FDA

LAB-2

DATA SORTING PRACRICE EXERCISE QUESTIONS:

```
> mtcars
                     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
>
```

```
> str(mtcars)
'data.frame':   32 obs. of  11 variables:
 $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
 $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
 $ disp: num  160 160 108 258 360 ...
 $ hp  : num  110 110 93 110 175 105 245 62 95 123 ...
 $ drat: num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
 $ wt  : num  2.62 2.88 2.32 3.21 3.44 ...
 $ qsec: num  16.5 17 18.6 19.4 17 ...
 $ vs  : num  0 0 1 1 0 1 0 1 1 1 ...
 $ am  : num  1 1 1 0 0 0 0 0 0 0 ...
 $ gear: num  4 4 4 3 3 3 3 4 4 4 ...
 $ carb: num  4 4 1 1 2 1 4 2 2 4 ...
```

```
> typeof(mtcars)
[1] "list"
>
>
> ncol(mtcars)
[1] 11
> nrow(mtcars)
[1] 32
>
```

```
> mtcars
                   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
> rownames(mtcars)
 [1] "Mazda RX4"           "Mazda RX4 Wag"       "Datsun 710"          "Hornet 4 Drive"      "Hornet Sportabout"
 [6] "Valiant"             "Duster 360"          "Merc 240D"           "Merc 230"            "Merc 280"
[11] "Merc 280C"           "Merc 450SE"          "Merc 450SL"          "Merc 450SLC"         "Cadillac Fleetwood"
[16] "Lincoln Continental" "Chrysler Imperial"   "Fiat 128"            "Honda Civic"         "Toyota Corolla"
[21] "Toyota Corona"       "Dodge Challenger"    "AMC Javelin"         "Camaro Z28"          "Pontiac Firebird"
[26] "Fiat X1-9"           "Porsche 914-2"       "Lotus Europa"        "Ford Pantera L"      "Ferrari Dino"
[31] "Maserati Bora"       "Volvo 142E"
>
> colnames(mtcars)
 [1] "mpg"  "cyl"  "disp" "hp"   "drat" "wt"   "qsec" "vs"   "am"   "gear" "carb"
>
> ncol(mtcars)
[1] 11
> nrow(mtcars)
[1] 32
```

```
> mtcars[2,]
               mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4 Wag  21   6  160 110  3.9 2.875 17.02  0  1    4    4
> mtcars[c(2,5,13),]
                 mpg cyl  disp  hp drat    wt  qsec vs am gear carb
Mazda RX4 Wag   21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
Hornet Sportabout 18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
Merc 450SL      17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
>
> mtcars[15:20,]
                  mpg cyl  disp  hp drat    wt  qsec vs am gear carb
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
>
```

```
> mtcars[c(13:24,28,30),]
                  mpg cyl  disp  hp drat    wt  qsec vs am gear carb
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
Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
>
```

```
> ?seq()
> mtcars[seq(1,32,by=2),]
                  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
Datsun 710          22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
Merc 230            22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
Merc 280C           17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
Merc 450SL          17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
Cadillac Fleetwood  10.4   8 472.0 205 2.93 5.250 17.98  0  0    3    4
Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
```

```
> mtcars[seq(2,32,by=2),]
                  mpg cyl  disp  hp drat    wt  qsec vs am gear carb
Mazda RX4 Wag       21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
Hornet 4 Drive      21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
Valiant             18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
Merc 240D           24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
Merc 280            19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
Fiat 128            32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
>
```

```
> mtcars[seq(1,32,by=3),]
                   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
Hornet 4 Drive    21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
Duster 360        14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
Merc 280          19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
Merc 450SL        17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
Honda Civic       30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
Dodge Challenger  15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
Pontiac Firebird  19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
Lotus Europa      30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
Maserati Bora     15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
>
```

```
> mtcars[c(1,nrow(mtcars)),]
          mpg cyl disp  hp drat   wt  qsec vs am gear carb
Mazda RX4  21.0   6  160 110 3.90 2.62 16.46  0  1    4    4
Volvo 142E 21.4   4  121 109 4.11 2.78 18.60  1  1    4    2
>
> mtcars[,3]
 [1] 160.0 160.0 108.0 258.0 360.0 225.0 360.0 146.7 140.8 167.6 167.6 275.8 275.8 275.8 472.0 460.0 440.0  78.7  75.7
[20]  71.1 120.1 318.0 304.0 350.0 400.0  79.0 120.3  95.1 351.0 145.0 301.0 121.0
>
> mtcars[,"wt"]
 [1] 2.620 2.875 2.320 3.215 3.440 3.460 3.570 3.190 3.150 3.440 3.440 4.070 3.730 3.780 5.250 5.424 5.345 2.200 1.615
[20] 1.835 2.465 3.520 3.435 3.840 3.845 1.935 2.140 1.513 3.170 2.770 3.570 2.780
```

```
> mtcars[,c("mpg","qsec")]
                   mpg  qsec
Mazda RX4         21.0 16.46
Mazda RX4 Wag     21.0 17.02
Datsun 710        22.8 18.61
Hornet 4 Drive    21.4 19.44
Hornet Sportabout 18.7 17.02
Valiant           18.1 20.22
Duster 360        14.3 15.84
Merc 240D         24.4 20.00
Merc 230          22.8 22.90
Merc 280          19.2 18.30
Merc 280C         17.8 18.90
Merc 450SE        16.4 17.40
Merc 450SL        17.3 17.60
Merc 450SLC       15.2 18.00
Cadillac Fleetwood 10.4 17.98
Lincoln Continental 10.4 17.82
Chrysler Imperial 14.7 17.42
Fiat 128          32.4 19.47
Honda Civic       30.4 18.52
Toyota Corolla    33.9 19.90
Toyota Corona     21.5 20.01
Dodge Challenger  15.5 16.87
AMC Javelin       15.2 17.30
Camaro Z28        13.3 15.41
Pontiac Firebird  19.2 17.05
Fiat X1-9         27.3 18.90
Porsche 914-2     26.0 16.70
Lotus Europa      30.4 16.90
Ford Pantera L    15.8 14.50
Ferrari Dino      19.7 15.50
Maserati Bora     15.0 14.60
Volvo 142E        21.4 18.60
>
```

```
> mtcars[,1:3]
                   mpg cyl  disp
Mazda RX4         21.0   6 160.0
Mazda RX4 Wag     21.0   6 160.0
Datsun 710        22.8   4 108.0
Hornet 4 Drive    21.4   6 258.0
Hornet Sportabout 18.7   8 360.0
Valiant           18.1   6 225.0
Duster 360        14.3   8 360.0
Merc 240D         24.4   4 146.7
Merc 230          22.8   4 140.8
Merc 280          19.2   6 167.6
Merc 280C         17.8   6 167.6
Merc 450SE        16.4   8 275.8
Merc 450SL        17.3   8 275.8
Merc 450SLC       15.2   8 275.8
Cadillac Fleetwood  10.4   8 472.0
Lincoln Continental 10.4   8 460.0
Chrysler Imperial   14.7   8 440.0
Fiat 128          32.4   4  78.7
Honda Civic       30.4   4  75.7
Toyota Corolla    33.9   4  71.1
Toyota Corona     21.5   4 120.1
Dodge Challenger  15.5   8 318.0
AMC Javelin       15.2   8 304.0
Camaro Z28        13.3   8 350.0
Pontiac Firebird  19.2   8 400.0
Fiat X1-9         27.3   4  79.0
Porsche 914-2     26.0   4 120.3
Lotus Europa      30.4   4  95.1
Ford Pantera L    15.8   8 351.0
Ferrari Dino      19.7   6 145.0
Maserati Bora     15.0   8 301.0
Volvo 142E        21.4   4 121.0
```

```
> mtcars[,5:10]
                   drat    wt  qsec vs am gear
Mazda RX4         3.90 2.620 16.46  0  1    4
Mazda RX4 Wag     3.90 2.875 17.02  0  1    4
Datsun 710        3.85 2.320 18.61  1  1    4
Hornet 4 Drive    3.08 3.215 19.44  1  0    3
Hornet Sportabout 3.15 3.440 17.02  0  0    3
Valiant           2.76 3.460 20.22  1  0    3
Duster 360        3.21 3.570 15.84  0  0    3
Merc 240D         3.69 3.190 20.00  1  0    4
Merc 230          3.92 3.150 22.90  1  0    4
Merc 280          3.92 3.440 18.30  1  0    4
Merc 280C         3.92 3.440 18.90  1  0    4
Merc 450SE        3.07 4.070 17.40  0  0    3
Merc 450SL        3.07 3.730 17.60  0  0    3
Merc 450SLC       3.07 3.780 18.00  0  0    3
Cadillac Fleetwood  2.93 5.250 17.98  0  0    3
Lincoln Continental 3.00 5.424 17.82  0  0    3
Chrysler Imperial   3.23 5.345 17.42  0  0    3
Fiat 128          4.08 2.200 19.47  1  1    4
Honda Civic       4.93 1.615 18.52  1  1    4
Toyota Corolla    4.22 1.835 19.90  1  1    4
Toyota Corona     3.70 2.465 20.01  1  0    3
Dodge Challenger  2.76 3.520 16.87  0  0    3
AMC Javelin       3.15 3.435 17.30  0  0    3
Camaro Z28        3.73 3.840 15.41  0  0    3
Pontiac Firebird  3.08 3.845 17.05  0  0    3
Fiat X1-9         4.08 1.935 18.90  1  1    4
Porsche 914-2     4.43 2.140 16.70  0  1    5
Lotus Europa      3.77 1.513 16.90  1  1    5
Ford Pantera L    4.22 3.170 14.50  0  1    5
Ferrari Dino      3.62 2.770 15.50  0  1    5
Maserati Bora     3.54 3.570 14.60  0  1    5
Volvo 142E        4.11 2.780 18.60  1  1    4
```

```
> mtcars[,c(3:7,9,11)]
                   disp  hp drat    wt  qsec am carb
Mazda RX4         160.0 110 3.90 2.620 16.46  1    4
Mazda RX4 Wag     160.0 110 3.90 2.875 17.02  1    4
Datsun 710        108.0  93 3.85 2.320 18.61  1    1
Hornet 4 Drive    258.0 110 3.08 3.215 19.44  0    1
Hornet Sportabout 360.0 175 3.15 3.440 17.02  0    2
Valiant           225.0 105 2.76 3.460 20.22  0    1
Duster 360        360.0 245 3.21 3.570 15.84  0    4
Merc 240D         146.7  62 3.69 3.190 20.00  0    2
Merc 230          140.8  95 3.92 3.150 22.90  0    2
Merc 280          167.6 123 3.92 3.440 18.30  0    4
Merc 280C         167.6 123 3.92 3.440 18.90  0    4
Merc 450SE        275.8 180 3.07 4.070 17.40  0    3
Merc 450SL        275.8 180 3.07 3.730 17.60  0    3
Merc 450SLC       275.8 180 3.07 3.780 18.00  0    3
Cadillac Fleetwood  472.0 205 2.93 5.250 17.98  0    4
Lincoln Continental 460.0 215 3.00 5.424 17.82  0    4
Chrysler Imperial   440.0 230 3.23 5.345 17.42  0    4
Fiat 128           78.7  66 4.08 2.200 19.47  1    1
Honda Civic        75.7  52 4.93 1.615 18.52  1    2
Toyota Corolla     71.1  65 4.22 1.835 19.90  1    1
Toyota Corona      120.1  97 3.70 2.465 20.01  0    1
Dodge Challenger   318.0 150 2.76 3.520 16.87  0    2
AMC Javelin        304.0 150 3.15 3.435 17.30  0    2
Camaro Z28         350.0 245 3.73 3.840 15.41  0    4
Pontiac Firebird   400.0 175 3.08 3.845 17.05  0    2
Fiat X1-9          79.0  66 4.08 1.935 18.90  1    1
Porsche 914-2      120.3  91 4.43 2.140 16.70  1    2
Lotus Europa       95.1 113 3.77 1.513 16.90  1    2
Ford Pantera L     351.0 264 4.22 3.170 14.50  1    4
Ferrari Dino       145.0 175 3.62 2.770 15.50  1    6
Maserati Bora      301.0 335 3.54 3.570 14.60  1    8
Volvo 142E         121.0 109 4.11 2.780 18.60  1    2
```

```
> mtcars[,seq(1,ncol(mtcars),by=2)]
                    mpg  disp drat  qsec am carb
Mazda RX4          21.0 160.0 3.90 16.46  1    4
Mazda RX4 Wag      21.0 160.0 3.90 17.02  1    4
Datsun 710         22.8 108.0 3.85 18.61  1    1
Hornet 4 Drive     21.4 258.0 3.08 19.44  0    1
Hornet Sportabout  18.7 360.0 3.15 17.02  0    2
Valiant            18.1 225.0 2.76 20.22  0    1
Duster 360         14.3 360.0 3.21 15.84  0    4
Merc 240D          24.4 146.7 3.69 20.00  0    2
Merc 230           22.8 140.8 3.92 22.90  0    2
Merc 280           19.2 167.6 3.92 18.30  0    4
Merc 280C          17.8 167.6 3.92 18.90  0    4
Merc 450SE         16.4 275.8 3.07 17.40  0    3
Merc 450SL         17.3 275.8 3.07 17.60  0    3
Merc 450SLC        15.2 275.8 3.07 18.00  0    3
Cadillac Fleetwood  10.4 472.0 2.93 17.98  0    4
Lincoln Continental 10.4 460.0 3.00 17.82  0    4
Chrysler Imperial   14.7 440.0 3.23 17.42  0    4
Fiat 128           32.4  78.7 4.08 19.47  1    1
Honda Civic        30.4  75.7 4.93 18.52  1    2
Toyota Corolla     33.9  71.1 4.22 19.90  1    1
Toyota Corona      21.5 120.1 3.70 20.01  0    1
Dodge Challenger   15.5 318.0 2.76 16.87  0    2
AMC Javelin        15.2 304.0 3.15 17.30  0    2
Camaro Z28         13.3 350.0 3.73 15.41  0    4
Pontiac Firebird   19.2 400.0 3.08 17.05  0    2
Fiat X1-9          27.3  79.0 4.08 18.90  1    1
Porsche 914-2      26.0 120.3 4.43 16.70  1    2
Lotus Europa       30.4  95.1 3.77 16.90  1    2
Ford Pantera L     15.8 351.0 4.22 14.50  1    4
Ferrari Dino       19.7 145.0 3.62 15.50  1    6
Maserati Bora      15.0 301.0 3.54 14.60  1    8
Volvo 142E         21.4 121.0 4.11 18.60  1    2
```

```
> mtcars[,seq(2,ncol(mtcars),by=2)]
                  cyl  hp    wt vs gear
Mazda RX4           6 110 2.620  0    4
Mazda RX4 Wag       6 110 2.875  0    4
Datsun 710          4  93 2.320  1    4
Hornet 4 Drive      6 110 3.215  1    3
Hornet Sportabout   8 175 3.440  0    3
Valiant             6 105 3.460  1    3
Duster 360          8 245 3.570  0    3
Merc 240D           4  62 3.190  1    4
Merc 230            4  95 3.150  1    4
Merc 280            6 123 3.440  1    4
Merc 280C           6 123 3.440  1    4
Merc 450SE          8 180 4.070  0    3
Merc 450SL          8 180 3.730  0    3
Merc 450SLC         8 180 3.780  0    3
Cadillac Fleetwood  8 205 5.250  0    3
Lincoln Continental 8 215 5.424  0    3
Chrysler Imperial   8 230 5.345  0    3
Fiat 128            4  66 2.200  1    4
Honda Civic         4  52 1.615  1    4
Toyota Corolla      4  65 1.835  1    4
Toyota Corona       4  97 2.465  1    3
Dodge Challenger    8 150 3.520  0    3
AMC Javelin         8 150 3.435  0    3
Camaro Z28          8 245 3.840  0    3
Pontiac Firebird    8 175 3.845  0    3
Fiat X1-9           4  66 1.935  1    4
Porsche 914-2       4  91 2.140  0    5
Lotus Europa        4 113 1.513  1    5
Ford Pantera L      8 264 3.170  0    5
Ferrari Dino        6 175 2.770  0    5
Maserati Bora       8 335 3.570  0    5
Volvo 142E          4 109 2.780  1    4
```

```
> mtcars[,seq(1,ncol(mtcars),by=3)]
                   mpg  hp  qsec gear
Mazda RX4         21.0 110 16.46    4
Mazda RX4 Wag     21.0 110 17.02    4
Datsun 710        22.8  93 18.61    4
Hornet 4 Drive    21.4 110 19.44    3
Hornet Sportabout 18.7 175 17.02    3
Valiant           18.1 105 20.22    3
Duster 360        14.3 245 15.84    3
Merc 240D         24.4  62 20.00    4
Merc 230          22.8  95 22.90    4
Merc 280          19.2 123 18.30    4
Merc 280C         17.8 123 18.90    4
Merc 450SE        16.4 180 17.40    3
Merc 450SL        17.3 180 17.60    3
Merc 450SLC       15.2 180 18.00    3
Cadillac Fleetwood  10.4 205 17.98    3
Lincoln Continental 10.4 215 17.82    3
Chrysler Imperial   14.7 230 17.42    3
Fiat 128          32.4  66 19.47    4
Honda Civic       30.4  52 18.52    4
Toyota Corolla    33.9  65 19.90    4
Toyota Corona     21.5  97 20.01    3
Dodge Challenger  15.5 150 16.87    3
AMC Javelin       15.2 150 17.30    3
Camaro Z28        13.3 245 15.41    3
Pontiac Firebird  19.2 175 17.05    3
Fiat X1-9         27.3  66 18.90    4
Porsche 914-2     26.0  91 16.70    5
Lotus Europa      30.4 113 16.90    5
Ford Pantera L    15.8 264 14.50    5
Ferrari Dino      19.7 175 15.50    5
Maserati Bora     15.0 335 14.60    5
Volvo 142E        21.4 109 18.60    4
```

```
> mtcars[,c(1,ncol(mtcars))]
                     mpg carb
Mazda RX4           21.0    4
Mazda RX4 Wag       21.0    4
Datsun 710          22.8    1
Hornet 4 Drive      21.4    1
Hornet Sportabout   18.7    2
Valiant             18.1    1
Duster 360          14.3    4
Merc 240D           24.4    2
Merc 230            22.8    2
Merc 280            19.2    4
Merc 280C           17.8    4
Merc 450SE          16.4    3
Merc 450SL          17.3    3
Merc 450SLC         15.2    3
Cadillac Fleetwood  10.4    4
Lincoln Continental 10.4    4
Chrysler Imperial   14.7    4
Fiat 128            32.4    1
Honda Civic         30.4    2
Toyota Corolla      33.9    1
Toyota Corona       21.5    1
Dodge Challenger    15.5    2
AMC Javelin         15.2    2
Camaro Z28          13.3    4
Pontiac Firebird    19.2    2
Fiat X1-9           27.3    1
Porsche 914-2       26.0    2
Lotus Europa        30.4    2
Ford Pantera L      15.8    4
Ferrari Dino        19.7    6
Maserati Bora       15.0    8
Volvo 142E          21.4    2
```

```
> mtcars[1,c(2,3)]
          cyl disp
Mazda RX4   6  160
>
> mtcars[1:2,c(2,3)]
               cyl disp
Mazda RX4        6  160
Mazda RX4 Wag    6  160
>
> mtcars[2,3]
[1] 160
```

```
> mtcars[mtcars$mpg>14,]
                  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
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
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
>
> mtcars[mtcars$hp<14,]
 [1] mpg  cyl  disp hp   drat wt   qsec vs   am   gear carb
<0 rows> (or 0-length row.names)
>

> mtcars[mtcars$hp<14,]
 [1] mpg  cyl  disp hp   drat wt   qsec vs   am   gear carb
<0 rows> (or 0-length row.names)
>
> mtcars[mtcars$hp<100,]
                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  1  1    4    1
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
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
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
>
```

```
> mtcars[100<mtcars$disp && mtcars$disp<200,]
                  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
```

HEAD AND TAIL FUNCTIONS PRACTICE EXERCISE PROBLEMS:

```
> head(mtcars)
                  mpg cyl disp  hp drat    wt  qsec vs am gear carb
Mazda RX4        21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
Mazda RX4 Wag    21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
Datsun 710       22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
Hornet 4 Drive   21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
Hornet Sportabout 18.7  8  360 175 3.15 3.440 17.02  0  0    3    2
Valiant          18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
>
> tail(mtcars)
                mpg cyl  disp  hp drat    wt qsec vs am gear carb
Porsche 914-2  26.0   4 120.3  91 4.43 2.140 16.7  0  1    5    2
Lotus Europa   30.4   4  95.1 113 3.77 1.513 16.9  1  1    5    2
Ford Pantera L 15.8   8 351.0 264 4.22 3.170 14.5  0  1    5    4
Ferrari Dino   19.7   6 145.0 175 3.62 2.770 15.5  0  1    5    6
Maserati Bora  15.0   8 301.0 335 3.54 3.570 14.6  0  1    5    8
Volvo 142E     21.4   4 121.0 109 4.11 2.780 18.6  1  1    4    2
>
> head(mtcars,n=10)
                  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
```

```
> tail(mtcars,n=15)
                 mpg cyl  disp  hp drat    wt  qsec vs am gear carb
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
```

DATA CLEANING PRACTICE EXERCISE:

```
> x<-c(9:20,1:5,3:7,0:8)
> x
 [1]  9 10 11 12 13 14 15 16 17 18 19 20  1  2  3  4  5  3  4  5  6  7  0  1  2  3  4  5  6  7  8
>
> duplicated(x)
 [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE
[20]  TRUE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
>
> duplicated(x,fromLast = TRUE)
 [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
[20]  TRUE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
>
> x[duplicated(x)]
 [1] 3 4 5 1 2 3 4 5 6 7
>
> x[!duplicated(x)]
 [1]  9 10 11 12 13 14 15 16 17 18 19 20  1  2  3  4  5  6  7  0  8
>
> x[duplicated(x,fromLast = TRUE)]
 [1] 1 2 3 4 5 3 4 5 6 7
>
> x[!duplicated(x,fromLast = TRUE)]
 [1]  9 10 11 12 13 14 15 16 17 18 19 20  0  1  2  3  4  5  6  7  8
```

```
> which(duplicated(x))
 [1] 18 19 20 24 25 26 27 28 29 30
>
> which(!duplicated(x))
 [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 21 22 23 31
>
> sum(duplicated(x))
[1] 10
>
> sum(!duplicated(x))
[1] 21
```

```
> a<-c(rep("A",3),rep("B",3),rep("C",2))
> b<-c(1,1,2,4,1,1,2,2)
> df<-data.frame(a,b)
> df
  a b
1 A 1
2 A 1
3 A 2
4 B 4
5 B 1
6 B 1
7 C 2
8 C 2
>
> duplicated(df)
[1] FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE
>
> df[duplicated(df), ]
  a b
2 A 1
6 B 1
8 C 2
>
> unique(df)
  a b
1 A 1
3 A 2
4 B 4
5 B 1
7 C 2
```

```
> which(duplicated(df))
[1] 2 6 8
```

```
> which(!duplicated(df))
[1] 1 3 4 5 7
>
> sum(!duplicated(df))
[1] 5
>
> sum(duplicated(df))
[1] 3
>
```

```
> 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

```
> str(iris)
'data.frame':   150 obs. of  5 variables:
 $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species     : Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 1 ...
> summary(iris)
  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width          Species
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa    :50
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor:50
 Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica :50
 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
> ncol(iris)
[1] 5
> nrow(iris)
[1] 150
```

```
> str(iris)
'data.frame':   150 obs. of  5 variables:
 $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species     : Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 1 ...
> summary(iris)
  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width          Species
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa    :50
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor:50
 Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica :50
 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
> ncol(iris)
[1] 5
> nrow(iris)
[1] 150
```

```
> duplicated(iris)
  [1] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
 [20] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
 [39] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
 [58] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
 [77] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
 [96] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
[115] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
[134] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
> iris[duplicated(iris), ]
    Sepal.Length Sepal.Width Petal.Length Petal.Width   Species
143          5.8         2.7          5.1         1.9 virginica
```

```
> iris[!duplicated(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
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

```
> which(duplicated(iris))
[1] 143
> which(!duplicated(iris))
  [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  26  27  28  29
 [30]  30  31  32  33  34  35  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58
 [59]  59  60  61  62  63  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87
 [88]  88  89  90  91  92  93  94  95  96  97  98  99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116
[117] 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 144 145 146
[146] 147 148 149 150
> sum(duplicated(iris))
[1] 1
> sum(!duplicated(iris))
[1] 149
```