workshop.nectric.com.au/tidyfc2024

Time Series Analysis & Forecasting Using R

1. Introduction to tsibbles

tsibble feasts Fable

Outline

1 Time series data and tsibbles

2 Example: Australian prison population

3 Example: Australian pharmaceutical sales

4 Lab Session 1

5 Time plots

6 Lab Session 2

Outline

1. Time series data and tsibbles
2. Example: Australian prison population
3. Example: Australian pharmaceutical sales
4. Lab Session 1
5. Time plots
6. Lab Session 2

Tidyverts packages

tidyverts.org

Tidyverts developers

Earo Wang

Mitchell O’Hara-Wild

Time series data

- Four-yearly Olympic winning times
- Annual Google profits
- Quarterly Australian beer production
- Monthly rainfall
- Weekly retail sales
- Daily IBM stock prices
- Hourly electricity demand
- 5-minute freeway traffic counts
- Time-stamped stock transaction data

Class packages

```r
# Data manipulation
library(dplyr)
# Plotting functions
library(ggplot2)
# Time and date manipulation
library(lubridate)
# Time series class
library(tsibble)
# Tidy time series data
library(tsibbledata)
# Time series graphics and statistics
library(feasts)
# Forecasting functions
library(fable)
```

Class packages

```
# Data manipulation
library(dplyr)
# Plotting functions
library(ggplot2)
# Time and date manipulation
library(lubridate)
# Time series class
library(tsibble)
# Tidy time series data
library(tsibbledata)
# Time series graphics and statistics
library(feasts)
# Forecasting functions
library(fable)
```

```
# All of the above
library(fpp3)
```

`tsibble` objects

```
global_economy
```

```
# A tsibble: 15,150 x 9 [1Y]
# Key:       Country [263]
   Country     Code   Year      GDP Growth   CPI Imports Exports Population
   <fct>       <fct> <dbl>    <dbl>  <dbl> <dbl>   <dbl>   <dbl>      <dbl>
 1 Afghanistan AFG    1960   5.38e8     NA    NA    7.02    4.13    8996351
 2 Afghanistan AFG    1961   5.49e8     NA    NA    8.10    4.45    9166764
 3 Afghanistan AFG    1962   5.47e8     NA    NA    9.35    4.88    9345868
 4 Afghanistan AFG    1963   7.51e8     NA    NA   16.9     9.17    9533954
 5 Afghanistan AFG    1964   8.00e8     NA    NA   18.1     8.89    9731361
 6 Afghanistan AFG    1965   1.01e9     NA    NA   21.4    11.3     9938414
 7 Afghanistan AFG    1966   1.40e9     NA    NA   18.6     8.57   10152331
 8 Afghanistan AFG    1967   1.67e9     NA    NA   14.2     6.77   10372630
 9 Afghanistan AFG    1968   1.37e9     NA    NA   15.2     8.90   10604346
10 Afghanistan AFG    1969   1.41e9     NA    NA   15.0    10.1    10854428
# i 15,140 more rows
```

`tsibble` objects

```r
global_economy
```

```
# A tsibble: 15,150 x 9 [1Y]
# Key:       Country [263]
   Country     Code    Year      GDP Growth   CPI Imports Exports Population
               <fct> <dbl>    <dbl>  <dbl> <dbl>   <dbl>   <dbl>      <dbl>
 1 Afghanistan AFG    1960   5.38e8     NA    NA    7.02    4.13    8996351
 2 Afghanistan AFG    1961   5.49e8     NA    NA    8.10    4.45    9166764
 3 Afghanistan AFG    1962   5.47e8     NA    NA    9.35    4.88    9345868
 4 Afghanistan AFG    1963   7.51e8     NA    NA   16.9     9.17    9533954
 5 Afghanistan AFG    1964   8.00e8     NA    NA   18.1     8.89    9731361
 6 Afghanistan AFG    1965   1.01e9     NA    NA   21.4    11.3     9938414
 7 Afghanistan AFG    1966   1.40e9     NA    NA   18.6     8.57   10152331
 8 Afghanistan AFG    1967   1.67e9     NA    NA   14.2     6.77   10372630
 9 Afghanistan AFG    1968   1.37e9     NA    NA   15.2     8.90   10604346
10 Afghanistan AFG    1969   1.41e9     NA    NA   15.0    10.1    10854428
# i 15,140 more rows
```

Index

`tsibble` objects

```
global_economy
```

```
# A tsibble: 15,150 x 9 [1Y]
# Key:       Country [263]
   Country     Code   Year      GDP Growth   CPI Imports Exports Population
   Index  Key        > <dbl>    <dbl>  <dbl> <dbl>   <dbl>   <dbl>      <dbl>
 1 Afghanistan AFG    1960  5.38e8     NA    NA    7.02    4.13    8996351
 2 Afghanistan AFG    1961  5.49e8     NA    NA    8.10    4.45    9166764
 3 Afghanistan AFG    1962  5.47e8     NA    NA    9.35    4.88    9345868
 4 Afghanistan AFG    1963  7.51e8     NA    NA   16.9     9.17    9533954
 5 Afghanistan AFG    1964  8.00e8     NA    NA   18.1     8.89    9731361
 6 Afghanistan AFG    1965  1.01e9     NA    NA   21.4    11.3     9938414
 7 Afghanistan AFG    1966  1.40e9     NA    NA   18.6     8.57   10152331
 8 Afghanistan AFG    1967  1.67e9     NA    NA   14.2     6.77   10372630
 9 Afghanistan AFG    1968  1.37e9     NA    NA   15.2     8.90   10604346
10 Afghanistan AFG    1969  1.41e9     NA    NA   15.0    10.1    10854428
# i 15,140 more rows
```

tsibble objects

```r
global_economy
```

```
# A tsibble: 15,150 x 9 [1Y]
# Key:       Country [263]
   Country     Code   Year        GDP Growth   CPI Imports Exports Population
                    > <d                                     <dbl>      <dbl>
 1 Afghanistan AFG    1960     5.38e8     NA    NA    7.02    4.13    8996351
 2 Afghanistan AFG    1961     5.49e8     NA    NA    8.10    4.45    9166764
 3 Afghanistan AFG    1962     5.47e8     NA    NA    9.35    4.88    9345868
 4 Afghanistan AFG    1963     7.51e8     NA    NA   16.9     9.17    9533954
 5 Afghanistan AFG    1964     8.00e8     NA    NA   18.1     8.89    9731361
 6 Afghanistan AFG    1965     1.01e9     NA    NA   21.4    11.3     9938414
 7 Afghanistan AFG    1966     1.40e9     NA    NA   18.6     8.57   10152331
 8 Afghanistan AFG    1967     1.67e9     NA    NA   14.2     6.77   10372630
 9 Afghanistan AFG    1968     1.37e9     NA    NA   15.2     8.90   10604346
10 Afghanistan AFG    1969     1.41e9     NA    NA   15.0    10.1    10854428
# i 15,140 more rows
```

Index

Key

Measured variables

tsibble objects

```
tourism
```

```
# A tsibble: 24,320 x 5 [1Q]
# Key:       Region, State, Purpose [304]
   Quarter Region   State           Purpose  Trips
     <qtr> <chr>    <chr>           <chr>    <dbl>
 1 1998 Q1 Adelaide South Australia Business  135.
 2 1998 Q2 Adelaide South Australia Business  110.
 3 1998 Q3 Adelaide South Australia Business  166.
 4 1998 Q4 Adelaide South Australia Business
 5 1999 Q1 Adelaide South Australia Business
 6 1999 Q2 Adelaide South Australia Business
 7 1999 Q3 Adelaide South Australia Business
 8 1999 Q4 Adelaide South Australia Business
 9 2000 Q1 Adelaide South Australia Business  154.
10 2000 Q2 Adelaide South Australia Business  169.
# i 24,310 more rows
```

Domestic visitor nights in thousands by state/region and purpose.

tsibble objects

```
tourism
```

```
# A tsibble: 24,320 x 5 [1Q]
# Key:       Region, State, Purpose [304]
   Quarter Region   State           Purpose  Trips
           <chr>    <chr>           <chr>    <dbl>
 1 1998 Q1 Adelaide South Australia Business  135.
 2 1998 Q2 Adelaide South Australia Business  110.
 3 1998 Q3 Adelaide South Australia Business  166.
 4 1998 Q4 Adelaide South Australia Business
 5 1999 Q1 Adelaide South Australia Business
 6 1999 Q2 Adelaide South Australia Business
 7 1999 Q3 Adelaide South Australia Business
 8 1999 Q4 Adelaide South Australia Business
 9 2000 Q1 Adelaide South Australia Business  154.
10 2000 Q2 Adelaide South Australia Business  169.
# i 24,310 more rows
```

Index

Domestic visitor nights in thousands by state/region and purpose.

tsibble objects

```
tourism
```

```
# A tsibble: 24,320 x 5 [1Q]
# Key:       Region, State, Purpose [304]
   Quarter Region   State           Purpose  Trips
                                    <chr>    <dbl>
 1 1998 Q1 Adelaide South Australia Business  135.
 2 1998 Q2 Adelaide South Australia Business  110.
 3 1998 Q3 Adelaide South Australia Business  166.
 4 1998 Q4 Adelaide South Australia Business
 5 1999 Q1 Adelaide South Australia Business
 6 1999 Q2 Adelaide South Australia Business
 7 1999 Q3 Adelaide South Australia Business
 8 1999 Q4 Adelaide South Australia Business
 9 2000 Q1 Adelaide South Australia Business  154.
10 2000 Q2 Adelaide South Australia Business  169.
# i 24,310 more rows
```

Index

Keys

Domestic visitor nights in thousands by state/region and purpose.

tsibble objects

```r
tourism
```

```
# A tsibble: 24,320 x 5 [1Q]
# Key:       Region, State, Purpose [304]
   Quarter Region   State           Purpose  Trips
                                             <dbl>
 1 1998 Q1 Adelaide South Australia Business  135.
 2 1998 Q2 Adelaide South Australia Business  110.
 3 1998 Q3 Adelaide South Australia Business  166.
 4 1998 Q4 Adelaide South Australia Business
 5 1999 Q1 Adelaide South Australia Business
 6 1999 Q2 Adelaide South Australia Business
 7 1999 Q3 Adelaide South Australia Business
 8 1999 Q4 Adelaide South Australia Business
 9 2000 Q1 Adelaide South Australia Business  154.
10 2000 Q2 Adelaide South Australia Business  169.
# i 24,310 more rows
```

Index

Keys

Measure

Domestic visitor nights in thousands by state/region and purpose.

`tsibble` objects

- A `tsibble` allows storage and manipulation of multiple time series in R.
- It contains:
  - An index: time information about the observation
  - Measured variable(s): numbers of interest
  - Key variable(s): optional unique identifiers for each series
- It works with tidyverse functions.

The `tsibble` index

Example

```r
mydata <- tsibble(
  year = 2012:2016,
  y = c(123, 39, 78, 52, 110),
  index = year
)
mydata
```

```
# A tsibble: 5 x 2 [1Y]
   year     y
  <int> <dbl>
1  2012   123
2  2013    39
3  2014    78
4  2015    52
5  2016   110
```

The `tsibble` index

For observations more frequent than once per year, we need to use a time class function on the index.

```
z
```

```
# A tibble: 5 x 2
  Month    Observation
  <chr>          <dbl>
1 2019 Jan          50
2 2019 Feb          23
3 2019 Mar          34
4 2019 Apr          30
5 2019 May          25
```

The `tsibble` index

For observations more frequent than once per year, we need to use a time class function on the index.

```
z |>
  mutate(Month = yearmonth(Month)) |>
  as_tsibble(index = Month)
```

```
# A tsibble: 5 x 2 [1M]
     Month Observation
     <mth>       <dbl>
1 2019 Jan          50
2 2019 Feb          23
3 2019 Mar          34
4 2019 Apr          30
5 2019 May          25
```

The `tsibble` index

Common time index variables can be created with these functions:

Frequency	Function
Annual	`start:end`
Quarterly	`yearquarter()`
Monthly	`yearmonth()`
Weekly	`yearweek()`
Daily	`as_date()`, `ymd()`
Sub-daily	`as_datetime()`

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5 Time plots

6 Lab Session 2

Australian prison population

Read a csv file and convert to a tsibble

```
prison <- readr::read_csv("data/prison_population.csv")
```

```
# A tibble: 3,072 x 6
   date       state gender legal     indigenous count
   <date>     <chr> <chr>  <chr>     <chr>      <dbl>
 1 2005-03-01 ACT   Female Remanded  ATSI           0
 2 2005-03-01 ACT   Female Remanded  Other          2
 3 2005-03-01 ACT   Female Sentenced ATSI           0
 4 2005-03-01 ACT   Female Sentenced Other          0
 5 2005-03-01 ACT   Male   Remanded  ATSI           7
 6 2005-03-01 ACT   Male   Remanded  Other         58
 7 2005-03-01 ACT   Male   Sentenced ATSI           0
 8 2005-03-01 ACT   Male   Sentenced Other          0
 9 2005-03-01 NSW   Female Remanded  ATSI          51
10 2005-03-01 NSW   Female Remanded  Other        131
# i 3,062 more rows
```

Read a csv file and convert to a tsibble

```
prison <- readr::read_csv("data/prison_population.csv") |>
  mutate(Quarter = yearquarter(date))
```

```
# A tibble: 3,072 x 7
   date       state gender legal     indigenous count Quarter
   <date>     <chr> <chr>  <chr>     <chr>      <dbl>   <qtr>
 1 2005-03-01 ACT   Female Remanded  ATSI           0 2005 Q1
 2 2005-03-01 ACT   Female Remanded  Other          2 2005 Q1
 3 2005-03-01 ACT   Female Sentenced ATSI           0 2005 Q1
 4 2005-03-01 ACT   Female Sentenced Other          0 2005 Q1
 5 2005-03-01 ACT   Male   Remanded  ATSI           7 2005 Q1
 6 2005-03-01 ACT   Male   Remanded  Other         58 2005 Q1
 7 2005-03-01 ACT   Male   Sentenced ATSI           0 2005 Q1
 8 2005-03-01 ACT   Male   Sentenced Other          0 2005 Q1
 9 2005-03-01 NSW   Female Remanded  ATSI          51 2005 Q1
10 2005-03-01 NSW   Female Remanded  Other        131 2005 Q1
# i 3,062 more rows
```

Read a csv file and convert to a tsibble

```
prison <- readr::read_csv("data/prison_population.csv") |>
  mutate(Quarter = yearquarter(date)) |>
  select(-date)
```

```
# A tibble: 3,072 x 6
   state gender legal      indigenous count Quarter
   <chr> <chr>  <chr>      <chr>      <dbl>   <qtr>
 1 ACT   Female Remanded   ATSI           0 2005 Q1
 2 ACT   Female Remanded   Other          2 2005 Q1
 3 ACT   Female Sentenced ATSI           0 2005 Q1
 4 ACT   Female Sentenced Other          0 2005 Q1
 5 ACT   Male   Remanded   ATSI           7 2005 Q1
 6 ACT   Male   Remanded   Other         58 2005 Q1
 7 ACT   Male   Sentenced ATSI           0 2005 Q1
 8 ACT   Male   Sentenced Other          0 2005 Q1
 9 NSW   Female Remanded   ATSI          51 2005 Q1
10 NSW   Female Remanded   Other        131 2005 Q1
# i 3,062 more rows
```

Read a csv file and convert to a tsibble

```r
prison <- readr::read_csv("data/prison_population.csv") |>
  mutate(Quarter = yearquarter(date)) |>
  select(-date) |>
  as_tsibble(
    index = Quarter,
    key = c(state, gender, legal, indigenous)
  )
```

```
# A tsibble: 3,072 x 6 [1Q]
# Key:       state, gender, legal, indigenous [64]
   state gender legal    indigenous count Quarter
   <chr> <chr>  <chr>    <chr>      <dbl>   <qtr>
 1 ACT   Female Remanded ATSI           0 2005 Q1
 2 ACT   Female Remanded ATSI           1 2005 Q2
 3 ACT   Female Remanded ATSI           0 2005 Q3
 4 ACT   Female Remanded ATSI           0 2005 Q4
 5 ACT   Female Remanded ATSI           1 2006 Q1
 6 ACT   Female Remanded ATSI           1 2006 Q2
```

Outline

1. Time series data and tsibbles
2. Example: Australian prison population
3. Example: Australian pharmaceutical sales
4. Lab Session 1
5. Time plots
6. Lab Session 2

Australian Pharmaceutical Benefits Scheme

Australian Pharmaceutical Benefits Scheme

The **Pharmaceutical Benefits Scheme** (PBS) is the Australian government drugs subsidy scheme.

Australian Pharmaceutical Benefits Scheme

The **Pharmaceutical Benefits Scheme** (PBS) is the Australian government drugs subsidy scheme.

- Many drugs bought from pharmacies are subsidised to allow more equitable access to modern drugs.
- The cost to government is determined by the number and types of drugs purchased. Currently nearly 1% of GDP.
- The total cost is budgeted based on forecasts of drug usage.
- Costs are disaggregated by drug type (ATC1 x15 / ATC2 84), concession category (x2) and patient type (x2), giving $84 \times 2 \times 2 = 336$ time series.

Working with `tsibble` objects

```r
PBS
```

```
# A tsibble: 67,596 x 9 [1M]
# Key:       Concession, Type, ATC1, ATC2 [336]
      Month Concession   Type    ATC1  ATC1_desc ATC2  ATC2_desc Scripts  Cost
      <mth> <chr>        <chr>   <chr> <chr>     <chr> <chr>       <dbl> <dbl>
 1 1991 Jul Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   18228 67877
 2 1991 Aug Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   15327 57011
 3 1991 Sep Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   14775 55020
 4 1991 Oct Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   15380 57222
 5 1991 Nov Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   14371 52120
 6 1991 Dec Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   15028 54299
 7 1992 Jan Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   11040 39753
 8 1992 Feb Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   15165 54405
 9 1992 Mar Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   16898 61108
10 1992 Apr Concessional Co-pay~ A     Alimenta~ A01   STOMATOL~   18141 65356
# i 67,586 more rows
```

Working with `tsibble` objects

We can use the `filter()` function to select rows.

```
PBS |>
  filter(ATC2 == "A10")
```

```
# A tsibble: 816 x 9 [1M]
# Key:       Concession, Type, ATC1, ATC2 [4]
      Month Concession   Type   ATC1  ATC1_desc ATC2  ATC2_desc Scripts   Cost
      <mth> <chr>        <chr>  <chr> <chr>     <chr> <chr>       <dbl>  <dbl>
 1 1991 Jul Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   89733 2.09e6
 2 1991 Aug Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   77101 1.80e6
 3 1991 Sep Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   76255 1.78e6
 4 1991 Oct Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   78681 1.85e6
 5 1991 Nov Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   70554 1.69e6
 6 1991 Dec Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   75814 1.84e6
 7 1992 Jan Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   64186 1.56e6
 8 1992 Feb Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   75899 1.73e6
 9 1992 Mar Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   89445 2.05e6
10 1992 Apr Concessional Co-pa~ A     Alimenta~ A10   ANTIDIAB~   97315 2.23e6
```

Working with `tsibble` objects

We can use the `select()` function to select columns.

```r
PBS |>
  filter(ATC2 == "A10") |>
  select(Month, Concession, Type, Cost)
```

```
# A tsibble: 816 x 4 [1M]
# Key:       Concession, Type [4]
      Month Concession   Type           Cost
      <mth> <chr>        <chr>         <dbl>
 1 1991 Jul Concessional Co-payments 2092878
 2 1991 Aug Concessional Co-payments 1795733
 3 1991 Sep Concessional Co-payments 1777231
 4 1991 Oct Concessional Co-payments 1848507
 5 1991 Nov Concessional Co-payments 1686458
 6 1991 Dec Concessional Co-payments 1843079
 7 1992 Jan Concessional Co-payments 1564702
 8 1992 Feb Concessional Co-payments 1732508
 9 1992 Mar Concessional Co-payments 2046102
```

Working with `tsibble` objects

We can use the `summarise()` function to summarise over keys.

```
PBS |>
  filter(ATC2 == "A10") |>
  select(Month, Concession, Type, Cost) |>
  summarise(total_cost = sum(Cost))
```

```
# A tsibble: 204 x 2 [1M]
      Month total_cost
      <mth>      <dbl>
 1 1991 Jul    3526591
 2 1991 Aug    3180891
 3 1991 Sep    3252221
 4 1991 Oct    3611003
 5 1991 Nov    3565869
 6 1991 Dec    4306371
 7 1992 Jan    5088335
 8 1992 Feb    2814520
 9 1992 Mar    2985811
```

Working with `tsibble` objects

We can use the `mutate()` function to create new variables.

```
PBS |>
  filter(ATC2 == "A10") |>
  select(Month, Concession, Type, Cost) |>
  summarise(total_cost = sum(Cost)) |>
  mutate(total_cost = total_cost / 1e6)
```

```
# A tsibble: 204 x 2 [1M]
      Month total_cost
      <mth>      <dbl>
 1 1991 Jul       3.53
 2 1991 Aug       3.18
 3 1991 Sep       3.25
 4 1991 Oct       3.61
 5 1991 Nov       3.57
 6 1991 Dec       4.31
 7 1992 Jan       5.09
 8 1992 Feb       2.81
```

Working with `tsibble` objects

We can use the `mutate()` function to create new variables.

```r
PBS |>
  filter(ATC2 == "A10") |>
  select(Month, Concession, Type, Cost) |>
  summarise(total_cost = sum(Cost)) |>
  mutate(total_cost = total_cost / 1e6) -> a10
```

```
# A tsibble: 204 x 2 [1M]
      Month total_cost
      <mth>      <dbl>
 1 1991 Jul       3.53
 2 1991 Aug       3.18
 3 1991 Sep       3.25
 4 1991 Oct       3.61
 5 1991 Nov       3.57
 6 1991 Dec       4.31
 7 1992 Jan       5.09
 8 1992 Feb       2.81
```

Outline

1 Time series data and tsibbles

2 Example: Australian prison population

3 Example: Australian pharmaceutical sales

4 Lab Session 1

5 Time plots

6 Lab Session 2

Lab Session 1a

1. Use the `readabs` package to download and tidy the time series data from table `"19"` of the `"6202.0"` catalogue.
2. Use `filter()` to remove time series relating to hours worked disaggregated by State/Territory. Also remove the aggregated time series (which specify `"Persons"`).
3. Split the series column into two columns, `workload` and `sex` using the `separate()` function.
4. Create a tsibble with the appropriate index and key variables, you will need to convert the date variable into a time variable with the appropriate granularity.

Lab Session 1b

Now let’s look at this data:

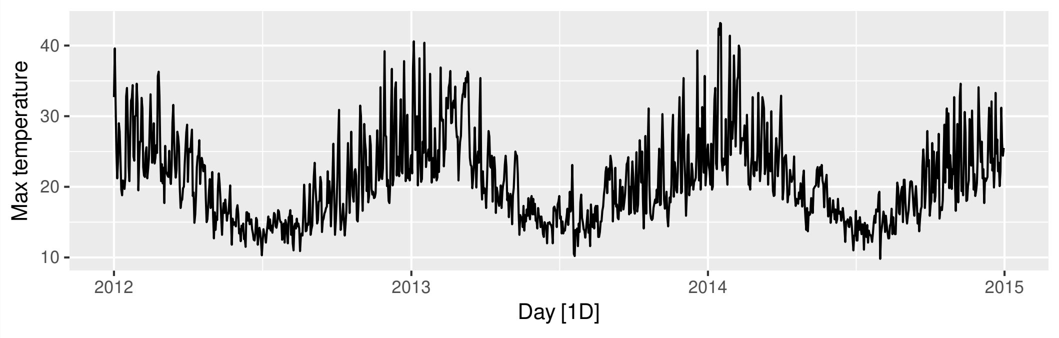
5. Find which series contains the most worked hours.
6. Create a new tsibble which aggregates over `sex`, and just has monthly worked hours by type.
7. What is the typical difference in total working hours between full time and part time employees? (try to visualise this!)

Outline

1. Time series data and tsibbles
2. Example: Australian prison population
3. Example: Australian pharmaceutical sales
4. Lab Session 1
5. **Time plots**
6. Lab Session 2

Time plots

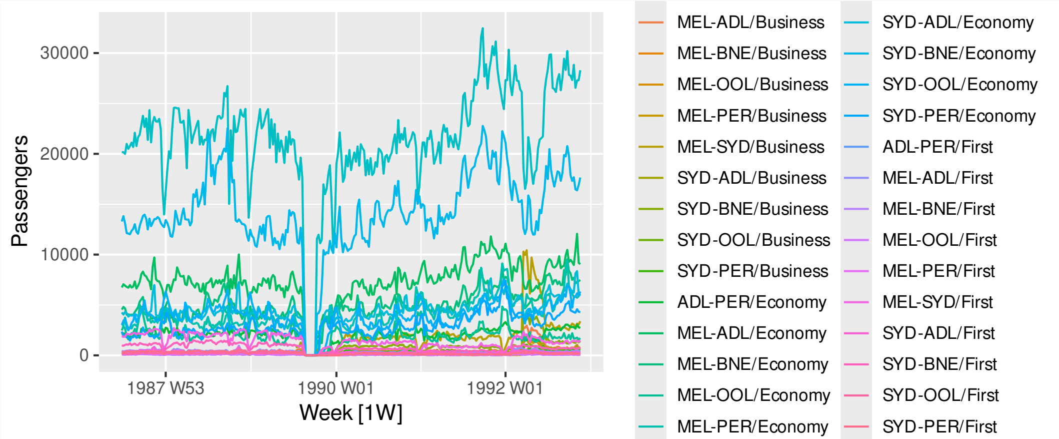
```
maxtemp <- vic_elec |>
  index_by(Day = date(Time)) |>
  summarise(Temperature = max(Temperature))
maxtemp |>
  autoplot(Temperature) +
  labs(y = "Max temperature")
```



Ansett airlines

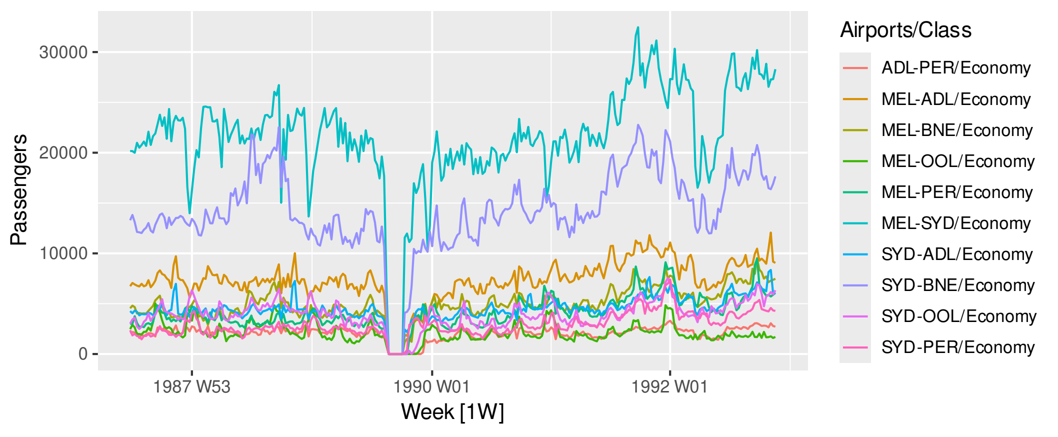
Ansett airlines

```
ansett |>
  autoplot(Passengers)
```



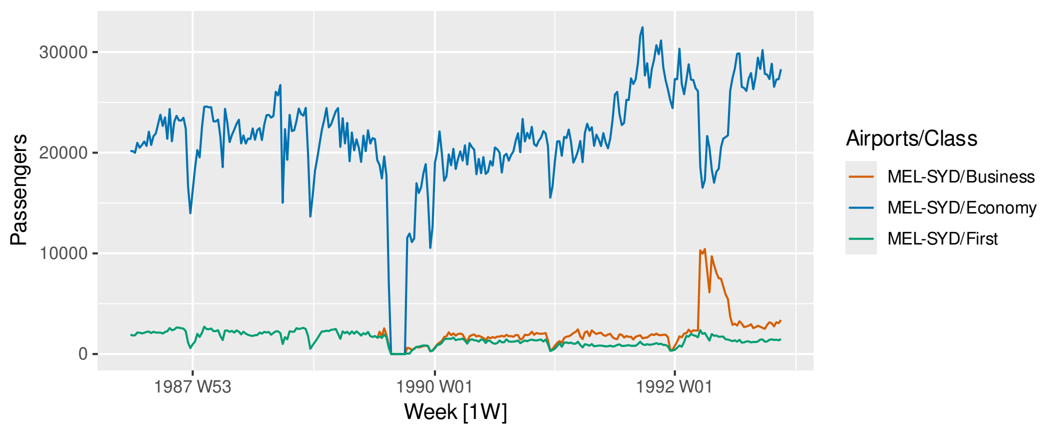
Ansett airlines

```r
ansett |>
  filter(Class == "Economy") |>
  autoplot(Passengers)
```



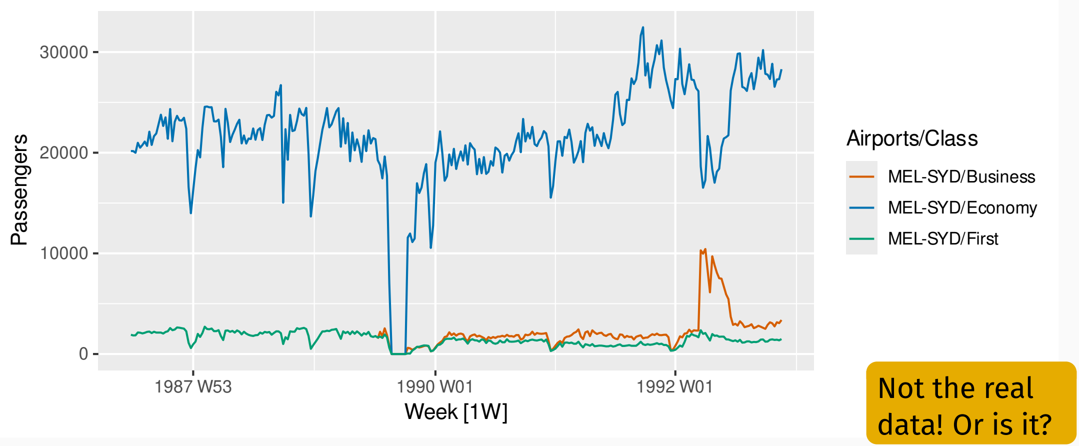
Ansett airlines

```
ansett |>
  filter(Airports == "MEL-SYD") |>
  autoplot(Passengers)
```



Ansett airlines

```
ansett |>
  filter(Airports == "MEL-SYD") |>
  autoplot(Passengers)
```



Not the real data! Or is it?

Outline

1 Time series data and tsibbles

2 Example: Australian prison population

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6 Lab Session 2

Lab Session 2

- Create time plots of the following four time series: `Bricks` from `aus_production`, `Lynx` from `pelt`, `Close` from `gafa_stock`, `Demand` from `vic_elec`.
- Use `help()` to find out about the data in each series.
- For the last plot, modify the axis labels and title.