Section 2.2 Practice: Simulation

Solutions

Use simulation to solve the following problems:

1. Your department is holding a raffle. They sell 30 tickets and offer seven prizes. They place the tickets in a hat and draw one for each prize. The tickets are sampled without replacement, i.e. the selected tickets are not placed back in the hat. What is the probability of winning a prize if you buy one ticket?

```
need.new.shoes <- replicate(10000, {
  hat <- 1:30
  mypick <- 15
  winners <- sample(hat, 7, replace=FALSE)
  am.i.a.winner <- mypick %in% winners
})
mean(need.new.shoes)
```

```
## [1] 0.2398
```

1b. What if the tickets are sampled with replacement?

```
need.new.shoes <- replicate(10000, {
  hat <- 1:30
  mypick <- 15
  winners <- sample(hat, 7, replace=TRUE)
  am.i.a.winner <- mypick %in% winners
})
mean(need.new.shoes)
```

```
## [1] 0.2157
```

2. If 100 balls are randomly placed into 20 urns, estimate the probability that at least one of the urns is empty. *Hint: look at the `length()` and `unique()` functions from chapter 1.*

```r
urns <- replicate(10000,{
  sample_urn <- sample(1:20, 100, replace=TRUE)
  length(unique(sample_urn))<20
})

mean(urns)
```

```
## [1] 0.1109
```

3. A standard deck of cards has 52 cards, four each of 2,3,4,5,6,7,8,9,10, J,Q,K,A. In blackjack, a player gets two cards and adds their values. Cards count as their usual numbers, except Aces are 11 (or 1), while K, Q, J are all 10. Use R to simulate dealing two cards, and compute these probabilities.

Hint, create the deck of cards using their numeric value, not the letters "J", "Q", "K" etc.

a. A blackjack means getting an Ace and a value ten card. What is the probability of getting a blackjack?

```
cards <- rep(c(2:10,10,10,10,11), 4)
blackjack <- replicate(10000,{
  hand <- sample(cards,2,replace=FALSE)
  sum(hand)==21
})
mean(blackjack)
```

```
## [1] 0.0489
```

b. What is the probability of getting 19? Assume that an Ace counts as 11?

```
sum_19 <- replicate(10000,{
  hand <- sample(cards,2,replace=FALSE)
  sum(hand)==19
})
mean(sum_19)
```

```
## [1] 0.0613
```

4. Deathrolling in World of Warcraft works as follows: Player 1 tosses a 1000 sided die. Say they get x_1. Then player 2 tosses a die with x_1 sides on it. Say they get x_2. Player 1 tosses a die with x_2 sides on it. This pattern continues until a player rolls a 1. The player who loses is the player who rolls a 1.

a. What is the probability a 1 will be rolled on the 4th roll in deathroll?

```
deathroll <- replicate(10000,{
  x_1 <- sample(1:1000,1)
  x_2 <- sample(1:x_1,1)
  x_3 <- sample(1:x_2,1)
  x_4 <- sample(1:x_3,1)
  (x_4==1)
  })

mean(deathroll)
```

```
## [1] 0.0731
```

b. What is the probability that the second person will loose?

```
deathroll2 <- replicate(10000,{
  x_1 <- sample(1:1000,1)
  x_2 <- sample(1:x_1,1)
  (x_2==1)
  })

mean(deathroll2)
```

```
## [1] 0.0068
```