

Assignment #9: Random Walk Simulation

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Problem 1: Simulate random walk using R.

Solution

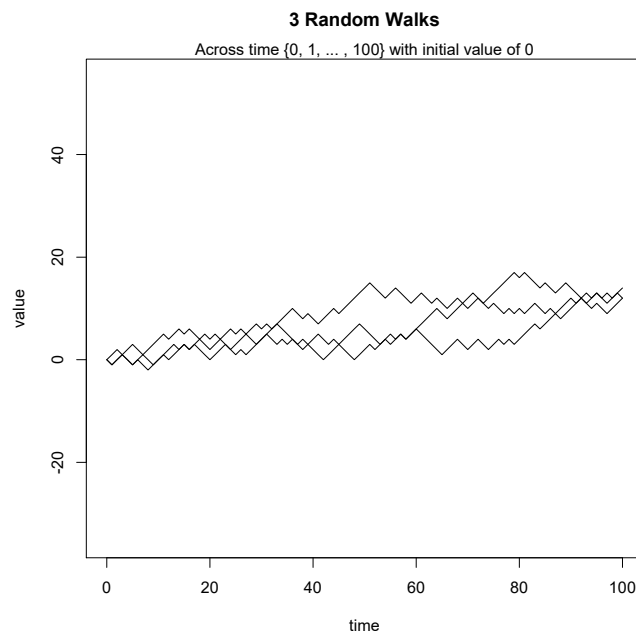
```

1 # Source: https://www.r-bloggers.com/a-plot-of-250-random-walks/
2
3 # Generate k random walks across time {0, 1, ... , T}
4 T <- 100
5 k <- 3
6 initial.value <- 0
7 GetRandomWalk <- function() {
8   # Add a standard normal at each step
9   initial.value + c(0, cumsum(sample(c(1, -1), T, replace=TRUE, prob=c(0.5,0.5))))
10 }
11 # Matrix of random walks
12 values <- replicate(k, GetRandomWalk())
13 # Create an empty plot
14 dev.new(height=8, width=12)
15 plot(0:T, rep(NA, T + 1), main=sprintf("%s Random Walks", k),
16      xlab="time", ylab="value",
17      ylim=10 + 4.5 * c(-1, 1) * sqrt(T))
18 mtext(sprintf("%s%s} with initial value of %s",
19              "Across time {0, 1, ... , ", T, initial.value))
20 for (i in 1:k) {
21   lines(0:T, values[, i], lwd=0.25)
22 }
23
24 for (i in 1:k) {
25   cat("Random-walk / k =", i, "\n")
26   cat("Mean: ", mean(values[,i]), "\n")
27   cat("Variance: ", var(values[,i]), "\n")
28 }

```

Listing 1: R script for simulating random walk

(1)



□

(2)

- $k = 1$
 - Mean = 7.188119
 - Variance = 24.35426
- $k = 2$
 - Mean = 7.861386
 - Variance = 21.72059
- $k = 3$
 - Mean = 4.138614
 - Variance = 9.440594

□

Problem 2: Simulate random walk using R.

Solution

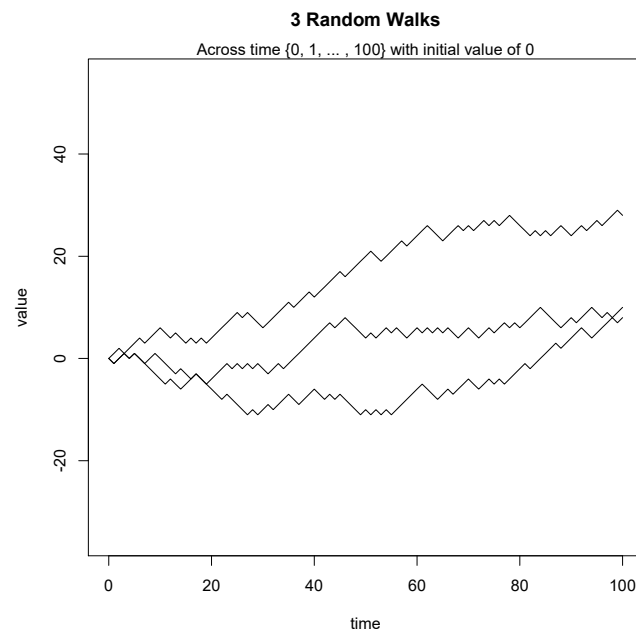
```

1 # Source: https://www.r-bloggers.com/a-plot-of-250-random-walks/
2
3 # Generate k random walks across time {0, 1, ... , T}
4 T <- 100
5 k <- 3
6 initial.value <- 0
7 GetRandomWalk <- function() {
8   # Add a standard normal at each step
9   initial.value + c(0, cumsum(sample(c(1, -1), T, replace=TRUE, prob=c(0.55,0.45))))
10 }
11 # Matrix of random walks
12 values <- replicate(k, GetRandomWalk())
13 # Create an empty plot
14 dev.new(height=8, width=12)
15 plot(0:T, rep(NA, T + 1), main=sprintf("%s Random Walks", k),
16      xlab="time", ylab="value",
17      ylim=10 + 4.5 * c(-1, 1) * sqrt(T))
18 mtext(sprintf("%s%s} with initial value of %s",
19              "Across time {0, 1, ... , ", T, initial.value))
20 for (i in 1:k) {
21   lines(0:T, values[, i], lwd=0.25)
22 }
23
24 for (i in 1:k) {
25   cat("Random-walk / k =", i, "\n")
26   cat("Mean: ", mean(values[, i]), "\n")
27   cat("Variance: ", var(values[, i]), "\n")
28 }

```

Listing 2: R script for simulating random walk

(1)



□

(2)

- $k = 1$
 - Mean = 4.336634
 - Variance = 25.34554
- $k = 2$
 - Mean = 16.33663
 - Variance = 88.58554
- $k = 3$
 - Mean = 3.425743
 - Variance = 16.84693

□