

Choosing things in dataframes

Packages

The usual:

```
library(tidyverse)
```

Doing things with data frames

Let's go back to our Australian athletes:

```
athletes
```

```
# A tibble: 202 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	
1	female	Netball	4.56	13.3	42.2	13.6	20	19.2	49	
2	female	Netball	4.15	6	38	12.7	59	21.2	110.	
3	female	Netball	4.16	7.6	37.5	12.3	22	21.4	89	
4	female	Netball	4.32	6.4	37.7	12.3	30	21.0	98.3	
5	female	Netball	4.06	5.8	38.7	12.8	78	21.8	122.	
6	female	Netball	4.12	6.1	36.6	11.8	21	21.4	90.4	
7	female	Netball	4.17	5	37.4	12.7	109	21.5	107.	
8	female	Netball	3.8	6.6	36.5	12.4	102	24.4	157.	
9	female	Netball	3.96	5.5	36.3	12.4	71	22.6	101.	
10	female	Netball	4.44	9.7	41.4	14.1	64	22.8	126.	

```
# i 192 more rows
```

Choosing a column

```
athletes %>% select(Sport)
```

```
# A tibble: 202 x 1
```

```
  Sport
```

```
  <chr>
```

```
1 Netball
```

```
2 Netball
```

```
3 Netball
```

```
4 Netball
```

```
5 Netball
```

```
6 Netball
```

```
7 Netball
```

```
8 Netball
```

```
9 Netball
```

```
10 Netball
```

```
# i 192 more rows
```

Choosing several columns

```
athletes %>% select(Sport, Hg, BMI)
```

```
# A tibble: 202 x 3
```

	Sport	Hg	BMI
	<chr>	<dbl>	<dbl>
1	Netball	13.6	19.2
2	Netball	12.7	21.2
3	Netball	12.3	21.4
4	Netball	12.3	21.0
5	Netball	12.8	21.8
6	Netball	11.8	21.4
7	Netball	12.7	21.5
8	Netball	12.4	24.4
9	Netball	12.4	22.6
10	Netball	14.1	22.8

```
# i 192 more rows
```

Choosing consecutive columns

```
athletes %>% select(Sex:WCC, BMI)
```

```
# A tibble: 202 x 5
```

	Sex	Sport	RCC	WCC	BMI
	<chr>	<chr>	<dbl>	<dbl>	<dbl>
1	female	Netball	4.56	13.3	19.2
2	female	Netball	4.15	6	21.2
3	female	Netball	4.16	7.6	21.4
4	female	Netball	4.32	6.4	21.0
5	female	Netball	4.06	5.8	21.8
6	female	Netball	4.12	6.1	21.4
7	female	Netball	4.17	5	21.5
8	female	Netball	3.8	6.6	24.4
9	female	Netball	3.96	5.5	22.6
10	female	Netball	4.44	9.7	22.8

```
# i 192 more rows
```

Choosing all-but some columns

```
athletes %>% select(-(RCC:LBM))
```

```
# A tibble: 202 x 4
```

	Sex	Sport	Ht	Wt
	<chr>	<chr>	<dbl>	<dbl>
1	female	Netball	177.	59.9
2	female	Netball	173.	63
3	female	Netball	176	66.3
4	female	Netball	170.	60.7
5	female	Netball	183	72.9
6	female	Netball	178.	67.9
7	female	Netball	177.	67.5
8	female	Netball	174.	74.1
9	female	Netball	174.	68.2
10	female	Netball	174.	68.8

```
# i 192 more rows
```

```
athletes %>% select(Sex, Sport, Ht, Wt)
```

Select-helpers

Other ways to select columns: those whose name:

- `starts_with` something
- `ends_with` something
- `contains` something
- matches a “regular expression”
- `everything()` select all the columns

Columns whose names begin with S

```
athletes %>% select(starts_with("S"))
```

```
# A tibble: 202 x 3
```

	Sex	Sport	SSF
	<chr>	<chr>	<dbl>
1	female	Netball	49
2	female	Netball	110.
3	female	Netball	89
4	female	Netball	98.3
5	female	Netball	122.
6	female	Netball	90.4
7	female	Netball	107.
8	female	Netball	157.
9	female	Netball	101.
10	female	Netball	126.

```
# i 192 more rows
```

Columns whose names end with C

either uppercase or lowercase:

```
athletes %>% select(ends_with("c"))
```

```
# A tibble: 202 x 3
   RCC    WCC    Hc
  <dbl> <dbl> <dbl>
1  4.56  13.3  42.2
2  4.15    6   38
3  4.16   7.6  37.5
4  4.32   6.4  37.7
5  4.06   5.8  38.7
6  4.12   6.1  36.6
7  4.17    5   37.4
8  3.8    6.6  36.5
9  3.96   5.5  36.3
10 4.44   9.7  41.4
# i 192 more rows
```

Case-sensitive

This works with any of the select-helpers:

```
athletes %>% select(ends_with("C", ignore.case=FALSE))
```

```
# A tibble: 202 x 2
```

```
      RCC      WCC
```

```
  <dbl> <dbl>
```

```
1  4.56  13.3
```

```
2  4.15    6
```

```
3  4.16   7.6
```

```
4  4.32   6.4
```

```
5  4.06   5.8
```

```
6  4.12   6.1
```

```
7  4.17    5
```

```
8  3.8    6.6
```

```
9  3.96   5.5
```

```
10 4.44   9.7
```

```
# i 192 more rows
```

Column names containing letter R

```
athletes %>% select(contains("r"))
```

```
# A tibble: 202 x 3
```

	Sport	RCC	Ferr
	<chr>	<dbl>	<dbl>
1	Netball	4.56	20
2	Netball	4.15	59
3	Netball	4.16	22
4	Netball	4.32	30
5	Netball	4.06	78
6	Netball	4.12	21
7	Netball	4.17	109
8	Netball	3.8	102
9	Netball	3.96	71
10	Netball	4.44	64

```
# i 192 more rows
```

Exactly two characters, ending with T

In regular expression terms, this is `^.t$`:

- `^` means “start of text”
- `.` means “exactly one character, but could be anything”
- `$` means “end of text”.

```
athletes %>% select(matches("^.t$"))
```

```
# A tibble: 202 x 2
```

	Ht	Wt
	<dbl>	<dbl>
1	177.	59.9
2	173.	63
3	176	66.3
4	170.	60.7
5	183	72.9
6	178.	67.9
7	177.	67.5
8	174	74.1

Choosing columns by property

- Use where as with summarizing several columns
- eg, to choose text columns:

```
athletes %>% select(where(is.character))
```

```
# A tibble: 202 x 2
```

	Sex	Sport
	<chr>	<chr>

1	female	Netball
---	--------	---------

2	female	Netball
---	--------	---------

3	female	Netball
---	--------	---------

4	female	Netball
---	--------	---------

5	female	Netball
---	--------	---------

6	female	Netball
---	--------	---------

7	female	Netball
---	--------	---------

8	female	Netball
---	--------	---------

9	female	Netball
---	--------	---------

10	female	Netball
----	--------	---------

Choosing rows by number

```
athletes %>% slice(16:25)
```

```
# A tibble: 10 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	Wt
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Netball	4.25	10.7	39.5	13.2	127	24.5	157.	
2	female	Netball	4.46	10.9	39.7	13.7	102	24.0	116.	
3	female	Netball	4.4	9.3	40.4	13.6	86	26.2	182.	
4	female	Netball	4.83	8.4	41.8	13.4	40	20.0	71.6	
5	female	Netball	4.23	6.9	38.3	12.6	50	25.7	144.	
6	female	Netball	4.24	8.4	37.6	12.5	58	25.6	201.	
7	female	Netball	3.95	6.6	38.4	12.8	33	19.9	68.9	
8	female	Netball	4.03	8.5	37.7	13	51	23.4	104.	
9	female	BBall	3.96	7.5	37.5	12.3	60	20.6	109.	
10	female	BBall	4.41	8.3	38.2	12.7	68	20.7	103.	

```
# i 1 more variable: Wt <dbl>
```

Non-consecutive rows

```
athletes %>%  
  slice(10, 13, 17, 42)
```

```
# A tibble: 4 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%H
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Netball	4.44	9.7	41.4	14.1	64	22.8	126.	
2	female	Netball	4.02	9.1	37.7	12.7	107	23.0	77	
3	female	Netball	4.46	10.9	39.7	13.7	102	24.0	116.	
4	female	Row	4.37	8.1	41.8	14.3	53	23.5	98	

```
# i 1 more variable: Wt <dbl>
```


A random sample of rows

```
athletes %>% slice_sample(n=8)
```

```
# A tibble: 8 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%B
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Swim	4.31	5.3	41.1	13.9	60	20.9	62.9	1
2	male	T400m	4.55	5.55	42.6	14.4	106	21.2	34.1	
3	male	TSprnt	5.69	10.8	50.5	18.5	53	24.5	42.3	
4	female	Tennis	4.66	6.4	40.9	13.9	109	18.4	38.2	
5	male	WPolo	5.34	6.2	49.8	17.2	143	27.8	75.7	1
6	female	Netball	4.32	6.4	37.7	12.3	30	21.0	98.3	1
7	male	WPolo	4.95	7.5	44.5	15	50	24.3	106.	1
8	female	Row	4.46	9.5	41.5	14.5	92	23.0	83	1

```
# i 1 more variable: Wt <dbl>
```

Rows for which something is true

```
athletes %>% filter(Sport == "Tennis")
```

```
# A tibble: 11 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%E
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Tennis	4	4.2	36.6	12	57	25.4	109	2
2	female	Tennis	4.4	4	40.8	13.9	73	22.1	98.1	1
3	female	Tennis	4.38	7.9	39.8	13.5	88	21.2	80.6	1
4	female	Tennis	4.08	6.6	37.8	12.1	182	20.5	68.3	1
5	female	Tennis	4.98	6.4	44.8	14.8	80	17.1	47.6	1
6	female	Tennis	5.16	7.2	44.3	14.5	88	18.3	61.9	1
7	female	Tennis	4.66	6.4	40.9	13.9	109	18.4	38.2	
8	male	Tennis	5.66	8.3	50.2	17.7	38	23.8	56.5	1
9	male	Tennis	5.03	6.4	42.7	14.3	122	22.0	47.6	
10	male	Tennis	4.97	8.8	43	14.9	233	22.3	60.4	1
11	male	Tennis	5.38	6.3	46	15.7	32	21.1	34.9	

```
# i 1 more variable: Wt <dbl>
```

More complicated selections

```
athletes %>% filter(Sport == "Tennis", RCC < 5)
```

```
# A tibble: 7 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%Bf
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Tennis	4	4.2	36.6	12	57	25.4	109	20
2	female	Tennis	4.4	4	40.8	13.9	73	22.1	98.1	19
3	female	Tennis	4.38	7.9	39.8	13.5	88	21.2	80.6	17
4	female	Tennis	4.08	6.6	37.8	12.1	182	20.5	68.3	15
5	female	Tennis	4.98	6.4	44.8	14.8	80	17.1	47.6	11
6	female	Tennis	4.66	6.4	40.9	13.9	109	18.4	38.2	8
7	male	Tennis	4.97	8.8	43	14.9	233	22.3	60.4	11

```
# i 1 more variable: Wt <dbl>
```

Another way to do “and”

```
athletes %>% filter(Sport == "Tennis") %>%  
  filter(RCC < 5)
```

```
# A tibble: 7 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	~%Bt
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Tennis	4	4.2	36.6	12	57	25.4	109	20
2	female	Tennis	4.4	4	40.8	13.9	73	22.1	98.1	19
3	female	Tennis	4.38	7.9	39.8	13.5	88	21.2	80.6	17
4	female	Tennis	4.08	6.6	37.8	12.1	182	20.5	68.3	15
5	female	Tennis	4.98	6.4	44.8	14.8	80	17.1	47.6	11
6	female	Tennis	4.66	6.4	40.9	13.9	109	18.4	38.2	8
7	male	Tennis	4.97	8.8	43	14.9	233	22.3	60.4	11

```
# i 1 more variable: Wt <dbl>
```

Either/Or

```
athletes %>% filter(Sport == "Tennis" | RCC > 5)
```

```
# A tibble: 66 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%F
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	female	Row	5.02	6.4	44.8	15.2	48	19.8	91	
2	female	T400m	5.31	9.5	47.1	15.9	29	21.4	57.9	
3	female	Field	5.33	9.3	47	15	62	25.3	103.	
4	female	TSprnt	5.16	8.2	45.3	14.7	34	20.3	46.1	
5	female	Tennis	4	4.2	36.6	12	57	25.4	109	
6	female	Tennis	4.4	4	40.8	13.9	73	22.1	98.1	
7	female	Tennis	4.38	7.9	39.8	13.5	88	21.2	80.6	
8	female	Tennis	4.08	6.6	37.8	12.1	182	20.5	68.3	
9	female	Tennis	4.98	6.4	44.8	14.8	80	17.1	47.6	
10	female	Tennis	5.16	7.2	44.3	14.5	88	18.3	61.9	

```
# i 56 more rows
```

```
# i 1 more variable: Wt <dbl>
```

Sorting into order

```
athletes %>% arrange(RCC)
```

```
# A tibble: 202 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	~%
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	
1	female	Netball	3.8	6.6	36.5	12.4	102	24.4	157.	
2	female	Netball	3.9	6.3	35.9	12.1	78	20.1	70	
3	female	T400m	3.9	6	38.9	13.5	16	19.4	48.4	
4	female	Row	3.91	7.3	37.6	12.9	43	22.3	126.	
5	female	Netball	3.95	6.6	38.4	12.8	33	19.9	68.9	
6	female	Row	3.95	3.3	36.9	12.5	40	24.5	74.9	
7	female	Netball	3.96	5.5	36.3	12.4	71	22.6	101.	
8	female	BBall	3.96	7.5	37.5	12.3	60	20.6	109.	
9	female	Tennis	4	4.2	36.6	12	57	25.4	109	
10	female	Netball	4.02	9.1	37.7	12.7	107	23.0	77	

```
# i 192 more rows  
# i 1 more variable: Wt <dbl>
```

Breaking ties by another variable

```
athletes %>% arrange(RCC, BMI)
```

```
# A tibble: 202 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	~%
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	
1	female	Netball	3.8	6.6	36.5	12.4	102	24.4	157.	
2	female	T400m	3.9	6	38.9	13.5	16	19.4	48.4	
3	female	Netball	3.9	6.3	35.9	12.1	78	20.1	70	
4	female	Row	3.91	7.3	37.6	12.9	43	22.3	126.	
5	female	Netball	3.95	6.6	38.4	12.8	33	19.9	68.9	
6	female	Row	3.95	3.3	36.9	12.5	40	24.5	74.9	
7	female	BBall	3.96	7.5	37.5	12.3	60	20.6	109.	
8	female	Netball	3.96	5.5	36.3	12.4	71	22.6	101.	
9	female	Tennis	4	4.2	36.6	12	57	25.4	109	
10	female	Netball	4.02	9.1	37.7	12.7	107	23.0	77	

```
# i 192 more rows
```

```
# i 1 more variable: Wt <dbl>
```

Descending order

```
athletes %>% arrange(desc(BMI))
```

```
# A tibble: 202 x 13
```

	Sex	Sport	RCC	WCC	Hc	Hg	Ferr	BMI	SSF	%Bf
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
1	male	Field	5.48	6.2	48.2	16.3	94	34.4	82.7	13
2	male	Field	4.96	8.3	45.3	15.7	141	33.7	114.	17
3	male	Field	5.48	4.6	49.4	18	132	32.5	55.7	8
4	female	Field	4.75	7.5	43.8	15.2	90	31.9	132.	23
5	male	Field	5.01	8.9	46	15.9	212	30.2	112.	19
6	male	Field	5.01	8.9	46	15.9	212	30.2	96.9	18
7	male	Field	5.09	8.9	46.3	15.4	44	30.0	71.1	14
8	female	Field	4.58	5.8	42.1	14.7	164	28.6	110.	21
9	female	Field	4.51	9	39.7	14.3	36	28.1	136.	24
10	male	WPolo	5.34	6.2	49.8	17.2	143	27.8	75.7	13

```
# i 192 more rows
```

```
# i 1 more variable: Wt <dbl>
```


“The top ones”

```
athletes %>%  
  arrange(desc(Wt)) %>%  
  slice(1:7) %>%  
  select(Sport, Wt)
```

```
# A tibble: 7 x 2
```

	Sport	Wt
	<chr>	<dbl>
1	Field	123.
2	BBall	114.
3	Field	111.
4	Field	108.
5	Field	103.
6	WPolo	101
7	BBall	100.

Another way

```
athletes %>%  
  slice_max(order_by = Wt, n=7) %>%  
  select(Sport, Wt)
```

```
# A tibble: 7 x 2
```

```
  Sport    Wt
```

```
  <chr> <dbl>
```

```
1 Field  123.
```

```
2 BBall  114.
```

```
3 Field  111.
```

```
4 Field  108.
```

```
5 Field  103.
```

```
6 WPolo  101
```

```
7 BBall  100.
```

Create new variables from old ones

```
athletes %>%  
  mutate(wt_lb = Wt * 2.2) %>%  
  select(Sport, Sex, Wt, wt_lb) %>%  
  arrange(Wt)
```

```
# A tibble: 202 x 4
```

	Sport	Sex	Wt	wt_lb
	<chr>	<chr>	<dbl>	<dbl>
1	Gym	female	37.8	83.2
2	Gym	female	43.8	96.4
3	Gym	female	45.1	99.2
4	Tennis	female	45.8	101.
5	Tennis	female	47.4	104.
6	Gym	female	47.8	105.
7	T400m	female	49.2	108.
8	Row	female	49.8	110.
9	T400m	female	50.9	112.

Turning the result into a number

Output is always data frame unless you explicitly turn it into something else, eg. the weight of the heaviest athlete, as a number:

```
athletes %>% arrange(desc(Wt)) %>%  
  pluck("Wt", 1) -> heavy  
heavy
```

```
[1] 123.2
```

```
heavy * 2.2
```

```
[1] 271.04
```

Or the 20 heaviest weights in descending order:

```
athletes %>%  
  arrange(desc(Wt)) %>%  
  slice(1:20) %>%  
  pluck("Wt")
```

Another way to do the last one

```
athletes %>%  
  arrange(desc(Wt)) %>%  
  slice(1:20) %>%  
  pull("Wt")
```

```
[1] 123.20 113.70 111.30 108.20 102.70 101.00 100.20 98.00  
[11] 97.00 96.90 96.30 94.80 94.80 94.70 94.70 94.60
```

`pull` grabs the column you name *as a vector* (of whatever it contains).

To find the mean height of the women athletes

Two ways:

```
athletes %>% group_by(Sex) %>% summarize(m = mean(Ht))
```

```
# A tibble: 2 x 2
```

```
  Sex      m  
  <chr> <dbl>
```

```
1 female 175.
```

```
2 male   186.
```

```
athletes %>%  
  filter(Sex == "female") %>%  
  summarize(m = mean(Ht))
```

```
# A tibble: 1 x 1
```

```
  m  
  <dbl>
```

```
1 175.
```

Summary of data selection/arrangement “verbs”

Verb	Purpose
<code>select</code>	Choose columns
<code>slice</code>	Choose rows by number
<code>slice_sample</code>	Choose random rows
<code>slice_max</code>	Choose rows with largest values on a variable (also <code>slice_min</code>)
<code>filter</code>	Choose rows satisfying conditions
<code>arrange</code>	Sort in order by column(s)
<code>mutate</code>	Create new variables
<code>group_by</code>	Create groups to work with
<code>summarize</code>	Calculate summary statistics (by groups if defined)
<code>pluck</code>	Extract items from data frame
<code>pull</code>	Extract a single column from a data frame as a vector

Looking things up in another data frame

- Suppose you are working in the nails department of a hardware store and you find that you have sold these items:

```
my_url <- "http://ritsokiguess.site/datafiles/nail_sales.csv"
sales <- read_csv(my_url)
sales
```

```
# A tibble: 6 x 2
  product_code sales
  <chr>         <dbl>
1 061-5344-6     10
2 161-0090-0      6
3 061-5388-2      2
4 161-0199-4      8
5 061-5375-2      5
6 061-4525-2      3
```


Product descriptions and prices

- but you don't remember what these product codes are, and you would like to know the total revenue from these sales.
- Fortunately you found a list of product descriptions and prices:

```
my_url <- "http://ritsokiguess.site/datafiles/nail_desc.csv"
desc <- read_csv(my_url)
desc
```

```
# A tibble: 7 x 5
```

	product_code	description	size	qty	price
	<chr>	<chr>	<chr>	<dbl>	<dbl>
1	061-4525-2	spike nail	"10\""	1	1.49
2	061-5329-4	masonry nail	"1.5\""	112	8.19
3	061-5344-6	finishing nail	"1\""	1298	6.99
4	061-5375-2	roofing nail	"1.25\""	192	6.99
5	061-5388-2	framing nail	"4\""	25	8.19
6	161-0090-0	wood nail	"1\""	25	2.39
7	161-0199-4	panel nail	"1-5/8\""	20	4.69

The lookup

- How do you “look up” the product codes to find the product descriptions and prices?
- `left_join`.

```
sales %>% left_join(desc)
```

```
# A tibble: 6 x 6
```

	product_code	sales	description	size	qty	price
	<chr>	<dbl>	<chr>	<chr>	<dbl>	<dbl>
1	061-5344-6	10	finishing nail	"1\""	1298	6.99
2	161-0090-0	6	wood nail	"1\""	25	2.39
3	061-5388-2	2	framing nail	"4\""	25	8.19
4	161-0199-4	8	panel nail	"1-5/8\""	20	4.69
5	061-5375-2	5	roofing nail	"1.25\""	192	6.99
6	061-4525-2	3	spike nail	"10\""	1	1.49

What we have

- this looks up all the rows in the *first* dataframe that are also in the *second*.
- by default matches all columns with same name in two dataframes (product_code here)
- get *all* columns in *both* dataframes. The rows are the ones for that product_code.

So now can work out how much the total revenue was:

```
sales %>% left_join(desc) %>%  
  mutate(product_revenue = sales*price) %>%  
  summarize(total_revenue = sum(product_revenue))
```

```
# A tibble: 1 x 1  
  total_revenue  
      <dbl>  
1         178.
```

More comments

- if any product codes are not matched, you get NA in the added columns
- anything in the *second* dataframe that was not in the first does not appear (here, any products that were not sold)
- other variations (examples follow):
 - ▶ if there are two columns with the same name in the two dataframes, and you only want to match on one, use `by` with one column name
 - ▶ if the columns you want to look up have different names in the two dataframes, use `by` with a “named list”

Matching on only some matching names

- Suppose the sales dataframe *also* had a column qty (which was the quantity sold):

```
sales %>% rename("qty"="sales") -> sales1
sales1
```

```
# A tibble: 6 x 2
  product_code    qty
  <chr>          <dbl>
1 061-5344-6      10
2 161-0090-0       6
3 061-5388-2       2
4 161-0199-4       8
5 061-5375-2       5
6 061-4525-2       3
```

- The qty in sales1 is the quantity sold, but the qty in desc is the number of nails in a package. These should *not* be matched: they are

Matching only on product code

```
sales1 %>%  
  left_join(desc, join_by(product_code))
```

A tibble: 6 x 6

	product_code	qty.x	description	size	qty.y	price
	<chr>	<dbl>	<chr>	<chr>	<dbl>	<dbl>
1	061-5344-6	10	finishing nail	"1\""	1298	6.99
2	161-0090-0	6	wood nail	"1\""	25	2.39
3	061-5388-2	2	framing nail	"4\""	25	8.19
4	161-0199-4	8	panel nail	"1-5/8\""	20	4.69
5	061-5375-2	5	roofing nail	"1.25\""	192	6.99
6	061-4525-2	3	spike nail	"10\""	1	1.49

- Get qty.x (from sales1) and qty.y (from desc).

Matching on different names 1/2

- Suppose the product code in sales was just code:

```
sales %>% rename("code" = "product_code") -> sales2  
sales2
```

```
# A tibble: 6 x 2  
  code      sales  
  <chr>    <dbl>  
1 061-5344-6    10  
2 161-0090-0     6  
3 061-5388-2     2  
4 161-0199-4     8  
5 061-5375-2     5  
6 061-4525-2     3
```

- How to match the two product codes that have different names?

Matching on different names 2/2

- Use `join_by`, but like this:

```
sales2 %>%  
  left_join(desc, join_by(code == product_code))
```

A tibble: 6 x 6

	code	sales	description	size	qty	price
	<chr>	<dbl>	<chr>	<chr>	<dbl>	<dbl>
1	061-5344-6	10	finishing nail	"1\""	1298	6.99
2	161-0090-0	6	wood nail	"1\""	25	2.39
3	061-5388-2	2	framing nail	"4\""	25	8.19
4	161-0199-4	8	panel nail	"1-5/8\""	20	4.69
5	061-5375-2	5	roofing nail	"1.25\""	192	6.99
6	061-4525-2	3	spike nail	"10\""	1	1.49

Other types of join

- `right_join`: interchanges roles, looking up keys from second dataframe in first.
- `anti_join`: give me all the rows in the first dataframe that are *not* in the second. (Use this eg. to see whether the product descriptions are incomplete.)
- `full_join`: give me all the rows in both dataframes, with missings as needed.

Full join here

```
sales %>% full_join(desc)
```

```
# A tibble: 7 x 6
```

	product_code <chr>	sales <dbl>	description <chr>	size <chr>	qty <dbl>	price <dbl>
1	061-5344-6	10	finishing nail	"1\""	1298	6.99
2	161-0090-0	6	wood nail	"1\""	25	2.39
3	061-5388-2	2	framing nail	"4\""	25	8.19
4	161-0199-4	8	panel nail	"1-5/8\""	20	4.69
5	061-5375-2	5	roofing nail	"1.25\""	192	6.99
6	061-4525-2	3	spike nail	"10\""	1	1.49
7	061-5329-4	NA	masonry nail	"1.5\""	112	8.19

- The missing sales for “masonry nail” says that it was in the lookup table desc, but we didn’t sell any.

The same thing, but with anti_join

Anything in first df but not in second?

```
desc %>% anti_join(sales)
```

```
# A tibble: 1 x 5
  product_code description    size    qty price
  <chr>         <chr>      <chr>  <dbl> <dbl>
1 061-5329-4    masonry nail "1.5\"  112    8.19
```

```
# sales %>% anti_join(desc)
```

Masonry nails are the only thing in our product description file that we did not sell any of.