Functions

Writing your own functions

So far we've seen many functions, like `c()`, `class()`, `filter()`, `dim()` ...

Why create your own functions?

- Cut down on repetitive code (easier to fix things!)
- Organize code into manageable chunks
- Avoid running code unintentionally
- Use names that make sense to you

Writing your own functions

Here we will write a function that multiplies some number (x) by 2:

```
times_2 <- function(x) x * 2
```

When you run the line of code above, you make it ready to use (no output yet!). Let's test it!

```
times_2(x = 10)
```

```
[1] 20
```

Writing your own functions: `{ }`

Adding the curly brackets - `{}` - allows you to use functions spanning multiple lines:

```
times_2 <- function(x) {
  x * 2
}
times_2(x = 10)
```

```
[1] 20
```

Writing your own functions: `return`

If we want something specific for the function's output, we use `return()`:

```
times_2 <- function(x) {
  output <- x * 2
  return(output)
}
times_2(x = 10)
```

```
[1] 20
```

Writing your own functions

The general syntax for a function is:

```
functionName <- function(inputs) {
 <function body>
return(value)
}
```

Writing your own functions: multiple inputs

Functions can take multiple inputs:

```
times_2_plus_y <- function(x, y) x * 2 + y
times_2_plus_y(x = 10, y = 3)
```

```
[1] 23
```

Writing your own functions: defaults

Functions can have "default" arguments. This lets us use the function without using an argument later:

```
times_2_plus_y <- function(x = 10, y = 3) x * 2 + y
times_2_plus_y()
```

```
[1] 23
```

Writing another simple function

Let's write a function, `sqdif`, that:

1. takes two numbers `x` and `y` with default values of 2 and 3.
2. takes the difference
3. squares this difference
4. then returns the final value

Writing another simple function

```
sqdif <- function(x = 2, y = 3) (x - y)^2
```

```
sqdif()
```

```
[1] 1
```

```
sqdif(x = 10, y = 5)
```

```
[1] 25
```

```
sqdif(10, 5)
```

```
[1] 25
```

Writing your own functions: characters

Functions can have any kind of input. Here is a function with characters:

```
loud <- function(word) {
  output <- rep(toupper(word), 5)
  return(output)
}
loud(word = "hooray!")
```

```
[1] "HOORAY!" "HOORAY!" "HOORAY!" "HOORAY!" "HOORAY!"
```

Functions for tibbles

We can use `filter(row_number()==n)` to extract a row of a tibble:

```
cars <- read_kaggle()

get_row <- function(dat, row) dat %>% filter(row_number() == row)

get_row(dat = cars, row = 10)
```

```
# A tibble: 1 × 10
  RefId IsBadBuy PurchDate Auction VehYear VehicleAge Make  Model Trim  SubModel
  <dbl>    <dbl> <chr>     <chr>     <dbl>      <dbl> <chr> <chr> <chr> <chr>
1    10        0 12/7/2009 ADESA      2007          2 FORD  FIVE… SEL   4D SEDA…
```

Functions for tibbles

`select(n)` will choose column `n`:

```
get_index <- function(dat, row, col) {
  dat %>%
    filter(row_number() == row) %>%
    select(col)
}

get_index(dat = cars, row = 10, col = 8)

# A tibble: 1 × 1
  Model
  <chr>
1 FIVE HUNDRED
```

Functions for tibbles

Including default values for arguments:

```
get_top <- function(dat, row = 1, col = 1) {
  dat %>%
    filter(row_number() == row) %>%
    select(col)
}

get_top(dat = cars)

# A tibble: 1 × 1
  RefId
  <dbl>
1     1
```

Using your custom functions: `sapply()`

Now that you've made a function… You can "apply" functions easily with `sapply()`!

These functions take the form:

```
sapply(<a vector or list>, some_function)
```

Using your custom functions: **sapply()**

- There are no parentheses on the functions!

```
sapply(cars, class)
```

```
                                RefId                                 IsBadBuy
                            "numeric"                              "numeric"
                            PurchDate                               Auction
                            "character"                            "character"
                               VehYear                             VehicleAge
                            "numeric"                              "numeric"
                                  Make                                 Model
                            "character"                            "character"
                                  Trim                                SubModel
                            "character"                            "character"
                                 Color                            Transmission
                            "character"                            "character"
                            WheelTypeID                              WheelType
                            "character"                            "character"
                                VehOdo                             Nationality
                            "numeric"                              "character"
                                  Size                       TopThreeAmericanName
                            "character"                            "character"
MMRAcquisitionAuctionAveragePrice   MMRAcquisitionAuctionCleanPrice
                            "character"                            "character"
 MMRAcquisitionRetailAveragePrice     MMRAcquisitonRetailCleanPrice
                            "character"                            "character"
    MMRCurrentAuctionAveragePrice      MMRCurrentAuctionCleanPrice
                            "character"                            "character"
     MMRCurrentRetailAveragePrice       MMRCurrentRetailCleanPrice
```

Using your custom functions: **sapply()**

```
sapply(pull(cars, VehOdo), times_2_plus_y)
```

```
  [1] 178095 187189 147617 131237 138737 162111 130659 131613  99845 169747
 [11] 160163 150841 158633 142511 149447 144267 161475 150315 131853 168999
 [21] 109175 133075 196263 119581 131329 104215 177919 152349 130789 160131
 [31] 155391 112603 156485 115449 156871 165891 152611 111425 153175 130159
 [41] 130809 173781 137983 161901 105551 144385 119719 159155 146585 100457
 [51] 164295 116051  81841 175289 161939 100619 161593 124481 174019 128123
 [61] 155357 117779 127117 180055 179413 129025 151029 161219 191119  71595
 [71] 167005 140299 152107 144961 169087 122165 172969  87799 114679 118853
 [81] 159917 157121  96775 160237 131593 102293 176735 111821 173407 162851
 [91] 130761 149911  98659 147623  86827 156827 148055 129647 160985 170009
[101] 131425 112131 124463 124383 134855 151615 177985 179701 162679 160157
[111] 154469 133365 165055 163863 148265 144837 128239 142849 129303 170779
[121] 190889 138677  93129 169813 142127 162001 133093 135573 143907 141485
[131] 188639 138883 108539 118147 172059 129357 137751 129111 147979  47765
[141] 101067 121111 183119 126757 118785  88737  89033 166479 185067 136333
[151] 175553 172831  72287 161579 186695 147929 136369 129681 150971 118577
[161] 126305  93393 117797 130729 150477 170087 175405 185635 194445 147455
[171]  95103 126161 128131 176057 164331 169529 104229  99789 185567  92005
[181] 125983 157987 128919 121047 147453 142431 121063 133393 178063  72853
[191] 117649 145187 158033 177337 117001 190053 101291 177667 136083 116771
[201] 158571 161815 188025 173753 122641 158669 185797 119605 150219 135395
[211] 100773 116903 150143 147743  87073 111369 117365 125593 154359 138863
[221] 172935 138963 172691 158063 189015 155575 134863 146821 120405  98595
[231] 122633 168911 170527 145989 179541 137103 125913 150205 176349 105585
[241] 170671 138063 129113 132869 154103 168779 105735  91363 126995 157189
[251] 186793 106929 166165 146321 150317 147035 130921 185587 164545 177449
[261] 144043 154763 101549 117861 159799 183549 124545 133139 126161 164319
[271] 120683 185951 149943 124469 158165 111515 107287 147665 177059 188145
```

Using your custom functions "on the fly" to iterate

```
sapply(pull(cars, VehOdo), function(x) x / 1000)
```

```
  [1]  89.046  93.593  73.807  65.617  69.367  81.054  65.328  65.805  49.921
 [10]  84.872  80.080  75.419  79.315  71.254  74.722  72.132  80.736  75.156
 [19]  65.925  84.498  54.586  66.536  98.130  59.789  65.663  52.106  88.958
 [28]  76.173  65.393  80.064  77.694  56.300  78.241  57.723  78.434  82.944
 [37]  76.304  55.711  76.586  65.078  65.403  86.889  68.990  80.949  52.774
 [46]  72.191  59.858  79.576  73.291  50.227  82.146  58.024  40.919  87.643
 [55]  80.968  50.308  80.795  62.239  87.008  64.060  77.677  58.888  63.557
 [64]  90.026  89.705  64.511  75.513  80.608  95.558  35.796  83.501  70.148
 [73]  76.052  72.479  84.542  61.081  86.483  43.898  57.338  59.425  79.957
 [82]  78.559  48.386  80.117  65.795  51.145  88.366  55.909  86.702  81.424
 [91]  65.379  74.954  49.328  73.810  43.412  78.412  74.026  64.822  80.491
[100]  85.003  65.711  56.064  62.230  62.190  67.426  75.806  88.991  89.849
[109]  81.338  80.077  77.233  66.681  82.526  81.930  74.131  72.417  64.118
[118]  71.423  64.650  85.388  95.443  69.337  46.563  84.905  71.062  80.999
[127]  66.545  67.785  71.952  70.741  94.318  69.440  54.268  59.072  86.028
[136]  64.677  68.874  64.554  73.988  23.881  50.532  60.554  91.558  63.377
[145]  59.391  44.367  44.515  83.238  92.532  68.165  87.775  86.414  36.142
[154]  80.788  93.346  73.963  68.183  64.839  75.484  59.287  63.151  46.695
[163]  58.897  65.363  75.237  85.042  87.701  92.816  97.221  73.726  47.550
[172]  63.079  64.064  88.027  82.164  84.763  52.113  49.893  92.782  46.001
[181]  62.990  78.992  64.458  60.522  73.725  71.214  60.530  66.695  89.030
[190]  36.425  58.823  72.592  79.015  88.667  58.499  95.025  50.644  88.832
[199]  68.040  58.384  79.284  80.906  94.011  86.875  61.319  79.333  92.897
[208]  59.801  75.108  67.696  50.385  58.450  75.070  73.870  43.535  55.683
[217]  58.681  62.795  77.178  69.430  86.466  69.480  86.344  79.030  94.506
[226]  77.786  67.430  73.409  60.201  49.296  61.315  84.454  85.262  72.993
[235]  89.769  68.550  62.955  75.101  88.173  52.791  85.334  69.030  64.555
[244]  66.433  77.050  84.388  52.866  45.680  63.496  78.593  93.395  53.463
```

Applying functions with **across** from **dplyr**

`across()` makes it easy to apply the same transformation to multiple columns. Usually used with `summarize()`.

```
across( .cols = <columns>, .fns = function, ... )
```

- List columns first : `.cols =`
- List function next: `.fns =`
- Then list any arguments for the function

Applying functions with **across** from **dplyr**.

Combining with `summarize()`:

```
cars_dbl <- cars %>% select(Make, Model, where(is.double))

cars_dbl %>%
  group_by(Make) %>%
  summarize(across(.cols = everything(), .fns = mean))
```

```
# A tibble: 33 × 12
   Make   Model  RefId IsBadBuy VehYear VehicleAge VehOdo  BYRNO VNZIP1 VehBCost
   <chr>  <dbl>  <dbl>    <dbl>   <dbl>      <dbl>  <dbl>  <dbl>  <dbl>    <dbl>
 1 ACURA     NA 36021.   0.273    2003.       6.52 81732. 21851. 61217.    9039.
 2 BUICK     NA 35431.   0.157    2004.       5.65 76238. 19755. 51298.    6169.
 3 CADIL…    NA 34173.   0.152    2004.       5.24 73770. 20383. 50775.   10958.
 4 CHEVR…    NA 35417.   0.0975   2006.       3.97 73390. 26912. 58874.    6835.
 5 CHRYS…    NA 37614.   0.129    2006.       3.65 66814. 31268. 58562.    6507.
 6 DODGE     NA 36851.   0.103    2006.       3.75 68261. 36094. 58788.    7047.
 7 FORD      NA 36866.   0.154    2005.       4.75 76749. 19887. 59427.    6403.
 8 GMC       NA 35245.   0.116    2004.       5.61 79273. 18802. 58113.    8342.
 9 HONDA     NA 35109.   0.109    2004.       5.33 77877. 24161. 52659.    8350.
10 HUMMER    NA 19533    0        2006        3    70809  21053  95673    11920
# … with 23 more rows, and 2 more variables: IsOnlineSale <dbl>,
#   WarrantyCost <dbl>
```

Applying functions with **across** from **dplyr**.

Combining with `summarize()`:

```
# Adding arguments to the end!
#
cars_dbl %>%
  group_by(Make) %>%
  summarize(across(.cols = everything(), .fns = mean, na.rm = TRUE))
```

```
# A tibble: 33 × 12
   Make   Model  RefId IsBadBuy VehYear VehicleAge VehOdo  BYRNO VNZIP1 VehBCost
   <chr>  <dbl>  <dbl>    <dbl>   <dbl>      <dbl>  <dbl>  <dbl>  <dbl>    <dbl>
 1 ACURA     NA 36021.   0.273    2003.       6.52 81732. 21851. 61217.    9039.
 2 BUICK     NA 35431.   0.157    2004.       5.65 76238. 19755. 51298.    6169.
 3 CADIL…    NA 34173.   0.152    2004.       5.24 73770. 20383. 50775.   10958.
 4 CHEVR…    NA 35417.   0.0975   2006.       3.97 73390. 26912. 58874.    6835.
 5 CHRYS…    NA 37614.   0.129    2006.       3.65 66814. 31268. 58562.    6507.
 6 DODGE     NA 36851.   0.103    2006.       3.75 68261. 36094. 58788.    7047.
 7 FORD      NA 36866.   0.154    2005.       4.75 76749. 19887. 59427.    6403.
 8 GMC       NA 35245.   0.116    2004.       5.61 79273. 18802. 58113.    8342.
 9 HONDA     NA 35109.   0.109    2004.       5.33 77877. 24161. 52659.    8350.
10 HUMMER    NA 19533    0        2006        3    70809  21053  95673    11920
# … with 23 more rows, and 2 more variables: IsOnlineSale <dbl>,
#   WarrantyCost <dbl>
```

Applying functions with **across** from **dplyr**.

Using different `tidyselect()` options:

```
cars_dbl %>%
  group_by(Make) %>%
  summarize(across(.cols = starts_with("Veh"), .fns = mean))
```

```
# A tibble: 33 × 5
   Make      VehYear VehicleAge VehOdo VehBCost
   <chr>       <dbl>      <dbl>  <dbl>    <dbl>
 1 ACURA       2003.       6.52 81732.    9039.
 2 BUICK       2004.       5.65 76238.    6169.
 3 CADILLAC    2004.       5.24 73770.   10958.
 4 CHEVROLET   2006.       3.97 73390.    6835.
 5 CHRYSLER    2006.       3.65 66814.    6507.
 6 DODGE       2006.       3.75 68261.    7047.
 7 FORD        2005.       4.75 76749.    6403.
 8 GMC         2004.       5.61 79273.    8342.
 9 HONDA       2004.       5.33 77877.    8350.
10 HUMMER      2006        3    70809    11920
# … with 23 more rows
```

Applying functions with **across** from **dplyr**.

Combining with `mutate()`:

```
cars_dbl %>%
  mutate(across(.cols = starts_with("Veh"), .fns = round, digits = -3))
```

```
# A tibble: 72,983 × 12
   Make     Model RefId IsBadBuy VehYear VehicleAge VehOdo BYRNO VNZIP1 VehBCost
   <chr>    <chr> <dbl>    <dbl>   <dbl>      <dbl>  <dbl> <dbl>  <dbl>    <dbl>
 1 MAZDA    MAZD…     1        0    2000          0  89000 21973  33619     7000
 2 DODGE    1500…     2        0    2000          0  94000 19638  33619     8000
 3 DODGE    STRA…     3        0    2000          0  74000 19638  33619     5000
 4 DODGE    NEON      4        0    2000          0  66000 19638  33619     4000
 5 FORD     FOCUS     5        0    2000          0  69000 19638  33619     4000
 6 MITSUBI… GALA…     6        0    2000          0  81000 19638  33619     6000
 7 KIA      SPEC…     7        0    2000          0  65000 19638  33619     4000
 8 FORD     TAUR…     8        0    2000          0  66000 19638  33619     4000
 9 KIA      SPEC…     9        0    2000          0  50000 21973  33619     6000
10 FORD     FIVE…    10        0    2000          0  85000 21973  33619     8000
# … with 72,973 more rows, and 2 more variables: IsOnlineSale <dbl>,
#   WarrantyCost <dbl>
```

Applying functions with **across** from **dplyr**.

Combining with `mutate()`:

```
cars_dbl %>%
  mutate(across(
    .cols = everything(),
    .fns = str_replace_all,
    pattern = "A",
    replacement = "a"
  ))
```

```
# A tibble: 72,983 × 12
   Make     Model RefId IsBadBuy VehYear VehicleAge VehOdo BYRNO VNZIP1 VehBCost
   <chr>    <chr> <chr> <chr>    <chr>   <chr>      <chr>  <chr> <chr>  <chr>
 1 MaZDa    MaZD… 1     0        2006    3          89046  21973 33619  7100
 2 DODGE    1500… 2     0        2004    5          93593  19638 33619  7600
 3 DODGE    STRa… 3     0        2005    4          73807  19638 33619  4900
 4 DODGE    NEON  4     0        2004    5          65617  19638 33619  4100
 5 FORD     FOCUS 5     0        2005    4          69367  19638 33619  4000
 6 MITSUBI… GaLa… 6     0        2004    5          81054  19638 33619  5600
 7 KIa      SPEC… 7     0        2004    5          65328  19638 33619  4200
 8 FORD     TaUR… 8     0        2005    4          65805  19638 33619  4500
 9 KIa      SPEC… 9     0        2007    2          49921  21973 33619  5600
10 FORD     FIVE… 10    0        2007    2          84872  21973 33619  7700
# … with 72,973 more rows, and 2 more variables: IsOnlineSale <chr>,
#   WarrantyCost <chr>
```

Applying functions with **across** from **dplyr**.

Combining with `mutate()`:

```
# Child mortality data
mort <- read_mortality() %>% rename(country = `...1`)

mort %>%
  select(country, starts_with("194")) %>%
  mutate(across(
    .cols = c(`1943`, `1944`, `1945`),
    .fns = replace_na,
    replace = 0
  ))
```

```
# A tibble: 197 × 11
   country `1940` `1941` `1942` `1943` `1944` `1945` `1946` `1947` `1948` `1949`
   <chr>    <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>
 1 Afghan… NA     NA     NA      0      0      0     NA     NA     NA     NA
 2 Albania  1.53   1.31   1.48   1.46   1.43   1.40   1.37   1.41   1.37   1.34
 3 Algeria NA     NA     NA      0      0      0     NA     NA     NA     NA
 4 Angola   4.46   4.46   4.46   4.34   4.34   4.34   4.33   4.22   4.22   4.21
 5 Argent…  0.641  0.603  0.602  0.558  0.551  0.510  0.503  0.496  0.494  0.492
 6 Armenia NA     NA     NA      0      0      0     NA     NA     NA     NA
 7 Aruba   NA     NA     NA      0      0      0     NA     NA     NA     NA
 8 Austra…  0.263  0.275  0.276  0.299  0.260  0.271  0.295  0.279  0.271  0.271
 9 Austria  0.504  0.474  0.417  0.389  0.360  0.311  0.311  0.312  0.274  0.274
10 Azerba… NA     NA     NA      0      0      0     NA     NA     NA     NA
# … with 187 more rows
```

Summary

- Simple functions take the form:
  - `NEW_FUNCTION <- function(x, y) x + y ..`
  - Can specify defaults like `function(x = 1, y = 2)`
- Apply your functions with `sapply(<a vector or list>, some_function)`
- Use `across()` to apply functions across multiple columns of data

Website

- Class Website
- Lab

The end!