

# Intro to R

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	SubMod
	<dbl>	<dbl>	<chr>	<chr>	<dbl>	<dbl>	<chr>	<chr>	<chr>	<chr>
1	10	0	12/7/2009	ADESA	2007	2	FORD	FIVE...	SEL	4D SED

## 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
"character"	"character"



## Using your custom functions: `sapply()`

```
sapply(pull(cars, Veh0do), 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

```
supply(pull(cars, Veh0do), function(x) x / 1000)
```

[1]	89.046	93.593	73.807	65.617	69.367	81.054	65.328	65.805	49.92
[10]	84.872	80.080	75.419	79.315	71.254	74.722	72.132	80.736	75.15
[19]	65.925	84.498	54.586	66.536	98.130	59.789	65.663	52.106	88.95
[28]	76.173	65.393	80.064	77.694	56.300	78.241	57.723	78.434	82.94
[37]	76.304	55.711	76.586	65.078	65.403	86.889	68.990	80.949	52.77
[46]	72.191	59.858	79.576	73.291	50.227	82.146	58.024	40.919	87.64
[55]	80.968	50.308	80.795	62.239	87.008	64.060	77.677	58.888	63.55
[64]	90.026	89.705	64.511	75.513	80.608	95.558	35.796	83.501	70.14
[73]	76.052	72.479	84.542	61.081	86.483	43.898	57.338	59.425	79.95
[82]	78.559	48.386	80.117	65.795	51.145	88.366	55.909	86.702	81.42
[91]	65.379	74.954	49.328	73.810	43.412	78.412	74.026	64.822	80.49
[100]	85.003	65.711	56.064	62.230	62.190	67.426	75.806	88.991	89.84
[109]	81.338	80.077	77.233	66.681	82.526	81.930	74.131	72.417	64.11
[118]	71.423	64.650	85.388	95.443	69.337	46.563	84.905	71.062	80.99
[127]	66.545	67.785	71.952	70.741	94.318	69.440	54.268	59.072	86.02
[136]	64.677	68.874	64.554	73.988	23.881	50.532	60.554	91.558	63.37
[145]	59.391	44.367	44.515	83.238	92.532	68.165	87.775	86.414	36.14
[154]	80.788	93.346	73.963	68.183	64.839	75.484	59.287	63.151	46.69
[163]	58.897	65.363	75.237	85.042	87.701	92.816	97.221	73.726	47.55
[172]	63.079	64.064	88.027	82.164	84.763	52.113	49.893	92.782	46.00
[181]	62.990	78.992	64.458	60.522	73.725	71.214	60.530	66.695	89.03
[190]	36.425	58.823	72.592	79.015	88.667	58.499	95.025	50.644	88.83
[199]	68.040	58.384	79.284	80.906	94.011	86.875	61.319	79.333	92.89
[208]	59.801	75.108	67.696	50.385	58.450	75.070	73.870	43.535	55.68
[217]	58.681	62.795	77.178	69.430	86.466	69.480	86.344	79.030	94.50
[226]	77.786	67.430	73.409	60.201	49.296	61.315	84.454	85.262	72.99
[235]	89.769	68.550	62.955	75.101	88.173	52.791	85.334	69.030	64.55
[244]	66.433	77.050	84.388	52.866	45.680	63.496	78.593	93.395	53.46
[253]	88.001	78.150	75.157	78.516	65.450	88.700	88.071	88.700	78.00

## 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	CHRY...	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	CHRY...	NA	37614.	0.129	2006.	3.65	66814.	31268.	58562.	6507.
6	DODGE	NA	36851.	0.103	2006.	3.75	68261.	36094.	58788.	7047.
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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

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