12.6.1

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February 25, 2018

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 3.4.3
```

```
## -- Attaching packages ---------------------------------- tidyverse 1.2.1 --
```

```
## v ggplot2 2.2.1     v purrr   0.2.4
## v tibble  1.4.2     v dplyr   0.7.4
## v tidyr   0.8.0     v stringr 1.2.0
## v readr   1.1.1     v forcats 0.2.0
```

```
## Warning: package 'ggplot2' was built under R version 3.4.3
```

```
## Warning: package 'tibble' was built under R version 3.4.3
```

```
## Warning: package 'tidyr' was built under R version 3.4.3
```

```
## Warning: package 'readr' was built under R version 3.4.3
```

```
## Warning: package 'purrr' was built under R version 3.4.3
```

```
## Warning: package 'dplyr' was built under R version 3.4.3
```

```
## Warning: package 'stringr' was built under R version 3.4.2
```

```
## Warning: package 'forcats' was built under R version 3.4.3
```

```
## -- Conflicts ------------------------------------- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(tidyr)
who
```

```
## # A tibble: 7,240 x 60
##    country     iso2  iso3   year new_sp_m014 new_sp_m1524 new_sp_m2534
##    <chr>       <chr> <chr> <int>       <int>        <int>        <int>
##  1 Afghanistan AF    AFG    1980          NA           NA           NA
##  2 Afghanistan AF    AFG    1981          NA           NA           NA
##  3 Afghanistan AF    AFG    1982          NA           NA           NA
##  4 Afghanistan AF    AFG    1983          NA           NA           NA
##  5 Afghanistan AF    AFG    1984          NA           NA           NA
##  6 Afghanistan AF    AFG    1985          NA           NA           NA
##  7 Afghanistan AF    AFG    1986          NA           NA           NA
##  8 Afghanistan AF    AFG    1987          NA           NA           NA
##  9 Afghanistan AF    AFG    1988          NA           NA           NA
## 10 Afghanistan AF    AFG    1989          NA           NA           NA
## # ... with 7,230 more rows, and 53 more variables: new_sp_m3544 <int>,
## #   new_sp_m4554 <int>, new_sp_m5564 <int>, new_sp_m65 <int>,
## #   new_sp_f014 <int>, new_sp_f1524 <int>, new_sp_f2534 <int>,
## #   new_sp_f3544 <int>, new_sp_f4554 <int>, new_sp_f5564 <int>,
## #   new_sp_f65 <int>, new_sn_m014 <int>, new_sn_m1524 <int>,
## #   new_sn_m2534 <int>, new_sn_m3544 <int>, new_sn_m4554 <int>,
## #   new_sn_m5564 <int>, new_sn_m65 <int>, new_sn_f014 <int>,
```

```
## #   new_sn_f1524 <int>, new_sn_f2534 <int>, new_sn_f3544 <int>,
## #   new_sn_f4554 <int>, new_sn_f5564 <int>, new_sn_f65 <int>,
## #   new_ep_m014 <int>, new_ep_m1524 <int>, new_ep_m2534 <int>,
## #   new_ep_m3544 <int>, new_ep_m4554 <int>, new_ep_m5564 <int>,
## #   new_ep_m65 <int>, new_ep_f014 <int>, new_ep_f1524 <int>,
## #   new_ep_f2534 <int>, new_ep_f3544 <int>, new_ep_f4554 <int>,
## #   new_ep_f5564 <int>, new_ep_f65 <int>, newrel_m014 <int>,
## #   newrel_m1524 <int>, newrel_m2534 <int>, newrel_m3544 <int>,
## #   newrel_m4554 <int>, newrel_m5564 <int>, newrel_m65 <int>,
## #   newrel_f014 <int>, newrel_f1524 <int>, newrel_f2534 <int>,
## #   newrel_f3544 <int>, newrel_f4554 <int>, newrel_f5564 <int>,
## #   newrel_f65 <int>
```

```
who1 <- who %>%
  gather(new_sp_m014:newrel_f65, key = "key", value = "cases", na.rm = TRUE)
who1
```

```
## # A tibble: 76,046 x 6
##    country     iso2  iso3   year key         cases
##  * <chr>       <chr> <chr> <int> <chr>       <int>
##  1 Afghanistan AF    AFG    1997 new_sp_m014     0
##  2 Afghanistan AF    AFG    1998 new_sp_m014    30
##  3 Afghanistan AF    AFG    1999 new_sp_m014     8
##  4 Afghanistan AF    AFG    2000 new_sp_m014    52
##  5 Afghanistan AF    AFG    2001 new_sp_m014   129
##  6 Afghanistan AF    AFG    2002 new_sp_m014    90
##  7 Afghanistan AF    AFG    2003 new_sp_m014   127
##  8 Afghanistan AF    AFG    2004 new_sp_m014   139
##  9 Afghanistan AF    AFG    2005 new_sp_m014   151
## 10 Afghanistan AF    AFG    2006 new_sp_m014   193
## # ... with 76,036 more rows
```

```
who1 %>%
  count(key)
```

```
## # A tibble: 56 x 2
##    key              n
##    <chr>        <int>
##  1 new_ep_f014   1032
##  2 new_ep_f1524  1021
##  3 new_ep_f2534  1021
##  4 new_ep_f3544  1021
##  5 new_ep_f4554  1017
##  6 new_ep_f5564  1017
##  7 new_ep_f65    1014
##  8 new_ep_m014   1038
##  9 new_ep_m1524  1026
## 10 new_ep_m2534  1020
## # ... with 46 more rows
```

```
who2 <- who1 %>%
  mutate(key = stringr::str_replace(key, "newrel", "new_rel"))
```

```
## Warning: package 'bindrcpp' was built under R version 3.4.3
```

```
who2
```

```
## # A tibble: 76,046 x 6
##    country     iso2  iso3   year key         cases
##    <chr>       <chr> <chr> <int> <chr>       <int>
##  1 Afghanistan AF    AFG    1997 new_sp_m014     0
##  2 Afghanistan AF    AFG    1998 new_sp_m014    30
##  3 Afghanistan AF    AFG    1999 new_sp_m014     8
##  4 Afghanistan AF    AFG    2000 new_sp_m014    52
##  5 Afghanistan AF    AFG    2001 new_sp_m014   129
##  6 Afghanistan AF    AFG    2002 new_sp_m014    90
##  7 Afghanistan AF    AFG    2003 new_sp_m014   127
##  8 Afghanistan AF    AFG    2004 new_sp_m014   139
##  9 Afghanistan AF    AFG    2005 new_sp_m014   151
## 10 Afghanistan AF    AFG    2006 new_sp_m014   193
## # ... with 76,036 more rows
```

```
who3 <- who2 %>%
  separate(key, c("new", "type", "sexage"), sep = "_")
who3
```

```
## # A tibble: 76,046 x 8
##    country     iso2  iso3   year new   type  sexage cases
##    <chr>       <chr> <chr> <int> <chr> <chr> <chr>  <int>
##  1 Afghanistan AF    AFG    1997 new   sp    m014       0
##  2 Afghanistan AF    AFG    1998 new   sp    m014      30
##  3 Afghanistan AF    AFG    1999 new   sp    m014       8
##  4 Afghanistan AF    AFG    2000 new   sp    m014      52
##  5 Afghanistan AF    AFG    2001 new   sp    m014     129
##  6 Afghanistan AF    AFG    2002 new   sp    m014      90
##  7 Afghanistan AF    AFG    2003 new   sp    m014     127
##  8 Afghanistan AF    AFG    2004 new   sp    m014     139
##  9 Afghanistan AF    AFG    2005 new   sp    m014     151
## 10 Afghanistan AF    AFG    2006 new   sp    m014     193
## # ... with 76,036 more rows
```

```
who3 %>%
  count(new)
```

```
## # A tibble: 1 x 2
##   new       n
##   <chr> <int>
## 1 new   76046
```

```
who4 <- who3 %>%
  select(-new, -iso2, -iso3)

who5 <- who4 %>%
  separate(sexage, c("sex", "age"), sep = 1)
who5
```

```
## # A tibble: 76,046 x 6
##    country      year type  sex   age   cases
##    <chr>       <int> <chr> <chr> <chr> <int>
##  1 Afghanistan  1997 sp    m     014       0
##  2 Afghanistan  1998 sp    m     014      30
##  3 Afghanistan  1999 sp    m     014       8
##  4 Afghanistan  2000 sp    m     014      52
##  5 Afghanistan  2001 sp    m     014     129
```

```
##  6 Afghanistan  2002 sp    m     014      90
##  7 Afghanistan  2003 sp    m     014     127
##  8 Afghanistan  2004 sp    m     014     139
##  9 Afghanistan  2005 sp    m     014     151
## 10 Afghanistan  2006 sp    m     014     193
## # ... with 76,036 more rows
```

Question 3

I claimed that `iso2` and `iso3` were redundant with `country`. Confirm this claim.

```
select(who3, country, iso2, iso3) %>%
  distinct() %>%
  group_by(country) %>%
  filter(n() > 1)
```

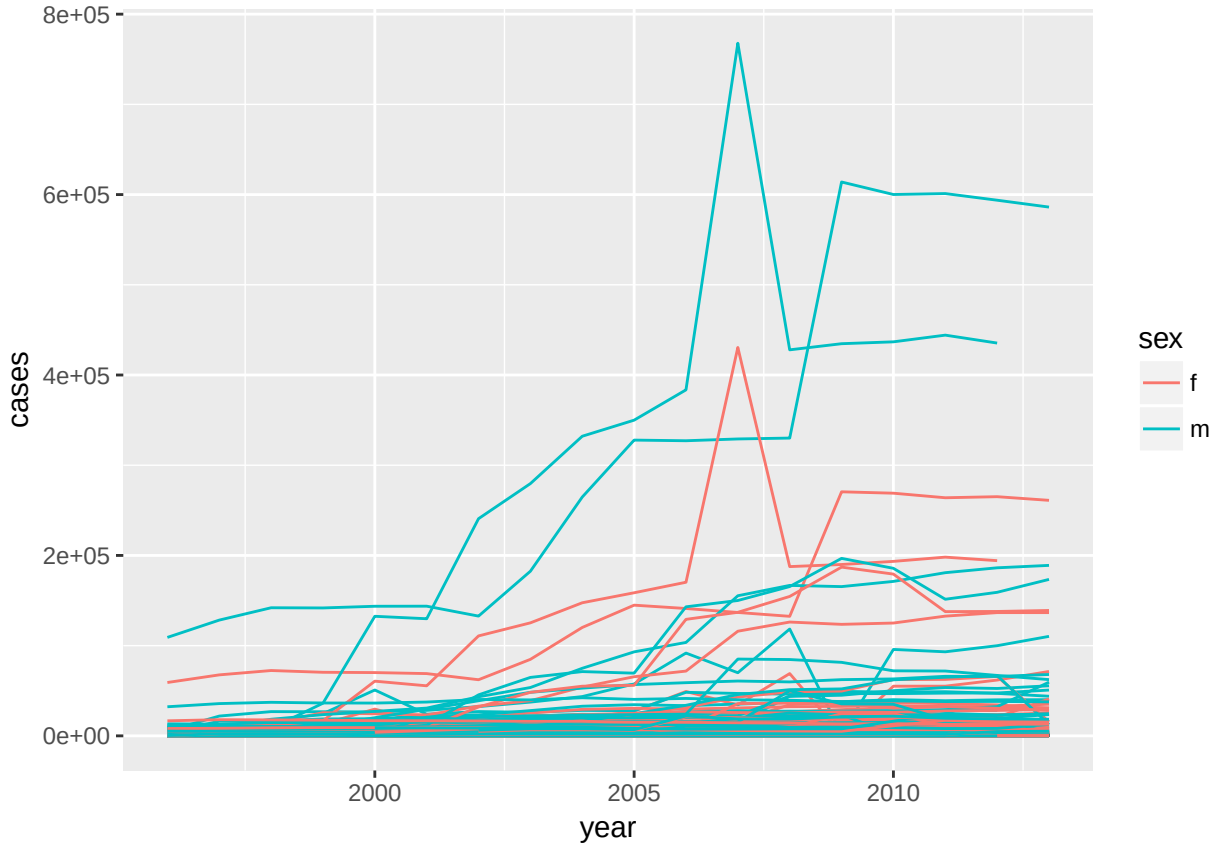
```
## # A tibble: 0 x 3
## # Groups:   country [0]
## # ... with 3 variables: country <chr>, iso2 <chr>, iso3 <chr>
```

Since this returns 0 distinct tibbles and groups, it shows that iso2 and iso3 are redundant with country.

Question 4

For each country, year, and sex compute the total number of cases of TB. Make an informative visualisation of the data.

```
who5 %>%
  group_by(country, year, sex) %>%
  filter(year > 1995) %>%
  summarise(cases = sum(cases)) %>%
  unite(country_sex, country, sex, remove = FALSE) %>%
  ggplot(aes(x = year, y = cases, group = country_sex, colour = sex)) +
  geom_line()
```



Countries were combined with sex because there were so many countries that a ggplot would not represent each one well.