Lab01

Siddhartha Sinha

2023-11-27

# AIM: To calculate the sampling distribution and the standard error

# DATASET:

iris

## Sepal.Length Sepal.Width Petal.Length Petal.Width Species  
## 1 5.1 3.5 1.4 0.2 setosa  
## 2 4.9 3.0 1.4 0.2 setosa  
## 3 4.7 3.2 1.3 0.2 setosa  
## 4 4.6 3.1 1.5 0.2 setosa  
## 5 5.0 3.6 1.4 0.2 setosa  
## 6 5.4 3.9 1.7 0.4 setosa  
## 7 4.6 3.4 1.4 0.3 setosa  
## 8 5.0 3.4 1.5 0.2 setosa  
## 9 4.4 2.9 1.4 0.2 setosa  
## 10 4.9 3.1 1.5 0.1 setosa  
## 11 5.4 3.7 1.5 0.2 setosa  
## 12 4.8 3.4 1.6 0.2 setosa  
## 13 4.8 3.0 1.4 0.1 setosa  
## 14 4.3 3.0 1.1 0.1 setosa  
## 15 5.8 4.0 1.2 0.2 setosa  
## 16 5.7 4.4 1.5 0.4 setosa  
## 17 5.4 3.9 1.3 0.4 setosa  
## 18 5.1 3.5 1.4 0.3 setosa  
## 19 5.7 3.8 1.7 0.3 setosa  
## 20 5.1 3.8 1.5 0.3 setosa  
## 21 5.4 3.4 1.7 0.2 setosa  
## 22 5.1 3.7 1.5 0.4 setosa  
## 23 4.6 3.6 1.0 0.2 setosa  
## 24 5.1 3.3 1.7 0.5 setosa  
## 25 4.8 3.4 1.9 0.2 setosa  
## 26 5.0 3.0 1.6 0.2 setosa  
## 27 5.0 3.4 1.6 0.4 setosa  
## 28 5.2 3.5 1.5 0.2 setosa  
## 29 5.2 3.4 1.4 0.2 setosa  
## 30 4.7 3.2 1.6 0.2 setosa  
## 31 4.8 3.1 1.6 0.2 setosa  
## 32 5.4 3.4 1.5 0.4 setosa  
## 33 5.2 4.1 1.5 0.1 setosa  
## 34 5.5 4.2 1.4 0.2 setosa  
## 35 4.9 3.1 1.5 0.2 setosa  
## 36 5.0 3.2 1.2 0.2 setosa  
## 37 5.5 3.5 1.3 0.2 setosa  
## 38 4.9 3.6 1.4 0.1 setosa  
## 39 4.4 3.0 1.3 0.2 setosa  
## 40 5.1 3.4 1.5 0.2 setosa  
## 41 5.0 3.5 1.3 0.3 setosa  
## 42 4.5 2.3 1.3 0.3 setosa  
## 43 4.4 3.2 1.3 0.2 setosa  
## 44 5.0 3.5 1.6 0.6 setosa  
## 45 5.1 3.8 1.9 0.4 setosa  
## 46 4.8 3.0 1.4 0.3 setosa  
## 47 5.1 3.8 1.6 0.2 setosa  
## 48 4.6 3.2 1.4 0.2 setosa  
## 49 5.3 3.7 1.5 0.2 setosa  
## 50 5.0 3.3 1.4 0.2 setosa  
## 51 7.0 3.2 4.7 1.4 versicolor  
## 52 6.4 3.2 4.5 1.5 versicolor  
## 53 6.9 3.1 4.9 1.5 versicolor  
## 54 5.5 2.3 4.0 1.3 versicolor  
## 55 6.5 2.8 4.6 1.5 versicolor  
## 56 5.7 2.8 4.5 1.3 versicolor  
## 57 6.3 3.3 4.7 1.6 versicolor  
## 58 4.9 2.4 3.3 1.0 versicolor  
## 59 6.6 2.9 4.6 1.3 versicolor  
## 60 5.2 2.7 3.9 1.4 versicolor  
## 61 5.0 2.0 3.5 1.0 versicolor  
## 62 5.9 3.0 4.2 1.5 versicolor  
## 63 6.0 2.2 4.0 1.0 versicolor  
## 64 6.1 2.9 4.7 1.4 versicolor  
## 65 5.6 2.9 3.6 1.3 versicolor  
## 66 6.7 3.1 4.4 1.4 versicolor  
## 67 5.6 3.0 4.5 1.5 versicolor  
## 68 5.8 2.7 4.1 1.0 versicolor  
## 69 6.2 2.2 4.5 1.5 versicolor  
## 70 5.6 2.5 3.9 1.1 versicolor  
## 71 5.9 3.2 4.8 1.8 versicolor  
## 72 6.1 2.8 4.0 1.3 versicolor  
## 73 6.3 2.5 4.9 1.5 versicolor  
## 74 6.1 2.8 4.7 1.2 versicolor  
## 75 6.4 2.9 4.3 1.3 versicolor  
## 76 6.6 3.0 4.4 1.4 versicolor  
## 77 6.8 2.8 4.8 1.4 versicolor  
## 78 6.7 3.0 5.0 1.7 versicolor  
## 79 6.0 2.9 4.5 1.5 versicolor  
## 80 5.7 2.6 3.5 1.0 versicolor  
## 81 5.5 2.4 3.8 1.1 versicolor  
## 82 5.5 2.4 3.7 1.0 versicolor  
## 83 5.8 2.7 3.9 1.2 versicolor  
## 84 6.0 2.7 5.1 1.6 versicolor  
## 85 5.4 3.0 4.5 1.5 versicolor  
## 86 6.0 3.4 4.5 1.6 versicolor  
## 87 6.7 3.1 4.7 1.5 versicolor  
## 88 6.3 2.3 4.4 1.3 versicolor  
## 89 5.6 3.0 4.1 1.3 versicolor  
## 90 5.5 2.5 4.0 1.3 versicolor  
## 91 5.5 2.6 4.4 1.2 versicolor  
## 92 6.1 3.0 4.6 1.4 versicolor  
## 93 5.8 2.6 4.0 1.2 versicolor  
## 94 5.0 2.3 3.3 1.0 versicolor  
## 95 5.6 2.7 4.2 1.3 versicolor  
## 96 5.7 3.0 4.2 1.2 versicolor  
## 97 5.7 2.9 4.2 1.3 versicolor  
## 98 6.2 2.9 4.3 1.3 versicolor  
## 99 5.1 2.5 3.0 1.1 versicolor  
## 100 5.7 2.8 4.1 1.3 versicolor  
## 101 6.3 3.3 6.0 2.5 virginica  
## 102 5.8 2.7 5.1 1.9 virginica  
## 103 7.1 3.0 5.9 2.1 virginica  
## 104 6.3 2.9 5.6 1.8 virginica  
## 105 6.5 3.0 5.8 2.2 virginica  
## 106 7.6 3.0 6.6 2.1 virginica  
## 107 4.9 2.5 4.5 1.7 virginica  
## 108 7.3 2.9 6.3 1.8 virginica  
## 109 6.7 2.5 5.8 1.8 virginica  
## 110 7.2 3.6 6.1 2.5 virginica  
## 111 6.5 3.2 5.1 2.0 virginica  
## 112 6.4 2.7 5.3 1.9 virginica  
## 113 6.8 3.0 5.5 2.1 virginica  
## 114 5.7 2.5 5.0 2.0 virginica  
## 115 5.8 2.8 5.1 2.4 virginica  
## 116 6.4 3.2 5.3 2.3 virginica  
## 117 6.5 3.0 5.5 1.8 virginica  
## 118 7.7 3.8 6.7 2.2 virginica  
## 119 7.7 2.6 6.9 2.3 virginica  
## 120 6.0 2.2 5.0 1.5 virginica  
## 121 6.9 3.2 5.7 2.3 virginica  
## 122 5.6 2.8 4.9 2.0 virginica  
## 123 7.7 2.8 6.7 2.0 virginica  
## 124 6.3 2.7 4.9 1.8 virginica  
## 125 6.7 3.3 5.7 2.1 virginica  
## 126 7.2 3.2 6.0 1.8 virginica  
## 127 6.2 2.8 4.8 1.8 virginica  
## 128 6.1 3.0 4.9 1.8 virginica  
## 129 6.4 2.8 5.6 2.1 virginica  
## 130 7.2 3.0 5.8 1.6 virginica  
## 131 7.4 2.8 6.1 1.9 virginica  
## 132 7.9 3.8 6.4 2.0 virginica  
## 133 6.4 2.8 5.6 2.2 virginica  
## 134 6.3 2.8 5.1 1.5 virginica  
## 135 6.1 2.6 5.6 1.4 virginica  
## 136 7.7 3.0 6.1 2.3 virginica  
## 137 6.3 3.4 5.6 2.4 virginica  
## 138 6.4 3.1 5.5 1.8 virginica  
## 139 6.0 3.0 4.8 1.8 virginica  
## 140 6.9 3.1 5.4 2.1 virginica  
## 141 6.7 3.1 5.6 2.4 virginica  
## 142 6.9 3.1 5.1 2.3 virginica  
## 143 5.8 2.7 5.1 1.9 virginica  
## 144 6.8 3.2 5.9 2.3 virginica  
## 145 6.7 3.3 5.7 2.5 virginica  
## 146 6.7 3.0 5.2 2.3 virginica  
## 147 6.3 2.5 5.0 1.9 virginica  
## 148 6.5 3.0 5.2 2.0 virginica  
## 149 6.2 3.4 5.4 2.3 virginica  
## 150 5.9 3.0 5.1 1.8 virginica

## DATASET DESCRIPTION:

This famous Fisher’s or Anderson’s iris data set gives the measurements in centimeters of the variables sepal length, sepal width, petal length and petal width, respectively, for 50 flowers from each of 3 species of iris. The species are Iris setosa, Iris versicolor, and Iris virginica.

## DATASET VISUALIZATION USING A VARIABLE:

i=iris  
print(i)

## Sepal.Length Sepal.Width Petal.Length Petal.Width Species  
## 1 5.1 3.5 1.4 0.2 setosa  
## 2 4.9 3.0 1.4 0.2 setosa  
## 3 4.7 3.2 1.3 0.2 setosa  
## 4 4.6 3.1 1.5 0.2 setosa  
## 5 5.0 3.6 1.4 0.2 setosa  
## 6 5.4 3.9 1.7 0.4 setosa  
## 7 4.6 3.4 1.4 0.3 setosa  
## 8 5.0 3.4 1.5 0.2 setosa  
## 9 4.4 2.9 1.4 0.2 setosa  
## 10 4.9 3.1 1.5 0.1 setosa  
## 11 5.4 3.7 1.5 0.2 setosa  
## 12 4.8 3.4 1.6 0.2 setosa  
## 13 4.8 3.0 1.4 0.1 setosa  
## 14 4.3 3.0 1.1 0.1 setosa  
## 15 5.8 4.0 1.2 0.2 setosa  
## 16 5.7 4.4 1.5 0.4 setosa  
## 17 5.4 3.9 1.3 0.4 setosa  
## 18 5.1 3.5 1.4 0.3 setosa  
## 19 5.7 3.8 1.7 0.3 setosa  
## 20 5.1 3.8 1.5 0.3 setosa  
## 21 5.4 3.4 1.7 0.2 setosa  
## 22 5.1 3.7 1.5 0.4 setosa  
## 23 4.6 3.6 1.0 0.2 setosa  
## 24 5.1 3.3 1.7 0.5 setosa  
## 25 4.8 3.4 1.9 0.2 setosa  
## 26 5.0 3.0 1.6 0.2 setosa  
## 27 5.0 3.4 1.6 0.4 setosa  
## 28 5.2 3.5 1.5 0.2 setosa  
## 29 5.2 3.4 1.4 0.2 setosa  
## 30 4.7 3.2 1.6 0.2 setosa  
## 31 4.8 3.1 1.6 0.2 setosa  
## 32 5.4 3.4 1.5 0.4 setosa  
## 33 5.2 4.1 1.5 0.1 setosa  
## 34 5.5 4.2 1.4 0.2 setosa  
## 35 4.9 3.1 1.5 0.2 setosa  
## 36 5.0 3.2 1.2 0.2 setosa  
## 37 5.5 3.5 1.3 0.2 setosa  
## 38 4.9 3.6 1.4 0.1 setosa  
## 39 4.4 3.0 1.3 0.2 setosa  
## 40 5.1 3.4 1.5 0.2 setosa  
## 41 5.0 3.5 1.3 0.3 setosa  
## 42 4.5 2.3 1.3 0.3 setosa  
## 43 4.4 3.2 1.3 0.2 setosa  
## 44 5.0 3.5 1.6 0.6 setosa  
## 45 5.1 3.8 1.9 0.4 setosa  
## 46 4.8 3.0 1.4 0.3 setosa  
## 47 5.1 3.8 1.6 0.2 setosa  
## 48 4.6 3.2 1.4 0.2 setosa  
## 49 5.3 3.7 1.5 0.2 setosa  
## 50 5.0 3.3 1.4 0.2 setosa  
## 51 7.0 3.2 4.7 1.4 versicolor  
## 52 6.4 3.2 4.5 1.5 versicolor  
## 53 6.9 3.1 4.9 1.5 versicolor  
## 54 5.5 2.3 4.0 1.3 versicolor  
## 55 6.5 2.8 4.6 1.5 versicolor  
## 56 5.7 2.8 4.5 1.3 versicolor  
## 57 6.3 3.3 4.7 1.6 versicolor  
## 58 4.9 2.4 3.3 1.0 versicolor  
## 59 6.6 2.9 4.6 1.3 versicolor  
## 60 5.2 2.7 3.9 1.4 versicolor  
## 61 5.0 2.0 3.5 1.0 versicolor  
## 62 5.9 3.0 4.2 1.5 versicolor  
## 63 6.0 2.2 4.0 1.0 versicolor  
## 64 6.1 2.9 4.7 1.4 versicolor  
## 65 5.6 2.9 3.6 1.3 versicolor  
## 66 6.7 3.1 4.4 1.4 versicolor  
## 67 5.6 3.0 4.5 1.5 versicolor  
## 68 5.8 2.7 4.1 1.0 versicolor  
## 69 6.2 2.2 4.5 1.5 versicolor  
## 70 5.6 2.5 3.9 1.1 versicolor  
## 71 5.9 3.2 4.8 1.8 versicolor  
## 72 6.1 2.8 4.0 1.3 versicolor  
## 73 6.3 2.5 4.9 1.5 versicolor  
## 74 6.1 2.8 4.7 1.2 versicolor  
## 75 6.4 2.9 4.3 1.3 versicolor  
## 76 6.6 3.0 4.4 1.4 versicolor  
## 77 6.8 2.8 4.8 1.4 versicolor  
## 78 6.7 3.0 5.0 1.7 versicolor  
## 79 6.0 2.9 4.5 1.5 versicolor  
## 80 5.7 2.6 3.5 1.0 versicolor  
## 81 5.5 2.4 3.8 1.1 versicolor  
## 82 5.5 2.4 3.7 1.0 versicolor  
## 83 5.8 2.7 3.9 1.2 versicolor  
## 84 6.0 2.7 5.1 1.6 versicolor  
## 85 5.4 3.0 4.5 1.5 versicolor  
## 86 6.0 3.4 4.5 1.6 versicolor  
## 87 6.7 3.1 4.7 1.5 versicolor  
## 88 6.3 2.3 4.4 1.3 versicolor  
## 89 5.6 3.0 4.1 1.3 versicolor  
## 90 5.5 2.5 4.0 1.3 versicolor  
## 91 5.5 2.6 4.4 1.2 versicolor  
## 92 6.1 3.0 4.6 1.4 versicolor  
## 93 5.8 2.6 4.0 1.2 versicolor  
## 94 5.0 2.3 3.3 1.0 versicolor  
## 95 5.6 2.7 4.2 1.3 versicolor  
## 96 5.7 3.0 4.2 1.2 versicolor  
## 97 5.7 2.9 4.2 1.3 versicolor  
## 98 6.2 2.9 4.3 1.3 versicolor  
## 99 5.1 2.5 3.0 1.1 versicolor  
## 100 5.7 2.8 4.1 1.3 versicolor  
## 101 6.3 3.3 6.0 2.5 virginica  
## 102 5.8 2.7 5.1 1.9 virginica  
## 103 7.1 3.0 5.9 2.1 virginica  
## 104 6.3 2.9 5.6 1.8 virginica  
## 105 6.5 3.0 5.8 2.2 virginica  
## 106 7.6 3.0 6.6 2.1 virginica  
## 107 4.9 2.5 4.5 1.7 virginica  
## 108 7.3 2.9 6.3 1.8 virginica  
## 109 6.7 2.5 5.8 1.8 virginica  
## 110 7.2 3.6 6.1 2.5 virginica  
## 111 6.5 3.2 5.1 2.0 virginica  
## 112 6.4 2.7 5.3 1.9 virginica  
## 113 6.8 3.0 5.5 2.1 virginica  
## 114 5.7 2.5 5.0 2.0 virginica  
## 115 5.8 2.8 5.1 2.4 virginica  
## 116 6.4 3.2 5.3 2.3 virginica  
## 117 6.5 3.0 5.5 1.8 virginica  
## 118 7.7 3.8 6.7 2.2 virginica  
## 119 7.7 2.6 6.9 2.3 virginica  
## 120 6.0 2.2 5.0 1.5 virginica  
## 121 6.9 3.2 5.7 2.3 virginica  
## 122 5.6 2.8 4.9 2.0 virginica  
## 123 7.7 2.8 6.7 2.0 virginica  
## 124 6.3 2.7 4.9 1.8 virginica  
## 125 6.7 3.3 5.7 2.1 virginica  
## 126 7.2 3.2 6.0 1.8 virginica  
## 127 6.2 2.8 4.8 1.8 virginica  
## 128 6.1 3.0 4.9 1.8 virginica  
## 129 6.4 2.8 5.6 2.1 virginica  
## 130 7.2 3.0 5.8 1.6 virginica  
## 131 7.4 2.8 6.1 1.9 virginica  
## 132 7.9 3.8 6.4 2.0 virginica  
## 133 6.4 2.8 5.6 2.2 virginica  
## 134 6.3 2.8 5.1 1.5 virginica  
## 135 6.1 2.6 5.6 1.4 virginica  
## 136 7.7 3.0 6.1 2.3 virginica  
## 137 6.3 3.4 5.6 2.4 virginica  
## 138 6.4 3.1 5.5 1.8 virginica  
## 139 6.0 3.0 4.8 1.8 virginica  
## 140 6.9 3.1 5.4 2.1 virginica  
## 141 6.7 3.1 5.6 2.4 virginica  
## 142 6.9 3.1 5.1 2.3 virginica  
## 143 5.8 2.7 5.1 1.9 virginica  
## 144 6.8 3.2 5.9 2.3 virginica  
## 145 6.7 3.3 5.7 2.5 virginica  
## 146 6.7 3.0 5.2 2.3 virginica  
## 147 6.3 2.5 5.0 1.9 virginica  
## 148 6.5 3.0 5.2 2.0 virginica  
## 149 6.2 3.4 5.4 2.3 virginica  
## 150 5.9 3.0 5.1 1.8 virginica

Here we named our iris dataset by a variable ‘i’ and thus visualized the whole dataset.

# DIMENSION OF THE DATASET:

dim(i)

## [1] 150 5

Here we can see that our dataset has 150 rows and 5 columns.

# FIRST 6 OBSERVATIONS:

head(iris)

## Sepal.Length Sepal.Width Petal.Length Petal.Width Species  
## 1 5.1 3.5 1.4 0.2 setosa  
## 2 4.9 3.0 1.4 0.2 setosa  
## 3 4.7 3.2 1.3 0.2 setosa  
## 4 4.6 3.1 1.5 0.2 setosa  
## 5 5.0 3.6 1.4 0.2 setosa  
## 6 5.4 3.9 1.7 0.4 setosa

Here we can see the first 6 observations of the iris dataset.

# LAST 6 OBSERVATIONS:

tail(iris)

## Sepal.Length Sepal.Width Petal.Length Petal.Width Species  
## 145 6.7 3.3 5.7 2.5 virginica  
## 146 6.7 3.0 5.2 2.3 virginica  
## 147 6.3 2.5 5.0 1.9 virginica  
## 148 6.5 3.0 5.2 2.0 virginica  
## 149 6.2 3.4 5.4 2.3 virginica  
## 150 5.9 3.0 5.1 1.8 virginica

Here we can see the last 6 observations of the iris dataset.

# DESCRIPTIVE STATISTICS:

## SUMMARY OF THE DATASET:

summary(iris)

## Sepal.Length Sepal.Width Petal.Length Petal.Width   
## Min. :4.300 Min. :2.000 Min. :1.000 Min. :0.100   
## 1st Qu.:5.100 1st Qu.:2.800 1st Qu.:1.600 1st Qu.:0.300   
## Median :5.800 Median :3.000 Median :4.350 Median :1.300   
## Mean :5.843 Mean :3.057 Mean :3.758 Mean :1.199   
## 3rd Qu.:6.400 3rd Qu.:3.300 3rd Qu.:5.100 3rd Qu.:1.800   
## Max. :7.900 Max. :4.400 Max. :6.900 Max. :2.500   
## Species   
## setosa :50   
## versicolor:50   
## virginica :50   
##   
##   
##

Here we can see the minimum value, the first quartile, median (second quartile), third quartile , mean and the maximum value of each of the 5 columns of the dataset. Let our target variable be “sepal length”. Thus we can see the value of our target variable ranges from 4.3cm to 7.9cm.

## MEAN OF OUR TARGET VARIABLE:

mean(iris$Sepal.Length)

## [1] 5.843333

Thus we can see the average length of our target variable is 5.843cm.

## STANDARD DEVIATION OF OUR TARGET VARIABLE:

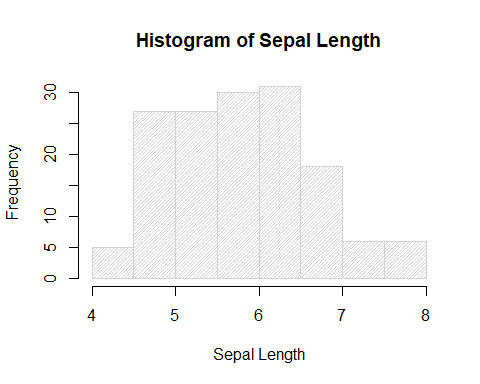
sd(iris$Sepal.Length)

## [1] 0.8280661

Thus the standard deviation of our target variable is 0.828. A standard deviation close to zero indicates that data points are close to the mean. Here, the standard deviation obtained is 0.828 which indicates that the data points are close to mean.

# VISUALIZING THE DISTRIBUTION OF OUR TARGET VARIABLE:

hist(iris$Sepal.Length, xlab="Sepal Length", main="Histogram of Sepal Length", density = 40)



# POPULATION:

population=iris$Sepal.Length  
population

## [1] 5.1 4.9 4.7 4.6 5.0 5.4 4.6 5.0 4.4 4.9 5.4 4.8 4.8 4.3 5.8 5.7 5.4 5.1  
## [19] 5.7 5.1 5.4 5.1 4.6 5.1 4.8 5.0 5.0 5.2 5.2 4.7 4.8 5.4 5.2 5.5 4.9 5.0  
## [37] 5.5 4.9 4.4 5.1 5.0 4.5 4.4 5.0 5.1 4.8 5.1 4.6 5.3 5.0 7.0 6.4 6.9 5.5  
## [55] 6.5 5.7 6.3 4.9 6.6 5.2 5.0 5.9 6.0 6.1 5.6 6.7 5.6 5.8 6.2 5.6 5.9 6.1  
## [73] 6.3 6.1 6.4 6.6 6.8 6.7 6.0 5.7 5.5 5.5 5.8 6.0 5.4 6.0 6.7 6.3 5.6 5.5  
## [91] 5.5 6.1 5.8 5.0 5.6 5.7 5.7 6.2 5.1 5.7 6.3 5.8 7.1 6.3 6.5 7.6 4.9 7.3  
## [109] 6.7 7.2 6.5 6.4 6.8 5.7 5.8 6.4 6.5 7.7 7.7 6.0 6.9 5.6 7.7 6.3 6.7 7.2  
## [127] 6.2 6.1 6.4 7.2 7.4 7.9 6.4 6.3 6.1 7.7 6.3 6.4 6.0 6.9 6.7 6.9 5.8 6.8  
## [145] 6.7 6.7 6.3 6.5 6.2 5.9

Here we can clearly see all the 150 observations of our target variable from the dataset.

# SAMPLE 01:

samplesize=15 # choosing 15 observations from the dataset  
s1=sample(population, 15, replace=TRUE) # choosing a sample of size 15 from the population using simple random sampling with replacement technique  
s1

## [1] 4.6 5.1 5.9 4.6 7.2 5.4 6.3 5.8 4.9 5.2 6.2 6.3 5.0 6.2 5.7

Here we can the see the 15 samples chosen by simple random sampling with replacement technique from the population of 150.

## MEAN OF SAMPLE 01:

mean(s1)

## [1] 5.626667

Here we can see the mean of our 15 samples.

## STANDARD DEVIATION OF SAMPLE 01:

sd(s1)

## [1] 0.741106

Here we can see the standard deviation of our 15 samples.

# SAMPLE 02:

samplesize=10 # choosing 10 observations from the dataset  
s2=sample(population, samplesize, replace=TRUE) # choosing a sample of size 10 from the population using simple random sampling with replacement technique  
s2

## [1] 5.0 6.2 4.9 6.0 6.3 5.1 4.6 7.3 7.2 5.1

Here we can the see the 10 samples chosen by simple random sampling with replacement technique from the population of 150.

## MEAN OF SAMPLE 02:

mean(s2)

## [1] 5.77

Here we can see the mean of our 10 samples.

## STANDARD DEVIATION OF SAMPLE 02:

sd(s2)

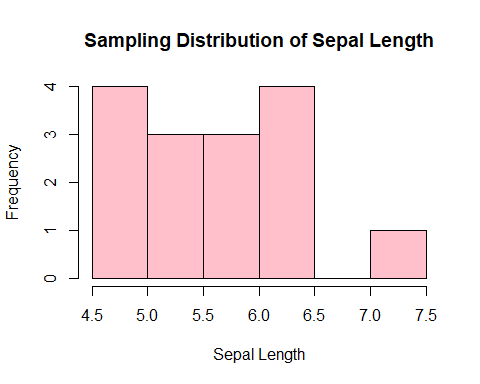
## [1] 0.9730251

Here we can see the standard deviation of our 10 samples.

# SAMPLING DISTRIBUTION:

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 15 WITHOUT REPLICATION:

hist(s1,xlab="Sepal Length", main="Sampling Distribution of Sepal Length", col="pink") # Finding how it is distributed using histogram

 We can observe that this graph doesn’t give a great idea about how the sample is distributed, we thus use replicate function to replicate the statistic. “replicate()” function in R Programming Language is used to evaluate an expression N number of times repeatedly. Here, it is replicated 1000 times.

## FINDING SAMPLING DISTRIBUTION OF SAMPLE SIZE 15 WITH REPLICATION:

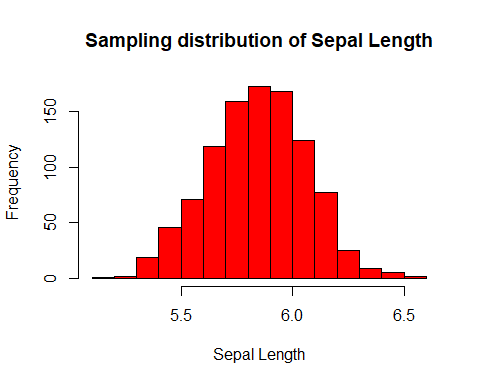
samp\_dist1= replicate(1000, mean(sample(iris$Sepal.Length, 15, replace=TRUE)))  
samp\_dist1

## [1] 5.733333 5.813333 5.813333 5.920000 6.046667 5.886667 5.986667 5.680000  
## [9] 6.020000 5.986667 6.033333 5.733333 6.120000 5.986667 6.120000 5.993333  
## [17] 5.800000 5.893333 6.040000 5.786667 6.000000 5.873333 5.566667 5.966667  
## [25] 5.973333 5.720000 5.506667 5.806667 5.360000 6.106667 6.146667 5.686667  
## [33] 5.733333 5.620000 5.866667 5.980000 5.653333 5.626667 5.613333 5.693333  
## [41] 5.960000 6.086667 6.193333 5.526667 5.940000 5.753333 5.613333 5.846667  
## [49] 6.220000 5.826667 5.453333 6.000000 5.880000 5.706667 5.660000 5.820000  
## [57] 5.680000 6.000000 5.740000 6.213333 5.766667 5.713333 6.100000 5.666667  
## [65] 5.573333 5.853333 6.353333 5.766667 5.566667 6.473333 6.173333 6.086667  
## [73] 6.293333 6.046667 6.033333 5.593333 5.780000 5.966667 5.713333 5.840000  
## [81] 6.146667 6.073333 5.180000 6.073333 5.900000 5.486667 5.993333 5.720000  
## [89] 6.033333 6.020000 6.073333 5.760000 5.640000 6.066667 5.680000 5.660000  
## [97] 5.600000 5.860000 5.673333 6.020000 5.766667 6.106667 6.113333 5.826667  
## [105] 6.173333 5.646667 5.780000 6.220000 5.866667 5.800000 5.560000 5.893333  
## [113] 5.993333 5.486667 5.740000 5.986667 5.953333 5.960000 5.640000 5.706667  
## [121] 5.800000 6.286667 5.800000 5.913333 5.920000 6.086667 6.246667 5.660000  
## [129] 6.006667 6.053333 5.840000 5.626667 5.846667 5.826667 5.946667 5.673333  
## [137] 5.853333 5.733333 5.866667 5.780000 6.126667 5.926667 5.580000 5.840000  
## [145] 5.773333 5.740000 5.946667 5.646667 5.960000 6.046667 5.873333 5.820000  
## [153] 5.426667 5.806667 5.733333 5.873333 5.520000 6.186667 5.840000 6.000000  
## [161] 5.773333 5.606667 5.600000 6.086667 5.926667 5.580000 5.640000 6.220000  
## [169] 5.753333 6.040000 5.726667 5.820000 5.573333 6.106667 5.900000 6.126667  
## [177] 5.846667 5.666667 5.793333 5.906667 5.853333 5.980000 5.813333 6.186667  
## [185] 5.846667 6.073333 5.626667 6.100000 5.913333 5.893333 5.760000 5.980000  
## [193] 6.253333 5.506667 5.626667 5.593333 5.906667 5.693333 5.826667 5.953333  
## [201] 5.726667 5.820000 6.000000 5.653333 6.460000 5.706667 5.780000 6.060000  
## [209] 5.626667 6.140000 6.086667 5.900000 5.680000 5.973333 5.766667 5.933333  
## [217] 5.746667 5.713333 6.066667 5.606667 6.173333 5.900000 6.300000 6.006667  
## [225] 5.733333 5.913333 5.426667 5.526667 5.640000 5.540000 5.833333 5.746667  
## [233] 5.593333 5.600000 5.386667 5.720000 5.593333 6.200000 5.733333 5.866667  
## [241] 5.720000 5.880000 6.160000 5.740000 5.833333 6.073333 5.713333 6.033333  
## [249] 6.033333 5.946667 5.760000 6.100000 6.406667 6.360000 6.060000 5.433333  
## [257] 5.766667 5.820000 5.626667 5.826667 5.733333 5.766667 5.753333 5.780000  
## [265] 5.840000 5.993333 5.893333 6.333333 5.566667 6.180000 5.920000 5.900000  
## [273] 5.540000 6.126667 5.366667 5.893333 5.586667 5.940000 6.233333 5.706667  
## [281] 5.980000 6.080000 5.940000 5.640000 5.986667 5.666667 5.826667 5.946667  
## [289] 5.446667 5.646667 5.720000 5.946667 5.906667 5.486667 5.993333 5.846667  
## [297] 5.920000 5.913333 5.893333 5.766667 5.326667 5.880000 6.066667 5.833333  
## [305] 5.933333 5.953333 5.553333 5.680000 5.746667 5.700000 5.566667 5.920000  
## [313] 5.813333 5.713333 5.986667 5.953333 5.993333 6.133333 6.013333 5.580000  
## [321] 5.226667 5.726667 6.220000 6.193333 5.553333 5.493333 5.580000 6.020000  
## [329] 5.473333 6.060000 5.446667 6.086667 5.493333 5.866667 6.033333 5.853333  
## [337] 5.553333 5.480000 5.773333 5.853333 5.380000 5.620000 5.820000 5.660000  
## [345] 5.840000 5.873333 6.160000 5.586667 5.900000 5.940000 5.500000 5.700000  
## [353] 6.060000 6.073333 5.973333 5.740000 5.913333 6.193333 5.886667 5.846667  
## [361] 5.826667 5.786667 6.053333 5.926667 5.820000 5.853333 6.033333 6.066667  
## [369] 5.873333 5.666667 5.953333 5.793333 5.486667 5.700000 5.926667 6.013333  
## [377] 5.993333 6.313333 5.980000 6.200000 5.713333 6.126667 6.133333 6.080000  
## [385] 5.833333 6.226667 5.866667 5.920000 5.806667 5.646667 6.193333 5.640000  
## [393] 5.580000 5.746667 5.560000 5.466667 5.786667 5.953333 5.713333 5.873333  
## [401] 5.753333 5.933333 5.693333 6.140000 6.053333 5.560000 5.893333 5.846667  
## [409] 6.133333 6.180000 5.660000 5.760000 5.640000 6.140000 6.060000 5.666667  
## [417] 6.100000 6.080000 6.193333 6.020000 5.613333 6.006667 5.753333 5.786667  
## [425] 5.886667 5.640000 5.633333 6.000000 5.953333 6.106667 5.566667 5.966667  
## [433] 5.893333 6.006667 5.940000 5.886667 5.620000 5.946667 5.926667 5.926667  
## [441] 6.126667 5.706667 5.886667 5.393333 5.713333 5.653333 5.680000 5.740000  
## [449] 5.566667 5.733333 6.026667 5.986667 5.813333 5.366667 5.946667 6.060000  
## [457] 5.613333 5.606667 5.773333 5.820000 5.793333 5.893333 5.766667 5.680000  
## [465] 5.866667 6.113333 5.820000 6.406667 5.693333 5.540000 6.060000 5.760000  
## [473] 6.186667 5.580000 5.780000 5.993333 5.980000 5.673333 5.913333 5.933333  
## [481] 5.940000 5.960000 6.120000 6.160000 5.753333 5.960000 6.013333 6.093333  
## [489] 5.933333 6.093333 5.780000 5.873333 5.986667 5.993333 5.726667 5.893333  
## [497] 6.120000 5.726667 5.880000 5.780000 6.233333 5.700000 5.906667 6.053333  
## [505] 6.153333 5.986667 6.166667 6.346667 6.006667 6.073333 5.953333 5.893333  
## [513] 5.746667 5.660000 5.606667 6.040000 6.173333 5.953333 5.480000 5.640000  
## [521] 5.953333 5.926667 5.813333 5.940000 5.500000 5.713333 5.660000 5.840000  
## [529] 5.766667 5.733333 5.326667 5.906667 5.726667 5.746667 5.806667 6.146667  
## [537] 5.993333 5.920000 5.673333 5.486667 5.800000 5.713333 6.193333 5.580000  
## [545] 5.753333 6.193333 5.640000 5.646667 5.366667 5.913333 5.466667 5.673333  
## [553] 5.600000 5.926667 5.393333 5.806667 5.566667 5.913333 5.500000 5.600000  
## [561] 5.920000 5.966667 5.893333 5.493333 5.920000 5.640000 5.880000 5.766667  
## [569] 5.746667 5.713333 6.060000 5.586667 5.666667 6.180000 6.066667 5.553333  
## [577] 5.880000 6.266667 6.213333 5.726667 5.820000 5.786667 6.146667 5.720000  
## [585] 5.853333 6.013333 6.100000 5.766667 5.993333 6.153333 5.873333 5.926667  
## [593] 5.546667 5.893333 5.953333 5.380000 5.660000 5.693333 5.993333 6.040000  
## [601] 5.693333 6.120000 5.993333 5.940000 5.686667 5.533333 5.893333 5.760000  
## [609] 6.033333 5.900000 5.966667 5.833333 5.606667 5.746667 5.840000 5.726667  
## [617] 5.880000 5.860000 6.020000 5.953333 5.940000 6.126667 5.866667 5.466667  
## [625] 5.760000 5.953333 5.393333 5.953333 6.040000 5.400000 5.560000 6.006667  
## [633] 5.713333 5.486667 5.886667 5.746667 6.020000 6.000000 5.560000 5.920000  
## [641] 5.846667 5.940000 5.826667 6.013333 5.600000 5.286667 5.873333 5.900000  
## [649] 5.713333 5.866667 6.180000 5.860000 6.013333 6.013333 5.726667 6.053333  
## [657] 6.006667 6.060000 5.986667 5.733333 5.840000 5.626667 5.940000 6.386667  
## [665] 5.893333 6.080000 6.086667 5.666667 6.033333 6.066667 5.966667 5.586667  
## [673] 5.786667 5.673333 5.846667 6.206667 6.546667 5.820000 6.233333 5.766667  
## [681] 6.133333 6.073333 6.280000 5.933333 6.073333 5.906667 5.733333 5.413333  
## [689] 5.806667 6.000000 6.113333 5.620000 6.020000 5.600000 5.880000 5.706667  
## [697] 5.713333 5.833333 5.900000 5.806667 6.086667 6.073333 5.673333 6.160000  
## [705] 5.573333 6.013333 5.733333 5.473333 5.860000 5.960000 5.840000 5.560000  
## [713] 5.800000 6.326667 5.406667 5.973333 6.126667 6.000000 6.420000 5.813333  
## [721] 6.120000 6.133333 5.713333 5.693333 5.720000 5.886667 6.060000 5.613333  
## [729] 5.873333 6.026667 5.393333 5.720000 5.886667 5.826667 6.160000 5.480000  
## [737] 6.046667 5.880000 5.760000 5.700000 5.420000 6.266667 6.373333 5.553333  
## [745] 5.473333 5.326667 6.033333 5.866667 5.606667 5.846667 5.953333 5.713333  
## [753] 5.486667 5.620000 5.926667 6.000000 5.866667 6.133333 6.086667 5.940000  
## [761] 5.886667 5.633333 6.026667 5.886667 6.146667 5.686667 5.840000 5.833333  
## [769] 5.440000 6.226667 6.280000 6.193333 5.880000 6.153333 6.006667 5.953333  
## [777] 5.426667 5.980000 5.966667 6.033333 5.646667 6.020000 5.773333 5.966667  
## [785] 5.426667 5.933333 5.866667 5.873333 6.040000 5.540000 5.760000 6.000000  
## [793] 5.713333 5.720000 5.953333 5.540000 5.500000 5.800000 6.153333 6.226667  
## [801] 5.780000 6.066667 6.040000 5.840000 6.180000 5.493333 5.693333 6.020000  
## [809] 5.813333 6.100000 5.900000 5.913333 5.926667 5.926667 5.526667 5.900000  
## [817] 6.160000 5.693333 6.366667 5.673333 5.646667 5.453333 5.633333 5.980000  
## [825] 5.566667 5.760000 5.800000 6.226667 6.086667 5.653333 5.640000 5.793333  
## [833] 5.933333 5.493333 5.900000 5.673333 5.953333 6.506667 5.960000 6.013333  
## [841] 5.940000 5.900000 6.026667 6.180000 5.926667 6.046667 5.933333 5.693333  
## [849] 5.893333 6.013333 6.066667 5.306667 6.253333 5.540000 5.606667 5.646667  
## [857] 5.800000 6.113333 5.546667 5.733333 5.986667 6.033333 5.926667 5.880000  
## [865] 5.560000 5.513333 5.933333 5.926667 5.673333 6.106667 5.686667 5.580000  
## [873] 5.513333 5.853333 6.026667 5.826667 6.146667 5.680000 5.593333 5.446667  
## [881] 5.573333 5.946667 5.766667 6.053333 5.480000 5.766667 5.933333 5.793333  
## [889] 5.760000 5.620000 6.020000 5.733333 5.640000 5.826667 5.833333 5.860000  
## [897] 5.693333 5.606667 6.006667 5.600000 5.860000 5.706667 5.993333 5.580000  
## [905] 5.953333 5.693333 5.973333 5.346667 5.973333 5.620000 5.953333 5.960000  
## [913] 5.813333 5.606667 6.020000 5.746667 6.100000 5.893333 5.880000 6.060000  
## [921] 5.660000 5.686667 6.013333 6.206667 5.886667 5.700000 5.953333 5.913333  
## [929] 5.800000 5.713333 5.886667 5.826667 5.786667 5.986667 5.960000 5.773333  
## [937] 5.706667 5.846667 5.700000 6.013333 5.560000 6.013333 5.566667 5.353333  
## [945] 5.766667 5.906667 5.480000 5.833333 6.106667 5.846667 5.640000 5.780000  
## [953] 5.620000 5.426667 5.786667 5.980000 5.720000 5.566667 5.346667 5.660000  
## [961] 5.753333 5.966667 6.046667 5.746667 5.973333 5.820000 5.993333 5.846667  
## [969] 5.586667 5.906667 5.860000 5.800000 5.493333 5.766667 5.780000 5.713333  
## [977] 6.120000 6.053333 5.453333 5.606667 5.880000 5.773333 6.060000 6.120000  
## [985] 5.500000 5.886667 5.793333 5.893333 5.426667 6.193333 6.186667 6.120000  
## [993] 5.606667 5.820000 5.793333 5.780000 5.766667 5.846667 5.880000 5.886667

Now we have successfully replicated a 1000 times the process of randomly selecting 15 samples from the 150 population.

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 15 WITH REPLICATION:

hist(samp\_dist1, xlab="Sepal Length", main="Sampling distribution of Sepal Length", col="red") # Finding how it is distributed using histogram

 Now we have a proper idea about how the histogram is distributed.

## FINDING VARIANCE OF THE SAMPLING DISTRIBUTION OF SAMPLE SIZE 15:

var(samp\_dist1)

## [1] 0.04749403

Thus, we get the variance of the sampling distribution of sample size 15.

## STANDARD ERROR OF SAMPLE SIZE 15:

# Method 1:  
sd(samp\_dist1)

## [1] 0.2179312

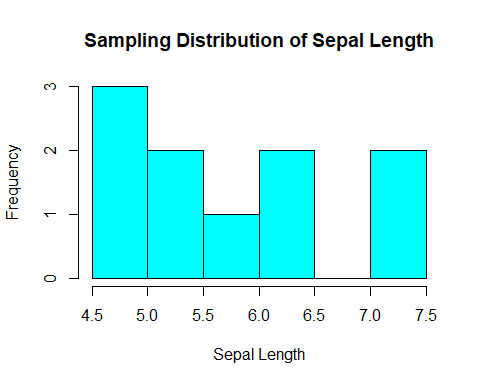
# Method 2:  
a=sample(iris$Sepal.Length, 15, replace = TRUE)  
b=sd(a)/sqrt(15)  
b

## [1] 0.1819646

Here, we can see Method 1 is the best standard error as it yields a result closer to 0 than Method 2.

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 10 WITHOUT REPLICATION:

hist(s2,xlab="Sepal Length", main="Sampling Distribution of Sepal Length", col="cyan") # Finding how it is distributed using histogram

 We can observe that this graph doesn’t give a great idea about how the sample is distributed, we thus use replicate function to replicate the statistic. “replicate()” function in R Programming Language is used to evaluate an expression N number of times repeatedly. Here, it is replicated 1000 times.

## FINDING SAMPLING DISTRIBUTION OF SAMPLE SIZE 10 WITH REPLICATION:

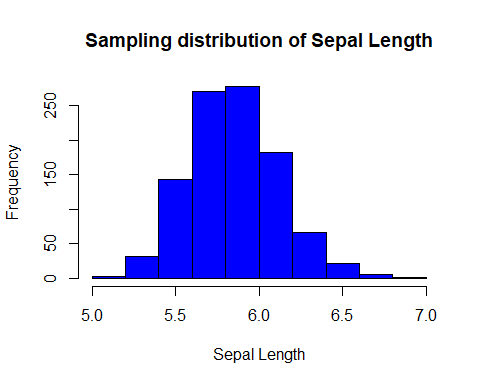
samp\_dist2= replicate(1000, mean(sample(iris$Sepal.Length, 10, replace=TRUE)))  
samp\_dist2

## [1] 5.50 6.20 5.58 6.32 5.97 6.01 5.48 5.91 6.02 5.91 5.80 5.79 5.32 6.25  
## [15] 5.51 5.89 5.60 5.88 5.90 6.26 5.91 6.05 5.77 5.69 5.84 6.31 6.00 6.16  
## [29] 5.64 5.45 5.65 5.70 5.92 6.11 5.69 5.63 5.57 5.75 5.76 5.62 5.80 6.14  
## [43] 5.97 5.35 5.76 5.70 5.79 5.54 5.57 5.74 5.45 5.75 6.18 5.79 5.57 5.59  
## [57] 5.48 5.80 6.05 5.61 5.58 5.74 6.09 5.90 5.97 5.76 5.45 5.55 5.94 6.32  
## [71] 5.74 5.75 6.09 5.85 5.33 5.61 6.02 5.86 6.08 6.08 5.78 5.99 5.87 5.30  
## [85] 5.96 5.59 5.89 5.66 5.73 5.82 5.49 5.89 6.47 6.36 5.50 5.25 5.88 5.83  
## [99] 5.74 5.97 5.68 5.38 6.43 6.06 6.01 5.75 5.87 5.63 5.78 5.56 5.71 6.00  
## [113] 5.75 5.41 5.72 5.86 5.72 5.95 5.56 6.06 5.61 6.29 6.00 6.01 5.88 5.77  
## [127] 5.97 6.10 5.71 5.84 5.51 5.89 6.36 6.13 6.00 6.15 5.54 5.95 5.81 5.80  
## [141] 5.61 5.72 5.89 6.13 5.59 5.71 5.78 5.63 5.52 6.23 5.70 5.67 5.55 5.97  
## [155] 6.68 5.70 5.99 5.57 5.65 5.68 5.64 6.10 6.03 5.95 5.49 5.83 5.37 5.78  
## [169] 6.00 6.20 5.63 6.27 5.59 5.90 6.18 6.13 6.38 6.01 6.34 5.59 5.40 5.61  
## [183] 5.90 6.33 5.45 5.59 6.21 5.98 6.22 5.80 5.98 5.74 5.91 5.86 5.80 5.77  
## [197] 5.34 5.79 6.00 5.84 6.18 6.03 6.18 5.62 5.56 6.41 6.22 5.66 5.98 6.31  
## [211] 5.87 6.04 5.78 5.84 5.84 5.14 6.00 5.96 6.08 5.94 6.06 5.76 5.52 5.83  
## [225] 6.07 5.77 5.89 6.07 5.58 5.94 5.67 6.14 6.22 5.70 5.87 5.93 6.01 6.06  
## [239] 5.62 6.40 6.02 6.15 6.37 5.75 5.80 5.45 5.80 5.49 5.97 5.98 5.63 5.50  
## [253] 5.84 6.26 6.16 6.03 6.15 5.80 5.50 5.83 5.98 5.91 5.96 5.47 5.95 5.56  
## [267] 5.46 6.14 5.85 5.84 5.83 5.59 6.06 6.29 5.57 5.95 5.43 5.84 5.39 5.58  
## [281] 6.22 5.52 5.69 5.87 6.20 6.03 5.90 5.37 5.65 6.25 6.10 5.87 5.79 6.03  
## [295] 6.25 5.41 5.62 5.93 5.93 6.16 5.59 5.80 5.65 5.83 5.78 6.00 5.83 5.78  
## [309] 5.65 6.39 5.76 5.88 5.67 5.62 5.82 6.06 6.02 5.56 5.82 6.04 6.19 5.82  
## [323] 6.04 5.80 5.83 5.67 5.93 5.54 5.95 6.15 6.19 5.62 5.94 6.06 6.13 5.82  
## [337] 5.96 5.59 6.05 5.94 5.75 5.66 5.79 6.52 5.68 5.85 5.92 6.00 5.33 5.53  
## [351] 5.89 5.78 6.49 5.97 6.05 6.43 5.44 5.99 5.51 5.53 5.77 6.06 5.88 5.83  
## [365] 5.93 5.89 5.64 6.81 6.08 6.17 5.71 5.67 6.47 5.93 5.74 6.20 6.12 5.55  
## [379] 5.61 5.59 5.71 6.29 6.25 5.52 5.78 6.14 5.71 6.43 5.85 5.43 5.44 5.90  
## [393] 5.96 6.00 5.64 5.80 5.66 5.90 5.86 6.03 5.53 6.16 5.95 5.66 5.96 5.57  
## [407] 5.70 5.72 5.52 5.86 5.90 5.65 5.70 5.85 5.61 6.14 5.79 6.72 5.35 5.76  
## [421] 5.96 6.12 5.59 6.19 5.23 6.08 5.76 6.06 6.12 5.84 5.77 6.24 6.39 5.98  
## [435] 5.55 6.27 5.79 5.79 6.11 6.13 6.24 6.31 5.94 5.76 5.88 5.76 5.53 6.24  
## [449] 6.65 5.64 6.20 5.62 5.58 5.75 6.04 5.54 5.87 5.55 5.86 5.74 5.75 6.38  
## [463] 5.80 5.89 5.97 5.90 6.25 6.05 5.90 6.04 5.78 5.91 6.23 5.91 5.68 5.92  
## [477] 6.05 6.15 5.46 5.91 6.16 5.56 5.94 5.84 6.20 5.65 5.88 6.35 5.89 6.08  
## [491] 5.96 5.61 6.00 5.87 6.04 5.56 5.68 6.33 5.83 5.51 5.68 5.68 5.99 6.07  
## [505] 5.52 5.57 5.57 5.53 5.76 5.87 5.52 6.15 5.82 5.80 6.20 5.74 6.53 5.51  
## [519] 5.91 6.12 5.80 6.10 5.82 5.94 5.74 6.22 6.44 6.11 5.78 6.09 5.61 5.65  
## [533] 6.50 5.43 6.08 6.13 5.91 5.68 5.92 5.70 6.25 5.80 5.76 6.00 6.36 6.27  
## [547] 5.67 6.16 5.88 5.76 5.71 6.06 5.78 5.96 5.43 6.05 5.81 5.89 5.96 5.76  
## [561] 5.83 5.96 5.89 5.47 5.42 5.96 5.79 6.12 5.70 5.53 5.61 5.56 6.15 5.66  
## [575] 6.18 5.79 5.96 6.08 6.14 5.40 5.36 5.55 5.83 5.89 5.94 5.79 5.93 5.84  
## [589] 5.94 5.81 5.86 6.14 5.75 6.03 6.06 5.91 5.36 5.86 5.74 5.85 5.79 5.97  
## [603] 6.00 5.52 6.24 5.39 6.07 5.87 6.42 5.88 5.27 5.86 5.63 6.08 6.08 5.67  
## [617] 5.88 6.01 5.92 5.91 5.75 5.70 5.68 5.40 5.43 5.91 5.67 6.16 5.88 5.85  
## [631] 6.75 5.80 5.49 6.05 5.56 5.52 5.59 5.73 5.83 5.71 6.02 5.43 6.15 5.84  
## [645] 5.73 5.39 6.06 5.76 5.84 5.75 5.70 5.29 6.13 5.66 5.94 5.47 5.85 5.36  
## [659] 5.67 5.59 6.23 5.97 6.02 5.72 5.89 6.22 5.96 5.64 5.85 5.54 6.06 5.98  
## [673] 5.72 5.69 5.80 5.56 5.55 5.87 5.55 5.64 5.85 5.80 5.63 5.61 5.72 6.02  
## [687] 5.52 6.18 5.52 5.71 5.99 5.93 5.89 6.15 6.10 5.92 5.85 5.87 5.86 5.70  
## [701] 5.41 5.99 5.67 5.87 5.92 5.76 5.15 5.41 5.82 6.03 5.46 6.36 5.33 6.08  
## [715] 6.35 5.79 5.10 6.07 6.01 6.15 5.98 5.59 5.65 5.61 6.11 5.74 6.02 5.89  
## [729] 5.73 5.69 5.38 5.82 6.18 5.56 5.83 5.94 5.90 5.77 6.01 5.54 6.10 6.35  
## [743] 5.89 5.68 5.68 5.95 5.75 6.10 5.68 5.73 5.86 6.24 5.41 5.51 6.20 5.92  
## [757] 5.59 6.09 6.21 5.60 6.32 6.22 5.97 5.94 5.81 6.14 5.56 5.47 5.69 5.61  
## [771] 6.02 6.05 5.90 6.58 6.11 5.54 6.08 5.62 5.78 5.72 5.60 6.23 6.47 5.91  
## [785] 6.18 6.01 5.85 6.09 5.74 5.89 5.92 5.57 5.47 5.83 6.07 6.02 5.77 5.82  
## [799] 6.05 5.78 6.10 5.81 5.84 5.98 5.87 5.62 5.98 5.86 5.73 5.80 5.98 5.98  
## [813] 6.08 5.93 6.32 5.90 5.78 6.39 6.04 5.84 5.54 6.01 6.02 5.73 5.76 6.07  
## [827] 5.47 6.00 5.67 5.67 6.03 5.82 5.58 5.77 5.89 6.08 5.64 5.73 6.06 5.63  
## [841] 5.98 5.54 5.95 5.87 6.27 5.77 5.94 6.21 6.41 6.01 5.92 5.81 6.08 5.38  
## [855] 6.22 5.67 5.79 5.96 5.80 5.59 6.05 6.21 5.87 5.60 5.73 6.10 5.63 5.76  
## [869] 5.81 5.70 5.97 6.11 6.20 5.54 6.44 5.54 5.80 5.41 5.39 6.56 5.48 5.73  
## [883] 5.70 5.82 5.94 5.96 5.66 5.67 5.40 5.90 5.82 5.78 6.33 6.03 5.89 5.75  
## [897] 5.61 5.94 5.99 6.13 5.41 6.09 5.82 5.70 6.08 5.98 5.52 5.64 5.43 5.39  
## [911] 6.47 5.79 5.67 5.73 5.71 5.60 5.86 5.84 6.18 5.43 5.85 5.72 5.58 5.63  
## [925] 5.87 5.65 6.22 5.73 5.70 5.91 5.74 6.16 5.61 5.69 6.26 6.13 5.97 5.60  
## [939] 5.62 6.10 5.64 5.34 5.71 5.86 5.70 6.03 5.89 5.75 6.08 5.83 5.98 6.09  
## [953] 5.81 5.74 5.93 6.15 5.78 5.80 5.45 5.62 6.17 5.82 5.78 6.35 5.93 6.09  
## [967] 6.11 5.76 5.91 5.81 5.76 5.89 5.95 5.75 6.35 6.69 6.60 5.44 5.83 5.78  
## [981] 5.94 6.13 5.56 5.77 6.20 5.77 5.62 6.06 6.05 5.57 5.49 6.47 5.66 5.47  
## [995] 6.50 5.72 6.27 5.43 5.36 5.79

Now we have successfully replicated a 1000 times the process of randomly selecting 10 samples from the 150 population.

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 10 WITH REPLICATION:

hist(samp\_dist2, xlab="Sepal Length", main="Sampling distribution of Sepal Length", col="blue") # Finding how it is distributed using histogram

 Now we have a proper idea about how the histogram is distributed.

## FINDING VARIANCE OF THE SAMPLING DISTRIBUTION OF SAMPLE SIZE 10:

var(samp\_dist2)

## [1] 0.06983163

Thus, we get the variance of the sampling distribution of sample size 10.

## STANDARD ERROR OF SAMPLE SIZE 10:

# Method 1:  
sd(samp\_dist2)

## [1] 0.2642567

# Method 2:  
c=sample(iris$Sepal.Length, 10, replace = TRUE)  
d=sd(c)/sqrt(10)  
d

## [1] 0.2238303

Here, we can see Method 1 is the best standard error as it yields a result closer to 0 than Method 2.

# CONCLUSION:

We can clearly conclude that when we select a sample size of 15 we get the standard error much closer to 0 than when we select a sample size of 10. Thus, it can be concluded that larger the sample size better is the standard error. Lets do further exploration to validate this claim.

# FURTHER EXPLORATION:

# POPULATION:

population=iris$Sepal.Length  
population

## [1] 5.1 4.9 4.7 4.6 5.0 5.4 4.6 5.0 4.4 4.9 5.4 4.8 4.8 4.3 5.8 5.7 5.4 5.1  
## [19] 5.7 5.1 5.4 5.1 4.6 5.1 4.8 5.0 5.0 5.2 5.2 4.7 4.8 5.4 5.2 5.5 4.9 5.0  
## [37] 5.5 4.9 4.4 5.1 5.0 4.5 4.4 5.0 5.1 4.8 5.1 4.6 5.3 5.0 7.0 6.4 6.9 5.5  
## [55] 6.5 5.7 6.3 4.9 6.6 5.2 5.0 5.9 6.0 6.1 5.6 6.7 5.6 5.8 6.2 5.6 5.9 6.1  
## [73] 6.3 6.1 6.4 6.6 6.8 6.7 6.0 5.7 5.5 5.5 5.8 6.0 5.4 6.0 6.7 6.3 5.6 5.5  
## [91] 5.5 6.1 5.8 5.0 5.6 5.7 5.7 6.2 5.1 5.7 6.3 5.8 7.1 6.3 6.5 7.6 4.9 7.3  
## [109] 6.7 7.2 6.5 6.4 6.8 5.7 5.8 6.4 6.5 7.7 7.7 6.0 6.9 5.6 7.7 6.3 6.7 7.2  
## [127] 6.2 6.1 6.4 7.2 7.4 7.9 6.4 6.3 6.1 7.7 6.3 6.4 6.0 6.9 6.7 6.9 5.8 6.8  
## [145] 6.7 6.7 6.3 6.5 6.2 5.9

Here we can clearly see all the 150 observations of our target variable from the dataset.

# SAMPLE 03:

samplesize=50 # choosing 50 observations from the dataset  
s3=sample(population,samplesize,replace = TRUE) # choosing a sample of size 50 from the population using simple random sampling with replacement technique  
s3

## [1] 5.0 5.7 4.7 5.8 6.9 4.9 5.1 4.8 5.1 6.4 6.8 6.7 6.8 6.3 6.4 5.6 6.4 6.4 5.7  
## [20] 5.4 6.5 5.9 6.5 5.8 5.6 5.5 5.0 7.1 5.1 5.0 4.6 5.4 5.0 5.8 6.3 6.5 7.7 6.0  
## [39] 5.7 4.4 4.8 6.7 6.3 6.4 5.0 6.3 5.5 4.8 4.4 6.3

Here we can the see the 50 samples chosen by simple random sampling with replacement technique from the population of 150.

## MEAN OF SAMPLE 03:

mean(s3)

## [1] 5.776

Here we can see the mean of our 50 samples.

## STANDARD DEVIATION OF SAMPLE 03:

sd(s3)

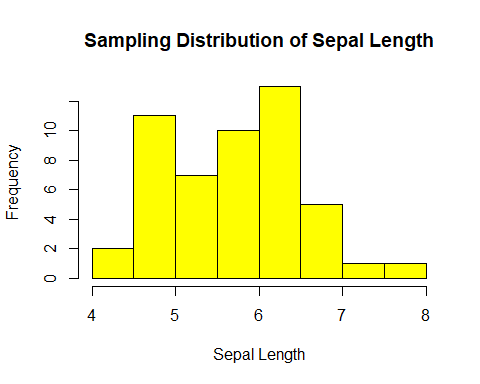
## [1] 0.7867681

Here we can see the standard deviation of our 50 samples.

# SAMPLING DISTRIBUTION:

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 50 WITHOUT REPLICATION:

hist(s3, xlab="Sepal Length", main="Sampling Distribution of Sepal Length", col="yellow")

 We can observe that this graph doesn’t give a great idea about how the sample is distributed, we thus use replicate function to replicate the statistic. “replicate()” function in R Programming Language is used to evaluate an expression N number of times repeatedly. Here, it is replicated 1000 times.

## FINDING SAMPLING DISTRIBUTION OF SAMPLE SIZE 50 WITH REPLICATION:

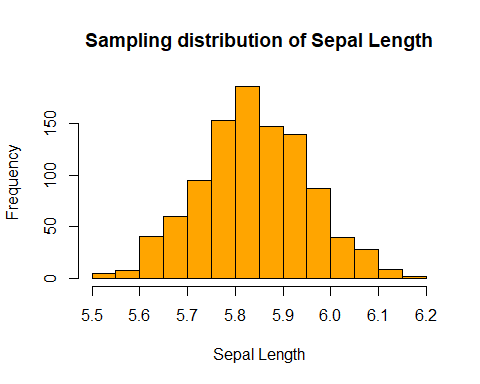
samp\_dist3=replicate(1000, mean(sample(iris$Sepal.Length, 50, replace = TRUE)))  
samp\_dist3

## [1] 5.906 5.654 5.856 5.924 5.608 5.934 5.770 5.868 5.934 5.998 6.012 5.770  
## [13] 5.854 5.922 5.860 5.878 5.842 5.806 5.858 5.922 5.912 5.838 5.802 5.542  
## [25] 6.102 5.826 5.870 5.916 5.928 5.880 5.818 6.074 5.624 5.748 6.046 5.832  
## [37] 5.626 6.046 5.880 5.822 5.818 5.772 5.872 5.782 5.990 5.704 5.822 5.800  
## [49] 5.938 5.740 5.730 5.772 5.966 5.854 5.988 5.690 5.838 5.946 5.832 5.904  
## [61] 5.734 5.828 6.034 5.808 5.786 5.670 5.858 5.908 5.902 5.962 5.884 5.958  
## [73] 5.650 5.700 5.732 5.920 6.006 5.920 5.906 5.824 5.836 5.862 5.758 5.766  
## [85] 5.644 5.850 5.826 5.548 5.772 5.812 5.818 5.780 5.880 5.794 5.792 5.982  
## [97] 5.850 5.826 5.912 5.810 5.756 5.698 5.844 5.864 5.822 5.970 5.750 5.966  
## [109] 5.986 5.774 5.666 5.922 5.870 5.850 5.834 5.962 5.858 5.774 5.818 5.922  
## [121] 5.880 6.024 5.668 5.748 6.000 5.920 5.790 5.644 5.916 5.818 5.824 5.622  
## [133] 5.928 5.994 5.716 5.698 6.088 5.594 5.954 5.840 6.044 5.904 5.804 5.842  
## [145] 5.692 5.898 5.764 5.794 5.664 5.862 5.710 5.920 5.658 5.704 5.788 5.834  
## [157] 5.800 5.788 5.646 5.912 5.760 5.982 6.002 5.950 5.908 5.850 5.922 5.694  
## [169] 5.964 5.952 5.778 5.982 5.936 5.780 5.758 5.940 5.746 5.828 5.910 5.650  
## [181] 5.864 5.702 5.866 5.828 5.776 5.832 5.894 5.912 5.846 5.620 5.872 5.846  
## [193] 5.900 6.048 5.850 5.828 5.854 5.898 5.756 5.772 5.870 5.794 5.734 5.794  
## [205] 5.680 5.806 5.740 5.616 5.910 5.866 5.800 5.692 5.878 5.856 5.920 5.772  
## [217] 5.864 5.856 5.794 5.870 6.054 5.802 5.736 5.904 5.750 5.882 5.770 5.832  
## [229] 5.880 5.620 5.732 6.140 5.734 5.800 5.724 5.922 5.968 5.870 5.802 5.852  
## [241] 5.778 5.786 5.644 5.774 6.158 6.068 5.856 5.758 5.878 6.006 5.812 5.910  
## [253] 5.916 5.980 6.086 5.880 6.058 5.968 5.886 5.766 6.014 5.866 5.670 5.798  
## [265] 6.040 5.856 5.548 6.022 5.852 5.818 5.738 5.954 5.964 5.912 5.728 5.910  
## [277] 5.894 5.540 5.700 5.892 5.650 5.824 5.940 5.814 5.828 5.780 5.902 6.000  
## [289] 5.844 5.864 5.686 5.826 5.978 5.762 5.990 5.886 5.908 5.880 5.704 5.964  
## [301] 5.850 5.884 5.900 5.818 5.810 5.770 5.876 5.742 5.780 5.524 5.792 5.858  
## [313] 5.948 5.908 5.732 6.004 5.848 5.746 5.714 5.902 5.996 5.916 5.676 5.730  
## [325] 5.734 5.902 6.050 5.714 5.952 6.058 5.876 5.884 5.788 5.828 5.820 5.850  
## [337] 5.916 5.676 5.694 6.044 5.898 5.938 5.910 5.936 5.754 6.084 5.688 5.772  
## [349] 5.728 5.952 5.710 5.990 5.888 5.808 5.772 5.786 5.990 5.892 5.754 5.644  
## [361] 5.830 5.882 5.872 5.646 6.052 5.808 5.816 5.982 5.624 5.762 5.744 5.826  
## [373] 5.794 5.818 5.930 6.072 5.944 5.762 5.748 5.858 5.914 5.994 5.830 6.042  
## [385] 6.006 5.942 5.922 5.802 5.900 5.734 5.828 5.712 5.912 5.850 5.818 5.676  
## [397] 5.700 5.844 5.892 5.998 5.926 5.876 5.872 5.912 5.834 5.924 6.110 5.856  
## [409] 6.020 6.024 5.810 5.858 5.662 5.738 5.980 5.932 5.868 5.836 5.854 5.802  
## [421] 5.668 5.886 5.938 5.762 5.748 6.072 6.042 5.994 5.874 5.990 5.772 5.796  
## [433] 5.756 5.762 5.786 5.772 5.720 5.874 5.770 5.782 5.774 5.748 5.668 5.722  
## [445] 6.004 5.800 5.920 5.806 5.974 5.880 5.912 5.904 5.996 5.838 5.864 5.916  
## [457] 5.980 5.862 5.806 5.816 5.962 5.780 5.800 5.718 5.802 5.802 5.760 5.858  
## [469] 5.904 5.786 5.800 5.736 5.834 5.816 5.746 5.846 5.708 5.822 5.700 5.986  
## [481] 5.960 5.810 5.660 5.678 5.934 5.826 5.778 5.798 5.832 5.858 6.058 5.956  
## [493] 5.766 5.850 5.862 5.818 6.106 5.868 5.730 5.816 5.588 5.680 5.658 5.706  
## [505] 5.956 5.926 5.700 5.692 5.884 5.758 5.854 5.936 5.656 5.992 5.676 5.568  
## [517] 5.770 6.088 5.752 5.810 5.794 5.644 5.804 6.116 5.948 5.840 5.858 5.810  
## [529] 5.890 5.730 5.962 5.684 5.862 5.868 5.934 5.884 5.730 5.776 5.870 5.950  
## [541] 5.840 5.730 5.616 5.928 5.808 5.742 5.884 5.924 5.720 5.858 5.802 5.754  
## [553] 5.882 6.064 5.828 5.664 5.818 5.810 5.760 5.752 5.808 5.974 5.780 5.792  
## [565] 5.970 5.664 5.804 5.844 5.916 5.892 5.788 5.860 5.750 5.870 5.812 5.800  
## [577] 5.806 5.806 5.966 6.076 5.912 6.032 5.802 5.988 6.104 5.712 5.974 6.054  
## [589] 6.026 5.920 5.764 5.774 5.794 5.798 5.822 5.848 5.780 6.028 5.806 5.726  
## [601] 5.876 5.950 5.736 5.798 5.988 5.842 5.856 5.922 5.652 5.804 5.940 5.818  
## [613] 5.728 5.898 5.742 5.808 5.938 5.790 5.712 5.752 5.682 5.692 5.826 5.928  
## [625] 5.794 5.782 5.890 5.824 5.776 5.622 5.948 6.130 5.886 5.646 5.702 6.088  
## [637] 6.006 5.634 5.674 5.742 5.770 5.608 6.014 5.718 5.898 5.740 5.762 5.622  
## [649] 5.980 5.806 5.724 5.928 5.852 5.706 6.028 5.824 5.822 5.566 5.866 5.716  
## [661] 5.946 5.914 5.840 5.648 5.912 5.774 5.708 6.158 5.994 5.640 5.860 5.774  
## [673] 5.796 5.862 5.932 5.920 5.830 5.926 5.794 5.744 5.832 5.960 5.706 5.834  
## [685] 5.854 5.846 5.900 6.012 5.960 5.784 5.850 5.788 5.868 5.862 5.902 5.996  
## [697] 5.766 5.938 5.772 5.914 5.780 5.806 5.788 5.904 5.908 5.764 5.908 5.974  
## [709] 6.036 5.618 5.838 5.968 5.944 6.022 5.776 5.952 6.012 5.886 5.906 5.734  
## [721] 5.610 5.822 5.838 5.834 5.854 5.674 5.790 5.916 6.014 5.864 5.862 5.998  
## [733] 5.812 5.770 5.810 5.752 5.946 5.926 5.844 5.764 6.070 5.914 5.914 5.906  
## [745] 6.060 5.900 5.880 5.708 5.850 5.744 5.908 5.906 5.716 5.866 5.912 5.842  
## [757] 6.016 5.584 5.782 5.804 5.682 5.766 5.840 5.846 5.744 5.682 5.982 5.678  
## [769] 5.736 5.814 5.800 5.898 5.744 5.656 5.608 5.846 5.946 5.852 5.952 5.778  
## [781] 5.940 5.876 5.826 5.796 5.892 5.832 5.818 5.912 5.818 5.950 5.684 5.916  
## [793] 5.626 5.976 5.938 5.762 5.828 5.842 5.936 5.778 5.670 5.958 5.918 5.992  
## [805] 5.796 5.840 6.042 5.614 5.908 5.854 5.896 5.826 5.768 5.822 5.812 5.914  
## [817] 5.660 5.784 6.090 5.732 5.830 5.582 5.906 6.070 5.622 5.918 5.752 5.770  
## [829] 5.760 5.820 5.716 5.840 5.978 5.890 5.738 5.990 6.002 5.672 5.868 5.840  
## [841] 5.778 5.784 5.808 5.988 5.728 5.766 5.724 5.970 5.734 5.764 5.728 5.654  
## [853] 5.694 5.806 5.890 5.856 5.982 5.926 5.842 5.948 5.912 6.072 6.038 5.778  
## [865] 5.922 5.894 5.900 6.124 5.704 5.664 5.788 5.890 5.960 5.966 5.880 5.728  
## [877] 5.802 6.094 5.742 6.064 5.994 5.908 5.828 5.754 5.888 5.946 5.716 5.650  
## [889] 5.936 5.784 5.972 5.870 5.590 5.936 5.828 5.902 5.850 6.088 5.890 5.998  
## [901] 5.626 5.840 5.956 5.896 6.028 5.880 5.800 5.886 5.940 5.686 5.682 6.092  
## [913] 5.816 5.618 5.850 5.848 5.952 5.732 5.988 5.742 5.826 5.880 5.764 5.824  
## [925] 5.872 5.890 5.892 5.858 5.940 6.058 5.856 5.838 5.762 5.836 5.852 6.082  
## [937] 5.638 5.936 5.862 5.748 5.842 5.926 5.978 5.888 5.986 5.770 5.780 5.676  
## [949] 5.826 5.810 5.646 5.632 5.910 5.624 5.948 5.664 5.594 5.806 5.886 5.716  
## [961] 5.844 5.808 5.740 5.768 5.860 5.788 5.716 5.786 5.782 5.756 5.836 5.826  
## [973] 5.992 5.810 5.810 5.720 5.832 5.832 5.648 5.740 5.922 5.806 5.956 6.000  
## [985] 5.654 6.024 5.798 6.108 5.752 5.792 6.006 5.796 5.980 5.650 5.802 5.810  
## [997] 5.782 5.782 5.682 5.934

Now we have successfully replicated a 1000 times the process of randomly selecting 50 samples from the 150 population.

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 15 WITH REPLICATION:

hist(samp\_dist3, xlab="Sepal Length", main="Sampling distribution of Sepal Length", col="orange") # Finding how it is distributed using histogram

 Now we have a proper idea about how the histogram is distributed.

## FINDING VARIANCE OF THE SAMPLING DISTRIBUTION OF SAMPLE SIZE 50:

var(samp\_dist3)

## [1] 0.01288975

Thus, we get the variance of the sampling distribution of sample size 50.

## STANDARD ERROR OF SAMPLE SIZE 50:

# Method 1  
sd(samp\_dist3)

## [1] 0.113533

# Method 2  
p=sample(iris$Sepal.Length, 50, replace = TRUE)  
q=sd(p)/sqrt(50)  
q

## [1] 0.1064131

Here, we can see Method 1 is the best standard error as it yields a result closer to 0 than Method 2.

# SAMPLE 04:

samplesize=100 # choosing 100 observations from the dataset  
s4=sample(population,samplesize,replace = TRUE) # choosing a sample of size 100 from the population using simple random sampling with replacement technique  
s4

## [1] 5.6 6.5 5.1 5.5 4.9 6.7 5.8 7.4 6.7 4.9 6.7 5.2 6.7 5.4 6.3 5.9 5.7 4.4  
## [19] 6.6 4.8 5.1 4.6 6.3 7.2 6.4 5.1 5.7 5.0 5.7 7.7 5.2 5.6 6.7 4.4 6.3 4.9  
## [37] 5.6 4.9 6.8 6.7 4.9 5.1 6.3 6.3 5.8 6.7 5.1 5.7 5.0 4.9 6.1 7.7 6.3 5.0  
## [55] 5.5 5.2 5.5 5.1 5.6 5.4 4.9 5.1 4.6 5.5 6.9 4.7 6.8 6.7 5.7 4.7 6.4 6.7  
## [73] 5.1 6.3 4.9 5.1 7.2 6.7 5.7 5.4 5.5 5.0 5.2 6.6 5.6 6.4 5.6 6.3 5.1 6.8  
## [91] 6.5 7.1 6.4 6.9 5.0 5.7 5.5 6.2 6.5 5.0

Here we can the see the 100 samples chosen by simple random sampling with replacement technique from the population of 150.

## MEAN OF SAMPLE 04:

mean(s4)

## [1] 5.799

Here we can see the mean of our 100 samples.

## STANDARD DEVIATION OF SAMPLE 04:

sd(s4)

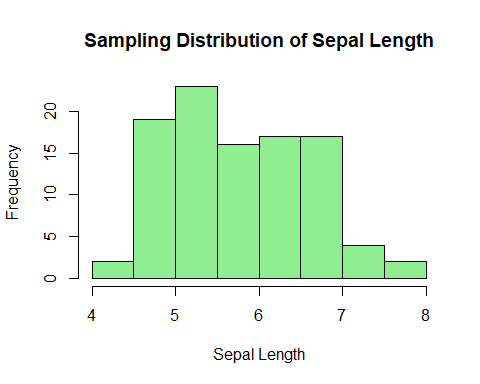
## [1] 0.801324

Here we can see the standard deviation of our 100 samples.

# SAMPLING DISTRIBUTION:

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 50 WITHOUT REPLICATION:

hist(s4, xlab="Sepal Length", main="Sampling Distribution of Sepal Length", col="#90EE90")

 We can observe that this graph doesn’t give a great idea about how the sample is distributed, we thus use replicate function to replicate the statistic. “replicate()” function in R Programming Language is used to evaluate an expression N number of times repeatedly. Here, it is replicated 1000 times.

## FINDING SAMPLING DISTRIBUTION OF SAMPLE SIZE 50 WITH REPLICATION:

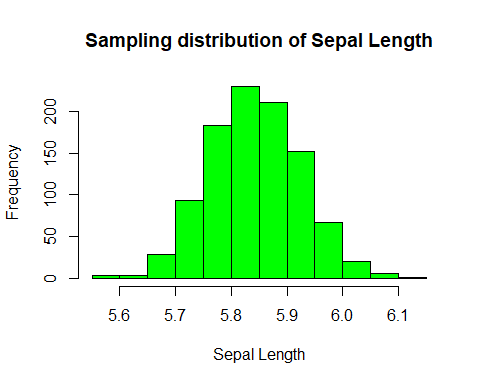
samp\_dist4=replicate(1000, mean(sample(iris$Sepal.Length, 100, replace = TRUE)))  
samp\_dist4

## [1] 5.843 5.930 5.802 5.950 5.991 5.768 5.798 5.819 5.873 5.747 5.963 5.952  
## [13] 5.657 5.919 5.796 5.907 5.818 5.820 5.868 5.692 5.770 5.834 5.896 5.785  
## [25] 5.834 5.882 5.852 5.706 5.791 5.724 5.934 5.915 5.907 5.758 5.840 6.022  
## [37] 5.879 5.929 5.734 5.993 5.859 6.015 5.929 5.775 5.764 5.856 5.828 5.917  
## [49] 5.701 5.656 5.800 5.784 5.852 5.852 5.874 5.796 5.912 5.890 5.867 5.863  
## [61] 5.767 5.728 5.901 5.846 5.823 5.945 5.830 5.765 5.841 5.909 5.864 5.836  
## [73] 5.968 5.803 5.705 5.816 5.740 5.877 5.820 5.868 5.739 5.947 5.739 5.866  
## [85] 5.843 5.880 5.803 5.798 5.888 5.995 5.919 5.740 5.884 5.920 5.760 5.686  
## [97] 5.835 5.862 5.668 5.914 5.757 5.747 5.706 5.868 5.749 5.786 5.802 5.820  
## [109] 5.889 5.889 5.869 5.959 5.909 5.827 5.790 5.823 5.909 5.926 5.954 5.706  
## [121] 5.929 5.965 5.578 5.832 5.783 5.864 5.767 5.859 5.880 5.921 5.832 5.864  
## [133] 5.881 5.823 5.785 5.780 5.802 5.831 5.822 5.787 5.741 5.949 5.904 5.805  
## [145] 5.877 5.792 5.819 5.740 5.841 5.828 5.849 5.913 5.930 5.701 5.893 5.798  
## [157] 5.717 5.756 5.911 5.799 5.809 5.792 5.868 5.723 5.876 6.043 5.834 5.818  
## [169] 5.601 5.888 5.925 5.798 6.008 5.792 5.711 5.779 5.774 5.837 5.894 5.809  
## [181] 5.718 5.936 5.831 5.809 5.834 5.717 5.870 5.906 5.677 5.792 5.806 5.814  
## [193] 6.080 5.720 5.845 5.879 5.772 5.783 5.808 5.844 5.766 5.778 5.903 5.694  
## [205] 5.833 5.917 5.901 5.897 5.774 5.907 6.020 5.845 5.907 5.785 5.904 5.837  
## [217] 5.731 5.810 5.952 5.794 5.790 5.763 5.905 5.778 5.817 5.810 5.769 5.882  
## [229] 5.875 5.829 5.849 5.786 5.920 5.883 5.688 5.864 5.870 5.721 5.906 5.713  
## [241] 5.762 5.882 5.763 5.889 5.776 5.809 5.836 5.887 5.812 5.777 5.874 5.936  
## [253] 5.776 6.012 5.782 5.846 5.922 5.710 5.977 5.864 5.880 5.917 5.812 5.838  
## [265] 5.810 5.878 5.752 5.901 5.921 5.821 5.860 5.805 5.730 5.804 5.933 5.833  
## [277] 5.829 5.757 5.681 5.768 5.843 5.931 5.838 5.834 5.812 5.790 5.881 5.917  
## [289] 5.831 5.878 5.946 5.797 5.849 5.788 5.942 5.871 5.776 5.869 5.910 5.782  
## [301] 5.795 5.927 5.790 5.978 5.815 5.870 6.003 5.885 5.774 5.835 5.821 5.849  
## [313] 5.941 5.793 5.945 5.836 5.976 5.934 5.792 5.737 5.963 5.856 5.950 5.953  
## [325] 5.870 5.754 5.843 5.843 5.871 5.924 5.982 5.884 5.814 5.868 5.825 5.934  
## [337] 6.038 6.117 5.927 5.897 5.852 5.658 5.956 5.802 5.672 5.767 5.779 5.950  
## [349] 5.808 5.838 5.790 5.919 5.877 5.879 5.843 5.871 5.698 5.917 5.892 5.669  
## [361] 5.885 5.864 5.772 5.796 5.761 5.881 5.879 5.976 5.915 5.763 5.851 5.852  
## [373] 5.862 5.915 5.856 5.814 5.774 5.715 5.795 5.837 5.759 5.856 5.788 5.876  
## [385] 5.908 5.977 5.940 5.831 5.629 5.711 5.691 5.795 5.788 5.951 5.849 5.744  
## [397] 5.716 5.743 5.818 5.869 5.892 5.780 5.867 5.869 5.643 6.002 5.846 5.907  
## [409] 5.961 5.855 5.756 5.957 5.806 5.750 5.736 5.865 5.788 5.951 5.869 5.846  
## [421] 5.721 5.843 6.060 5.789 5.707 5.721 5.718 5.808 5.968 5.869 5.834 5.901  
## [433] 5.774 5.777 5.911 5.725 5.849 5.797 5.810 5.808 5.929 5.896 5.960 5.862  
## [445] 5.880 6.011 5.588 5.972 5.719 5.771 6.070 5.845 5.962 5.873 5.992 5.761  
## [457] 5.777 5.926 5.924 5.915 5.763 5.898 5.904 5.975 5.871 5.588 5.998 5.838  
## [469] 5.843 5.757 5.959 5.847 5.926 5.820 5.949 5.931 5.848 5.946 5.892 5.922  
## [481] 5.722 5.710 5.936 5.982 5.739 5.930 5.932 5.847 5.854 5.833 5.801 5.908  
## [493] 5.753 5.963 5.868 5.713 5.957 5.856 5.809 5.689 5.729 5.892 5.787 5.878  
## [505] 5.853 5.804 5.885 5.889 5.814 5.854 5.784 5.968 5.885 5.900 5.884 5.835  
## [517] 5.717 5.814 5.944 5.883 5.738 5.770 5.934 5.901 5.859 5.886 5.789 5.827  
## [529] 5.896 5.899 5.760 5.896 5.832 5.865 5.909 5.964 5.818 5.851 5.708 5.720  
## [541] 5.834 5.863 5.945 5.793 5.877 5.748 5.870 5.755 5.779 5.859 5.728 5.784  
## [553] 5.924 5.895 5.765 5.885 5.824 5.974 5.768 6.081 5.830 5.846 5.778 5.742  
## [565] 5.947 5.950 5.795 5.779 5.974 5.893 5.747 5.855 5.712 5.763 5.829 5.920  
## [577] 5.833 5.928 5.801 5.805 5.914 5.870 5.682 6.023 5.664 5.892 5.860 5.760  
## [589] 5.760 5.985 5.850 5.828 5.684 5.860 5.766 5.821 5.815 5.778 5.958 5.943  
## [601] 5.823 5.866 5.919 5.934 6.092 5.970 5.843 5.864 5.846 5.899 5.809 5.767  
## [613] 5.746 5.810 5.894 5.875 5.900 5.775 5.791 5.858 5.776 6.006 5.893 5.890  
## [625] 5.756 6.021 5.957 5.652 5.892 5.993 6.014 5.777 5.852 5.780 5.973 5.864  
## [637] 5.727 6.023 5.829 5.847 5.820 5.798 5.767 5.873 5.785 5.753 5.835 5.901  
## [649] 5.960 5.837 5.714 5.981 5.841 5.869 5.801 5.892 5.812 5.815 5.871 5.802  
## [661] 5.847 5.834 5.847 5.970 5.658 5.833 5.799 5.823 5.831 5.792 5.865 5.806  
## [673] 5.834 5.850 5.830 5.958 5.886 5.848 5.817 5.751 5.872 5.933 5.934 5.829  
## [685] 5.878 5.780 5.831 5.917 5.837 5.971 5.920 5.845 5.779 5.701 5.788 5.898  
## [697] 5.914 5.789 5.977 5.917 5.848 5.915 5.880 5.839 5.814 5.681 5.849 5.830  
## [709] 5.729 5.784 5.790 5.809 5.746 5.851 5.820 5.746 5.857 5.812 5.936 5.867  
## [721] 5.967 5.735 5.842 5.765 5.875 5.900 5.847 5.912 5.748 5.897 5.817 6.018  
## [733] 5.903 5.961 5.778 5.731 5.847 5.901 5.784 5.802 5.803 5.834 5.800 5.842  
## [745] 5.818 5.697 5.744 5.681 5.826 5.767 5.783 5.935 5.795 5.837 5.834 5.765  
## [757] 5.799 5.929 5.880 5.811 5.690 5.830 5.781 5.846 5.913 5.833 5.882 5.996  
## [769] 5.890 6.007 5.825 5.762 5.864 5.787 5.766 5.838 5.681 5.873 5.919 5.798  
## [781] 5.728 5.835 5.951 5.943 5.791 5.924 5.740 5.789 6.019 5.885 5.947 5.884  
## [793] 5.972 5.853 6.045 5.882 5.903 5.913 5.851 5.814 5.822 5.902 5.834 5.873  
## [805] 5.984 5.724 5.750 5.796 5.836 5.860 5.749 5.749 5.845 5.776 5.881 5.887  
## [817] 5.889 5.725 5.838 5.773 5.898 5.733 5.727 5.864 5.894 5.872 5.938 5.934  
## [829] 5.725 5.859 5.699 5.880 5.848 5.840 6.001 5.882 5.793 5.798 5.888 5.802  
## [841] 5.841 5.948 5.875 5.777 5.888 5.898 5.862 5.676 5.911 5.959 5.795 5.869  
## [853] 5.883 5.768 5.738 5.773 5.796 5.889 5.807 5.878 5.845 5.788 5.814 5.886  
## [865] 5.796 5.829 5.742 5.851 5.908 5.994 5.839 5.918 5.805 5.709 5.779 5.938  
## [877] 5.890 5.716 5.924 5.971 5.854 5.907 5.889 5.728 5.999 5.842 5.939 5.816  
## [889] 5.833 5.787 5.911 5.778 5.734 5.782 5.780 5.996 5.736 5.814 5.818 5.840  
## [901] 5.823 5.791 5.866 5.930 5.939 5.753 5.789 5.941 5.726 5.897 5.789 5.909  
## [913] 5.985 5.792 5.836 5.954 5.777 5.908 5.792 5.797 5.857 5.866 5.840 5.834  
## [925] 5.817 5.750 5.949 5.823 5.717 5.754 5.925 5.850 5.869 5.947 5.990 5.785  
## [937] 5.905 5.777 5.912 5.924 5.871 5.783 5.720 5.818 5.773 5.868 5.856 5.812  
## [949] 5.842 5.919 5.855 5.896 5.882 5.876 5.883 5.965 5.819 5.673 5.754 5.916  
## [961] 5.826 5.805 5.940 5.822 5.904 5.680 5.821 5.894 5.857 5.934 5.896 6.066  
## [973] 5.649 5.875 5.923 5.784 5.861 5.772 5.823 5.869 5.909 5.931 5.805 5.903  
## [985] 5.715 5.749 5.911 5.854 5.958 5.708 5.813 5.771 5.773 5.732 5.596 5.914  
## [997] 5.795 5.842 5.962 5.848

Now we have successfully replicated a 1000 times the process of randomly selecting 100 samples from the 150 population.

## VISUALIZING SAMPLING DISTRIBUTION OF SAMPLE SIZE 15 WITH REPLICATION:

hist(samp\_dist4, xlab="Sepal Length", main="Sampling distribution of Sepal Length", col="#00FF00") # Finding how it is distributed using histogram



Now we have a proper idea about how the histogram is distributed.

## FINDING VARIANCE OF THE SAMPLING DISTRIBUTION OF SAMPLE SIZE 100:

var(samp\_dist4)

## [1] 0.006751876

Thus, we get the variance of the sampling distribution of sample size 100.

## STANDARD ERROR OF SAMPLE SIZE 100:

# Method 1  
sd(samp\_dist4)

## [1] 0.0821698

# Method 2  
u=sample(iris$Sepal.Length, 100, replace = TRUE)  
v=sd(u)/sqrt(100)  
v

## [1] 0.08618491

Here, we can see Method 1 is the best standard error as it yields a result closer to 0 than Method 2.

# FINAL CONCLUSION:

When we select a larger sample size the standard error gets more and more closer to 0. This claim is validated with proper relevant results from the standard error calculation of different sample sizes of 10, 15, 50 and 100, with sample size 10 giving the standard error furthest from 0 while sample size 100 giving the standard error closest to 0.