Answer: 5/12

0.5

### Explanation

The outcomes that give rise to this event are  $(1, 2), (1, 3), \dots, (1, 6), (2, 3), (2, 4), \dots, (2, 6), (3, 4), \dots, (3, 6), (4, 5), (4, 6), (5, 6)$  where in each ordered pair, the numbers correspond to the first and second die respectively. It can be easily verified that there are 15 such outcomes, each of probability  $1/36$ , thus  $15 \times 1/36 = 5/12$ .

Submit

You have used 4 of 4 attempts

**i** Answers are displayed within the problem

4

3.0/3.0 points (graded)

5 Engineers and 3 artists align at random along line. What is the probability that the first and last are Engineers?

☐ 3/14☐ 8/16☐ 9/14☒ 5/14 ✓**Explanation**

The 5 engineers and 3 artists can line up in  $\binom{8}{3}$  ways, each corresponding to one choice of the the 3 artist locations out of the total 8. Note that all these arrangements are equally likely, hence this space is uniform.

If the first and last are engineers, then there are 6 locations left, and the number of ways to choose the locations of the artists is  $\binom{6}{3}$ .

Hence the probability that the first and last are engineers is

$$\frac{\binom{6}{3}}{\binom{8}{3}} = \frac{6 \cdot 5 \cdot 4}{8 \cdot 7 \cdot 6} = \frac{5}{14}.$$

In the sequential probability section we will see an easier way to find the answer.

You have used 2 of 2 attempts

**i** Answers are displayed within the problem

5

0 points possible (ungraded)

Which of the following are distributed uniformly when rolling two fair dice?

☒ The outcome (number) of the first die, e.g., "4", or "6", ✓☒ The ordered pair of outcomes, e.g., (1, 3), (3, 1), or (6, 6), ✓

- ☐ The unordered pair of outcomes, e.g.,  $\{1, 3\}$  or  $\{6, 6\}$ ,
- ☐ the difference between the first and second outcomes, e.g.  $(1, 3) \rightarrow -2$ ,
- ☒ the difference between the first and second outcomes mod 6, e.g.  
 $(1, 3) \rightarrow (-2)_6 = 4$  ✓
- ☐ The absolute value of difference  $(1, 3) \rightarrow |1 - 3| = 2$
- ☒ The lower of the two outcomes, e.g.  $(1, 3) \rightarrow 1$ ,
- ☐ the sum of the two outcomes, e.g.  $(1, 3) \rightarrow 4$



### Explanation

- True.
- True.
- False.  $P(\{1, 3\}) = \frac{2}{36} \neq P(\{6, 6\}) = \frac{1}{36}$
- False.  $P(\text{difference is } 0) = \frac{6}{36} \neq P(\text{difference is } 1) = \frac{5}{36}$
- True.
- False.  $P(\text{absolute difference is } 0) = \frac{6}{36} \neq P(\text{absolute difference is } 1) = \frac{10}{36}$
- False.  $P(\text{minimum is } 1) = \frac{11}{36} \neq P(\text{minimum is } 2) = \frac{9}{36}$
- False.  $P(\text{sum is } 2) = \frac{1}{36} \neq P(\text{sum is } 3) = \frac{2}{36}$

Submit

You have used 3 of 3 attempts

**i** Answers are displayed within the problem

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