1. Exploring Data Types

```
sin(pi/4)
[1] 0.7071068
> atan(pi/4)
[1] 0.6657738
> 1:25
 [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
> x = c(2:25)
> x(1)
Error in x(1) : could not find function "x"
> x[1]
[1] 2
> tan(na)
Error: object 'na' not found
> tan(NA)
[1] NA
> atan(90)
[1] 1.559686
> atan(pi/2)
[1] 1.003885
> x[0]
integer(0)
> x[1] = 22
> x
 [1] 22  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
> x[0] = 11
> x
 [1] 22  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
> x[0]
numeric(0)
> 2==2
[1] TRUE
```

2. Data Frames

```
> empid = c(1, 2, 3)
> empname = c("A", "B", "C")
> empdesig = c("CSE", "ECE", "ECM")
> empsal = c(1200, 12, 12000)
> empage = c(12, 33, 123)
> empgender = c("M", "M", "F")
> df = data.frame(empid, empname, empdesig, empsal, empage, empgender)
> df
  empid empname empdesig empsal empage empgender
1     1       A      CSE   1200     12         M
2     2       B      ECE     12     33         M
3     3       C      ECM  12000    123         F

>

> df[1,4]
[1] 1200
> nrow(df)
[1] 3
> ncol(mtcars)
[1] 11
```

3. MT cars Data Analysis

```
> dff = mtcars

> dff
                   mpg cyl  disp  hp drat    wt  qsec vs am gear carb
Mazda RX4          21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag      21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
Datsun 710         22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive     21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout  18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
Valiant            18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
Duster 360         14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
Merc 240D          24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
Merc 230           22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
Merc 280           19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
Merc 280C          17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
Merc 450SE         16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
Merc 450SL         17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
Merc 450SLC        15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
Cadillac Fleetwood 10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
Lincoln Continental 10.4  8 460.0 215 3.00 5.424 17.82  0  0    3    4
Chrysler Imperial  14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
Fiat 128           32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
Honda Civic        30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
Toyota Corolla     33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
Toyota Corona      21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
Dodge Challenger   15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
AMC Javelin        15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
Camaro Z28         13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
Pontiac Firebird   19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
Fiat X1-9          27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
Porsche 914-2      26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
Lotus Europa       30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Ford Pantera L     15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
Ferrari Dino       19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
Maserati Bora      15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
Volvo 142E         21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2


> dff$vs = factor(dff$vs, labels = c("Low", "High"))
> dff
                   mpg cyl  disp  hp drat    wt  qsec   vs am gear carb
Mazda RX4          21.0   6 160.0 110 3.90 2.620 16.46  Low  1    4    4
Mazda RX4 Wag      21.0   6 160.0 110 3.90 2.875 17.02  Low  1    4    4
Datsun 710         22.8   4 108.0  93 3.85 2.320 18.61 High  1    4    1
Hornet 4 Drive     21.4   6 258.0 110 3.08 3.215 19.44 High  0    3    1
Hornet Sportabout  18.7   8 360.0 175 3.15 3.440 17.02  Low  0    3    2
Valiant            18.1   6 225.0 105 2.76 3.460 20.22 High  0    3    1
Duster 360         14.3   8 360.0 245 3.21 3.570 15.84  Low  0    3    4
Merc 240D          24.4   4 146.7  62 3.69 3.190 20.00 High  0    4    2
```

```
Merc 230           22.8   4 140.8  95 3.92 3.150 22.90 High  0    4    2
Merc 280           19.2   6 167.6 123 3.92 3.440 18.30 High  0    4    4
Merc 280C          17.8   6 167.6 123 3.92 3.440 18.90 High  0    4    4
Merc 450SE         16.4   8 275.8 180 3.07 4.070 17.40  Low  0    3    3
Merc 450SL         17.3   8 275.8 180 3.07 3.730 17.60  Low  0    3    3
Merc 450SLC        15.2   8 275.8 180 3.07 3.780 18.00  Low  0    3    3
Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  Low  0    3    4
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  Low  0    3    4
Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  Low  0    3    4
Fiat 128           32.4   4  78.7  66 4.08 2.200 19.47 High  1    4    1
Honda Civic        30.4   4  75.7  52 4.93 1.615 18.52 High  1    4    2
Toyota Corolla     33.9   4  71.1  65 4.22 1.835 19.90 High  1    4    1
Toyota Corona      21.5   4 120.1  97 3.70 2.465 20.01 High  0    3    1
Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  Low  0    3    2
AMC Javelin        15.2   8 304.0 150 3.15 3.435 17.30  Low  0    3    2
Camaro Z28         13.3   8 350.0 245 3.73 3.840 15.41  Low  0    3    4
Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  Low  0    3    2
Fiat X1-9          27.3   4  79.0  66 4.08 1.935 18.90 High  1    4    1
Porsche 914-2      26.0   4 120.3  91 4.43 2.140 16.70  Low  1    5    2
Lotus Europa       30.4   4  95.1 113 3.77 1.513 16.90 High  1    5    2
Ford Pantera L     15.8   8 351.0 264 4.22 3.170 14.50  Low  1    5    4
Ferrari Dino       19.7   6 145.0 175 3.62 2.770 15.50  Low  1    5    6
Maserati Bora      15.0   8 301.0 335 3.54 3.570 14.60  Low  1    5    8
Volvo 142E         21.4   4 121.0 109 4.11 2.780 18.60 High  1    4    2
```

```
> good = subset(dff, dff$vs=="High")
> good
                mpg cyl  disp  hp drat    wt  qsec   vs am gear carb
Datsun 710     22.8   4 108.0  93 3.85 2.320 18.61 High  1    4    1
Hornet 4 Drive 21.4   6 258.0 110 3.08 3.215 19.44 High  0    3    1
Valiant        18.1   6 225.0 105 2.76 3.460 20.22 High  0    3    1
Merc 240D      24.4   4 146.7  62 3.69 3.190 20.00 High  0    4    2
Merc 230       22.8   4 140.8  95 3.92 3.150 22.90 High  0    4    2
Merc 280       19.2   6 167.6 123 3.92 3.440 18.30 High  0    4    4
Merc 280C      17.8   6 167.6 123 3.92 3.440 18.90 High  0    4    4
Fiat 128       32.4   4  78.7  66 4.08 2.200 19.47 High  1    4    1
Honda Civic    30.4   4  75.7  52 4.93 1.615 18.52 High  1    4    2
Toyota Corolla 33.9   4  71.1  65 4.22 1.835 19.90 High  1    4    1
Toyota Corona  21.5   4 120.1  97 3.70 2.465 20.01 High  0    3    1
Fiat X1-9      27.3   4  79.0  66 4.08 1.935 18.90 High  1    4    1
Lotus Europa   30.4   4  95.1 113 3.77 1.513 16.90 High  1    5    2
Volvo 142E     21.4   4 121.0 109 4.11 2.780 18.60 High  1    4    2
```

```
> high = subset(dff, dff$mpg>19.0)
> high
                mpg cyl  disp  hp drat    wt  qsec   vs am gear carb
Mazda RX4        21.0   6 160.0 110 3.90 2.620 16.46  Low  1    4    4
Mazda RX4 Wag    21.0   6 160.0 110 3.90 2.875 17.02  Low  1    4    4
Datsun 710       22.8   4 108.0  93 3.85 2.320 18.61 High  1    4    1
Hornet 4 Drive   21.4   6 258.0 110 3.08 3.215 19.44 High  0    3    1
Merc 240D        24.4   4 146.7  62 3.69 3.190 20.00 High  0    4    2
```

```
Merc 230         22.8   4 140.8  95 3.92 3.150 22.90 High  0    4    2
Merc 280         19.2   6 167.6 123 3.92 3.440 18.30 High  0    4    4
Fiat 128         32.4   4  78.7  66 4.08 2.200 19.47 High  1    4    1
Honda Civic      30.4   4  75.7  52 4.93 1.615 18.52 High  1    4    2
Toyota Corolla   33.9   4  71.1  65 4.22 1.835 19.90 High  1    4    1
Toyota Corona    21.5   4 120.1  97 3.70 2.465 20.01 High  0    3    1
Pontiac Firebird 19.2   8 400.0 175 3.08 3.845 17.05  Low  0    3    2
Fiat X1-9        27.3   4  79.0  66 4.08 1.935 18.90 High  1    4    1
Porsche 914-2    26.0   4 120.3  91 4.43 2.140 16.70  Low  1    5    2
Lotus Europa     30.4   4  95.1 113 3.77 1.513 16.90 High  1    5    2
Ferrari Dino     19.7   6 145.0 175 3.62 2.770 15.50  Low  1    5    6
Volvo 142E       21.4   4 121.0 109 4.11 2.780 18.60 High  1    4    2


> lesshigh = subset(dff, (dff$mpg>19.0 & dff$mpg<22.0))
> lesshigh
                mpg cyl  disp  hp drat    wt  qsec   vs am gear carb
Mazda RX4        21.0   6 160.0 110 3.90 2.620 16.46  Low  1    4    4
Mazda RX4 Wag    21.0   6 160.0 110 3.90 2.875 17.02  Low  1    4    4
Hornet 4 Drive   21.4   6 258.0 110 3.08 3.215 19.44 High  0    3    1
Merc 280         19.2   6 167.6 123 3.92 3.440 18.30 High  0    4    4
Toyota Corona    21.5   4 120.1  97 3.70 2.465 20.01 High  0    3    1
Pontiac Firebird 19.2   8 400.0 175 3.08 3.845 17.05  Low  0    3    2
Ferrari Dino     19.7   6 145.0 175 3.62 2.770 15.50  Low  1    5    6
Volvo 142E       21.4   4 121.0 109 4.11 2.780 18.60 High  1    4    2

> summary(dff)
      mpg             cyl             disp             hp             drat
 Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0   Min.   :2.760
 1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5   1st Qu.:3.080
 Median :19.20   Median :6.000   Median :196.3   Median :123.0   Median :3.695
 Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7   Mean   :3.597
 3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0   3rd Qu.:3.920
 Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0   Max.   :4.930
       wt             qsec          vs              am              gear
 Min.   :1.513   Min.   :14.50   Low :18   Min.   :0.0000   Min.   :3.000
 1st Qu.:2.581   1st Qu.:16.89   High:14   1st Qu.:0.0000   1st Qu.:3.000
 Median :3.325   Median :17.71             Median :0.0000   Median :4.000
 Mean   :3.217   Mean   :17.85             Mean   :0.4062   Mean   :3.688
 3rd Qu.:3.610   3rd Qu.:18.90             3rd Qu.:1.0000   3rd Qu.:4.000
 Max.   :5.424   Max.   :22.90             Max.   :1.0000   Max.   :5.000
     carb
 Min.   :1.000
 1st Qu.:2.000
 Median :2.000
 Mean   :2.812
 3rd Qu.:4.000
 Max.   :8.000
```