UNIVERSITY OF JOHANNESBURG

Statistics 2A (Practical)

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Practical 5

5.1 Exercises

1. Given a class of 20 girls and 15 boys.

   (a) In how many ways can a committee of seven consisting of 5 girls and 2 boys be chosen?

   ```
   > # By the Fundamental Principle of Counting the total number
   > # of committee is
   > choose(20,5)*choose(15,2)
   [1] 1627920
   ```

   (b) What is the probability that a committee of seven, chosen at random from the class, consists of five girls and two boys?

   ```
   > # The probability that a committee of seven will consist of 5 girls and
   > # 2 boys to be
   > (choose(20,5)*choose(15,2))/choose(35,7)
   [1] 0.2420872
   ```

   (c) How many of the possible committees of seven have no boys? (i.e. consists only of girls)

   ```
   > #The number of ways to choose 7 girls from the 20 girls in the class is
   > choose(20,7)*choose(15,0)
   [1] 77520
   ```

   (d) What is the probability that a committee of seven, chosen at random from the class, consists only of girls?

   ```
   > # The probability that a committee of seven consists only of girls is
   > (choose(20,7)*choose(15,0))/choose(35,7)
   [1] 0.01152796
   ```

2. You're on the game show "Let's Make a Deal," and Monty Hall is the host. Your job: choose one of three doors. If you choose the door hiding a car, you'll win it! Otherwise, you win nothing. What happens? You choose Door 1. Monty then opens the second door, and it's empty. Your door still might be right! But then, he gives you the opportunity to switch to Door 3 before unveiling the car. Should you switch, or should you stay? The answer is surprising, and makes for a great lesson in probability. Suppose the player plays this game $n = 10$ times, simulate the problem to provide an approximation of

```
> # Which door has the car?
> n=10
> car=sample(3,n,replace=T)
> car

 [1] 3 3 1 3 1 3 1 1 1 1

> # Which door is chosen?
> door=sample(3,n,replace=T)
> door

 [1] 3 2 1 2 3 3 1 3 1 2
```

(a) the probability of winning by switching doors when given the opportunity (the exact probability is 2/3)

```
> # Switch and win: the car is not behind the chosen door.
> switchwin = (door!=car)
> switchwin

 [1] FALSE  TRUE FALSE  TRUE  TRUE FALSE FALSE  TRUE FALSE  TRUE

> sum(switchwin)/n

[1] 0.5
```

(b) the probability of winning by staying with the initial door selection (the exact probability is 1/3)

```
> # Not switch and win: the car is behind the chosen door.
> noswitchwin = (door==car)
> noswitchwin

 [1]  TRUE FALSE  TRUE FALSE FALSE  TRUE  TRUE FALSE  TRUE FALSE

> sum(noswitchwin)/n

[1] 0.5
```

(c) Repeat (a) and (b) when the player plays this game 1000 and 10,000 times. Coment on the results in relation to the law of large numbers.

$$P\left(\frac{\text{number of switch and win}}{n}\right) = \frac{2}{3}$$
$$P\left(\frac{\text{number of not switch and win}}{n}\right) = \frac{1}{3}$$