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Question #3

Condition1:

The probability of getting a “6” in a single toss is $1/6$. die1 and die2 are mutually independence.

If we rolled 2 dices at once, the probability of getting at least one “6” will be:

- Scenario1: A “6” appeared at die1, and a “6” did not appear at die2.

$$(1/6) * (5/6) = 5/36$$

- Scenario2: A “6” did not appear at die1, and a “6” appeared at die2.

$$(5/6) * (1/6) = 5/36$$

- Scenario3: A “6” appeared at die1, and a “6” appeared at die2.

$$(1/6)^2 = 1/36$$

The Probability of getting at least one “6” is $(5/36) + (5/36) + (1/36) = (11/36)$

Condition2:

If we change a fair die into an unfair die with two “6”, one “1, 2, 3, 4”. The probability of getting a “6” in a single toss is $2/6$.

Let die1 be unfair die, and die2 be fair die.

If we rolled unfair die and a fair die at once, the probability of getting at least one “6” will be:

- Scenario1: A “6” appeared at die1, and a “6” did not appear at die2.

$$(2/6) * (5/6) = 10/36$$

- Scenario2: A “6” did not appear at die1, and a “6” appeared at die2.

$$(4/6) * (1/6) = 4/36$$

- Scenario3: A “6” appeared at die1, and a “6” appeared at die2.

$$(2/6) * (1/6) = 2/36$$

The probability of getting at least a “6” with unfair die and fair die is $10/36 + 4/36 + 3/36 = 16/36$

Conclusion: The probability of getting at least one “6” by rolling two dice is higher in condition2 than condition1. In condition2 I changed the fair dice into unfair dice with two “6”, one “1, 2, 3, 4.” In this case, the probability of getting a “6” is higher than the fair dice. Therefore, in order to increase the chance of getting a “6” than more often is to change the fair dice into the unfair dice with two “6”, three “6”, four “6”, five “6” or six “6”. The more “6” you have on a die, you higher probability of getting a “6”.

Code for simulate a fair roll:

```
sample(x=1:6,size = 2,replace = TRUE)
```

this code is to simulate two fair dice at once, with replacement

Let X denote number of x-th roll

X	1	2	3	4	5	6	7	8	9	10
outcome	4, 5	6, 2	6, 5	6, 5	2, 2	2, 1	6, 1	3, 3	4, 3	3, 2

Question#4

Interesting facts from the PUMS data:

- Average female age is older than average men age.
- Department of Census labeled the very old people as age “94”. Those older can be 100-year-old, or 120-year-old.
- There are more female than male in the dataset. Male=94400, Female=101914
- 62156 of 196314 people has no high school degree. More people do not have high school degree than people who has high school, some college, associate, bachelor, or advanced degree respectively.
- Female has higher educational background than male.
- Between age 25 and age 55, more people have high school degree than people who have no high school, some college, associate, bachelor, or advanced degree respectively.

Code:

- `summary(educ_hs[in_Bronx==1])`
- `summary(educ_hs[in_Brooklyn==1])`
- `summary(educ_hs[in_Manhattan==1])`
- `summary(educ_hs[in_StatenI==1])`
- `summary(educ_hs[in_Queens==1])`

Educational attainments in NYC

	Mean
Bronx	0.1964
Brooklyn	0.1961
Manhattan	0.1185
Staten Is.	0.2267
Queens	0.2124

- Based on my table above, average proportion for people who has high school in Staten Island is higher than every other borough. This result surprise us, because we thought that people who live in Manhattan would have more HS degree than the others.

Code: xtabs(~educ_indx+female+in_Brooklyn)

Educ Indx In Brooklyn	Male	Female
No HS	4614	4777
HS	2186	2642
SmColl	1524	1688
AS	487	699
Bach	1692	1965
Adv	1006	1334

- Based on the graph above, women have higher educational background than men in Brooklyn.
- We found that people who has ADV degree almost equal to bachelor degree in Brooklyn.