Monte Carlo

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1. Algoritma Simulasi Monte Carlo

Secara umum, simulasi Monte Carlo terdiri atas lima langkah:

1. Tentukan distribusi probabilitas.
2. Tentukan distribusi probabilitas kumulatif.
3. Tentukan suatu interval bilangan acak untuk setiap variable.
4. Bangkitkan bilangan acak.
5. Simulasikan percobaan.

2. Example Monte Carlo Simulation to Mawar Bakery

Mawar Bakery setiap hari membuat cake black forest dalam jumlah yang acak. **Manager Mawar ingin membuat kebijakan untuk mengelola stok cake black forest-nya (yaitu berapa banyak yang harus dibuatnya untuk 10 hari).** Survei permintaan black forest dari 200 pelanggan.

Permintaan	Frekuensi
0	10
1	20
2	40
3	60
4	40
5	30

```
#Create datum
cake_demand <- c(
    rep(0, 10), rep(1, 20), rep(2, 40),
    rep(3, 60), rep(4, 40), rep(5, 30)
)
cake_demand
```

```
##   [1] 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2
##  [38] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 3 3 3 3
##  [75] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
## [112] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
## [149] 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5
## [186] 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
```

Susun datum ini dalam bentuk table dengan kolum permintaan, frekuensi, probabilitas, dan probabilitas kumulatif.

```r
df_cake_demand <- as.data.frame(table(cake_demand))
df_cake_demand
```

```
##   cake_demand Freq
## 1           0   10
## 2           1   20
## 3           2   40
## 4           3   60
## 5           4   40
## 6           5   30
```

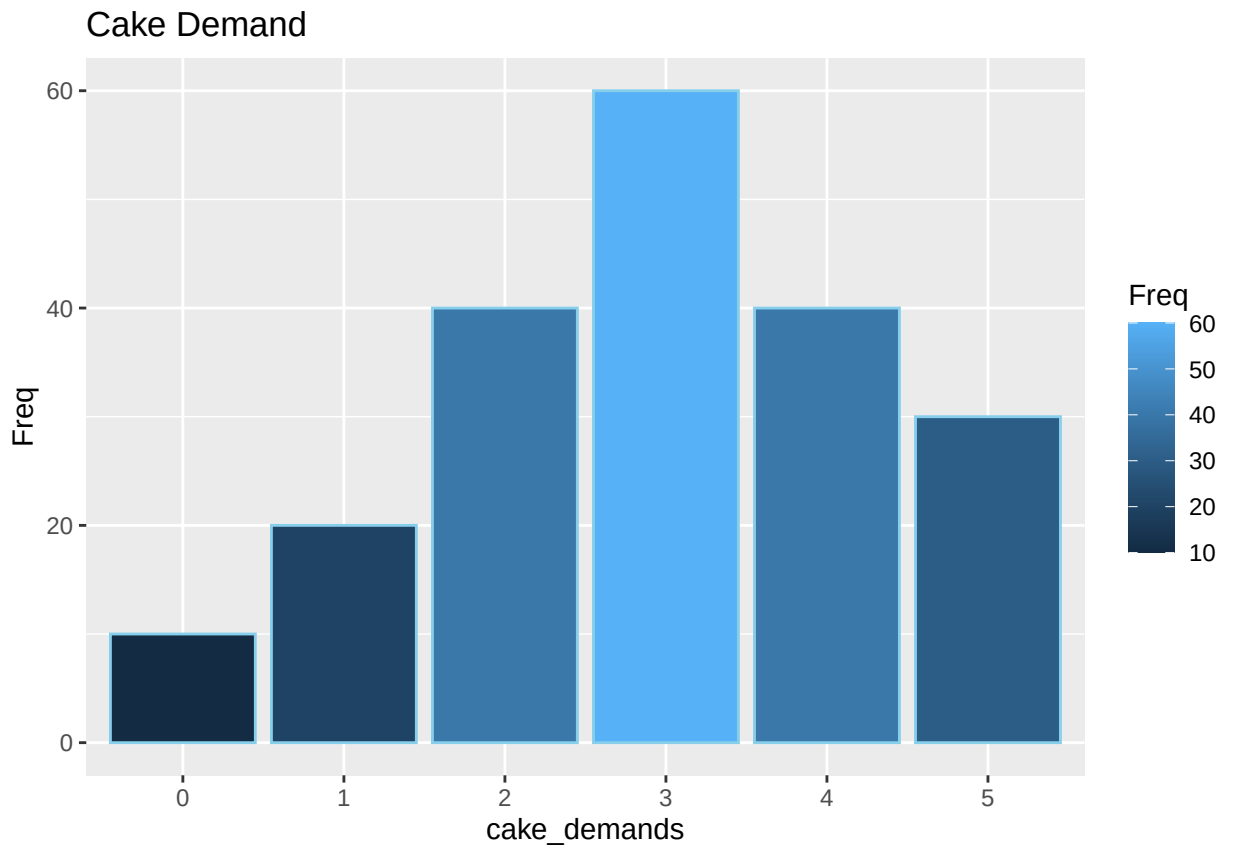
```r
#Compute the probability and cumulative probability
Pr <- df_cake_demand$Freq / sum(df_cake_demand$Freq)
sums.pr <- c()
for (i in 1:length(df_cake_demand$Freq)) {
    sums.pr[i] <- sum(Pr[1:i])
}

#Add probability and cumulative probability to df
df_cake_demand["Probability"] <- Pr
df_cake_demand["Cumulative.Probability"] <- sums.pr
names(df_cake_demand)[1] <- "cake_demands"
df_cake_demand
```

```
##   cake_demands Freq Probability Cumulative.Probability
## 1            0   10        0.05                    0.05
## 2            1   20        0.10                    0.15
## 3            2   40        0.20                    0.35
## 4            3   60        0.30                    0.65
## 5            4   40        0.20                    0.85
## 6            5   30        0.15                    1.00
```

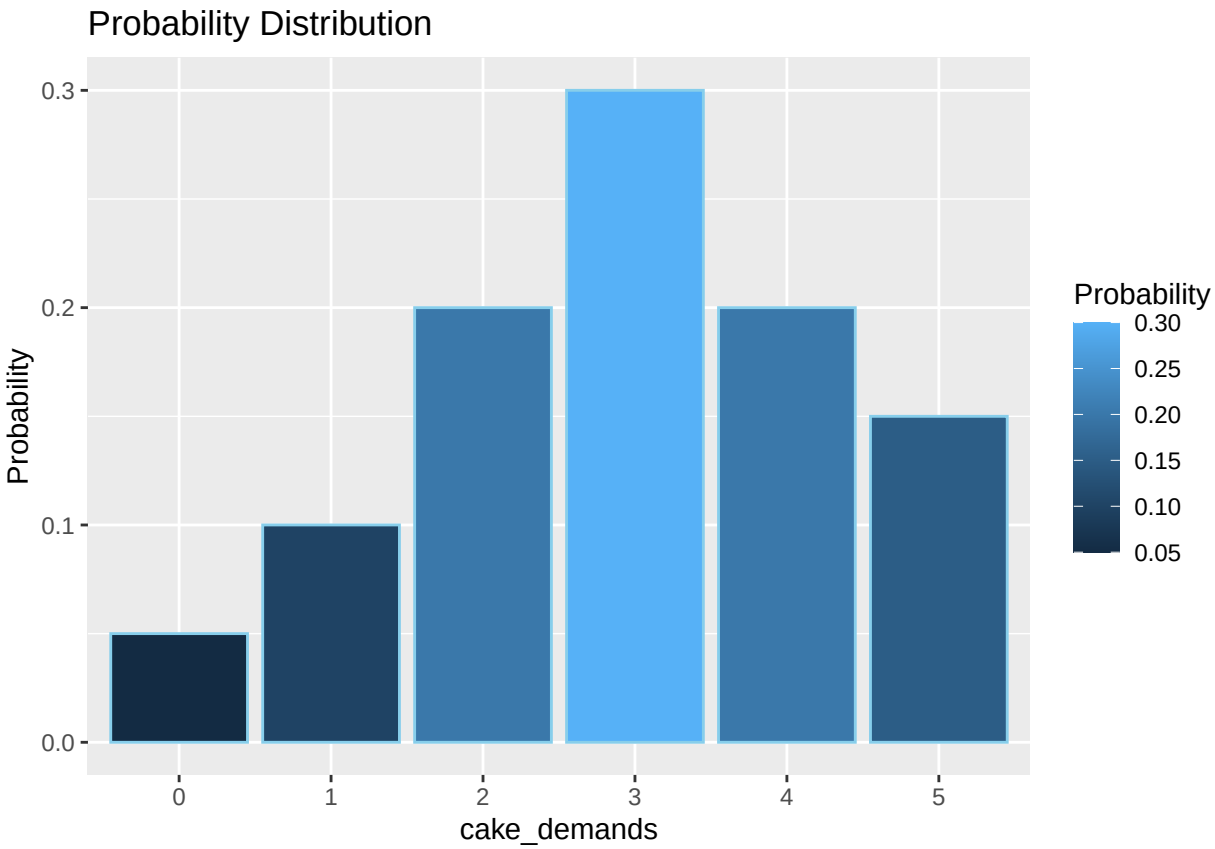
Visualization of probability distribution and cumulative probability.

```r
#import library for data visualization
library(ggplot2)

plt_cake_demand <- ggplot(
    data = df_cake_demand,
    mapping = aes(cake_demands, Freq)
) + geom_bar(
    stat = "identity",
    color = "skyblue",
    aes(fill = Freq)
) + ggtitle("Cake Demand")

plt_pr <- ggplot(
    data = df_cake_demand,
    mapping = aes(cake_demands, Probability)
) + geom_bar(
    stat = "identity",
    color = "skyblue",
    aes(fill = Probability)
) + ggtitle("Probability Distribution")

plt_cumulative_pr <- ggplot(
```

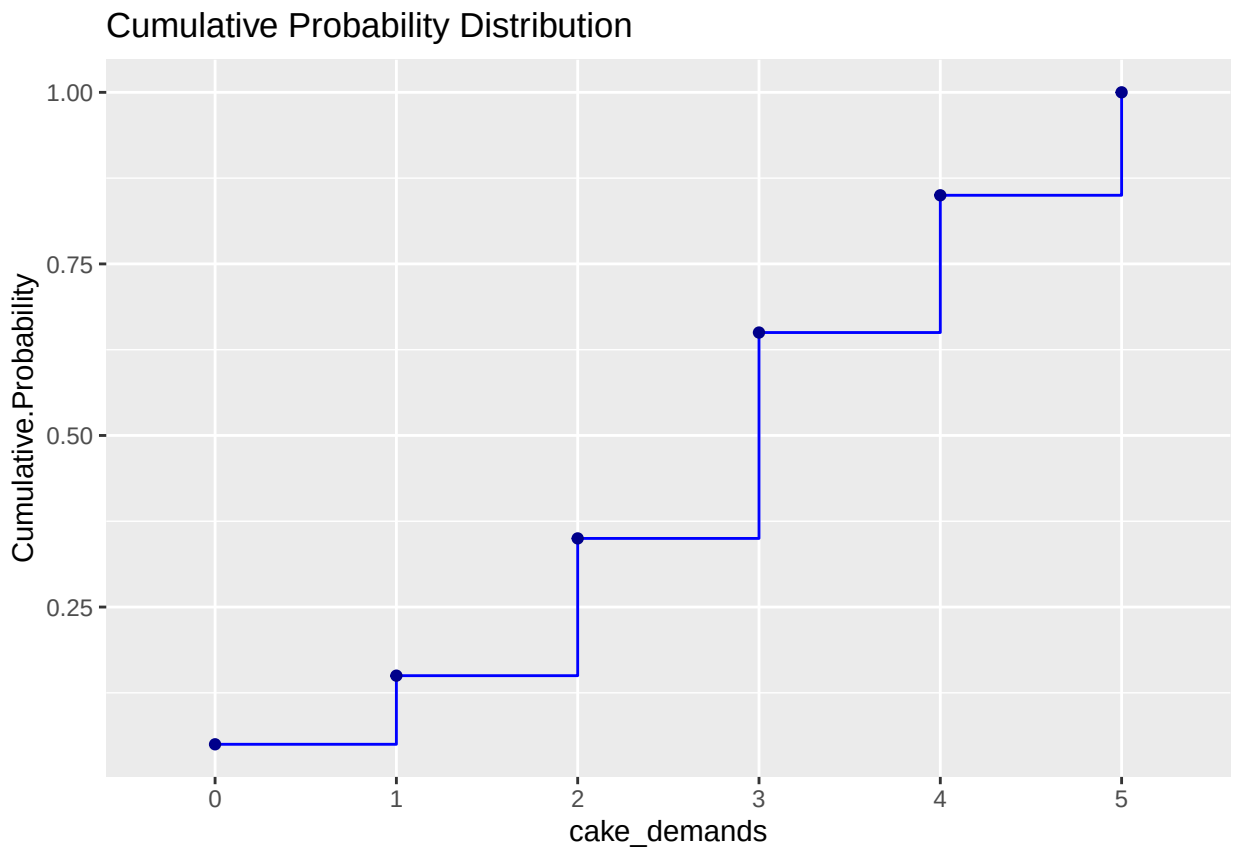
```
    data = df_cake_demand,
    mapping = aes(cake_demands, Cumulative.Probability, group = 1)
) + geom_step(color = "blue") + geom_point(color = "darkblue") +
    ggtitle("Cumulative Probability Distribution")

plt_cake_demand
```




```
plt_pr
```




```
plt_cumulative_pr
```



Bangkitkan bilangan acak dengan interval 1 sampai 100

```
floor(runif(100, 1, 100))
```

```
##   [1] 52 36 52 30 85 32  2 71 13  3  3 21 31 89 45  2 45 48 11 18  1 62 31 13 70
##  [26] 90 32  8 38  1 81 37  3  7 79 68 68 87 93 93 48 98  4 51 72 45 65 60 63 29
##  [51] 47 35 14 53  1 61  7 84 96 92 97 36 58 57 77 69 43 31 78 22 61 37 46 24  9
##  [76] 58 63 97 64  1 27 80 24 26 23 97 67 80 64 76 49 93 85 33 18 58 31 88 15 45
```

```
monte_carlo <- c()
for (i in 1:10) {
    get_number <- floor(runif(n = 1, min = 1, max = 100))
    if (get_number > 0 && get_number <= 5) monte_carlo[i] <- 0
    else if (get_number > 5 && get_number <= 15) monte_carlo[i] <- 1
    else if (get_number > 15 && get_number <= 35) monte_carlo[i] <- 2
    else if (get_number > 35 && get_number <= 65) monte_carlo[i] <- 3
    else if (get_number > 65 && get_number <= 85) monte_carlo[i] <- 4
    else if (get_number > 85 && get_number <= 100) monte_carlo[i] <- 5
}

df_monte_carlo <- data.frame("days" = seq(1, 10, 1), "demands" = monte_carlo)
df_monte_carlo
```

```
##    days demands
## 1     1       3
## 2     2       3
## 3     3       4
## 4     4       2
```

```
## 5     5       2
## 6     6       4
## 7     7       3
## 8     8       4
## 9     9       1
## 10   10       5
```

```
#Total demands in the next 10 days
sum(monte_carlo)
```

```
## [1] 31
```

Dengan demikian, total permintaan hingga 10 hari kedepannya adalah

```
sum(monte_carlo)
```

```
## [1] 31
```