Data transformation Notebook

This is an R Markdown Notebook. When you execute code within the notebook, the results appear beneath the code.

Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Ctrl+Shift+Enter*.

```
library(tidyverse)
```

Add a new chunk by clicking the *Insert Chunk* button on the toolbar or by pressing *Ctrl+Alt+I*.

When you save the notebook, an HTML file containing the code and output will be saved alongside it (click the *Preview* button or press *Ctrl+Shift+K* to preview the HTML file).

The preview shows you a rendered HTML copy of the contents of the editor. Consequently, unlike *Knit*, *Preview* does not run any R code chunks. Instead, the output of the chunk when it was last run in the editor is displayed.

```
data = cars

data
```

```
##    speed dist
## 1      4    2
## 2      4   10
## 3      7    4
## 4      7   22
## 5      8   16
## 6      9   10
## 7     10   18
## 8     10   26
## 9     10   34
## 10    11   17
## 11    11   28
## 12    12   14
## 13    12   20
## 14    12   24
## 15    12   28
## 16    13   26
## 17    13   34
## 18    13   34
## 19    13   46
## 20    14   26
## 21    14   36
## 22    14   60
## 23    14   80
## 24    15   20
```

```
## 25    15   26
## 26    15   54
## 27    16   32
## 28    16   40
## 29    17   32
## 30    17   40
## 31    17   50
## 32    18   42
## 33    18   56
## 34    18   76
## 35    18   84
## 36    19   36
## 37    19   46
## 38    19   68
## 39    20   32
## 40    20   48
## 41    20   52
## 42    20   56
## 43    20   64
## 44    22   66
## 45    23   54
## 46    24   70
## 47    24   92
## 48    24   93
## 49    24  120
## 50    25   85
```

Summary

```
summary(data)
```

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

```
data |> count(speed)
```

```
##    speed n
## 1      4 2
## 2      7 2
## 3      8 1
## 4      9 1
## 5     10 3
## 6     11 2
## 7     12 4
## 8     13 4
## 9     14 4
```

```
## 10    15 3
## 11    16 2
## 12    17 3
## 13    18 4
## 14    19 3
## 15    20 5
## 16    22 1
## 17    23 1
## 18    24 4
## 19    25 1
```

Group

```
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
```

```
mtcars %>% group_by(cyl) %>% summary(avg = mean(mpg))
```

```
##       mpg             cyl             disp             hp
```

```
##  Min.   :10.40   Min.   :4.000   Min.   : 71.1   Min.   : 52.0
##  1st Qu.:15.43   1st Qu.:4.000   1st Qu.:120.8   1st Qu.: 96.5
##  Median :19.20   Median :6.000   Median :196.3   Median :123.0
##  Mean   :20.09   Mean   :6.188   Mean   :230.7   Mean   :146.7
##  3rd Qu.:22.80   3rd Qu.:8.000   3rd Qu.:326.0   3rd Qu.:180.0
##  Max.   :33.90   Max.   :8.000   Max.   :472.0   Max.   :335.0
##       drat             wt             qsec             vs
##  Min.   :2.760   Min.   :1.513   Min.   :14.50   Min.   :0.0000
##  1st Qu.:3.080   1st Qu.:2.581   1st Qu.:16.89   1st Qu.:0.0000
##  Median :3.695   Median :3.325   Median :17.71   Median :0.0000
##  Mean   :3.597   Mean   :3.217   Mean   :17.85   Mean   :0.4375
##  3rd Qu.:3.920   3rd Qu.:3.610   3rd Qu.:18.90   3rd Qu.:1.0000
##  Max.   :4.930   Max.   :5.424   Max.   :22.90   Max.   :1.0000
##        am              gear            carb
##  Min.   :0.0000   Min.   :3.000   Min.   :1.000
##  1st Qu.:0.0000   1st Qu.:3.000   1st Qu.:2.000
##  Median :0.0000   Median :4.000   Median :2.000
##  Mean   :0.4062   Mean   :3.688   Mean   :2.812
##  3rd Qu.:1.0000   3rd Qu.:4.000   3rd Qu.:4.000
##  Max.   :1.0000   Max.   :5.000   Max.   :8.000
```

```
g_mtcars <- mtcars %>% group_by(cyl)

ungroup(g_mtcars)
```

```
## # A tibble: 32 x 11
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
##    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1  21       6  160    110  3.9   2.62  16.5     0     1     4     4
##  2  21       6  160    110  3.9   2.88  17.0     0     1     4     4
##  3  22.8     4  108     93  3.85  2.32  18.6     1     1     4     1
##  4  21.4     6  258    110  3.08  3.22  19.4     1     0     3     1
##  5  18.7     8  360    175  3.15  3.44  17.0     0     0     3     2
##  6  18.1     6  225    105  2.76  3.46  20.2     1     0     3     1
##  7  14.3     8  360    245  3.21  3.57  15.8     0     0     3     4
##  8  24.4     4  147.    62  3.69  3.19  20       1     0     4     2
##  9  22.8     4  141.    95  3.92  3.15  22.9     1     0     4     2
## 10  19.2     6  168.   123  3.92  3.44  18.3     1     0     4     4
## # i 22 more rows
```

```
starwars %>% rowwise() %>%
mutate(film_count = length(films))
```

```
## # A tibble: 87 x 15
## # Rowwise:
##    name     height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>     <int> <dbl> <chr>      <chr>      <chr>          <dbl> <chr> <chr>
##  1 Luke Sk~    172    77 blond      fair       blue            19   male  mascu~
##  2 C-3PO       167    75 <NA>       gold       yellow         112   none  mascu~
##  3 R2-D2        96    32 <NA>       white, bl~ red             33   none  mascu~
##  4 Darth V~    202   136 none       white      yellow          41.9 male  mascu~
##  5 Leia Or~    150    49 brown      light      brown           19   fema~ femin~
##  6 Owen La~    178   120 brown, gr~ light      blue            52   male  mascu~
```

```
##  7 Beru Wh~    165    75 brown      light      blue            47   fema~ femin~
##  8 R5-D4        97    32 <NA>       white, red red             NA   none  mascu~
##  9 Biggs D~    183    84 black      light      brown           24   male  mascu~
## 10 Obi-Wan~    182    77 auburn, w~ fair       blue-gray       57   male  mascu~
## # i 77 more rows
## # i 6 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>, film_count <int>
```

Manipulate Cases

```
mtcars |> filter(mpg > 20)
```

Extract Cases

```
##                 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
## 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
## Lotus Europa   30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
## Volvo 142E     21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
```

```
mtcars |> filter(mpg < 20)
```

```
##                    mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## 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 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
## 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
## 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
```

```
mtcars |> filter(disp > 120)
```

```
##                      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
## 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
## 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
## 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
## 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 |> distinct(gear)
```

```
##                gear
## Mazda RX4         4
## Hornet 4 Drive    3
## Porsche 914-2     5
```

```
mtcars |> distinct(disp)
```

```
##                      disp
## Mazda RX4           160.0
## Datsun 710          108.0
## Hornet 4 Drive      258.0
## Hornet Sportabout   360.0
## Valiant             225.0
## Merc 240D           146.7
## Merc 230            140.8
## Merc 280            167.6
## Merc 450SE          275.8
## Cadillac Fleetwood  472.0
## Lincoln Continental 460.0
```

```
## Chrysler Imperial   440.0
## Fiat 128             78.7
## Honda Civic          75.7
## Toyota Corolla       71.1
## Toyota Corona       120.1
## Dodge Challenger    318.0
## AMC Javelin         304.0
## Camaro Z28          350.0
## Pontiac Firebird    400.0
## Fiat X1-9            79.0
## Porsche 914-2       120.3
## Lotus Europa         95.1
## Ford Pantera L      351.0
## Ferrari Dino        145.0
## Maserati Bora       301.0
## Volvo 142E          121.0
```

```
mtcars |> distinct(am)
```

```
##                am
## Mazda RX4       1
## Hornet 4 Drive  0
```

```
mtcars |> slice(10:15)
```

```
##                   mpg cyl  disp  hp drat   wt  qsec vs am gear carb
## Merc 280          19.2   6 167.6 123 3.92 3.44 18.30  1  0    4    4
## Merc 280C         17.8   6 167.6 123 3.92 3.44 18.90  1  0    4    4
## Merc 450SE        16.4   8 275.8 180 3.07 4.07 17.40  0  0    3    3
## Merc 450SL        17.3   8 275.8 180 3.07 3.73 17.60  0  0    3    3
## Merc 450SLC       15.2   8 275.8 180 3.07 3.78 18.00  0  0    3    3
## Cadillac Fleetwood 10.4  8 472.0 205 2.93 5.25 17.98  0  0    3    4
```

```
mtcars |> slice(1:15)
```

```
##                   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
```

```
mtcars |> slice_sample(n = 5, replace = TRUE)
```

```
##                      mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## Lincoln Continental 10.4   8 460.0 215 3.00 5.424 17.82  0  0    3    4
## Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## Hornet 4 Drive...4  21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## Hornet 4 Drive...5  21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
```

```
mtcars |> slice_sample(n = 5, replace = FALSE)
```

```
##                    mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## 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
## Mazda RX4         21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
## Chrysler Imperial 14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## Merc 280          19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
```

```
mtcars |> slice_min(mpg, prop = 0.25)
```

```
##                     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
## Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
## Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
## Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
```

```
mtcars |> slice_min(disp, prop = 0.25)
```

```
##                 mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## Toyota Corolla 33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
## Honda Civic    30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
## Fiat 128       32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
## 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
## Datsun 710     22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## Toyota Corona  21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## Porsche 914-2  26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
```

```
mtcars |> slice_head(n = 5)
```

```
##                    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
```

```
mtcars |> slice_tail(n = 5)
```

```
##                 mpg cyl  disp  hp drat    wt qsec vs am gear carb
## 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
```

```
mtcars |> arrange(mpg)
```

ARRANGE CASES

```
##                     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
## Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
## Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
## Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
## Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
## Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    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 280C           17.8   6 167.6 123 3.92 3.440 18.90  1  0    4    4
## Valiant             18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
## Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
## Merc 280            19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
## Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
## Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
## 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
## Hornet 4 Drive      21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
## Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## Datsun 710          22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## Merc 230            22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
## Merc 240D           24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
## Porsche 914-2       26.0   4 120.3  91 4.43 2.140 16.70  0  1    5    2
## Fiat X1-9           27.3   4  79.0  66 4.08 1.935 18.90  1  1    4    1
## Honda Civic         30.4   4  75.7  52 4.93 1.615 18.52  1  1    4    2
## Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    2
## 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
```

```
mtcars |> arrange(desc(mpg))
```

```
##                      mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## Toyota Corolla      33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
## 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
## Lotus Europa        30.4   4  95.1 113 3.77 1.513 16.90  1  1    5    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
## Merc 240D           24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
## Datsun 710          22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
## Merc 230            22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
## Toyota Corona       21.5   4 120.1  97 3.70 2.465 20.01  1  0    3    1
## Hornet 4 Drive      21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
## Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1    4    2
## 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
## Ferrari Dino        19.7   6 145.0 175 3.62 2.770 15.50  0  1    5    6
## Merc 280            19.2   6 167.6 123 3.92 3.440 18.30  1  0    4    4
## Pontiac Firebird    19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
## 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
## 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
## Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
## Ford Pantera L      15.8   8 351.0 264 4.22 3.170 14.50  0  1    5    4
## Dodge Challenger    15.5   8 318.0 150 2.76 3.520 16.87  0  0    3    2
## Merc 450SLC         15.2   8 275.8 180 3.07 3.780 18.00  0  0    3    3
## AMC Javelin         15.2   8 304.0 150 3.15 3.435 17.30  0  0    3    2
## Maserati Bora       15.0   8 301.0 335 3.54 3.570 14.60  0  1    5    8
## Chrysler Imperial   14.7   8 440.0 230 3.23 5.345 17.42  0  0    3    4
## Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
## Camaro Z28          13.3   8 350.0 245 3.73 3.840 15.41  0  0    3    4
## 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
```

```
cars |> add_row(speed = 1, dist = 1)
```

Add Cases

```
##    speed dist
## 1      4    2
## 2      4   10
## 3      7    4
## 4      7   22
## 5      8   16
## 6      9   10
## 7     10   18
## 8     10   26
## 9     10   34
## 10    11   17
## 11    11   28
## 12    12   14
```

```
## 13    12   20
## 14    12   24
## 15    12   28
## 16    13   26
## 17    13   34
## 18    13   34
## 19    13   46
## 20    14   26
## 21    14   36
## 22    14   60
## 23    14   80
## 24    15   20
## 25    15   26
## 26    15   54
## 27    16   32
## 28    16   40
## 29    17   32
## 30    17   40
## 31    17   50
## 32    18   42
## 33    18   56
## 34    18   76
## 35    18   84
## 36    19   36
## 37    19   46
## 38    19   68
## 39    20   32
## 40    20   48
## 41    20   52
## 42    20   56
## 43    20   64
## 44    22   66
## 45    23   54
## 46    24   70
## 47    24   92
## 48    24   93
## 49    24  120
## 50    25   85
## 51     1    1
```

```
#?base::Logic

?Comparison
```

```
## starting httpd help server ... done
```

Manipulate Variables

```
mtcars |> pull(wt)
```

Extract Variables

```
##  [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
## [13] 3.730 3.780 5.250 5.424 5.345 2.200 1.615 1.835 2.465 3.520 3.435 3.840
## [25] 3.845 1.935 2.140 1.513 3.170 2.770 3.570 2.780
```

```
mtcars |> pull(disp)
```

```
##  [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
## [13] 275.8 275.8 472.0 460.0 440.0  78.7  75.7  71.1 120.1 318.0 304.0 350.0
## [25] 400.0  79.0 120.3  95.1 351.0 145.0 301.0 121.0
```

```
mtcars |> pull(mpg)
```

```
##  [1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2 10.4
## [16] 10.4 14.7 32.4 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4 15.8 19.7
## [31] 15.0 21.4
```

```
mtcars |> select(mpg, wt)
```

```
##                      mpg    wt
## Mazda RX4           21.0 2.620
## Mazda RX4 Wag       21.0 2.875
## Datsun 710          22.8 2.320
## Hornet 4 Drive      21.4 3.215
## Hornet Sportabout   18.7 3.440
## Valiant             18.1 3.460
## Duster 360          14.3 3.570
## Merc 240D           24.4 3.190
## Merc 230            22.8 3.150
## Merc 280            19.2 3.440
## Merc 280C           17.8 3.440
## Merc 450SE          16.4 4.070
## Merc 450SL          17.3 3.730
## Merc 450SLC         15.2 3.780
## Cadillac Fleetwood  10.4 5.250
## Lincoln Continental 10.4 5.424
## Chrysler Imperial   14.7 5.345
## Fiat 128            32.4 2.200
## Honda Civic         30.4 1.615
## Toyota Corolla      33.9 1.835
## Toyota Corona       21.5 2.465
## Dodge Challenger    15.5 3.520
## AMC Javelin         15.2 3.435
## Camaro Z28          13.3 3.840
## Pontiac Firebird    19.2 3.845
## Fiat X1-9           27.3 1.935
## Porsche 914-2       26.0 2.140
## Lotus Europa        30.4 1.513
## Ford Pantera L      15.8 3.170
## Ferrari Dino        19.7 2.770
## Maserati Bora       15.0 3.570
## Volvo 142E          21.4 2.780
```

```
mtcars |> select(am, disp)
```

```
##                     am  disp
## Mazda RX4            1 160.0
## Mazda RX4 Wag        1 160.0
## Datsun 710           1 108.0
## Hornet 4 Drive       0 258.0
## Hornet Sportabout    0 360.0
## Valiant              0 225.0
## Duster 360           0 360.0
## Merc 240D            0 146.7
## Merc 230             0 140.8
## Merc 280             0 167.6
## Merc 280C            0 167.6
## Merc 450SE           0 275.8
## Merc 450SL           0 275.8
## Merc 450SLC          0 275.8
## Cadillac Fleetwood   0 472.0
## Lincoln Continental  0 460.0
## Chrysler Imperial    0 440.0
## Fiat 128             1  78.7
## Honda Civic          1  75.7
## Toyota Corolla       1  71.1
## Toyota Corona        0 120.1
## Dodge Challenger     0 318.0
## AMC Javelin          0 304.0
## Camaro Z28           0 350.0
## Pontiac Firebird     0 400.0
## Fiat X1-9            1  79.0
## Porsche 914-2        1 120.3
## Lotus Europa         1  95.1
## Ford Pantera L       1 351.0
## Ferrari Dino         1 145.0
## Maserati Bora        1 301.0
## Volvo 142E           1 121.0
```

```
mtcars |> relocate(mpg, cyl, .after = last_col())
```

```
##                     disp  hp drat    wt  qsec vs am gear carb  mpg cyl
## Mazda RX4          160.0 110 3.90 2.620 16.46  0  1    4    4 21.0   6
## Mazda RX4 Wag      160.0 110 3.90 2.875 17.02  0  1    4    4 21.0   6
## Datsun 710         108.0  93 3.85 2.320 18.61  1  1    4    1 22.8   4
## Hornet 4 Drive     258.0 110 3.08 3.215 19.44  1  0    3    1 21.4   6
## Hornet Sportabout  360.0 175 3.15 3.440 17.02  0  0    3    2 18.7   8
## Valiant            225.0 105 2.76 3.460 20.22  1  0    3    1 18.1   6
## Duster 360         360.0 245 3.21 3.570 15.84  0  0    3    4 14.3   8
## Merc 240D          146.7  62 3.69 3.190 20.00  1  0    4    2 24.4   4
## Merc 230           140.8  95 3.92 3.150 22.90  1  0    4    2 22.8   4
## Merc 280           167.6 123 3.92 3.440 18.30  1  0    4    4 19.2   6
## Merc 280C          167.6 123 3.92 3.440 18.90  1  0    4    4 17.8   6
## Merc 450SE         275.8 180 3.07 4.070 17.40  0  0    3    3 16.4   8
## Merc 450SL         275.8 180 3.07 3.730 17.60  0  0    3    3 17.3   8
```

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

```
mtcars |> select(mpg:am)
```

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

```
## Volvo 142E          21.4   4 121.0 109 4.11 2.780 18.60  1  1
```

```
#df |> summary(across(everything(), mean))
```

```
mtcars |> rowwise() |> mutate(x_total = sum(c_across(1:2)))
```

MANIPULATE MULTIPLE VARIABLES AT ONCE

```
## # A tibble: 32 x 12
## # Rowwise:
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb x_total
##    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>   <dbl>
##  1  21       6  160    110  3.9   2.62  16.5     0     1     4     4    27
##  2  21       6  160    110  3.9   2.88  17.0     0     1     4     4    27
##  3  22.8     4  108     93  3.85  2.32  18.6     1     1     4     1    26.8
##  4  21.4     6  258    110  3.08  3.22  19.4     1     0     3     1    27.4
##  5  18.7     8  360    175  3.15  3.44  17.0     0     0     3     2    26.7
##  6  18.1     6  225    105  2.76  3.46  20.2     1     0     3     1    24.1
##  7  14.3     8  360    245  3.21  3.57  15.8     0     0     3     4    22.3
##  8  24.4     4  147.    62  3.69  3.19  20       1     0     4     2    28.4
##  9  22.8     4  141.    95  3.92  3.15  22.9     1     0     4     2    26.8
## 10  19.2     6  168.   123  3.92  3.44  18.3     1     0     4     4    25.2
## # i 22 more rows
```

```
mtcars |> mutate(gpm = 1 / mpg)
```

MAKE NEW VARIABLES

```
##                    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
##                           gpm
## Mazda RX4           0.04761905
## Mazda RX4 Wag       0.04761905
## Datsun 710          0.04385965
## Hornet 4 Drive      0.04672897
## Hornet Sportabout   0.05347594
## Valiant             0.05524862
## Duster 360          0.06993007
## Merc 240D           0.04098361
## Merc 230            0.04385965
## Merc 280            0.05208333
## Merc 280C           0.05617978
## Merc 450SE          0.06097561
## Merc 450SL          0.05780347
## Merc 450SLC         0.06578947
## Cadillac Fleetwood  0.09615385
## Lincoln Continental 0.09615385
## Chrysler Imperial   0.06802721
## Fiat 128            0.03086420
## Honda Civic         0.03289474
## Toyota Corolla      0.02949853
## Toyota Corona       0.04651163
## Dodge Challenger    0.06451613
## AMC Javelin         0.06578947
## Camaro Z28          0.07518797
## Pontiac Firebird    0.05208333
## Fiat X1-9           0.03663004
## Porsche 914-2       0.03846154
## Lotus Europa        0.03289474
## Ford Pantera L      0.06329114
## Ferrari Dino        0.05076142
## Maserati Bora       0.06666667
## Volvo 142E          0.04672897
```

```
mtcars |> mutate(gpm = 1 / mpg, .keep = "none")
```

```
##                           gpm
## Mazda RX4           0.04761905
```

```
## Mazda RX4 Wag       0.04761905
## Datsun 710          0.04385965
## Hornet 4 Drive      0.04672897
## Hornet Sportabout   0.05347594
## Valiant             0.05524862
## Duster 360          0.06993007
## Merc 240D           0.04098361
## Merc 230            0.04385965
## Merc 280            0.05208333
## Merc 280C           0.05617978
## Merc 450SE          0.06097561
## Merc 450SL          0.05780347
## Merc 450SLC         0.06578947
## Cadillac Fleetwood  0.09615385
## Lincoln Continental 0.09615385
## Chrysler Imperial   0.06802721
## Fiat 128            0.03086420
## Honda Civic         0.03289474
## Toyota Corolla      0.02949853
## Toyota Corona       0.04651163
## Dodge Challenger    0.06451613
## AMC Javelin         0.06578947
## Camaro Z28          0.07518797
## Pontiac Firebird    0.05208333
## Fiat X1-9           0.03663004
## Porsche 914-2       0.03846154
## Lotus Europa        0.03289474
## Ford Pantera L      0.06329114
## Ferrari Dino        0.05076142
## Maserati Bora       0.06666667
## Volvo 142E          0.04672897
```

```
mtcars |> rename(miles_per_gallon = mpg)
```

```
##                   miles_per_gallon cyl  disp  hp drat    wt  qsec vs am gear
## Mazda RX4                     21.0   6 160.0 110 3.90 2.620 16.46  0  1    4
## Mazda RX4 Wag                 21.0   6 160.0 110 3.90 2.875 17.02  0  1    4
## Datsun 710                    22.8   4 108.0  93 3.85 2.320 18.61  1  1    4
## Hornet 4 Drive                21.4   6 258.0 110 3.08 3.215 19.44  1  0    3
## Hornet Sportabout             18.7   8 360.0 175 3.15 3.440 17.02  0  0    3
## Valiant                       18.1   6 225.0 105 2.76 3.460 20.22  1  0    3
## Duster 360                    14.3   8 360.0 245 3.21 3.570 15.84  0  0    3
## Merc 240D                     24.4   4 146.7  62 3.69 3.190 20.00  1  0    4
## Merc 230                      22.8   4 140.8  95 3.92 3.150 22.90  1  0    4
## Merc 280                      19.2   6 167.6 123 3.92 3.440 18.30  1  0    4
## Merc 280C                     17.8   6 167.6 123 3.92 3.440 18.90  1  0    4
## Merc 450SE                    16.4   8 275.8 180 3.07 4.070 17.40  0  0    3
## Merc 450SL                    17.3   8 275.8 180 3.07 3.730 17.60  0  0    3
## Merc 450SLC                   15.2   8 275.8 180 3.07 3.780 18.00  0  0    3
## Cadillac Fleetwood            10.4   8 472.0 205 2.93 5.250 17.98  0  0    3
## Lincoln Continental           10.4   8 460.0 215 3.00 5.424 17.82  0  0    3
## Chrysler Imperial             14.7   8 440.0 230 3.23 5.345 17.42  0  0    3
## Fiat 128                      32.4   4  78.7  66 4.08 2.200 19.47  1  1    4
## Honda Civic                   30.4   4  75.7  52 4.93 1.615 18.52  1  1    4
```

```
## Toyota Corolla                33.9   4  71.1  65 4.22 1.835 19.90  1  1    4
## Toyota Corona                 21.5   4 120.1  97 3.70 2.465 20.01  1  0    3
## Dodge Challenger              15.5   8 318.0 150 2.76 3.520 16.87  0  0    3
## AMC Javelin                   15.2   8 304.0 150 3.15 3.435 17.30  0  0    3
## Camaro Z28                    13.3   8 350.0 245 3.73 3.840 15.41  0  0    3
## Pontiac Firebird              19.2   8 400.0 175 3.08 3.845 17.05  0  0    3
## Fiat X1-9                     27.3   4  79.0  66 4.08 1.935 18.90  1  1    4
## Porsche 914-2                 26.0   4 120.3  91 4.43 2.140 16.70  0  1    5
## Lotus Europa                  30.4   4  95.1 113 3.77 1.513 16.90  1  1    5
## Ford Pantera L                15.8   8 351.0 264 4.22 3.170 14.50  0  1    5
## Ferrari Dino                  19.7   6 145.0 175 3.62 2.770 15.50  0  1    5
## Maserati Bora                 15.0   8 301.0 335 3.54 3.570 14.60  0  1    5
## Volvo 142E                    21.4   4 121.0 109 4.11 2.780 18.60  1  1    4
##                      carb
## Mazda RX4               4
## Mazda RX4 Wag           4
## Datsun 710              1
## Hornet 4 Drive          1
## Hornet Sportabout       2
## Valiant                 1
## Duster 360              4
## Merc 240D               2
## Merc 230                2
## Merc 280                4
## Merc 280C               4
## Merc 450SE              3
## Merc 450SL              3
## Merc 450SLC             3
## Cadillac Fleetwood      4
## Lincoln Continental     4
## Chrysler Imperial       4
## Fiat 128                1
## Honda Civic             2
## Toyota Corolla          1
## Toyota Corona           1
## Dodge Challenger        2
## AMC Javelin             2
## Camaro Z28              4
## Pontiac Firebird        2
## Fiat X1-9               1
## Porsche 914-2           2
## Lotus Europa            2
## Ford Pantera L          4
## Ferrari Dino            6
## Maserati Bora           8
## Volvo 142E              2
```

Vectorized Functions

TO USE WITH MUTATE ()

```
lag(mtcars)
```

OFFSET

```
##                      mpg cyl  disp  hp drat    wt  qsec vs am gear carb
## ...1                  NA  NA    NA  NA   NA    NA    NA NA NA   NA   NA
## 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
```

```
lead(mtcars)
```

```
##                      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
## 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
## ...32                 NA  NA    NA  NA   NA    NA    NA NA NA   NA   NA
```

CUMULATIVE AGGREGATE

- dplyr::cumall() - cumulative all()
- dplyr::cumany() - cumulative any()
- cummax() - cumulative max()
- dplyr::cummean() - cumulative mean()
- cummin() - cumulative min()
- cumprod() - cumulative prod()
- cumsum() - cumulative sum()

```
cumall(1:12)
```

```
##  [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
```

```
cumany(1:12)
```

```
##  [1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE
```

```
cummax(1:12)
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12
```

```
cummean(1:12)
```

```
##  [1] 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5
```

```r
cummin(1:12)
```

```
##  [1] 1 1 1 1 1 1 1 1 1 1 1 1
```

```r
cumprod(1:12)
```

```
##  [1]         1         2         6        24       120       720      5040
##  [8]     40320    362880   3628800  39916800 479001600
```

```r
cumsum(1:12)
```

```
##  [1]  1  3  6 10 15 21 28 36 45 55 66 78
```

RANKING

- dplyr::cume_dist() - proportion of all values <=
- dplyr::dense_rank() - rank w ties = min, no gaps
- dplyr::min_rank() - rank with ties = min
- dplyr::ntile() - bins into n bins
- dplyr::percent_rank() - min_rank scaled to [0,1]
- dplyr::row_number() - rank with ties = "first"

```r
cume_dist(1:12)
```

```
##  [1] 0.08333333 0.16666667 0.25000000 0.33333333 0.41666667 0.50000000
##  [7] 0.58333333 0.66666667 0.75000000 0.83333333 0.91666667 1.00000000
```

```r
dense_rank(1:12)
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12
```

```r
min_rank(1:12)
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12
```

```r
x <- c(5, 1, 3, 2, 2, NA)
ntile(x, 2)
```

```
## [1]  2  1  2  1  1 NA
```

```r
ntile(x, 4)
```

```
## [1]  4  1  3  1  2 NA
```

```r
ntile(1:8, 3)
```

```
## [1] 1 1 1 2 2 2 3 3
```

```r
percent_rank(1:5)
```

```
## [1] 0.00 0.25 0.50 0.75 1.00
```

```r
row_number(1:12)
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12
```

MATH

- +, - , *, /, ^, %/%, %% - arithmetic ops
- log(), log2(), log10() - logs
- <, <=, >, >=, !=, == - logical comparisons
- dplyr::between() - x >= left & x <= right
- dplyr::near() - safe == for floating point numbers

```r
2 + 3
```

```
## [1] 5
```

```r
3 - 7
```

```
## [1] -4
```

```r
3 * 7
```

```
## [1] 21
```

```r
4 / 8
```

```
## [1] 0.5
```

```r
2 ^ 5
```

```
## [1] 32
```

```r
4 %/% 8
```

```
## [1] 0
```

```r
4 %% 8
```

```
## [1] 4
```

```r
log(10)
```

```
## [1] 2.302585
```

```r
log2(10)
```

```
## [1] 3.321928
```

```r
log10(100)
```

```
## [1] 2
```

```r
3 < 7
```

```
## [1] TRUE
```

```r
4 > 8
```

```
## [1] FALSE
```

```r
3 <= 4
```

```
## [1] TRUE
```

```r
7 >= 8
```

```
## [1] FALSE
```

```r
12 != 13
```

```
## [1] TRUE
```

```r
4 == 4
```

```
## [1] TRUE
```

```r
between(13,12,14)
```

```
## [1] TRUE
```

```r
near(29.9, 30)
```

```
## [1] FALSE
```

```
starwars |>
mutate(type = case_when(
height > 200 | mass > 200 ~ "large",
species == "Droid" ~ "robot",
TRUE ~ "other")
)
```

MISCELLANEOUS

```
## # A tibble: 87 x 15
##    name     height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>     <int> <dbl> <chr>      <chr>      <chr>          <dbl> <chr> <chr>
##  1 Luke Sk~    172    77 blond      fair       blue            19   male  mascu~
##  2 C-3PO       167    75 <NA>       gold       yellow         112   none  mascu~
##  3 R2-D2        96    32 <NA>       white, bl~ red             33   none  mascu~
##  4 Darth V~    202   136 none       white      yellow          41.9 male  mascu~
##  5 Leia Or~    150    49 brown      light      brown           19   fema~ femin~
##  6 Owen La~    178   120 brown, gr~ light      blue            52   male  mascu~
##  7 Beru Wh~    165    75 brown      light      blue            47   fema~ femin~
##  8 R5-D4        97    32 <NA>       white, red red             NA   none  mascu~
##  9 Biggs D~    183    84 black      light      brown           24   male  mascu~
## 10 Obi-Wan~    182    77 auburn, w~ fair       blue-gray       57   male  mascu~
## # i 77 more rows
## # i 6 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>, type <chr>
```

```
pmax(5:1, pi)
```

```
## [1] 5.000000 4.000000 3.141593 3.141593 3.141593
```

```
pmin(5:1, pi)
```

```
## [1] 3.141593 3.141593 3.000000 2.000000 1.000000
```

Summary Functions

COUNT

- dplyr::n() - number of values/rows
- dplyr::n_distinct() - # of uniques
- sum(!is.na()) - # of non-NAs

```
#summary(n= n(mtcars))
n_distinct(cars)
```

```
## [1] 49
```

```r
sum(!is.na(airquality))
```

```
## [1] 874
```

POSITION

- mean() - mean, also mean(!is.na())
- median() - median

```r
mean(12:30)
```

```
## [1] 21
```

```r
median(12:30)
```

```
## [1] 21
```

RANK

- quantile() - nth quantile
- min() - minimum value
- max() - maximum value

```r
quantile(1:3)
```

```
##   0%  25%  50%  75% 100%
##  1.0  1.5  2.0  2.5  3.0
```

```r
min(1:30)
```

```
## [1] 1
```

```r
max(1:30)
```

```
## [1] 30
```

SPREAD

- IQR() - Inter-Quartile Range
- mad() - median absolute deviation
- sd() - standard deviation
- var() - variance

```r
IQR(1:30)
```

```
## [1] 14.5
```

```r
mad(1:30)
```

```
## [1] 11.1195
```

```r
sd(1:30)
```

```
## [1] 8.803408
```

```r
var(1:30)
```

```
## [1] 77.5
```

Row Names

Tidy data does not use row names, which store a variable outside of the columns. To work with the row names, first move them into a column.

```r
a<- mtcars |> rownames_to_column(var = "C")
a
```

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

Combine Tables

```
df <- data.frame(a = 1:4, b = letters[1:4]) # Creating a data frame
df
```

COMBINE VARIABLES

```
##   a b
## 1 1 a
## 2 2 b
## 3 3 c
## 4 4 d
```

```
df2 <- data.frame(a = 5:7, b = letters[5:7])
rbind(df, df2) # Combining them using their rows
```

```
##   a b
## 1 1 a
## 2 2 b
## 3 3 c
## 4 4 d
## 5 5 e
## 6 6 f
## 7 7 g
```

```
df3 <- data.frame(c = 5:8, d = letters[5:8])
cbind(df, df3) # Combining them using their columns
```

```
##   a b c d
## 1 1 a 5 e
## 2 2 b 6 f
## 3 3 c 7 g
## 4 4 d 8 h
```

```
left_join(df, df2, by = NULL, copy = FALSE,
keep = FALSE, na_matches = "na")
```

RELATIONAL DATA

```
## Joining with `by = join_by(a, b)`
```

```
##   a b
## 1 1 a
## 2 2 b
## 3 3 c
## 4 4 d
```

```
right_join(df, df2, by = NULL, copy = FALSE,
keep = FALSE, na_matches = "na")
```

```
## Joining with `by = join_by(a, b)`
```

```
##   a b
## 1 5 e
## 2 6 f
## 3 7 g
```

```
inner_join(df, df2, by = NULL, copy = FALSE,
keep = FALSE, na_matches = "na")
```

```
## Joining with `by = join_by(a, b)`
```

```
## [1] a b
## <0 rows> (or 0-length row.names)
```

```
full_join(df, df2, by = NULL, copy = FALSE,
keep = FALSE, na_matches = "na")
```

```
## Joining with `by = join_by(a, b)`
```

```
##   a b
## 1 1 a
## 2 2 b
## 3 3 c
## 4 4 d
## 5 5 e
## 6 6 f
## 7 7 g
```