# STOR 320 Programming III

Lecture 23

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### Loop Functions (Apply Functions)

- Chapter 18 in R Programming for Data Science
- lapply(): Loop over a list and evaluate a function on each element
- sapply(): Same as lapply but try to simplify the result
- apply(): Apply a function over the margins of an array

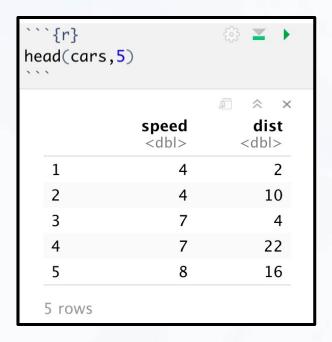
## lapply()

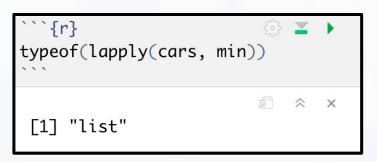
Operates on list, data frame and vectors

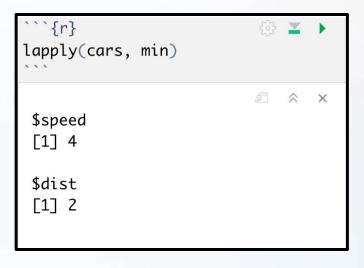
```
lapply(X, FUN, ...)
```

- Arguments:
  - X: A vector or an object
  - FUN: Function applied to each element of x
  - ...: Other arguments not in loop

## lapply()







```
\``{r}
lapply(cars, mean)

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$\frac{1}{2} \times
$\fr
```

## sapply()

Like lapply() but simplifies the output

```
sapply(X, FUN, OTHER)
```

- Arguments:
  - X: A vector or an object
  - FUN: Function applied to each element of x
  - OTHER: Other arguments not in loop

```
```{r}
sapply(cars, min)

.``

speed dist
4 2
```

```
typeof(sapply(cars, min))

in the same of the sam
```

### Example

 Use sapply() or lapply() to generate 100 random samples from normal distributions with means of 0 to 99 and save the random samples to A.

The k-th component of a is generated from N(k-1,1).

```
set.seed(200)
a = rep(NA, 100)
for (k in 1:100) {
 a[k]=rnorm(1,k-1,1)
set.seed(200)
A = sapply(0:99, rnorm, n=1, sd=1)
identical(a,A)
```

## apply()

- Takes data frame or matrix as an input
- Gives output in vector, list or array

#### apply(X, MARGIN, FUN, ...)

- X: an array or matrix
- MARGIN: take a value or range between 1 and 2 to define where to apply the function:
  - MARGIN=1: the manipulation is performed on rows
  - MARGIN=2: the manipulation is performed on columns
  - MARGIN=c(1,2): the manipulation is performed on rows and columns
- FUN: tells which function to apply.

### apply()

```
```{r}
M = matrix(1:1000,100,10)
sum\_row = apply(M, 1, sum)
sum\_col = apply(M, 2, sum)
identical(sum_row,as.integer(rowSums(M)))
identical(sum_col,as.integer(colSums(M)))
               ```{r}
              MIN = apply(Cigar, 2, min)
    TRUE
 Г17
              Q1 = apply(Cigar, 2, quantile, probs=0.25)
 [1] TRUE
              Q2 = apply(Cigar, 2, quantile, probs=0.5)
               Q3 = apply(Cigar, 2, quantile, probs=0.75)
              MAX = apply(Cigar, 2, max)
              FiveSum.Cigar = rbind(MIN, Q1, Q2, Q3, MAX)
              FiveSum.Cigar
   ndi sales
   pimin
                   state year
                                price
  pop
  pop16
  cpi
               MIN
                     1.0 63.0
                              23.400
                                       319.00
  215.200 30.6 1322.573 53.4
  23.400
               Q1
                    15.0 70.0
                              34.775
                                      1053.00
   781.175 38.8
  3327.869 107.9
  31.975
               Q2
                    26.5 77.5
                              52.300
                                      3174.00
   2315.300 62.9
  6281.201 121.2
  46,400
               03
                    40.0 85.0 98.100
   3914.325 107.6 11024.110 133.2
                                      5280.25
  90.500
                    51.0 92.0 201.900 30703.30 22920.000 140.3 23074.000 297.9 178.500
```

### Statistical Programming Assignment

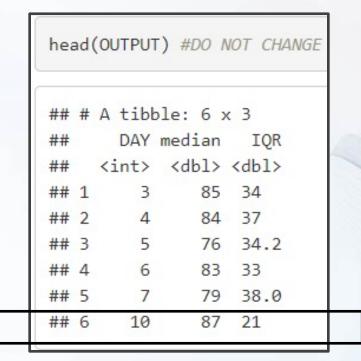
- Instructions
  - Download Analysis 3 Zip Folder
  - Unzip Folder
  - Open Analysis 3 Rmd File
  - Knit to HTML
  - Read Introduction
- Three Part Assignment
  - Each Part Self Contained
  - Most Answers Require Copy-and- Paste
  - Where You See COMPLETE You Should Write/Place Code
  - Leave Code as is When You See #DO NOT CHANGE

### Part 1: Discussion

- Process of Programming
  - Create Practice Example
  - Check Code Works
  - Apply Code to Real Data
  - Check Code Works
  - Create a Function of the Process
- Goals
  - Create a Function that Creates a Factor Variable of Abbreviated Weekdays (Easy)
  - Create a Function that Creates a Plot (Difficult)
- Start Working (15 min)

### Part 2: Discussion

- Focus on Traffic Volume (DATA2) and Specific Location ("L103")
- Look at Table
- Goal: Reconstruct this Table



### Part 2: Discussion

- Steps:
  - Given the Day in April, Create Function that Outputs the Associated Row
  - Use the Function in a Loop to Construct the Table
- Two Loops
  - Initiate with NULL
  - Initiate with Empty Tibble
- Look at Lecture on Loops
- Q3 is Tricky
- Start Working (15 min)

### Part 3: Discussion

- Functions That Apply Functions Across Dimensions Of R Object
- Doesn't Require a Loop
- Tibbles are Matrices
  - Apply Functions to Rows
  - Apply Functions to Columns (Think Summarize)
- Apply() Function to Matrix
  - To Rows apply(Matrix, 1, Function)
  - To Columns apply(Matrix, 2, Function)
- Start Working (Rest of Class)