SA1Item3

2024-03-19

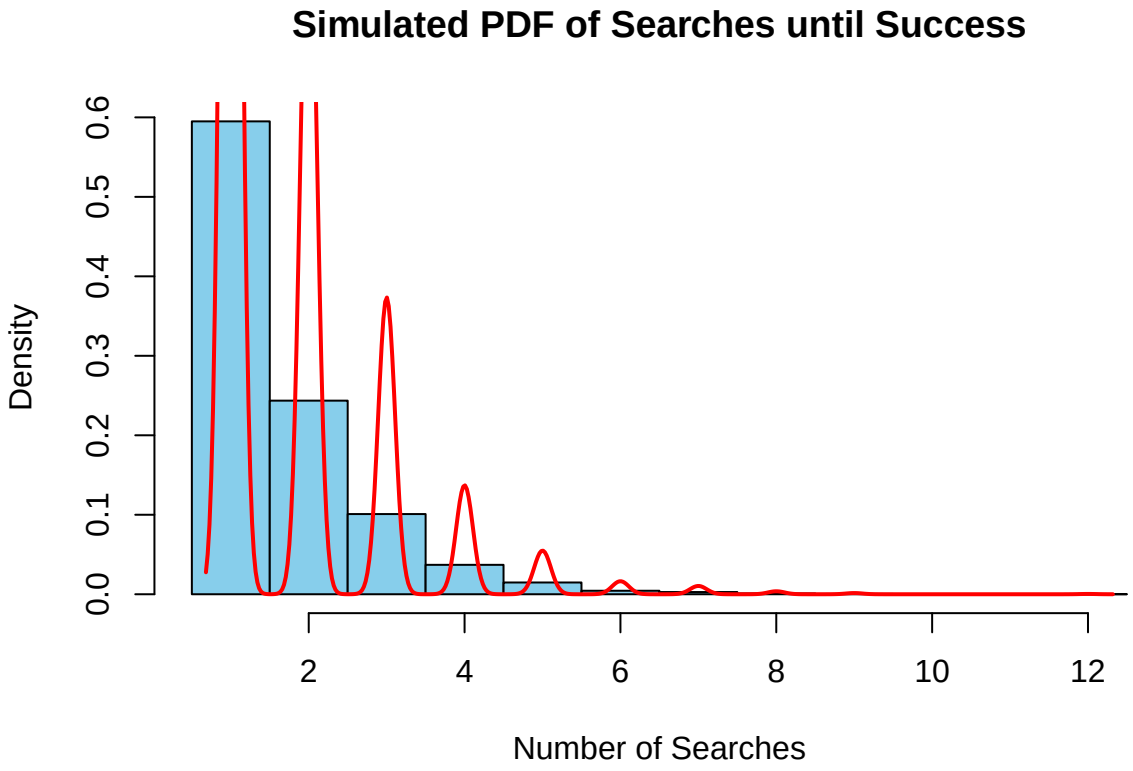
```r
# Set the number of simulations
n_simulations <- 10000

# Probability that any site contains the key phrase (test data: 60% chance)
p <- 0.6

# Function to simulate searches until success
simulate_searches <- function(p, n_simulations) {
  searches <- vector("numeric", length = n_simulations)
  for (i in 1:n_simulations) {
    success <- FALSE
    n_searches <- 0
    while (!success) {
      n_searches <- n_searches + 1
      if (runif(1) <= p) {
        success <- TRUE
      }
    }
    searches[i] <- n_searches
  }
  return(searches)
}

# Simulate searches
search_results <- simulate_searches(p, n_simulations)

# Plot the simulated pdf
hist(search_results, breaks = seq(0.5, max(search_results) + 0.5, by = 1),
     freq = FALSE, col = "skyblue", xlab = "Number of Searches",
     main = "Simulated PDF of Searches until Success")
lines(density(search_results), col = "red", lwd = 2)
```




```r
# Calculate mean and variance of the simulated distribution
mean_searches <- mean(search_results)
var_searches <- var(search_results)
cat("Mean of searches until success:", mean_searches, "\n")
```

```
## Mean of searches until success: 1.6657
```

```r
cat("Variance of searches until success:", var_searches, "\n")
```

```
## Variance of searches until success: 1.071451
```

```r
# Obtain the simulated conditional distribution when 3 searches have been carried out without success
conditional_searches <- search_results[search_results > 3] - 3

# Calculate mean and variance of the conditional distribution
mean_conditional <- mean(conditional_searches)
var_conditional <- var(conditional_searches)
cat("\nMean of conditional searches (X > 3):", mean_conditional, "\n")
```

```
##
## Mean of conditional searches (X > 3): 1.641322
```

```r
cat("Variance of conditional searches (X > 3):", var_conditional, "\n")
```

```
## Variance of conditional searches (X > 3): 1.078091
```

```r
# Markov memoryless property: P(X=4|X>3), P(X=1), P(X=5|X>3), P(X=2)
prob_x4_given_xgt3 <- sum(search_results == 4 & search_results > 3) / sum(search_results > 3)
prob_x1 <- sum(search_results == 1) / n_simulations
prob_x5_given_xgt3 <- sum(search_results == 5 & search_results > 3) / sum(search_results > 3)
prob_x2 <- sum(search_results == 2) / n_simulations

cat("\nMarkov memoryless property estimates:\n")
```

```
##
## Markov memoryless property estimates:
```

```r
cat("P(X=4|X>3):", prob_x4_given_xgt3, "\n")
```

```
## P(X=4|X>3): 0.6115702
```

```r
cat("P(X=1):", prob_x1, "\n")
```

```
## P(X=1): 0.595
```

```r
cat("P(X=5|X>3):", prob_x5_given_xgt3, "\n")
```

```
## P(X=5|X>3): 0.2446281
```

```r
cat("P(X=2):", prob_x2, "\n")
```

```
## P(X=2): 0.2436
```