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Monte Carlo Simulations: An overview with the help of R package

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Monte Carlo simulation method was introduced by John von Neumann and Stanislaw Ulam during 1940s. It was linked to the casino city and its name was adopted for the method. Monte Carlo methods are used in different fields such as Finance, Biological and Physical Sciences. Monte Carlo simulations are useful when we deal with uncertainty and try to estimate or predict the parameter of interest such as future stock price. It deals with estimating the parameter of interest by generating number of random samples through simulation using software package such as Microsoft Excel or programming languages such as R or Python. This paper provides an overview of Monte Carlo methods and construction of sample Monte Carlo simulation using R open source software package.

Keywords: Monte Carlo, Simulations, R Software, Probability

Introduction

Monte Carlo simulation[1,2,3,4,5] deals with simulating the outcome using random input values generated from a known distribution such as Uniform, Normal or exponential distribution. This process is repeated several times with different random values for the input variables and values are recorded during each simulation and it forms probability distribution for the parameter or outcome variable of interest. Final value of outcome or parameter of interest is calculated from average value of the parameter generated from the samples (probability distribution) during the simulation process.

Monte Carlo simulation is used in different fields such as Finance [6], Engineering [7], Physics [8], Project Management [9] and Radiological Science [10]

Stock Prediction

Monte Carlo methods are used to predict the movement of stock price [11, 12, 13] based on the historical data set. Monte Carlo methods are used in deciding strategy of option (one of the trading component in the stock market). Number of papers has been written on the use of Monte Carlo methods on Option strategy [13].

Let us start with a hypothetical stock data set which daily closing share prices for 263 days. We will be using R Software package[14] to predict the share price after 330 days using Monte Carlo Simulation method. We will be using normal distribution to generate the random sample distribution.

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Step-1:

First we need to define the work directory to import the stock data and use xlsx package to import the excel file. We will be importing mstock xlsx file which can be downloaded from the journal website www.ijsmi.com/book.php

Importing data set into R environment

```
setwd("C:\\test")
library(xlsx)
data = read.xlsx('mstock.xlsx',sheetIndex = 1)
```

Step-2:

We need to calculate the daily log return for the closing stock price. From the log returns we need to calculate the parameters for normal distribution i.e. mean and sigma

Log of Stock returns

```
logreturn <- diff(log(price1), lag=1)
mean<-mean(logreturn)
sigma<-sd(logreturn)
```

Step-3:

We will generate random samples of log returns using Monte Carlo method and it includes normal distribution to generate the samples. Here n is number of days we wanted to sample (330 days). One important thing we need to set the seed for simulation to any random number to get the same results whenever we run the program

Monte Carlo simulation

```
set.seed(400)
et<-330
simulation <- rnorm(n = et, mean = mean, sd = sigma)
```

Step-4:

We will repeat the process 10000 times to get more representative sample using replicate function. Here will be using stock R package to calculate gain of share price inside the replication function with initial value of the stock at 476. We can generate distribution of mean or median values of the stock gain

Replication of Samples

```
library(stocks)
st1=476
stock <- replicate(10000, {
  price1 <- rnorm(n = et, mean = mu, sd = sig)
  price2 <- gains_prices(price1,initial = st1)
  mean(price2)
})
```

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Step-5:

We can get the required projected value of the initial stock price (476) after 330 days from the below results and also generate the histogram of values

Summary of projection
mean(stock) summary(stock) hist(stock)

Output

Here from the below output we can infer that the stock might give a return of 621 in next 330 days with the q1 – 463 and q3-734. The histogram of projection values is given in the Figure-1 and density curve is given in the Figure-2

Output

```
mean(stock)
[1] 621.1812
summary(stock)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  186.4   463.9   580.6   621.2   734.0  2320.1
```

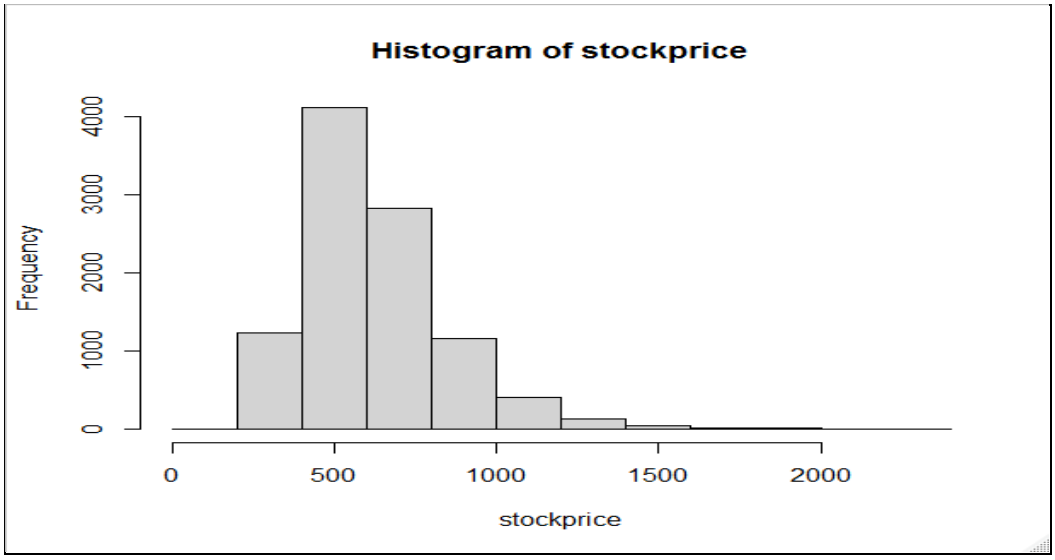

Figure-1: Histogram of stock projections

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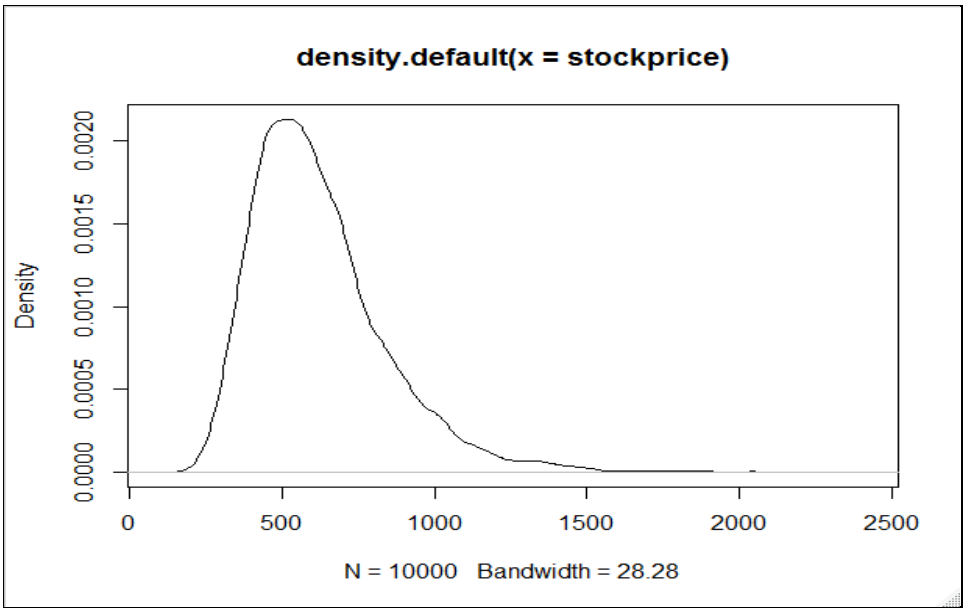

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