Tutorial 4 - Week 8

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Practice Document

For this demonstration, we will be using the Heart Disease datasets which are openly available from Public Heath Scotland. In particular, we will be focusing on the on the mortality rates dataset.

```
# Note: the above works for code generally and comments, but does not work for
# strings such as the URL. Additionally, don't forget to install the formatR
# package if you plan to use this!
library(tidyverse)
library(janitor)
library(lubridate)
library(kableExtra)
library(formatR)

# very very very very very very very very very very very very very very very very very
# very very very very very very very very very very very very very very very very very
# very very very very very very very very very very very very very very very very very
# very very very very very very very very very long comment
```

```
# Note: the above works for code generally and comments, but does not work for strings such as the URL.
library(tidyverse)
library(janitor)
library(lubridate)
```

```
library(kableExtra)
library(formatR)

# very very very very very very very very very very very very very very very very very very very very very v
```

But first an aside...

When knitting to PDF, you can wrap the code and comments using the `formatR` package and the arguments `tidy.opts=list(width.cutoff=80), tidy = TRUE` (see the output for the very... very long comment when knitted). However, this does not wrap strings, such as URLs due to LaTeX specific issues. There are very complicated ways around this, which we will not be covering as it requires other coding knowledge, but Kevin and Brittany have come up with 2 possible (though convoluted) solutions. For the Programming Assignment, the easiest solution may be to load the data from a saved file instead.

First solution

When you are writing code chunks and R leaves a blank space in the line number when the code is wrapped (e.g. line 64, blank space, line 65). When knitting to HTML the knitted document reflects this, unfortunately not the case when knitting to PDF. To unwrap the code, click enter at the beginning of the link without the number. This **however** means that the URL is not longer able to run without error. So, in a convoluted work around, you could have a chunk set to `eval=FALSE` meaning the code is not run but the knitted document shows the code. Then you could include a chunk below which will actually load the data (i.e., the code is run) but not show this in the knitted document (`echo=FALSE`)... convoluted as I said.

```
## Read in the 3 datasets
# Heart Disease Activity By Health Board
activity_raw <- read_csv("https://www.opendata.nhs.scot/dataset/0e17f3fc-9429-48aa-b1ba
                     -2b7e55688253/resource/748e2065-b447-4b75-99bd-f17f26f3eaef/downl
                     oad/hd_activitybyhbr.csv")

# Heart Disease Mortality By Health Board
mortality_raw <- read_csv("https://www.opendata.nhs.scot/dataset/0e17f3fc-9429-48aa
                     -b1ba-2b7e55688253/resource/dc0512a8-eb49-43b9-84f1-17ef95365d5
                     7/download/hd_mortalitybyhbr.csv")

# Health Board look up
hb <- read_csv("https://www.opendata.nhs.scot/dataset/9f942fdb-e59e-44f5-b534-
               d6e1729cc7b/resource/652ff726-e676-4a20-abda-435b98dd7bdc/download/hb1
               _hb21.csv")
```

Second solution

Kevin's solution is slightly different: for each data set, add a variable such as `link1, echo=FALSE` and then use it in the code to be printed. If you adopt this method, for reproducibility sake, in the text you could include the full URL to be printed out. For example:

> The heart disease activity dataset was from the Public Health Scotland website: https://www.opendata.nhs.scot/dataset/0e17f3fc-9429-48aa-b1ba-2b7e55688253/resource/748e2065-b447-4b75-99bd-f17f26f3eaef/download/hd_activitybyhbr.csv

or

The hearth disease activity dataset downloads from link1

Data from https://www.opendata.nhs.scot/dataset/0e17f3fc-9429-48aa-b1ba-2b7e55688253/resource/748e2065-b447-4b75-99bd-f17f26f3eaef/download/hd_activitybyhbr.csv

```
activity_raw2 <- read_csv(link1)
```

Data Wrangling

```
activity_raw %>%
  glimpse()
```

```
## Rows: 43,200
## Columns: 15
## $ FinancialYear        <chr> "2012/13", "2012/13", "2012/13", "2012/13", "2012~
## $ HBR                  <chr> "S08000015", "S08000015", "S08000015", "S08000015~
## $ HBRQF                <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
## $ AdmissionType        <chr> "All", "All", "All", "All", "All", "All", "All", ~
## $ AdmissionTypeQF      <chr> "d", "d", "d", "d", "d", "d", "d", "d", "d", "d",~
## $ AgeGroup             <chr> "0-44 years", "0-44 years", "45-64 years", "45-64~
## $ AgeGroupQF           <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
## $ Sex                  <chr> "Males", "Females", "Males", "Females", "Males", ~
## $ SexQF                <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
## $ Diagnosis            <chr> "Coronary Heart Disease", "Coronary Heart Disease~
## $ NumberOfDischarges   <dbl> 85, 24, 1168, 393, 781, 418, 723, 695, 14, 9, 277~
## $ NumberOfDischargesQF <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
## $ CrudeRate            <dbl> 90.40726, 24.85321, 2250.09151, 700.01069, 3957.0~
## $ CrudeRateQF          <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, N~
## $ EASR                 <dbl> 94.94039, 24.36125, 2244.84613, 698.97665, 4024.3~
```

```
activity <- activity_raw %>%
  left_join(hb, by = c("HBR" = "HB")) %>%
  select(FinancialYear,
         HBName,
         AdmissionType,
         AgeGroup,
         Sex,
         Diagnosis,
         NumberOfDischarges) %>%
  clean_names() %>%
  separate(financial_year, into = c("Year", NA), sep = "/", convert = TRUE) %>%
  mutate(sex = str_replace(sex, "Females", "Female"),
         sex = str_replace(sex, "Males", "Male")) %>%
  filter(sex            != "All",
         age_group      != "All",
         admission_type != "All",
         hb_name        != "S92000003")

mortality <- mortality_raw %>%
  left_join(hb, by = c("HBR" = "HB")) %>%
```

```
  select(Year,
         HBName,
         AgeGroup,
         Sex,
         Diagnosis,
         NumberOfDeaths) %>%
  clean_names() %>%
  mutate(sex = str_replace(sex, "Females", "Female"),
         sex = str_replace(sex, "Males", "Male")) %>%
  filter(sex       != "All",
         age_group != "All",
         hb_name   != "S92000003")
```

Is the activity dataset in long or wide format?

```
activity %>%
  head(n = 10)
```

```
## # A tibble: 10 x 7
##     Year hb_name                admission_type age_group   sex   diagn~1 numbe~2
##    <int> <chr>                  <chr>          <chr>       <chr> <chr>     <dbl>
##  1  2012 NHS Ayrshire and Arran Elective       0-44 years  Male  Corona~      21
##  2  2012 NHS Ayrshire and Arran Elective       0-44 years  Fema~ Corona~       9
##  3  2012 NHS Ayrshire and Arran Elective       45-64 years Male  Corona~     332
##  4  2012 NHS Ayrshire and Arran Elective       45-64 years Fema~ Corona~     111
##  5  2012 NHS Ayrshire and Arran Elective       65-74 years Male  Corona~     210
##  6  2012 NHS Ayrshire and Arran Elective       65-74 years Fema~ Corona~     114
##  7  2012 NHS Ayrshire and Arran Elective       75plus yea~ Male  Corona~     113
##  8  2012 NHS Ayrshire and Arran Elective       75plus yea~ Fema~ Corona~      54
##  9  2012 NHS Borders            Elective       0-44 years  Male  Corona~       2
## 10  2012 NHS Borders            Elective       0-44 years  Fema~ Corona~       0
## # ... with abbreviated variable names 1: diagnosis, 2: number_of_discharges
```

Data Visualization

How might we visualize the following: Since 2015, what influence does gender have on the rate of death for different diagnoses for those aged 75+ vs those under 75?

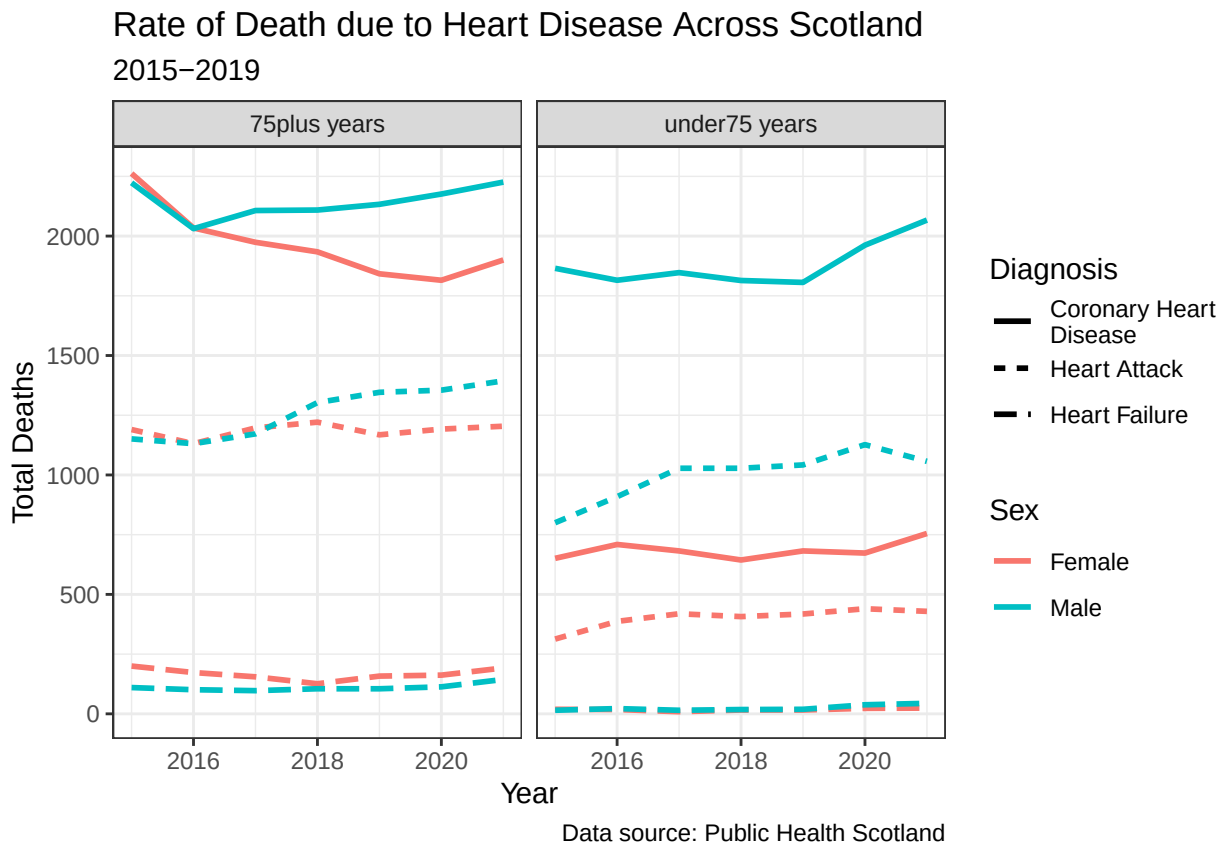
There are at least 2 different coding approaches you can take to this:

1. Create a separate data frame for plotting, which you can then reuse for other plots or tables.

```
mortality_plot <- mortality %>%
  filter(year >= 2015,
         age_group %in% c("under75 years", "75plus years")) %>%
  group_by(diagnosis, sex, age_group, year) %>%
  summarise(total_deaths = sum(number_of_deaths, na.rm=TRUE)) %>%
  #wrap string "Coronary Heart Disease" for better plotting
  mutate(diagnosis = str_wrap(diagnosis, width = 15))

mortality_plot %>%
```

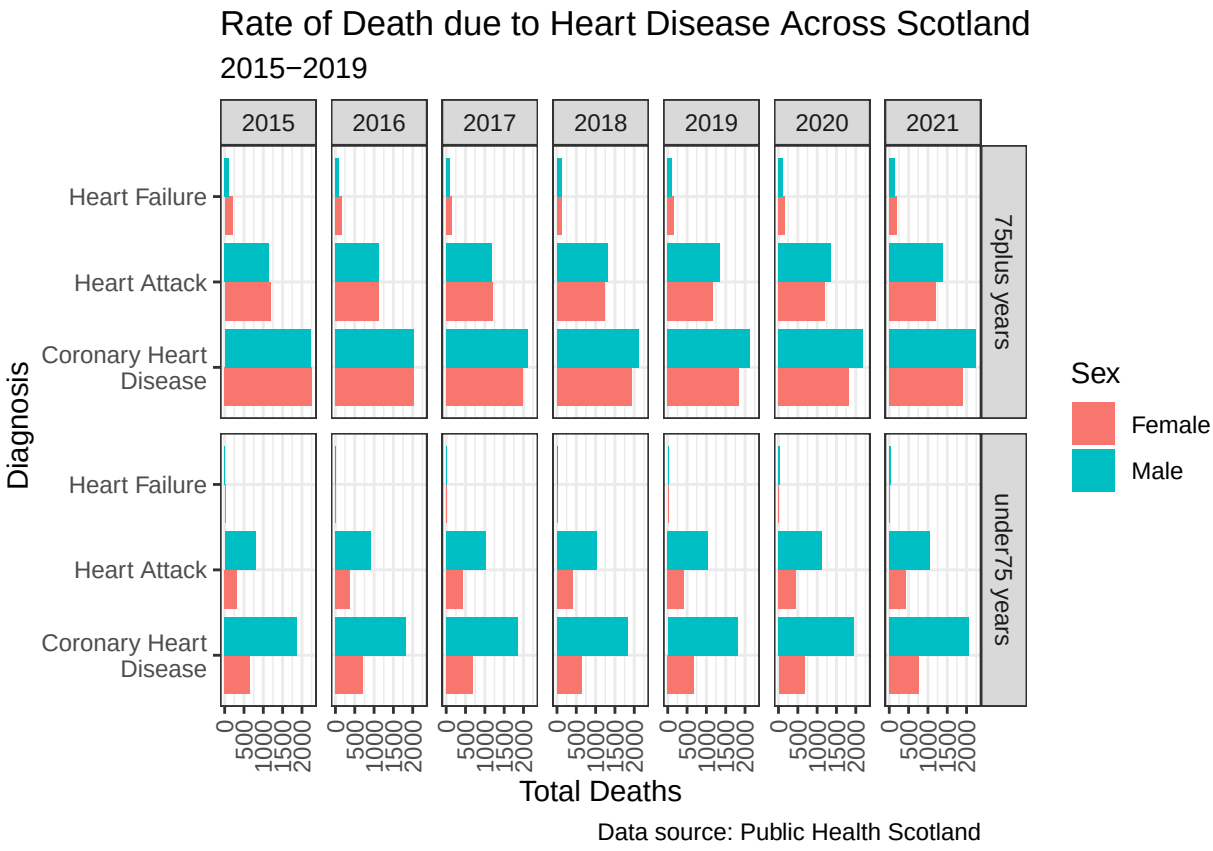
```
  ggplot(aes(x = year, y = total_deaths, color = sex)) +
  geom_line(aes(linetype = diagnosis), lwd = 1) +
  facet_wrap(~age_group) +
  labs(title = "Rate of Death due to Heart Disease Across Scotland",
       subtitle = "2015-2019",
       caption = "Data source: Public Health Scotland",
       y = "Total Deaths",
       x = "Year",
       color = "Sex",
       linetype = "Diagnosis") +
  theme_bw()
```



2. Pipe the data into the `ggplot` but do some data wrangling first.

```
mortality %>%
  filter(year >= 2015,
         age_group %in% c("under75 years", "75plus years")) %>%
  group_by(diagnosis, sex, age_group, year) %>%
  summarise(total_deaths = sum(number_of_deaths, na.rm=TRUE)) %>%
  #wrap string "Coronary Heart Disease" for better plotting
  mutate(diagnosis = str_wrap(diagnosis, width = 15)) %>%
  ggplot(aes(x = diagnosis, y = total_deaths, fill = sex)) +
  geom_col(position = "dodge") +
  facet_grid(age_group~year) +
  #compare facet_grid to facet_wrap
```

```
#facet_wrap(~age_group~year) +
labs(title = "Rate of Death due to Heart Disease Across Scotland",
     subtitle = "2015-2019",
     caption = "Data source: Public Health Scotland",
     y = "Total Deaths",
     x = "Diagnosis",
     fill = "Sex") +
coord_flip() +
theme_bw() +
#adjust the text on the x axis to be more legible
theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))
```



What about a table?

For analysis and data visualisation, tidy data (i.e., long data) is the ideal. However, for tables often wide data is more readable.

```
mortality_plot %>%
  pivot_wider(names_from = diagnosis, values_from = total_deaths) %>%
  ungroup()%>%
  kbl()
```

sex	age_group	year	Coronary Heart Disease	Heart Attack	Heart Failure
Female	75plus years	2015	2262	1190	200
Female	75plus years	2016	2034	1131	173
Female	75plus years	2017	1974	1197	155
Female	75plus years	2018	1934	1221	126
Female	75plus years	2019	1842	1168	158
Female	75plus years	2020	1815	1192	162
Female	75plus years	2021	1900	1204	192
Female	under75 years	2015	651	313	19
Female	under75 years	2016	709	387	18
Female	under75 years	2017	682	419	9
Female	under75 years	2018	644	407	16
Female	under75 years	2019	682	418	16
Female	under75 years	2020	673	440	23
Female	under75 years	2021	755	429	24
Male	75plus years	2015	2223	1151	110
Male	75plus years	2016	2031	1131	101
Male	75plus years	2017	2107	1172	97
Male	75plus years	2018	2109	1303	105
Male	75plus years	2019	2133	1346	105
Male	75plus years	2020	2176	1355	113
Male	75plus years	2021	2226	1394	144
Male	under75 years	2015	1865	800	15
Male	under75 years	2016	1815	909	22
Male	under75 years	2017	1847	1028	15
Male	under75 years	2018	1814	1028	18
Male	under75 years	2019	1806	1042	19
Male	under75 years	2020	1962	1127	38
Male	under75 years	2021	2067	1057	44

Aesthitics changes to the table

```
#remember the mortality plot data is grouped, so we may want to ungroup the data first before creating
mortality_plot %>%
  pivot_wider(names_from = diagnosis, values_from = total_deaths) %>%
  ungroup() %>%
  kbl(
    col.names = c(
      sex = "Sex",
      age_group = "Age Group",
      year = "Year",
      `Coronary Heart\nDisease` = "Coronary Heart Disease",
      `Heart Attack` = "Heart Attack",
      `Heart Failure` = "Heart Failure"
    )
  ) %>%
  kable_styling() %>%
  add_header_above(header = c("Heart Disease Mortality in Scotland 2015-2019" = 6)) %>%
  footnote("Source: Public Health Scotland")
```

Heart Disease Mortality in Scotland 2015-2019					
Sex	Age Group	Year	Coronary Heart Disease	Heart Attack	Heart Failure
Female	75plus years	2015	2262	1190	200
Female	75plus years	2016	2034	1131	173
Female	75plus years	2017	1974	1197	155
Female	75plus years	2018	1934	1221	126
Female	75plus years	2019	1842	1168	158
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Male	75plus years	2021	2226	1394	144
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Male	under75 years	2016	1815	909	22
Male	under75 years	2017	1847	1028	15
Male	under75 years	2018	1814	1028	18
Male	under75 years	2019	1806	1042	19
Male	under75 years	2020	1962	1127	38
Male	under75 years	2021	2067	1057	44

Note:

Source: Public Health Scotland

Hint: If you want to rearrange the columns order, you can do with `select()`

```
mortality_plot %>%
  pivot_wider(names_from = diagnosis, values_from = total_deaths) %>%
  select(year, age_group, everything()) %>%
  ungroup() %>%
  kbl(
    col.names = c(
      "year" = "Year",
      "age_group" = "Age Group",
      "sex" = "Sex",
      `Coronary Heart\nDisease` = "Coronary Heart Disease",
      `Heart Attack` = "Heart Attack",
      `Heart Failure` = "Heart Failure"
    )
  ) %>%
  kable_styling() %>%
  add_header_above(header = c("Heart Disease Mortality in Scotland 2015-2019" = 6)) %>%
  footnote("Source: Public Health Scotland")
```

Heart Disease Mortality in Scotland 2015-2019					
Year	Age Group	Sex	Coronary Heart Disease	Heart Attack	Heart Failure
2015	75plus years	Female	2262	1190	200
2016	75plus years	Female	2034	1131	173
2017	75plus years	Female	1974	1197	155
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Note:

Source: Public Health Scotland