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IT302 Lab Assignment 1

Q1. Consider a set of integers from 1 to 100. Write a R/Python code to find the probability that the selected number is :

(a) Even

Code

```
arr<-array(1:100)
even_arr<-arr[arr%%2==0]
prob_even<-length(even_arr)/length(arr)
print(prob_even)
```

Output

```
> arr<-array(1:100)
> even_arr<-arr[arr%%2==0]
> prob_even<-length(even_arr)/length(arr)
> print(prob_even)
[1] 0.5
```

(b) Odd

Code

```
arr<-array(1:100)
odd_arr<-arr[arr%%2==1]
prob_odd<-length(odd_arr)/length(arr)
print(prob_odd)
```

Output

```
> arr<-array(1:100)
> odd_arr<-arr[arr%%2==1]
> prob_odd<-length(odd_arr)/length(arr)
> print(prob_odd)
[1] 0.5
```

(c) Prime

Code

```r
isPrime<-function(n){
  if(n<=1){
    return(0)
  }
  for(i in 2:sqrt(n)){
    if(n%%i==0){
      return(0)
    }
  }
  return(1)
}

arr<-1:100
primes<-arr[sapply(arr,isPrime)]
prob_prime<-length(primes)/length(arr)
print(prob_prime)
```

Output

```
> isPrime<-function(n){
+   if(n<=1){
+     return(0)
+   }
+   for(i in 2:sqrt(n)){
+     if(n%%i==0){
+       return(0)
+     }
+   }
+   return(1)
+ }
>
> arr<-1:100
> primes<-arr[sapply(arr,isPrime)]
> prob_prime<-length(primes)/length(arr)
> print(prob_prime)
[1] 0.24
>
```

(d) Divisible by 4 and 6

Code

```
arr<-1:100
req<-arr[(arr%%4==0) & (arr%%6)==0]
prob=length(req)/length(arr)
print(prob)
```

Output

```
> arr<-1:100
> req<-arr[(arr%%4==0) & (arr%%6)==0]
> prob=length(req)/length(arr)
> print(prob)
[1] 0.08
```

Q2. Suppose a fair dice is rolled 10 times. Using R/Python find the probability that

(a) sum of the numbers is less than 22

We follow monte carlo simulation to solve this question

Code

```
n_sim <- 1000000
results <- numeric(n_sim)
for (i in 1:n_sim) {
  results[i] <- sum(sample(1:6, 10, replace = TRUE))
}
probability <- mean(results < 22)
print(probability)
```

Output

```
> n_sim <- 1000000
> results <- numeric(n_sim)
> for (i in 1:n_sim) {
+   results[i] <- sum(sample(1:6, 10, replace = TRUE))
+ }
> probability <- mean(results < 22)
> print(probability)
[1] 0.005281
```

(b) sum of the number is greater than 25

Code

```
n_sim <- 1000000
results <- numeric(n_sim)
for (i in 1:n_sim) {
  results[i] <- sum(sample(1:6, 10, replace = TRUE))
}
probability <- mean(results > 25)
print(probability)
```

Output

```
> n_sim <- 1000000
> results <- numeric(n_sim)
> for (i in 1:n_sim) {
+   results[i] <- sum(sample(1:6, 10, replace = TRUE))
+ }
> probability <- mean(results > 25)
> print(probability)
[1] 0.961263
```

Q3. Suppose a family has sixteen children. Assume that is child is equally likely to be either a boy or a girl. Write a R/Python code to find the probability that

(a) Exactly six of the children are boys

Code

```
n <- 16
k <- 6
p <- 0.5
probability <- choose(n, k) * p^k * (1 - p)^(n - k)
print(probability)
```

Output

```
> n <- 16
> k <- 6
> p <- 0.5
> probability <- choose(n, k) * p^k * (1 - p)^(n - k)
> print(probability)
[1] 0.1221924
```

(b) Exactly eight of the children are girls

Code

```r
n <- 16
k <- 8
p <- 0.5
probability <- choose(n, k) * p^k * (1 - p)^(n - k)
print(probability)
```

Output

```
> n <- 16
> k <- 8
> p <- 0.5
> probability <- choose(n, k) * p^k * (1 - p)^(n - k)
> print(probability)
[1] 0.1963806
```

(c) There are 6 or 7 boys

Code

```r
n <- 16
p <- 0.5
prob_6_boys <- dbinom(6, n, p)
prob_7_boys <- dbinom(7, n, p)
total_probability <- prob_6_boys + prob_7_boys
total_probability
```

Output

```
> n <- 16
> p <- 0.5
> prob_6_boys <- dbinom(6, n, p)
> prob_7_boys <- dbinom(7, n, p)
> total_probability <- prob_6_boys + prob_7_boys
> total_probability
[1] 0.2967529
```

(d) The number of boys lies between the interval [7,12]

Note: I have assumed 7 and 12 are included

Code

```
n <- 16
p <- 0.5
prob_7_to_12 <- sum(dbinom(7:12, n, p))
prob_7_to_12
```

Output

```
> n <- 16
> p <- 0.5
> prob_7_to_12 <- sum(dbinom(7:12, n, p))
> prob_7_to_12
[1] 0.7621155
```

Q4. A box contains 10 white balls, 20 red balls, and 30 green balls. If 7 balls are drawn with replacement, write a R/Python code to find the probability that

(a) 4 white and 3 red balls appears

Code

```
P_W <- 1/6
P_R <- 1/3

multinomial_coeff <- choose(7, 4) * choose(3, 3)
probability <- multinomial_coeff * (P_W^4) * (P_R^3)

cat("The probability of drawing 4 white balls and 3 red balls is:", probability, "\n")
```

Output

```
> P_W <- 1/6
> P_R <- 1/3
>
> multinomial_coeff <- choose(7, 4) * choose(3, 3)
> probability <- multinomial_coeff * (P_W^4) * (P_R^3)
>
> cat("The probability of drawing 4 white balls and 3 red balls is:", probability, "\n")
The probability of drawing 4 white balls and 3 red balls is: 0.001000229
>
```

(b) All 7 are the same color

Code

```
P_W <- 10/60
P_R <- 20/60
P_G <- 30/60
probability_same_color <- (P_W^7) + (P_R^7) + (P_G^7)

cat("The probability that all 7 balls are the same color is:",probability_same_color, "\n")
```

Output

```
> P_W <- 10/60
> P_R <- 20/60
> P_G <- 30/60
> probability_same_color <- (P_W^7) + (P_R^7) + (P_G^7)
>
> cat("The probability that all 7 balls are the same color is:",probability_same_color, "\n")
The probability that all 7 balls are the same color is: 0.00827332
```