Homework 1

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```
library(fpp3)
```

```
## -- Attaching packages --------------------------------------- fpp3 0.4.0 --

## v tibble      3.1.8          v tsibble     1.1.3
## v dplyr       1.0.10         v tsibbledata 0.4.1.9000
## v tidyr       1.2.1          v feasts      0.3.0
## v lubridate   1.9.0          v fable       0.3.2
## v ggplot2     3.4.0

## -- Conflicts ------------------------------------------------ fpp3_conflicts --
## x lubridate::date()    masks base::date()
## x dplyr::filter()      masks stats::filter()
## x tsibble::intersect() masks base::intersect()
## x tsibble::interval()  masks lubridate::interval()
## x dplyr::lag()         masks stats::lag()
## x tsibble::setdiff()   masks base::setdiff()
## x tsibble::union()     masks base::union()
```

```
library(tsibbledata)
library(tsibble)
library(ggplot2)
library(dplyr)
```

Problem 1

Explore the following four time series: Bricks from aus_production, Lynx from pelt, Close from gafa_stock, Demand from vic_elec.

Use ? (or help()) to find out about the data in each series. What is the time interval of each series? Use autoplot() to produce a time plot of each series. For the last plot, modify the axis labels and title.

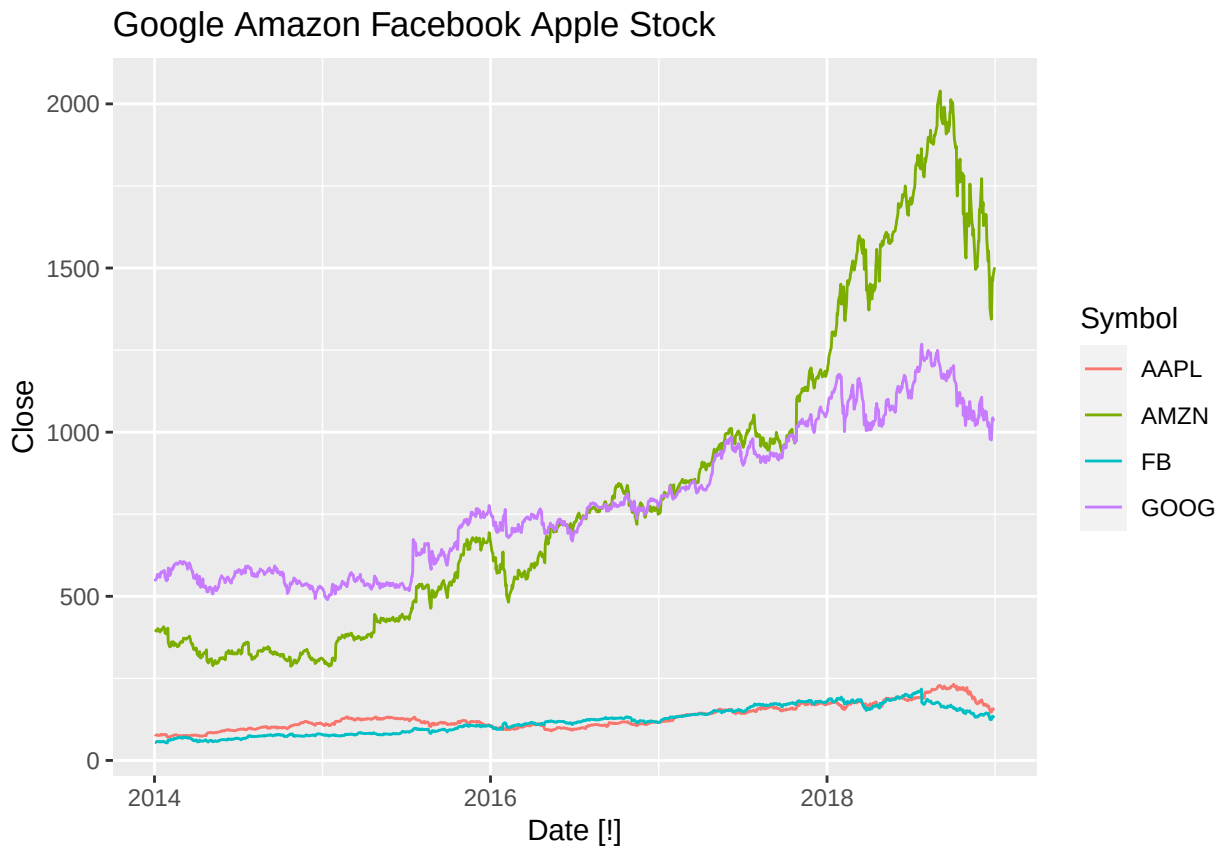
a)

Code)

```
head(gafa_stock)
```

```
## # A tsibble: 6 x 8 [!]
## # Key:       Symbol [1]
##   Symbol Date        Open  High   Low Close Adj_Close    Volume
##   <chr>  <date>     <dbl> <dbl> <dbl> <dbl>     <dbl>     <dbl>
## 1 AAPL   2014-01-02  79.4  79.6  78.9  79.0      67.0  58671200
## 2 AAPL   2014-01-03  79.0  79.1  77.2  77.3      65.5  98116900
## 3 AAPL   2014-01-06  76.8  78.1  76.2  77.7      65.9 103152700
## 4 AAPL   2014-01-07  77.8  78.0  76.8  77.1      65.4  79302300
## 5 AAPL   2014-01-08  77.0  77.9  77.0  77.6      65.8  64632400
## 6 AAPL   2014-01-09  78.1  78.1  76.5  76.6      65.0  69787200
```

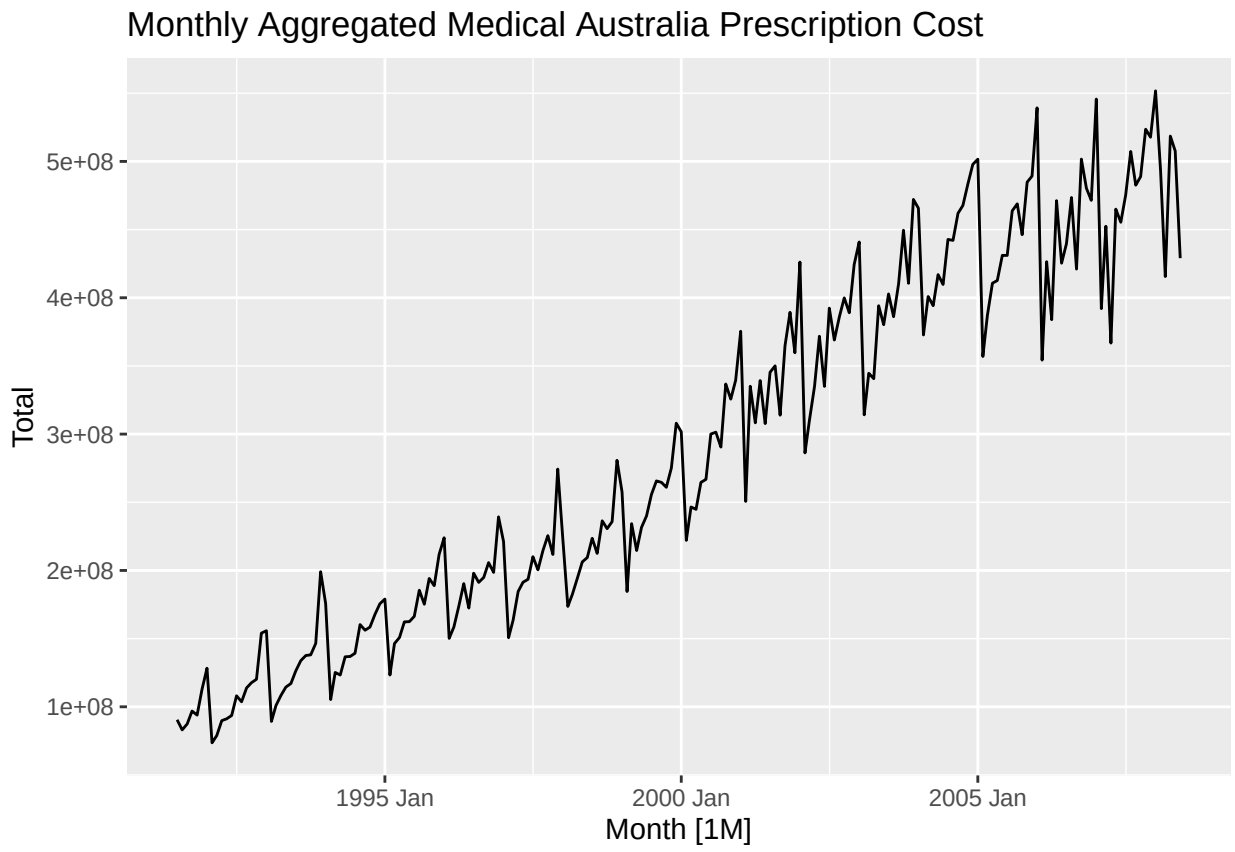
```
autoplot(gafa_stock, Close) + labs(title = "Google Amazon Facebook Apple Stock")
```




```
head(PBS)
```

```
## # A tsibble: 6 x 9 [1M]
## # Key:       Concession, Type, ATC1, ATC2 [1]
##      Month Concession   Type        ATC1  ATC1_desc  ATC2  ATC2_~1 Scripts  Cost
##      <mth> <chr>        <chr>       <chr> <chr>      <chr> <chr>     <dbl> <dbl>
## 1 1991 Jul Concessional Co-payments A     Alimentar~ A01   STOMAT~   18228 67877
## 2 1991 Aug Concessional Co-payments A     Alimentar~ A01   STOMAT~   15327 57011
## 3 1991 Sep Concessional Co-payments A     Alimentar~ A01   STOMAT~   14775 55020
## 4 1991 Oct Concessional Co-payments A     Alimentar~ A01   STOMAT~   15380 57222
## 5 1991 Nov Concessional Co-payments A     Alimentar~ A01   STOMAT~   14371 52120
## 6 1991 Dec Concessional Co-payments A     Alimentar~ A01   STOMAT~   15028 54299
## # ... with abbreviated variable name 1: ATC2_desc
```

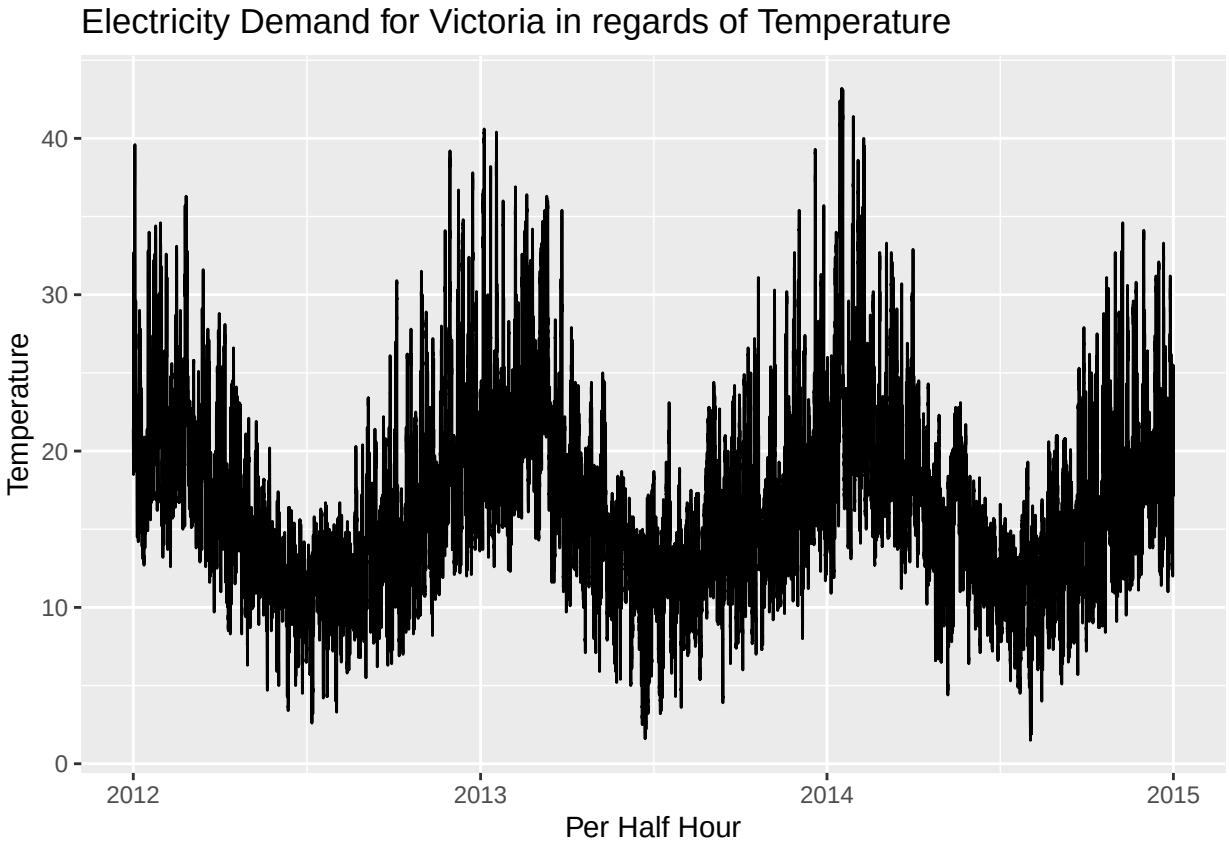
```
PBS %>%
  summarise(Total = sum(Cost)) %>%
  autoplot(Total) + labs(title = "Monthly Aggregated Medical Australia Prescription Cost")
```




```
head(vic_elec)
```

```
## # A tsibble: 6 x 5 [30m] <Australia/Melbourne>
##   Time                Demand Temperature Date       Holiday
##   <dttm>               <dbl>       <dbl> <date>     <lgl>
## 1 2012-01-01 00:00:00  4383.        21.4 2012-01-01 TRUE
## 2 2012-01-01 00:30:00  4263.        21.0 2012-01-01 TRUE
## 3 2012-01-01 01:00:00  4049.        20.7 2012-01-01 TRUE
## 4 2012-01-01 01:30:00  3878.        20.6 2012-01-01 TRUE
## 5 2012-01-01 02:00:00  4036.        20.4 2012-01-01 TRUE
## 6 2012-01-01 02:30:00  3866.        20.2 2012-01-01 TRUE
```

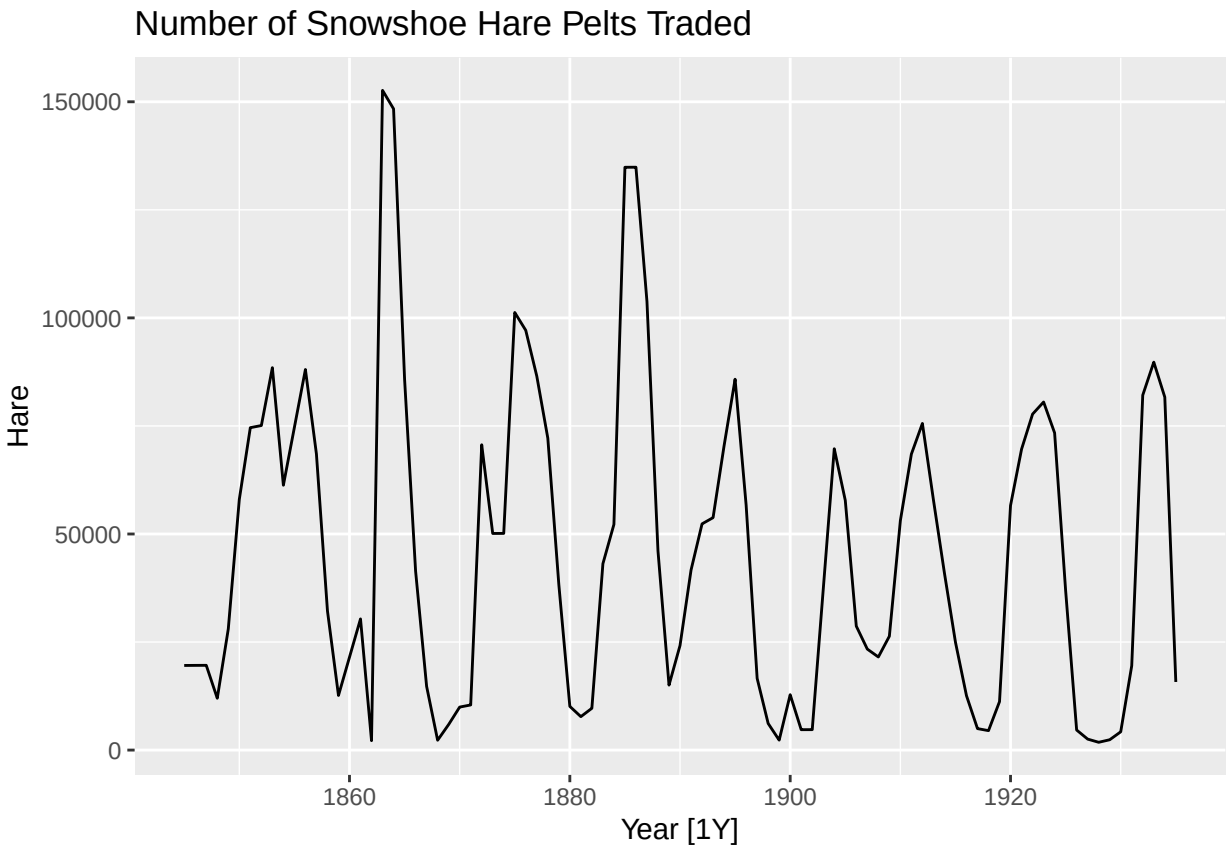
```
autoplot(vic_elec, Temperature) + labs(title =  "Electricity Demand for Victoria in regards of Temperatu
```




```
head(pelt)
```

```
## # A tsibble: 6 x 3 [1Y]
##    Year  Hare  Lynx
##   <dbl> <dbl> <dbl>
## 1  1845 19580 30090
## 2  1846 19600 45150
## 3  1847 19610 49150
## 4  1848 11990 39520
## 5  1849 28040 21230
## 6  1850 58000  8420
```

```
autoplot(pelt, Hare) + labs(title = "Number of Snowshoe Hare Pelts Traded")
```



b)

Answer)

1) The time interval for gafa_stock is daily (business trading days)
2) The time interval for PBS is monthly
3) The time interval for vic_elec is every 30 minutes
4) The time interval for pelt is yearly

Problem 2

The USgas package contains data on the demand for natural gas in the US.

Install the USgas package. Create a tsibble from us_total with year as the index and state as the key. Plot the annual natural gas consumption by state for the New England area (comprising the states of Maine, Vermont, New Hampshire, Massachusetts, Connecticut and Rhode Island).

a)

```
#install.packages("USgas")
library(USgas)
```

b)

```
head(us_total)
```

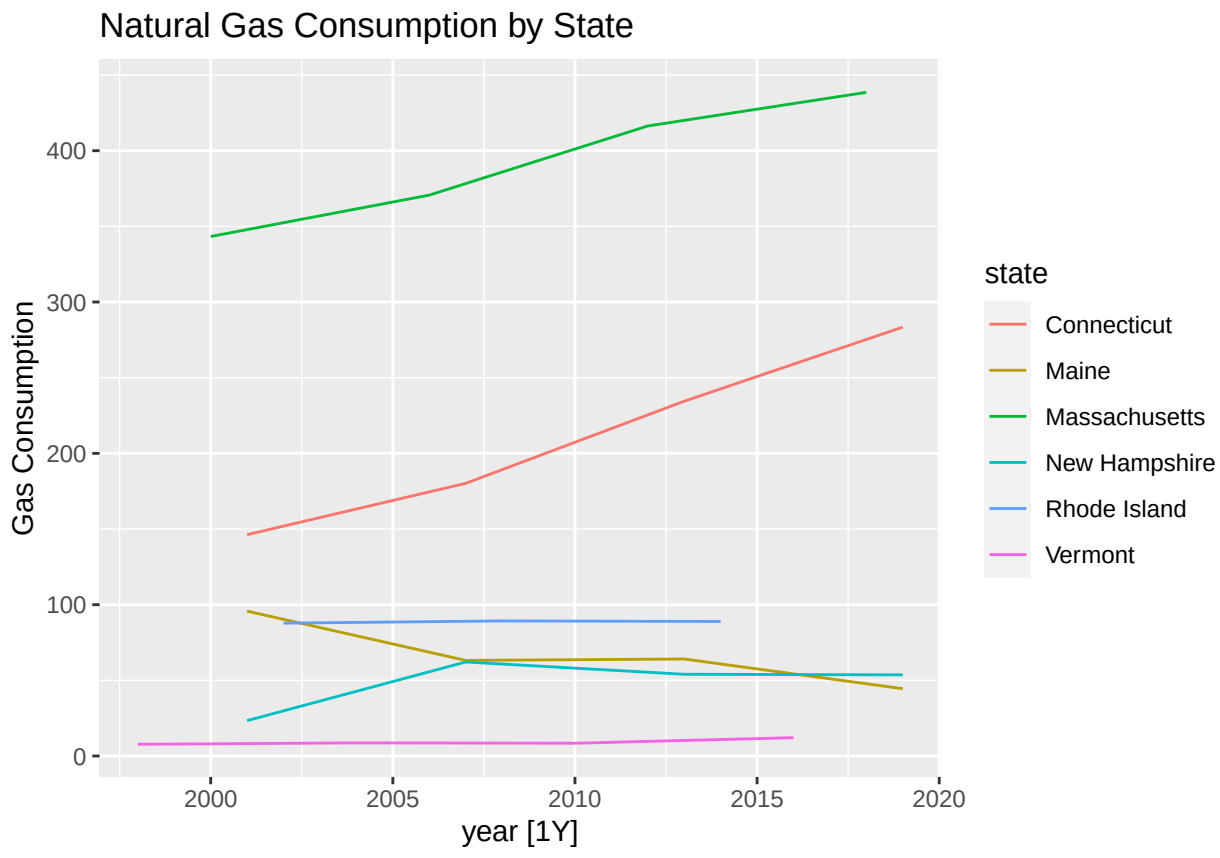
```
##   year   state      y
## 1 1997 Alabama 324158
## 2 1998 Alabama 329134
## 3 1999 Alabama 337270
## 4 2000 Alabama 353614
## 5 2001 Alabama 332693
## 6 2002 Alabama 379343
```

```
total <- us_total %>%
  filter(state == c("Maine", "Vermont", "New Hampshire", "Massachusetts", "Connecticut", "Rhode Island")
  mutate(y = y/1000) %>%
  as_tsibble(key = state, index = year)
```

c)

```
autoplot(total) + labs(y = "Gas Consumption", title = "Natural Gas Consumption by State")
```

```
## Plot variable not specified, automatically selected `.vars = y`
```



Problem 3

Monthly Australian retail data is provided in aus_retail. Select one of the time series as follows (but choose your own seed value):

set.seed(12345678) myseries <- aus_retail |> filter(`Series ID` == sample(aus_retail$`Series ID`,1)) Explore your chosen retail time series using the following functions:

autoplot(), gg_season(), gg_subseries(), gg_lag(),

ACF() |> autoplot()

Can you spot any seasonality, cyclicity and trend? What do you learn about the series?

Answer)

Japan departures have an increasing trend up until the late 1990's and then has a decreasing trend from there on, compared to the other countries, where their departures are increasing over time. In terms of seasonality, Japan has an alternating increasing and decreasing trend between quarters.

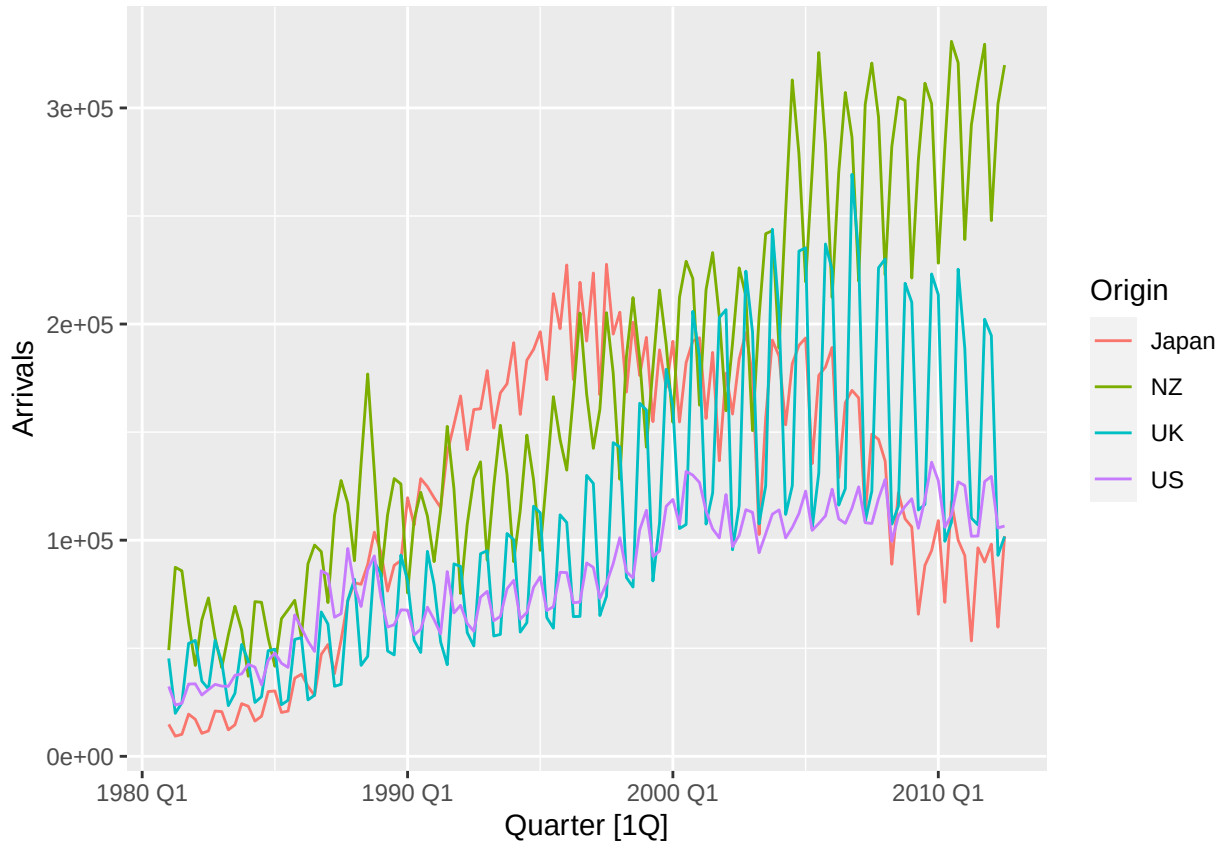
Code)

```
head(aus_arrivals)
```

```
## # A tsibble: 6 x 3 [1Q]
## # Key:       Origin [1]
##   Quarter Origin Arrivals
##     <qtr> <chr>     <int>
## 1 1981 Q1 Japan     14763
## 2 1981 Q2 Japan      9321
## 3 1981 Q3 Japan     10166
## 4 1981 Q4 Japan     19509
## 5 1982 Q1 Japan     17117
## 6 1982 Q2 Japan     10617
```

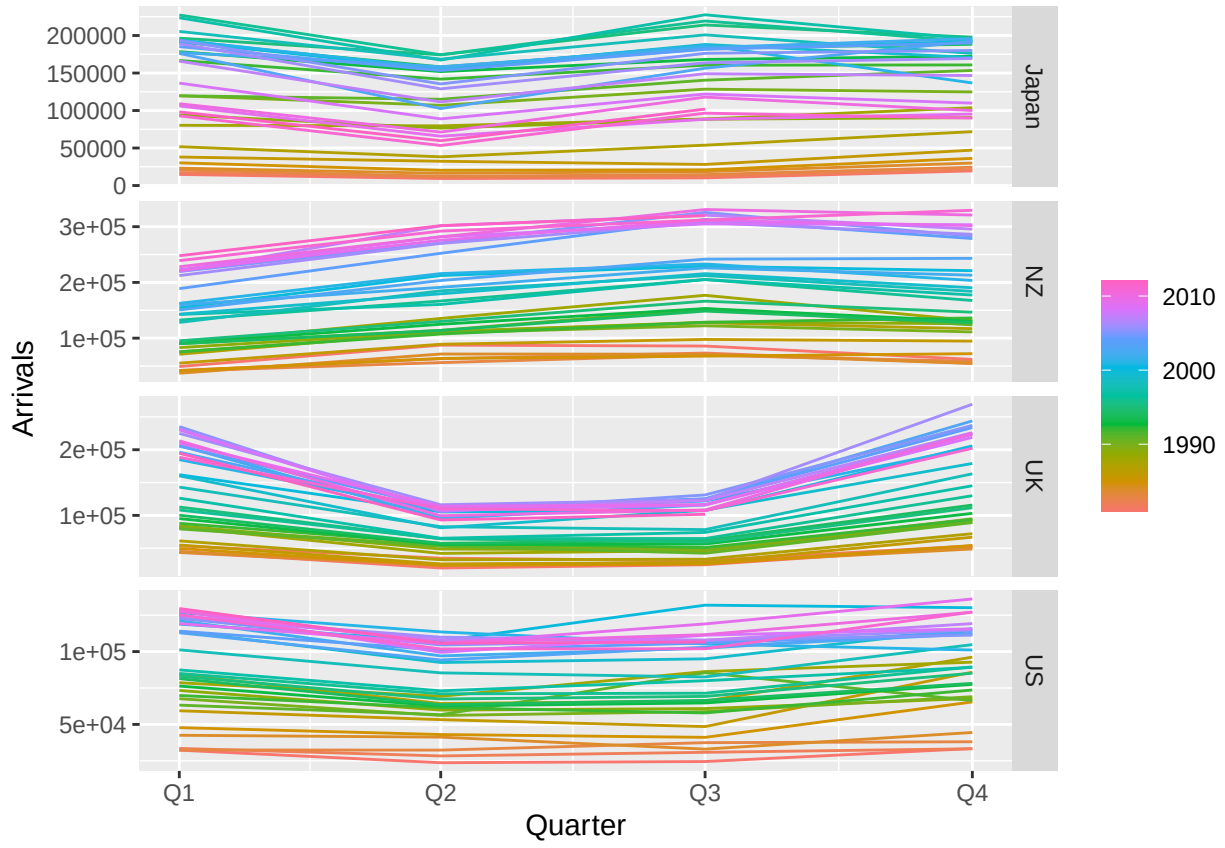
```
autoplot(aus_arrivals)
```

```
## Plot variable not specified, automatically selected `.vars = Arrivals`
```



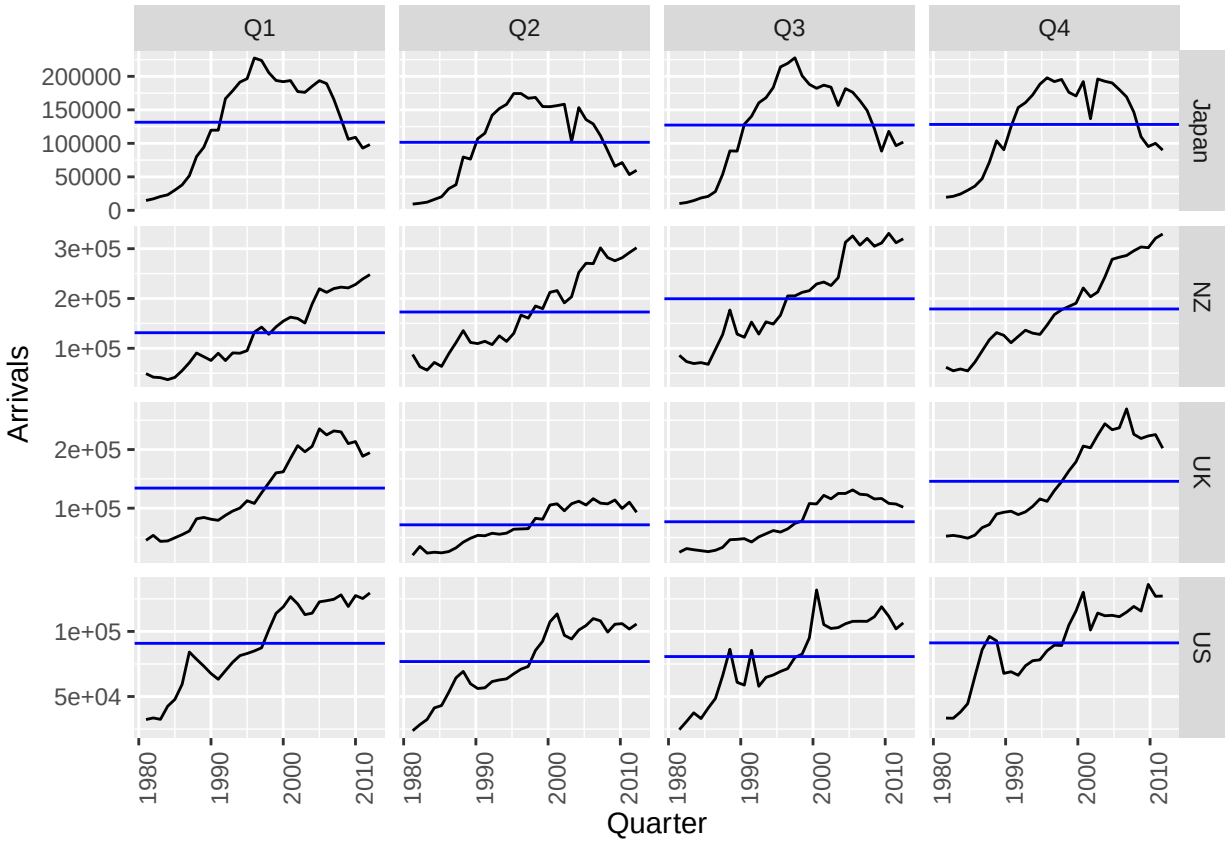

```
gg_season(aus_arrivals)
```

```
## Plot variable not specified, automatically selected ‘y = Arrivals‘
```




```
gg_subseries(aus_arrivals)
```

```
## Plot variable not specified, automatically selected `y = Arrivals`
```



Problem 4

Use the following graphics functions: autoplot(), gg_season(), gg_subseries(), gg_lag(), ACF() and explore features from the following time series: "Total Private" Employed from us_employment, Bricks from aus_production, Hare from pelt, "H02" Cost from PBS, and Barrels from us_gasoline.

Can you spot any seasonality, cyclicity and trend? What do you learn about the series? What can you say about the seasonal patterns? Can you identify any unusual years?

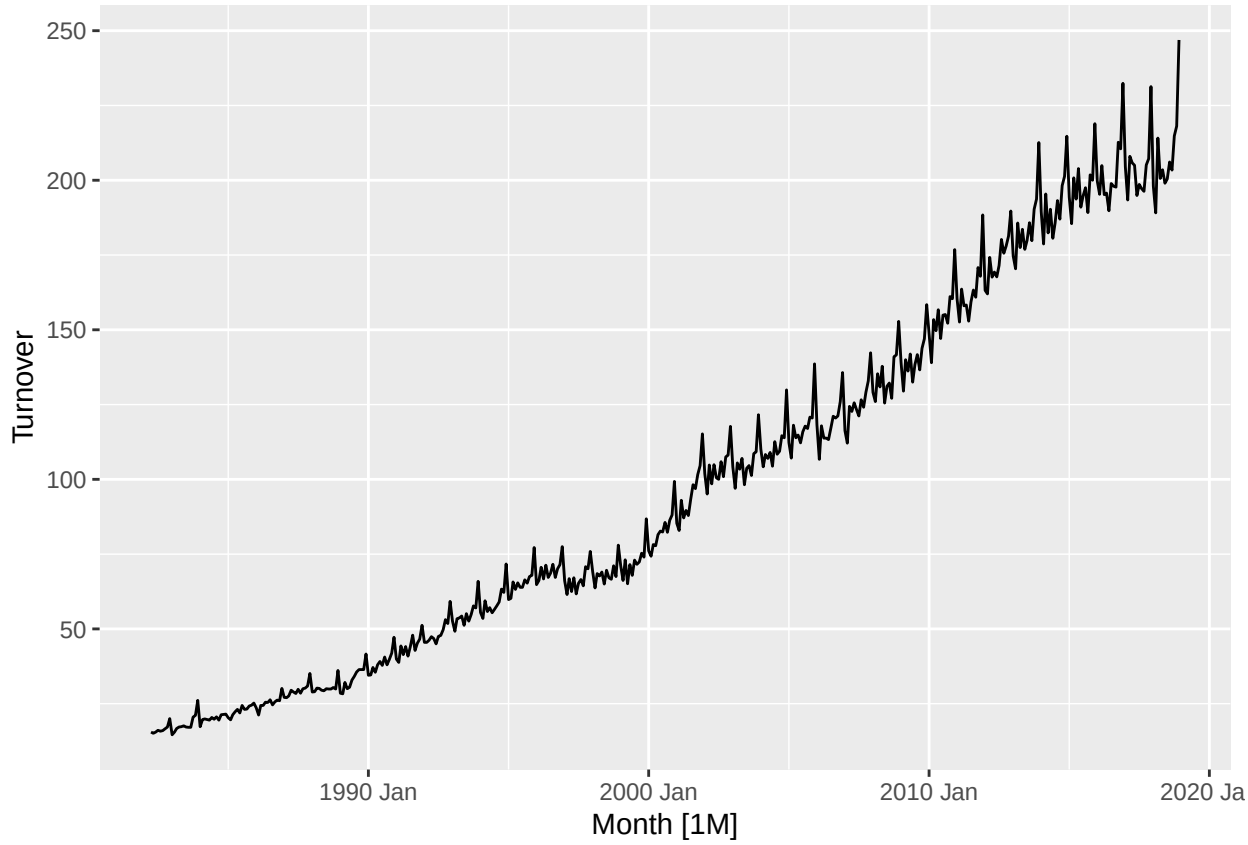
```
head(aus_retail)
```

```
## # A tsibble: 6 x 5 [1M]
## # Key:       State, Industry [1]
##   State                          Industry                 Serie~1    Month Turno~2
##   <chr>                          <chr>                    <chr>      <mth>   <dbl>
## 1 Australian Capital Territory Cafes, restaurants and ~ A33498~ 1982 Apr     4.4
## 2 Australian Capital Territory Cafes, restaurants and ~ A33498~ 1982 May     3.4
## 3 Australian Capital Territory Cafes, restaurants and ~ A33498~ 1982 Jun     3.6
## 4 Australian Capital Territory Cafes, restaurants and ~ A33498~ 1982 Jul     4
## 5 Australian Capital Territory Cafes, restaurants and ~ A33498~ 1982 Aug     3.6
## 6 Australian Capital Territory Cafes, restaurants and ~ A33498~ 1982 Sep     4.2
## # ... with abbreviated variable names 1: 'Series ID', 2: Turnover
```

```
set.seed(101)
myseries <- aus_retail %>%
  filter(`Series ID` == sample(aus_retail$`Series ID`,1))
```

```
autoplot(myseries)
```

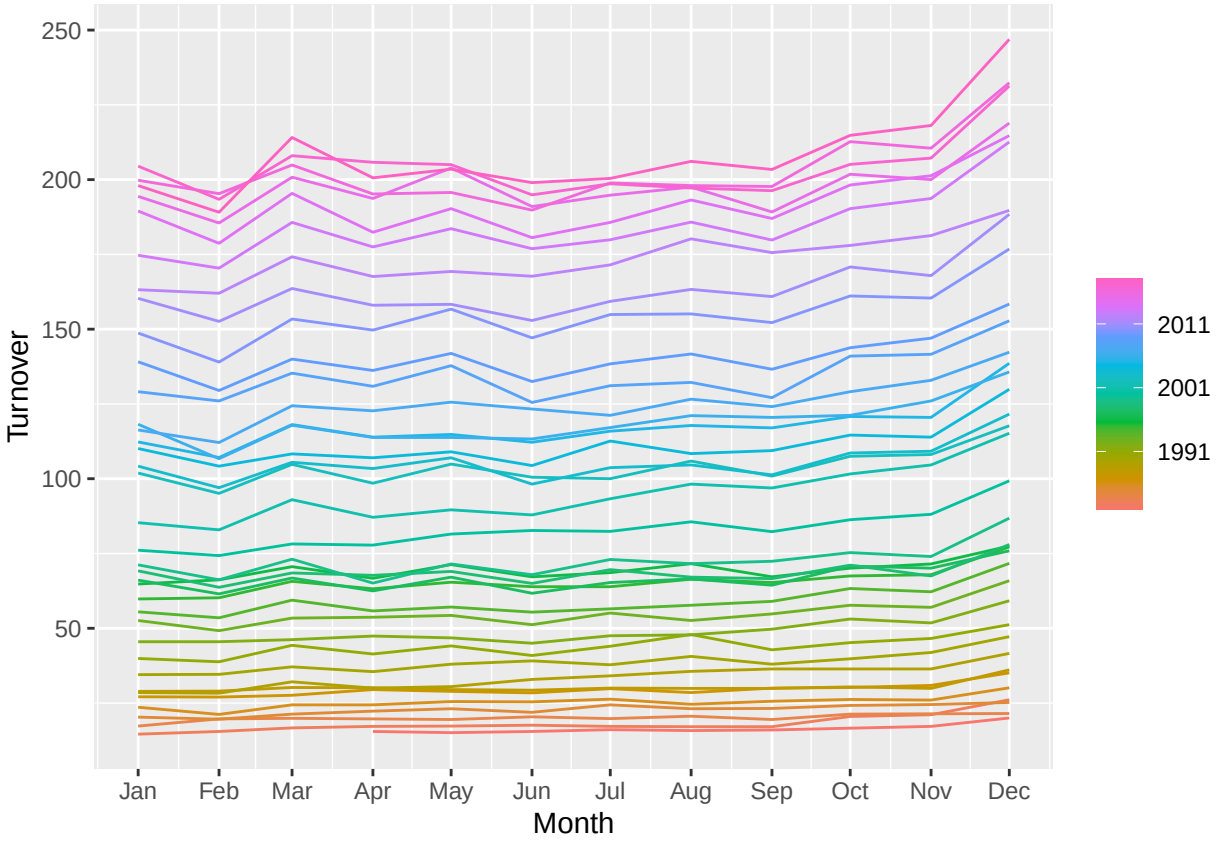
```
## Plot variable not specified, automatically selected `.vars = Turnover`
```



There is an apparent upward trend over time. There also seems to be a cyclical pattern but the fluctuations are greater after the 2000's.

```
gg_season(myseries)
```

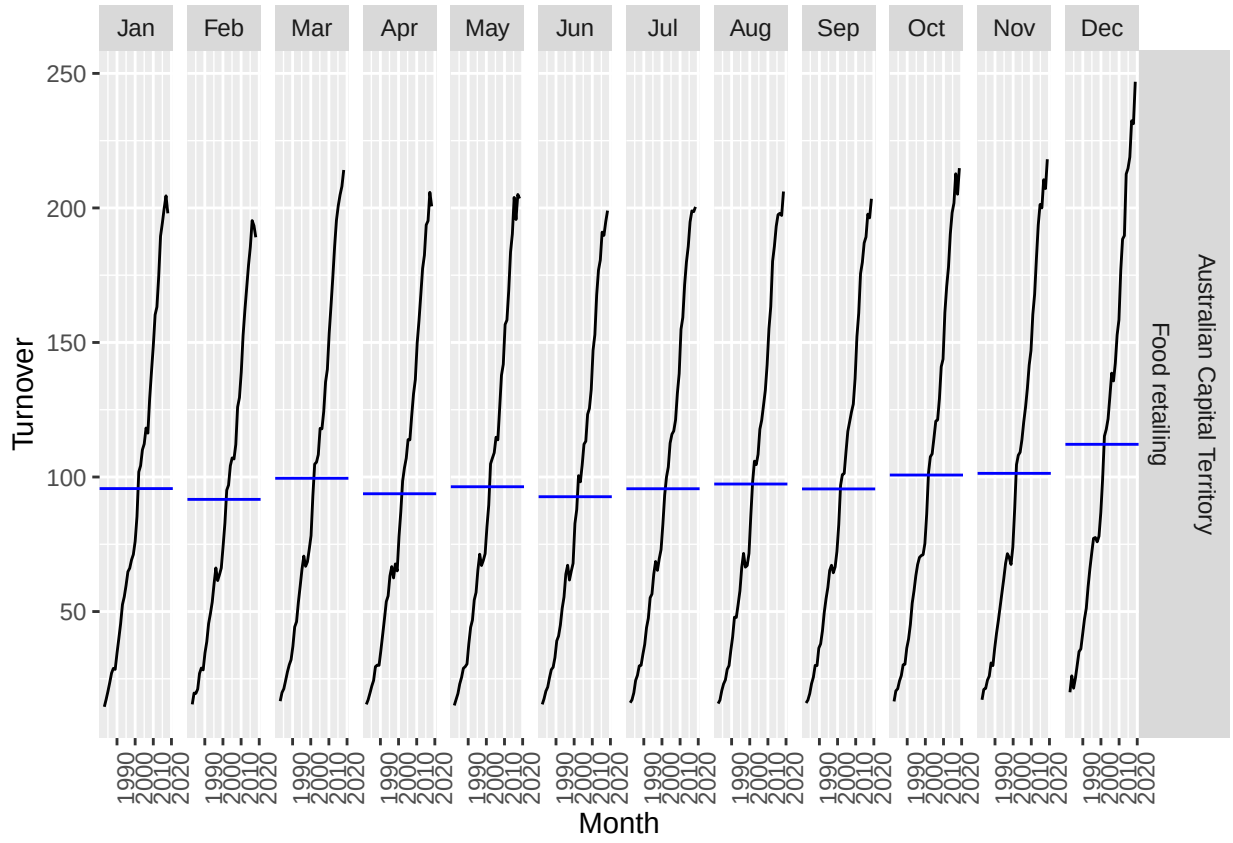
```
## Plot variable not specified, automatically selected `y = Turnover`
```



There is a seasonal pattern going on with sales jumping in December and then dropping for January. Sales are steady until September where they begin to increase until December

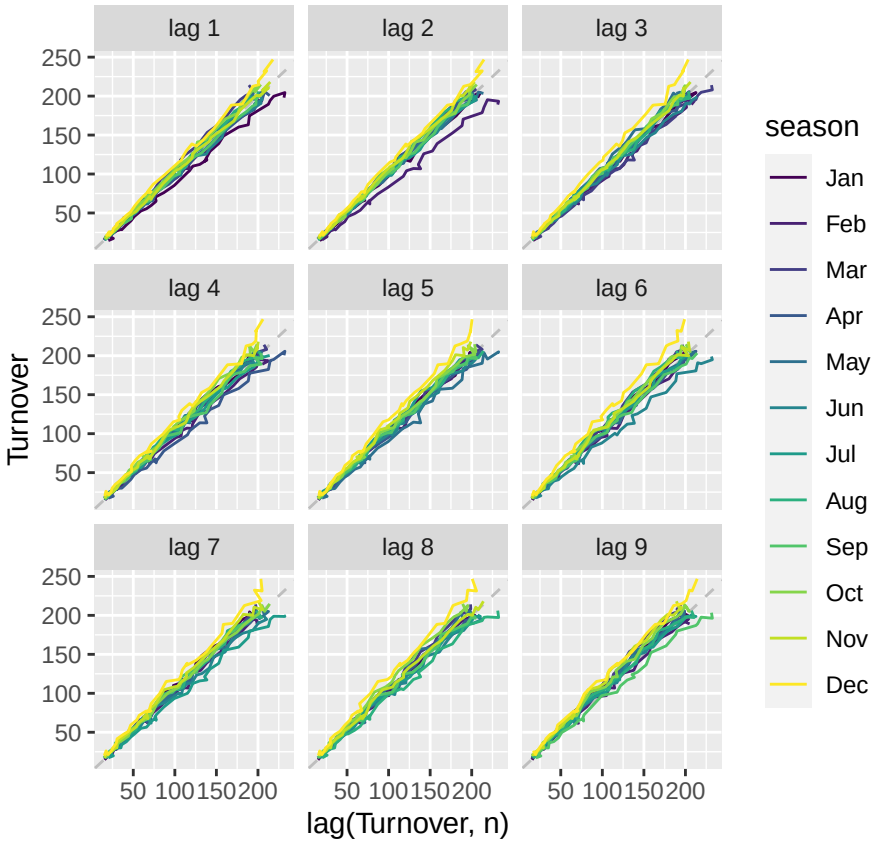
```
gg_subseries(myseries)
```

```
## Plot variable not specified, automatically selected `y = Turnover`
```




```
gg_lag(myseries)
```

```
## Plot variable not specified, automatically selected ‘y = Turnover‘
```


lag 1
lag 2
lag 3
lag 4
lag 5
lag 6
lag 7
lag 8
lag 9
Turnover
lag(Turnover, n)
50
100
150
200
250
season
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec