# Importing Data into R

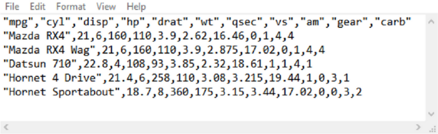
# Agenda

- read data from flat or delimited files
- read data from excel spreadsheets
- read data from other statistical softwares
- specify column/variable types
- read specific columns/variables

# Libraries

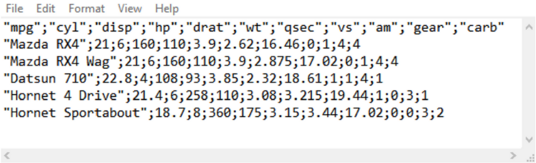
```r
library(readr)
library(readxl)
library(haven)
```

# Comma Separated Values



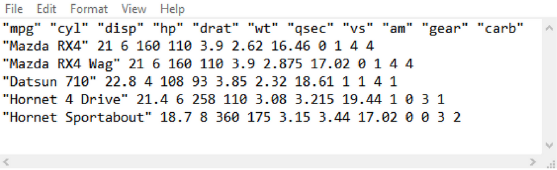
```
"mpg","cyl","disp","hp","drat","wt","qsec","vs","am","gear","carb"
"Mazda RX4",21,6,160,110,3.9,2.62,16.46,0,1,4,4
"Mazda RX4 Wag",21,6,160,110,3.9,2.875,17.02,0,1,4,4
"Datsun 710",22.8,4,108,93,3.85,2.32,18.61,1,1,4,1
"Hornet 4 Drive",21.4,6,258,110,3.08,3.215,19.44,1,0,3,1
"Hornet Sportabout",18.7,8,360,175,3.15,3.44,17.02,0,0,3,2
```

# Semi Colon Separated Values



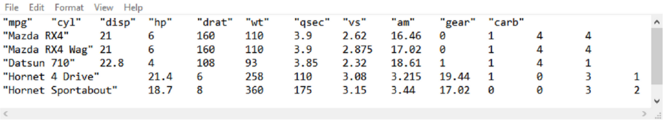
```
"mpg";"cyl";"disp";"hp";"drat";"wt";"qsec";"vs";"am";"gear";"carb"
"Mazda RX4";21;6;160;110;3.9;2.62;16.46;0;1;4;4
"Mazda RX4 Wag";21;6;160;110;3.9;2.875;17.02;0;1;4;4
"Datsun 710";22.8;4;108;93;3.85;2.32;18.61;1;1;4;1
"Hornet 4 Drive";21.4;6;258;110;3.08;3.215;19.44;1;0;3;1
"Hornet Sportabout";18.7;8;360;175;3.15;3.44;17.02;0;0;3;2
```

# Space Separated Values



```
"mpg" "cyl" "disp" "hp" "drat" "wt" "qsec" "vs" "am" "gear" "carb"
"Mazda RX4" 21 6 160 110 3.9 2.62 16.46 0 1 4 4
"Mazda RX4 Wag" 21 6 160 110 3.9 2.875 17.02 0 1 4 4
"Datsun 710" 22.8 4 108 93 3.85 2.32 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 3.44 17.02 0 0 3 2
```

# Tab Separated Values



```
"mpg"   "cyl"   "disp"  "hp"    "drat"  "wt"    "qsec"  "vs"    "am"    "gear"  "carb"
"Mazda RX4"     21      6       160     110     3.9     2.62    16.46   0       1       4       4
"Mazda RX4 Wag" 21      6       160     110     3.9     2.875   17.02   0       1       4       4
"Datsun 710"    22.8    4       108     93      3.85    2.32    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    3.44    17.02   0       0       3       2
```

# CSV

```r
read_csv('data/mtcars.csv')
```

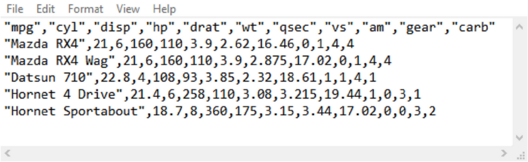
```
## # A tibble: 32 x 11
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    an
##    <dbl> <int> <dbl> <int> <dbl> <dbl> <dbl> <int> <int>
##  1  21.0     6   160   110  3.90  2.62  16.5     0     1
##  2  21.0     6   160   110  3.90  2.88  17.0     0     1
##  3  22.8     4   108    93  3.85  2.32  18.6     1     1
##  4  21.4     6   258   110  3.08  3.22  19.4     1     0
##  5  18.7     8   360   175  3.15  3.44  17.0     0     0
##  6  18.1     6   225   105  2.76  3.46  20.2     1     0
##  7  14.3     8   360   245  3.21  3.57  15.8     0     0
##  8  24.4     4   147    62  3.69  3.19  20.0     1     0
##  9  22.8     4   141    95  3.92  3.15  22.9     1     0
## 10  19.2     6   168   123  3.92  3.44  18.3     1     0
## # ... with 22 more rows
```

# CSV

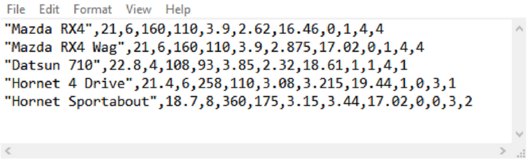
```r
read_delim('data/mtcars.csv', delim = ",")
```

```
## # A tibble: 32 x 11
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    am
##    <dbl> <int> <dbl> <int> <dbl> <dbl> <dbl> <int> <int>
##  1  21.0     6   160   110  3.90  2.62  16.5     0     1
##  2  21.0     6   160   110  3.90  2.88  17.0     0     1
##  3  22.8     4   108    93  3.85  2.32  18.6     1     1
##  4  21.4     6   258   110  3.08  3.22  19.4     1     0
##  5  18.7     8   360   175  3.15  3.44  17.0     0     0
##  6  18.1     6   225   105  2.76  3.46  20.2     1     0
##  7  14.3     8   360   245  3.21  3.57  15.8     0     0
##  8  24.4     4   147    62  3.69  3.19  20.0     1     0
##  9  22.8     4   141    95  3.92  3.15  22.9     1     0
## 10  19.2     6   168   123  3.92  3.44  18.3     1     0
## # ... with 22 more rows
```

## Column Names



```
"mpg","cyl","disp","hp","drat","wt","qsec","vs","am","gear","carb"
"Mazda RX4",21,6,160,110,3.9,2.62,16.46,0,1,4,4
"Mazda RX4 Wag",21,6,160,110,3.9,2.875,17.02,0,1,4,4
"Datsun 710",22.8,4,108,93,3.85,2.32,18.61,1,1,4,1
"Hornet 4 Drive",21.4,6,258,110,3.08,3.215,19.44,1,0,3,1
"Hornet Sportabout",18.7,8,360,175,3.15,3.44,17.02,0,0,3,2
```



```
"Mazda RX4",21,6,160,110,3.9,2.62,16.46,0,1,4,4
"Mazda RX4 Wag",21,6,160,110,3.9,2.875,17.02,0,1,4,4
"Datsun 710",22.8,4,108,93,3.85,2.32,18.61,1,1,4,1
"Hornet 4 Drive",21.4,6,258,110,3.08,3.215,19.44,1,0,3,1
"Hornet Sportabout",18.7,8,360,175,3.15,3.44,17.02,0,0,3,2
```

# Column Names

```
read_csv('data/mtcars1.csv')
```

```
## Warning: Duplicated column names deduplicated: '4' => '4
```

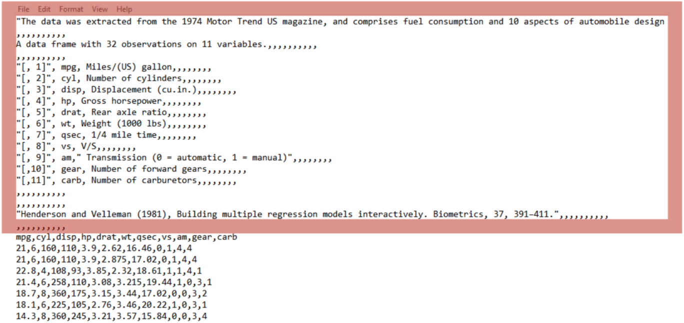
```
## # A tibble: 31 x 11
##     `21`   `6` `160` `110` `3.9` `2.62` `16.46`   `0`
##    <dbl> <int> <dbl> <int> <dbl>  <dbl>   <dbl> <int> <i
##  1  21.0     6   160   110  3.90   2.88    17.0     0
##  2  22.8     4   108    93  3.85   2.32    18.6     1
##  3  21.4     6   258   110  3.08   3.22    19.4     1
##  4  18.7     8   360   175  3.15   3.44    17.0     0
##  5  18.1     6   225   105  2.76   3.46    20.2     1
##  6  14.3     8   360   245  3.21   3.57    15.8     0
##  7  24.4     4   147    62  3.69   3.19    20.0     1
##  8  22.8     4   141    95  3.92   3.15    22.9     1
##  9  19.2     6   168   123  3.92   3.44    18.3     1
## 10  17.8     6   168   123  3.92   3.44    18.9     1
## # ... with 21 more rows
```

# Column Names

```
read_csv('data/mtcars1.csv', col_names = FALSE)
```

```
## # A tibble: 32 x 11
##       X1    X2    X3    X4    X5    X6    X7    X8    X9
##    <dbl> <int> <dbl> <int> <dbl> <dbl> <dbl> <int> <int>
##  1  21.0     6   160   110  3.90  2.62  16.5     0     1
##  2  21.0     6   160   110  3.90  2.88  17.0     0     1
##  3  22.8     4   108    93  3.85  2.32  18.6     1     1
##  4  21.4     6   258   110  3.08  3.22  19.4     1     0
##  5  18.7     8   360   175  3.15  3.44  17.0     0     0
##  6  18.1     6   225   105  2.76  3.46  20.2     1     0
##  7  14.3     8   360   245  3.21  3.57  15.8     0     0
##  8  24.4     4   147    62  3.69  3.19  20.0     1     0
##  9  22.8     4   141    95  3.92  3.15  22.9     1     0
## 10  19.2     6   168   123  3.92  3.44  18.3     1     0
## # ... with 22 more rows
```

# Skip Lines



```
"The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design
,,,,,,,,,,
A data frame with 32 observations on 11 variables.,,,,,,,,,,
,,,,,,,,,,
"[, 1]", mpg, Miles/(US) gallon,,,,,,,,
"[, 2]", cyl, Number of cylinders,,,,,,,,
"[, 3]", disp, Displacement (cu.in.),,,,,,,,
"[, 4]", hp, Gross horsepower,,,,,,,,
"[, 5]", drat, Rear axle ratio,,,,,,,,
"[, 6]", wt, Weight (1000 lbs),,,,,,,,
"[, 7]", qsec, 1/4 mile time,,,,,,,,
"[, 8]", vs, V/S,,,,,,,,
"[, 9]", am," Transmission (0 = automatic, 1 = manual)",,,,,,,,
"[,10]", gear, Number of forward gears,,,,,,,,
"[,11]", carb, Number of carburetors,,,,,,,,
,,,,,,,,,,
,,,,,,,,,,
"Henderson and Velleman (1981), Building multiple regression models interactively. Biometrics, 37, 391-411.",,,,,,,,,,
,,,,,,,,,,
mpg,cyl,disp,hp,drat,wt,qsec,vs,am,gear,carb
21,6,160,110,3.9,2.62,16.46,0,1,4,4
21,6,160,110,3.9,2.875,17.02,0,1,4,4
22.8,4,108,93,3.85,2.32,18.61,1,1,4,1
21.4,6,258,110,3.08,3.215,19.44,1,0,3,1
18.7,8,360,175,3.15,3.44,17.02,0,0,3,2
18.1,6,225,105,2.76,3.46,20.22,1,0,3,1
14.3,8,360,245,3.21,3.57,15.84,0,0,3,4
```

# Skip Lines

```r
read_csv('data/mtcars2.csv')
```

```
## Warning: Missing column names filled in: 'X2' [2], 'X3'
## 'X5' [5], 'X6' [6], 'X7' [7], 'X8' [8], 'X9' [9], 'X10'

## # A tibble: 51 x 11
##    `The data was ex~ X2    X3    X4    X5    X6    X7
##    <chr>             <chr> <chr> <chr> <chr> <chr> <chr
##  1 <NA>              <NA>  <NA>  <NA>  <NA>  <NA>  <NA>
##  2 A data frame wit~ <NA>  <NA>  <NA>  <NA>  <NA>  <NA>
##  3 <NA>              <NA>  <NA>  <NA>  <NA>  <NA>  <NA>
##  4 [, 1]             mpg   Mile~ <NA>  <NA>  <NA>  <NA>
##  5 [, 2]             cyl   Numb~ <NA>  <NA>  <NA>  <NA>
##  6 [, 3]             disp  Disp~ <NA>  <NA>  <NA>  <NA>
##  7 [, 4]             hp    Gros~ <NA>  <NA>  <NA>  <NA>
##  8 [, 5]             drat  Rear~ <NA>  <NA>  <NA>  <NA>
##  9 [, 6]             wt    Weig~ <NA>  <NA>  <NA>  <NA>
## 10 [, 7]             qsec  1/4 ~ <NA>  <NA>  <NA>  <NA>
## # ... with 41 more rows, and 1 more variable: X11 <chr>
```

# Skip Lines

```r
read_csv('data/mtcars2.csv', skip = 19)
```

```
## # A tibble: 32 x 11
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    am
##    <dbl> <int> <dbl> <int> <dbl> <dbl> <dbl> <int> <int>
##  1  21.0     6   160   110  3.90  2.62  16.5     0     1
##  2  21.0     6   160   110  3.90  2.88  17.0     0     1
##  3  22.8     4   108    93  3.85  2.32  18.6     1     1
##  4  21.4     6   258   110  3.08  3.22  19.4     1     0
##  5  18.7     8   360   175  3.15  3.44  17.0     0     0
##  6  18.1     6   225   105  2.76  3.46  20.2     1     0
##  7  14.3     8   360   245  3.21  3.57  15.8     0     0
##  8  24.4     4   147    62  3.69  3.19  20.0     1     0
##  9  22.8     4   141    95  3.92  3.15  22.9     1     0
## 10  19.2     6   168   123  3.92  3.44  18.3     1     0
## # ... with 22 more rows
```

# Maximum Lines

```r
read_csv('data/mtcars.csv', n_max = 20)
```

```
## # A tibble: 20 x 11
##      mpg   cyl  disp    hp  drat    wt  qsec    vs    am
##    <dbl> <int> <dbl> <int> <dbl> <dbl> <dbl> <int> <int>
##  1  21.0     6 160     110  3.90  2.62  16.5     0     1
##  2  21.0     6 160     110  3.90  2.88  17.0     0     1
##  3  22.8     4 108      93  3.85  2.32  18.6     1     1
##  4  21.4     6 258     110  3.08  3.22  19.4     1     0
##  5  18.7     8 360     175  3.15  3.44  17.0     0     0
##  6  18.1     6 225     105  2.76  3.46  20.2     1     0
##  7  14.3     8 360     245  3.21  3.57  15.8     0     0
##  8  24.4     4 147      62  3.69  3.19  20.0     1     0
##  9  22.8     4 141      95  3.92  3.15  22.9     1     0
## 10  19.2     6 168     123  3.92  3.44  18.3     1     0
## 11  17.8     6 168     123  3.92  3.44  18.9     1     0
## 12  16.4     8 276     180  3.07  4.07  17.4     0     0
## 13  17.3     8 276     180  3.07  3.73  17.6     0     0
## 14  15.2     8 276     180  3.07  3.78  18.0     0
```

# Column Types

| Data Type | Function |
|---|---|
| Integer | `col_integer()` |
| Double | col_double() |
| Logical | col_logical() |
| Categorical | col_factor() |
| Character | col_character() |
| Date/Time | col_datetime(), col_date(), col_time() |
| Skip | col_skip() |

# Column Types

```r
spec_csv('data/mtcars5.csv')
```

```
## cols(
##   mpg = col_double(),
##   cyl = col_integer(),
##   disp = col_double(),
##   hp = col_integer()
## )
```

# Column Types

| Objective | Function |
|---|---|
| Specify column data types | `col_types()` |
| Skip column | col_skip() |
| Read spcecific columns | cols_only() |

# Column Types

```
read_csv('data/mtcars5.csv',
         col_types = list(col_double(),
            col_factor(levels = c(4, 6, 8)),
            col_double(), col_integer()))
```

```
## # A tibble: 32 x 4
##       mpg cyl    disp    hp
##     <dbl> <fct> <dbl> <int>
##  1   21.0 6       160   110
##  2   21.0 6       160   110
##  3   22.8 4       108    93
##  4   21.4 6       258   110
##  5   18.7 8       360   175
##  6   18.1 6       225   105
##  7   14.3 8       360   245
##  8   24.4 4       147    62
##  9   22.8 4       141    95
## 10   19.2 6       168   123
## # ... with 22 more rows
```

# Skip Columns

```
read_csv('data/mtcars5.csv',
         col_types = list(col_double(),
            col_factor(levels = c(4, 6, 8)),
            col_skip(), col_integer()))
```

```
## # A tibble: 32 x 3
##      mpg cyl      hp
##    <dbl> <fct> <int>
##  1  21.0 6       110
##  2  21.0 6       110
##  3  22.8 4        93
##  4  21.4 6       110
##  5  18.7 8       175
##  6  18.1 6       105
##  7  14.3 8       245
##  8  24.4 4        62
##  9  22.8 4        95
## 10  19.2 6       123
## # ... with 22 more rows
```

# Read Specific Columns

```
read_csv('data/mtcars5.csv',
         col_types = cols_only(mpg = col_double(),
         cyl = col_factor(levels = c(4, 6, 8))))
```

```
## # A tibble: 32 x 2
##      mpg cyl
##    <dbl> <fct>
##  1  21.0 6
##  2  21.0 6
##  3  22.8 4
##  4  21.4 6
##  5  18.7 8
##  6  18.1 6
##  7  14.3 8
##  8  24.4 4
##  9  22.8 4
## 10  19.2 6
## # ... with 22 more rows
```

# readr & Base R

| Type | readr | Base R |
|---|---|---|
| comma | `read_csv()` | `read.csv()` |
| semicolon | read_csv2() | read.csv2() |
| tab | read_tsv() | read.delim() / read.table() |
| space | read_table() | read.table() |
| multiple spaces | read_table2() | read.table() |
| any delimiter | read_delim() | read.delim() |

# Your turn. . .

Open the below files, examine how the values are separated and read them into R using the appropriate function listed in the previous slide:

- mtcars.txt
- mtcars.tsv
- mtcars3.txt
- mtcars4.txt

# Spreadsheets

- list sheets in an excel file
- read data from an excel sheet
- read specific cells
- read specific rows
- read specific columns

# List Sheets

```
excel_sheets('data/sample.xls')
```

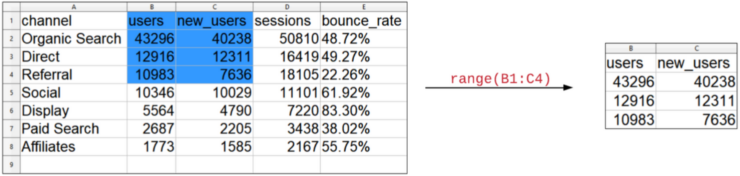
```
## [1] "ecom"
```

# Read Sheet

```
read_excel('data/sample.xls', sheet = 1)
```

```
## # A tibble: 7 x 5
##   channel        users new_users sessions bounce_rate
##   <chr>          <dbl>     <dbl>    <dbl> <chr>
## 1 Organic Search 43296     40238    50810 48.72%
## 2 Direct         12916     12311    16419 49.27%
## 3 Referral       10983      7636    18105 22.26%
## 4 Social         10346     10029    11101 61.92%
## 5 Display         5564      4790     7220 83.30%
## 6 Paid Search     2687      2205     3438 38.02%
## 7 Affiliates      1773      1585     2167 55.75%
```

# Read Specific Cells



| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | channel | users | new_users | sessions | bounce_rate |
| 2 | Organic Search | 43296 | 40238 | 50810 | 48.72% |
| 3 | Direct | 12916 | 12311 | 16419 | 49.27% |
| 4 | Referral | 10983 | 7636 | 18105 | 22.26% |
| 5 | Social | 10346 | 10029 | 11101 | 61.92% |
| 6 | Display | 5564 | 4790 | 7220 | 83.30% |
| 7 | Paid Search | 2687 | 2205 | 3438 | 38.02% |
| 8 | Affiliates | 1773 | 1585 | 2167 | 55.75% |
| 9 | | | | | |

`range(B1:C4)`

| B | C |
|---|---|
| users | new_users |
| 43296 | 40238 |
| 12916 | 12311 |
| 10983 | 7636 |

# Read Specific Cells

```r
read_excel('data/sample.xls', sheet = 1, range = "B1:C4")
```

```
## # A tibble: 3 x 2
##   users new_users
##   <dbl>     <dbl>
## 1 43296     40238
## 2 12916     12311
## 3 10983      7636
```

# Read Single Column

```
read_excel('data/sample.xls', sheet = 1,
    range = cell_cols(2))
```

```
## # A tibble: 7 x 1
##   users
##   <dbl>
## 1 43296
## 2 12916
## 3 10983
## 4 10346
## 5  5564
## 6  2687
## 7  1773
```

# Specific Rows

```
read_excel('data/sample.xls', sheet = 1,
    range = cell_rows(1:4))
```

```
## # A tibble: 3 x 5
##   channel        users new_users sessions bounce_rate
##   <chr>          <dbl>     <dbl>    <dbl> <chr>
## 1 Organic Search 43296     40238    50810 48.72%
## 2 Direct         12916     12311    16419 49.27%
## 3 Referral       10983      7636    18105 22.26%
```

# Specific Columns

```
read_excel('data/sample.xls', sheet = 1,
    range = cell_cols(2:3))
```

```
## # A tibble: 7 x 2
##   users new_users
##   <dbl>     <dbl>
## 1 43296     40238
## 2 12916     12311
## 3 10983      7636
## 4 10346     10029
## 5  5564      4790
## 6  2687      2205
## 7  1773      1585
```

# Statistical Softwares

- SAS
- SPSS
- STATA

# STATA

```r
haven::read_stata('data/airline.dta')
```

```
## # A tibble: 32 x 6
##     year     y     w     r     l     k
##    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1  1948  1.21 0.243 0.145  1.41 0.612
##  2  1949  1.35 0.260 0.218  1.38 0.559
##  3  1950  1.57 0.278 0.316  1.39 0.573
##  4  1951  1.95 0.297 0.394  1.55 0.564
##  5  1952  2.27 0.310 0.356  1.80 0.574
##  6  1953  2.73 0.322 0.359  1.93 0.711
##  7  1954  3.03 0.335 0.403  1.96 0.776
##  8  1955  3.56 0.350 0.396  2.12 0.827
##  9  1956  3.98 0.361 0.382  2.43 0.800
## 10  1957  4.42 0.379 0.305  2.71 0.921
## # ... with 22 more rows
```

# SPSS

```
read_spss('data/employee.sav')
```

```
## # A tibble: 474 x 9
##       id gender    educ   jobcat  salary salbegin jobtim
##    <dbl> <chr+lbl> <dbl+> <dbl+l> <dbl+> <dbl+lb> <dbl+l
##  1  1.00 m         15     3       57000  27000    98
##  2  2.00 m         16     1       40200  18750    98
##  3  3.00 f         12     1       21450  12000    98
##  4  4.00 f         8      1       21900  13200    98
##  5  5.00 m         15     1       45000  21000    98
##  6  6.00 m         15     1       32100  13500    98
##  7  7.00 m         15     1       36000  18750    98
##  8  8.00 f         12     1       21900  9750     98
##  9  9.00 f         15     1       27900  12750    98
## 10 10.0  f         12     1       24000  13500    98
## # ... with 464 more rows
```

# SAS

```r
read_sas('data/airline.sas7bdat')
```

```
## # A tibble: 32 x 6
##     YEAR     Y     W     R     L     K
##    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1  1948  1.21 0.243 0.145  1.41 0.612
##  2  1949  1.35 0.260 0.218  1.38 0.559
##  3  1950  1.57 0.278 0.316  1.39 0.573
##  4  1951  1.95 0.297 0.394  1.55 0.564
##  5  1952  2.27 0.310 0.356  1.80 0.574
##  6  1953  2.73 0.322 0.359  1.93 0.711
##  7  1954  3.03 0.335 0.403  1.96 0.776
##  8  1955  3.56 0.350 0.396  2.12 0.827
##  9  1956  3.98 0.361 0.382  2.43 0.800
## 10  1957  4.42 0.379 0.305  2.71 0.921
## # ... with 22 more rows
```

## Summary

| File Type | readr | foreign/sas7bdat |
|---|---|---|
| excel | read_excel() | |
| sas | read_sas() | read.sas7bdat() |
| spss | read_sav() / read_spss() | read.spss() |
| stata | read_dta() / read_stata() | read.dta() |

# Thank You

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