Date 08/02/2024 Expt. No. 3

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EXPERIMENT - 3

Aim:- Employ R to use random number generation & simulations to verify theoretical probabilities.

Introduction:- Probability theory plays a crucial role in understand and predicting uncertain events. In this practical, we will leverage the power of R to explore theoretical probabilities through random number generation and simulations. By comparing the results obtained through simulation with the expected theoretical probabilities, we aim to gain insights into the practical applications of probability theory.

Objective :-

The main objectives of this practical are :

1. Understand theoretical probabilities for simple events.
2. Utilize R to generate random numbers and simulate events.
3. Compare simulated probabilities with theoretical probabilities to validate results.

Materials :-

1. Rstudio or R environment installed.
2. Basic knowledge of probability theory.

Steps / Procedure :-

Step 1:- Define the theoretical probabilities for a set of simple

Teacher's Signature:

Aim :- Employ R to use random number generation & simulations to verify theoretical probabilities.

```r
# Step 1: Define theoretical probabilities
theoretical_probabilities <- rep(1/6, 6) # Assuming a fair six-sided die

# Step 2: Random Number Generation
simulated_rolls <- sample(1:6, size = 1000, replace = TRUE)

# Step 3: Calculate empirical probabilities
empirical_probabilities <- table(simulated_rolls) / length(simulated_rolls)

# Step 4: Visualization
par(mfrow = c(1, 2)) # Set up a side-by-side plot

# Plot theoretical probabilities
barplot(theoretical_probabilities, ylim = c(0, 0.5), col = "green",
        main = "Theoretical Probabilities", xlab = "Die Face", ylab = "Probability")

# Plot empirical probabilities
barplot(empirical_probabilities, ylim = c(0, 0.5), col = "orange",
        main = "Empirical Probabilities", xlab = "Die Face", ylab = "Probability")

# Step 5: Analysis
legend("topright", legend = c("Theoretical", "Empirical"), fill = c("green", "orange"))
```

events. For example, consider a fair six-sided die and calculate the probabilities of rolling each number (1 through 6).

Step 2 :- Use R to generate random numbers that mimic the outcomes of the theoretical events. For example of a fair-six sided die, use the sample function in R to simulate die rolls.

Step 3 :- Perform simulations using the generated random numbers. Calculate the empirical probabilities by counting the occurrences of each event in the simulated data.

Step 4 :- Create visualizations to compare theoretical & empirical probabilities. Plot bar charts or histograms for a clear representation.

Step 5 :- Compare the theoretical and empirical probabilities. Discuss any discrepancies and analyze the impact of sample size on the accuracy of simulation results.

Code :-

```
theoretical_probabilities <- rep(1/6, 6)
simulated_rolls <- sample (1:6, size = 1000, replace = TRUE)
empirical_probabilities <- table (simulated_rolls) / length(simulated_rolls)
par(mfrow = c(1,2))
barplot (theoretical_probabilities, ylim = c(0, 0.5), col = "green",
        main = "Theoretical Probabilities", xlab = "Die Face", ylab =
        "Probability")
barplot (empirical_probabilities, ylim = c(0, 0.5), col = "orange",
        main = "Empirical Probabilities", xlab = "Die Face", ylab =
        "Probability")
```

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```
> sample(1:6, size = 1000, replace = TRUE)
  [1] 5 3 3 1 1 5 1 4 4 1 2 4 6 4 4 6 4 2 4 5 4 3 6 4 5 5 6 6 2 1 6 4 1 1 3 1 4 1 4 1 4 6 1 1 5 5 5 2 3 3 3 6 3 4 4 3 3 4 2 3 1 2
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[977] 6 4 3 2 2 6 6 6 3 4 6 2 1 2 2 5 5 5 2 4 6 2 3 3
> table(simulated_rolls) / length(simulated_rolls)
simulated_rolls
    1     2     3     4     5     6
0.153 0.173 0.161 0.174 0.163 0.176
> rep(1/6, 6)
[1] 0.1666667 0.1666667 0.1666667 0.1666667 0.1666667 0.1666667
>
```

R - Global Environment

Values

empirical_probab	'table' num [1:6(1d)] 0.153 0.173 0.161 0.174 0.
simulated_rolls	int [1:1000] 3 3 2 5 2 5 3 3 4 1 ...
theoretical_prob	num [1:6] 0.167 0.167 0.167 0.167 0.167 ...

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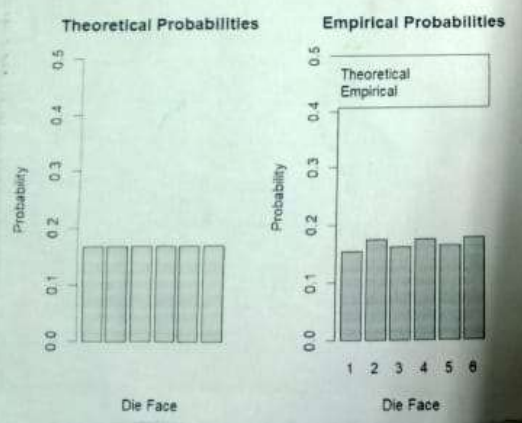

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legend ("topright", legend = c("Theoretical", "Empirical"),
fill = c("green", "orange"))

Conclusion :- Summarize the findings and insights gained from the comparision between theoretical and empirical probabilities. Discuss the practical applications of using simulations to verify theoretical concepts in probability theory.

Teacher's Signature: _____

SCREENSHOTS:

```r
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> sample(1:6, size = 1000, replace = TRUE)
   [1] 5 3 3 1 5 5 1 4 4 1 2 4 6 4 4 6 4 2 4 5 4 3 6 4 5 5 6 6 2 1 6 4 1 3 1 4 1 4 1 4 6 1 1 5 5 5 2 3 3 3 6 3 4 4 3 3 4 2 3 1 2
  [62] 5 2 4 3 2 5 6 6 5 5 4 1 2 3 4 2 4 4 1 6 2 4 1 6 5 6 5 3 6 2 4 2 3 5 6 5 5 6 5 4 2 6 5 1 4 4 3 1 1 6 2 5 6 6 4 1 2 3 5 1 2
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 [245] 4 6 1 4 5 4 1 4 6 6 2 5 5 4 4 2 5 2 6 5 1 4 4 2 5 3 5 3 5 5 2 5 1 2 2 4 5 4 1 4 3 2 5 4 1 1 5 1 6 1 5 4 3 4 3 1 4 5 1 1 4
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 [977] 6 4 3 2 2 6 6 6 3 4 6 2 1 2 2 5 5 5 2 4 6 2 3 3
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