



MONASH  
University

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BUSINESS  
SCHOOL

# ETC3550/ETC5550

## Applied forecasting

Ch2. Time series graphics

[OTexts.org/fpp3/](https://OTexts.org/fpp3/)



# tsibble objects

```
global_economy
```

```
# A tsibble: 15,150 x 6 [1Y]
```

```
# Key:          Country [263]
```

	Year	Country	GDP	Imports	Exports	Population
	<dbl>	<fct>	<dbl>	<dbl>	<dbl>	<dbl>
1	1960	Afghanistan	5377777811.	7.02	4.13	8996351
2	1961	Afghanistan	5488888896.	8.10	4.45	9166764
3	1962	Afghanistan	5466666678.	9.35	4.88	9345868
4	1963	Afghanistan	7511111191.	16.9	9.17	9533954
5	1964	Afghanistan	8000000044.	18.1	8.89	9731361
6	1965	Afghanistan	10066666638.	21.4	11.3	9938414
7	1966	Afghanistan	13999999967.	18.6	8.57	10152331
8	1967	Afghanistan	16733333418.	14.2	6.77	10372630
9	1968	Afghanistan	13733333367.	15.2	8.90	10604346
10	1969	Afghanistan	14088888922.	15.0	10.1	10854428

```
# i 15,140 more rows
```

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3	1962	Afghanistan	5466666678.	9.35	4.88	9345868
4	1963	Afghanistan	7511111191.	16.9	9.17	9533954
5	1964	Afghanistan	8000000044.	18.1	8.89	9731361
6	1965	Afghanistan	1006666638.	21.4	11.3	9938414
7	1966	Afghanistan	1399999967.	18.6	8.57	10152331
8	1967	Afghanistan	1673333418.	14.2	6.77	10372630
9	1968	Afghanistan	1373333367.	15.2	8.90	10604346
10	1969	Afghanistan	1408888922.	15.0	10.1	10854428

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	Year	Country	GDP	Imports	Exports	Population
	Index	Key	Measured variables			
1	1960	Afghanistan	5377777811.	7.02	4.13	8996351
2	1961	Afghanistan	5488888896.	8.10	4.45	9166764
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# i 15,140 more rows
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# 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 SA      Business 135.
2 1998 Q2 Adelaide SA      Business 110.
3 1998 Q3 Adelaide SA      Business 166.
4 1998 Q4 Adelaide SA      Business 127.
5 1999 Q1 Adelaide SA      Business 137.
6 1999 Q2 Adelaide SA      Business 200.
7 1999 Q3 Adelaide SA      Business 169.
8 1999 Q4 Adelaide SA      Business 134.
9 2000 Q1 Adelaide SA      Business 154.
10 2000 Q2 Adelaide SA      Business 169.
# i 24,310 more rows
```

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tourism

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# A tsibble: 24,320 x 5 [1Q]
# Key:           Region, State, Purpose [304]
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   <qtr>  <chr>    <chr> <chr>    <dbl>
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3 1998 Q3 Adelaide SA      Business 166.
4 1998 Q4 Adelaide SA      Business 127.
5 1999 Q1 Adelaide SA      Business 137.
6 1999 Q2 Adelaide SA      Business 200.
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# i 24,310 more rows
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Domestic visitor  
nights in  
thousands by  
state/region and  
purpose.

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# Key:      Region, State, Purpose [304]
```

	Quarter	Region	State	Purpose	Trips
	Index	Keys			Measure
1	1998 Q1	Adelaide	SA	Business	135.
2	1998 Q2	Adelaide	SA	Business	110.
3	1998 Q3	Adelaide	SA	Business	166.
4	1998 Q4	Adelaide	SA	Business	127.
5	1999 Q1	Adelaide	SA	Business	137.
6	1999 Q2	Adelaide	SA	Business	200.
7	1999 Q3	Adelaide	SA	Business	169.
8	1999 Q4	Adelaide	SA	Business	134.
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```
# i 24,310 more rows
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Domestic visitor  
nights in  
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# 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

Time index variables can be created with these functions:

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

# Seasonal or cyclic?

## Differences between seasonal and cyclic patterns:

- seasonal pattern constant length; cyclic pattern variable length
- average length of cycle longer than length of seasonal pattern
- magnitude of cycle more variable than magnitude of seasonal pattern

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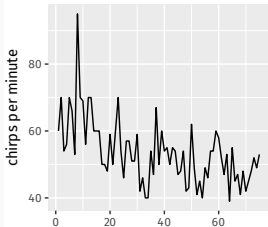
The timing of peaks and troughs is predictable with seasonal data, but unpredictable in the long term with cyclic data.

# Trend and seasonality in ACF plots

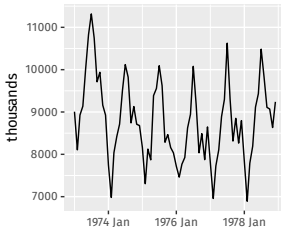
- When data have a trend, the autocorrelations for small lags tend to be large and positive.
- When data are seasonal, the autocorrelations will be larger at the seasonal lags (i.e., at multiples of the seasonal frequency)
- When data are trended and seasonal, you see a combination of these effects.

# Which is which?

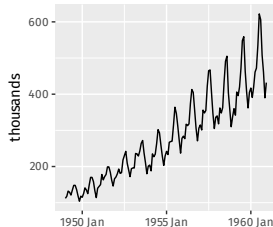
1. Daily temperature of cow



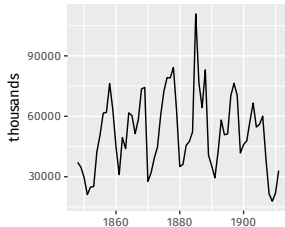
2. Monthly accidental deaths



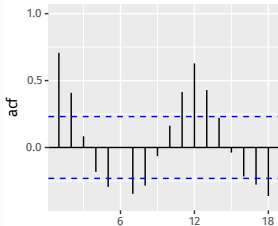
3. Monthly air passengers



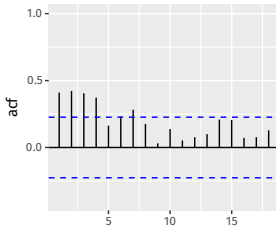
4. Annual mink trappings



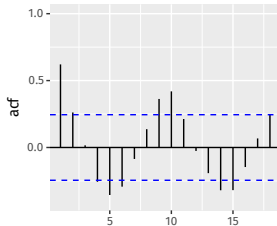
A



B



C



D

