STA 326 2.0 Programming and Data Analysis with R
Tutorial 1

Contents

1 Creating vectors

1. Create the following vectors:
   (a) 1, 2, 3, . . . , 100
   (b) 2, 4, 6, 8, . . . , 100
   (c)
2. Generate a sequence using the code `seq(from=1, to=10, by=1)`. What other ways can you generate the same sequence?
3. Using the function `rep()` , create the below sequence `1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4`
4. Create a vector that shows the square root the integers from 1 to 100.
5. Observe the differences in running the following codes.

```
vec1 <- 1.8:20.8
vec1
```

```
 [1]  1.8  2.8  3.8  4.8  5.8  6.8  7.8  8.8  9.8 10.8 11.8 12.8 13.8 14.8 15.8
[16] 16.8 17.8 18.8 19.8 20.8
```

```
vec2 <- 1.8:30
vec2
```

```
 [1]  1.8  2.8  3.8  4.8  5.8  6.8  7.8  8.8  9.8 10.8 11.8 12.8 13.8 14.8 15.8
[16] 16.8 17.8 18.8 19.8 20.8 21.8 22.8 23.8 24.8 25.8 26.8 27.8 28.8 29.8
```

2 Object classes and type of objects

6. Use `typeof` to identify the storage mode of the following objects and `class` to identify object classes.

```
a <- c("MON", "TUES", "WED", "THUR", "FRI")
typeof(a)
```

```
[1] "character"
```

```
class(a)
```

```
[1] "character"
```

```
b <- c(1, 2, 3, 4, 5)
typeof(b)
```

```
[1] "double"
```

```
class(b)
```

```
[1] "numeric"
```

```
c <- c(1L, 2L, 3L, 4L, 5L)
typeof(c)
```

```
[1] "integer"
```

```
class(c)
```

```
[1] "integer"
```

```
d <- c(TRUE, FALSE, TRUE, TRUE)
typeof(d)
```

```
[1] "logical"
```

```
class(d)
```

```
[1] "logical"
```

```r
e <- c(2+3i, 1+2i, 5+3i)
typeof(e)
```

```
[1] "complex"
```

```r
class(e)
```

```
[1] "complex"
```

```r
f <- c("MON", TRUE, 1, 1L)
typeof(f)
```

```
[1] "character"
```

```r
class(f)
```

```
[1] "character"
```

7. Explore comment on the output of follwong vector functions.

```r
a1 <- vector("numeric", 8)
a2 <- vector("complex", 8)
a3 <- vector("logical", 8)
a4 <- vector("character", 8)

b1 <- numeric(8)
b2 <- complex(8)
b3 <- logical(8)
b4 <- character(8)
```

Ans: Each of the values in the result is zero, FALSE, or an empty string, or whatever the equivalent of "empty".

3 Subsetting vectors

8. Consider the vector

```r
set.seed(32020)
st_normal <- rnorm(100)
st_normal
```

```
  [1]  0.18183635 -0.92262020  2.06110995 -1.50040396 -1.69529463  2.45410426
  [7]  0.16552699 -2.20702891 -0.21274657 -0.69387976 -0.67516314  1.03136276
 [13]  0.77649171  0.60913641 -1.06664784  0.34027083 -0.47879695 -0.40281847
 [19] -1.12500580 -0.79235873 -0.89371755 -2.72593829  0.99052081 -0.53966792
 [25]  2.44848942  1.82337921 -0.52409631 -2.52099047 -0.01338390 -0.67771367
 [31] -0.26224412 -1.96067034  0.03172268 -0.83045197  1.60051305  0.04106971
 [37]  0.93303006 -1.31390340 -0.25427286 -0.61430209 -0.09897693  0.33713741
```

```
 [43]  0.45989743 -0.79752346 -0.77387974 -0.57871649 -1.24023942 -1.74035257
 [49] -0.02742062 -2.21931034  0.23715755 -0.47101092 -0.22116294 -1.45243410
 [55]  0.27650330 -1.76656058  0.01328862 -1.30263545  1.20788668  1.47504605
 [61] -2.19540879  0.44796633  0.39314554 -3.15206211 -0.32687439 -0.54550496
 [67]  1.39978830 -2.19770996  1.46683852 -1.19686302  0.87487978 -0.83723410
 [73]  1.37510059 -0.80996752  0.56198382  0.40264681  0.13343941 -0.05576293
 [79]  1.66654211 -0.78997663  0.29758171  0.36613867  0.80338650 -1.43640458
 [85] -0.56015981 -0.12409835 -0.75476839  0.32283051  1.46941104 -0.30940270
 [91] -1.14718708 -0.93229533  0.06524165 -0.20590515 -0.69251943  0.93134043
 [97]  0.28856808  1.04544874  0.24806814  0.22931507
```

Drop the elements corresponds to the positions multiply of 10 (10, 20, 30, . . .)

```
st_normal[-seq(1, 100, by=10)]
```

```
 [1] -0.92262020  2.06110995 -1.50040396 -1.69529463  2.45410426  0.16552699
 [7] -2.20702891 -0.21274657 -0.69387976  1.03136276  0.77649171  0.60913641
[13] -1.06664784  0.34027083 -0.47879695 -0.40281847 -1.12500580 -0.79235873
[19] -2.72593829  0.99052081 -0.53966792  2.44848942  1.82337921 -0.52409631
[25] -2.52099047 -0.01338390 -0.67771367 -1.96067034  0.03172268 -0.83045197
[31]  1.60051305  0.04106971  0.93303006 -1.31390340 -0.25427286 -0.61430209
[37]  0.33713741  0.45989743 -0.79752346 -0.77387974 -0.57871649 -1.24023942
[43] -1.74035257 -0.02742062 -2.21931034 -0.47101092 -0.22116294 -1.45243410
[49]  0.27650330 -1.76656058  0.01328862 -1.30263545  1.20788668  1.47504605
[55]  0.44796633  0.39314554 -3.15206211 -0.32687439 -0.54550496  1.39978830
[61] -2.19770996  1.46683852 -1.19686302 -0.83723410  1.37510059 -0.80996752
[67]  0.56198382  0.40264681  0.13343941 -0.05576293  1.66654211 -0.78997663
[73]  0.36613867  0.80338650 -1.43640458 -0.56015981 -0.12409835 -0.75476839
[79]  0.32283051  1.46941104 -0.30940270 -0.93229533  0.06524165 -0.20590515
[85] -0.69251943  0.93134043  0.28856808  1.04544874  0.24806814  0.22931507
```

9. The following vector `exponential_dis` generated 100 random numbers from exponential distribution with mean 10.

```
set.seed(32020)
exponential_dis <- rexp(100, 10)
```

Select subset of `exponential_dis` to identify the following.

10. What are the

11. Create a vector with elements from 1 to 100 incrementing by 0.4

```
seq(1, 100, by=0.4)
```

```
  [1]  1.0  1.4  1.8  2.2  2.6  3.0  3.4  3.8  4.2  4.6  5.0  5.4  5.8  6.2  6.6
 [16]  7.0  7.4  7.8  8.2  8.6  9.0  9.4  9.8 10.2 10.6 11.0 11.4 11.8 12.2 12.6
 [31] 13.0 13.4 13.8 14.2 14.6 15.0 15.4 15.8 16.2 16.6 17.0 17.4 17.8 18.2 18.6
 [46] 19.0 19.4 19.8 20.2 20.6 21.0 21.4 21.8 22.2 22.6 23.0 23.4 23.8 24.2 24.6
 [61] 25.0 25.4 25.8 26.2 26.6 27.0 27.4 27.8 28.2 28.6 29.0 29.4 29.8 30.2 30.6
 [76] 31.0 31.4 31.8 32.2 32.6 33.0 33.4 33.8 34.2 34.6 35.0 35.4 35.8 36.2 36.6
```

```
 [91] 37.0 37.4 37.8 38.2 38.6 39.0 39.4 39.8 40.2 40.6 41.0 41.4 41.8 42.2 42.6
[106] 43.0 43.4 43.8 44.2 44.6 45.0 45.4 45.8 46.2 46.6 47.0 47.4 47.8 48.2 48.6
[121] 49.0 49.4 49.8 50.2 50.6 51.0 51.4 51.8 52.2 52.6 53.0 53.4 53.8 54.2 54.6
[136] 55.0 55.4 55.8 56.2 56.6 57.0 57.4 57.8 58.2 58.6 59.0 59.4 59.8 60.2 60.6
[151] 61.0 61.4 61.8 62.2 62.6 63.0 63.4 63.8 64.2 64.6 65.0 65.4 65.8 66.2 66.6
[166] 67.0 67.4 67.8 68.2 68.6 69.0 69.4 69.8 70.2 70.6 71.0 71.4 71.8 72.2 72.6
[181] 73.0 73.4 73.8 74.2 74.6 75.0 75.4 75.8 76.2 76.6 77.0 77.4 77.8 78.2 78.6
[196] 79.0 79.4 79.8 80.2 80.6 81.0 81.4 81.8 82.2 82.6 83.0 83.4 83.8 84.2 84.6
[211] 85.0 85.4 85.8 86.2 86.6 87.0 87.4 87.8 88.2 88.6 89.0 89.4 89.8 90.2 90.6
[226] 91.0 91.4 91.8 92.2 92.6 93.0 93.4 93.8 94.2 94.6 95.0 95.4 95.8 96.2 96.6
[241] 97.0 97.4 97.8 98.2 98.6 99.0 99.4 99.8
```

12. Consider the vector `x`.

```
x <- 1:10
```

What does each of the following codes do?

```
x[3]

x[c(2, 4)]

x[-1]

x[c(2, -4)]

x[c(2.4, 3.54)]
```

```
x[3] # print the 3rd element

x[c(2, 4)] # print the 2nd and 4th elemen

x[-1] # print all except 1st

x[c(2, -4)] # Cannot mix positive and negative

x[c(2.4, 3.54)] # real numbers are truncated to integers
```

4 Filtering vectors based on conditions

13. Consider the vector

```
x <- c(80, 39, NA, 51, 51, 11, NA, NA, NA, 100, 80, 70)
```

Write an R code to extract non-missing values in `x`

```
# Answer 4
x[!is.na(x)]
```

```
[1]  80  39  51  51  11 100  80  70
```

Write an R code to extract missing values and odd-numbers in `x`

```
x[x %% 2 == 1]
```

```
[1] 39 NA 51 51 11 NA NA NA
```

Write an R code to extract odd numbers on `x`

```
y <- x[x %% 2 == 1]
y[!is.na(y)]
```

```
[1] 39 51 51 11
```

Which values of `x` are NOT in the set `1:50`

```
x %in% 1:50
```

```
 [1] FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
```

5 Modify a vector

14. Consider the following vector `age` which includes the age of 10 individuals

```
age <- c(20, 30, 40, 41, 32, 32, 25,  NA, NA, -4, -6, 9999, 10000)
```

```
i. Convert all negative values to `NA`.

ii. Convert all values of `age` that are NOT from 10 to 100 and calculate the mean of valid responses.
```

15. Consider the following vector of 100 random numbers generated from the standard normal distribution.

    i. Change the first five values in the vector to 1.
    ii. Change the last five values in the vector to 0.
    iii. Assign all values grater than 0.5 to 1 and all values less than 0.5 to 0.
    iv. Recode the 0 values to "MALE" and others to "FEMALE"

6 Vector operations

7 Combination of all concepts

15. Create new data vectors for each column and write R codes to answer the following questions.

    i. What is the name of the 10th movie in the list?
    ii.