

Exercise: Time Series for a single variable

In this exercise we will use iNZight to create a Time Series plot and get the Additive and Multiplicative Decomposition for it.

The skills addressed are:

1. Use iNZight to generate a Time Series plot and a Seasonal plot for a single numeric variable.
2. Use iNZight to get an Additive and Multiplicative Decomposition.
3. Use iNZight to make a forecast for the future.

[iNZight Lite version [linked here](#)]

INSTRUCTIONS

Follow the instructions below to generate the graphs. Or you may prefer to [print the instructions](#). If you have any problems during this exercise, scroll down to **Common questions**.

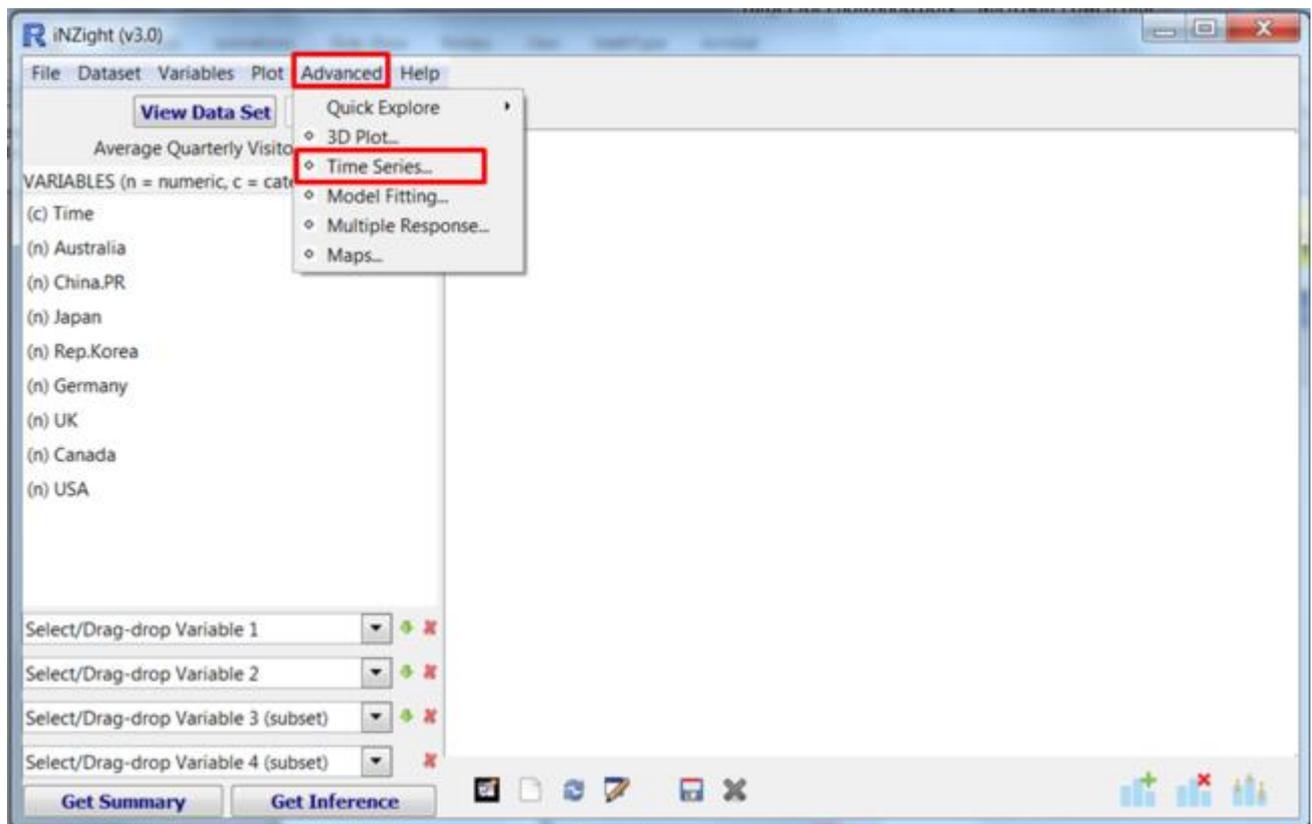
[**Linux users:** In the below Linux users should not press buttons that say "Animate", but use the equivalent button that does not say "animate" because of slow plotting speeds.]

Load the **Week8_AverageVisitorsQuarterly** dataset into iNZight using **File > Example data ...**. You will find the data set in **Module (package) FutureLearn**.

Generate a Time Series plot and a Seasonplot for a single numeric variable

The data we are using shows us the number of visitors from different countries who are currently staying in New Zealand. We will investigate the changes in the number of visitors from the USA over time using a Time Series plot for our data.

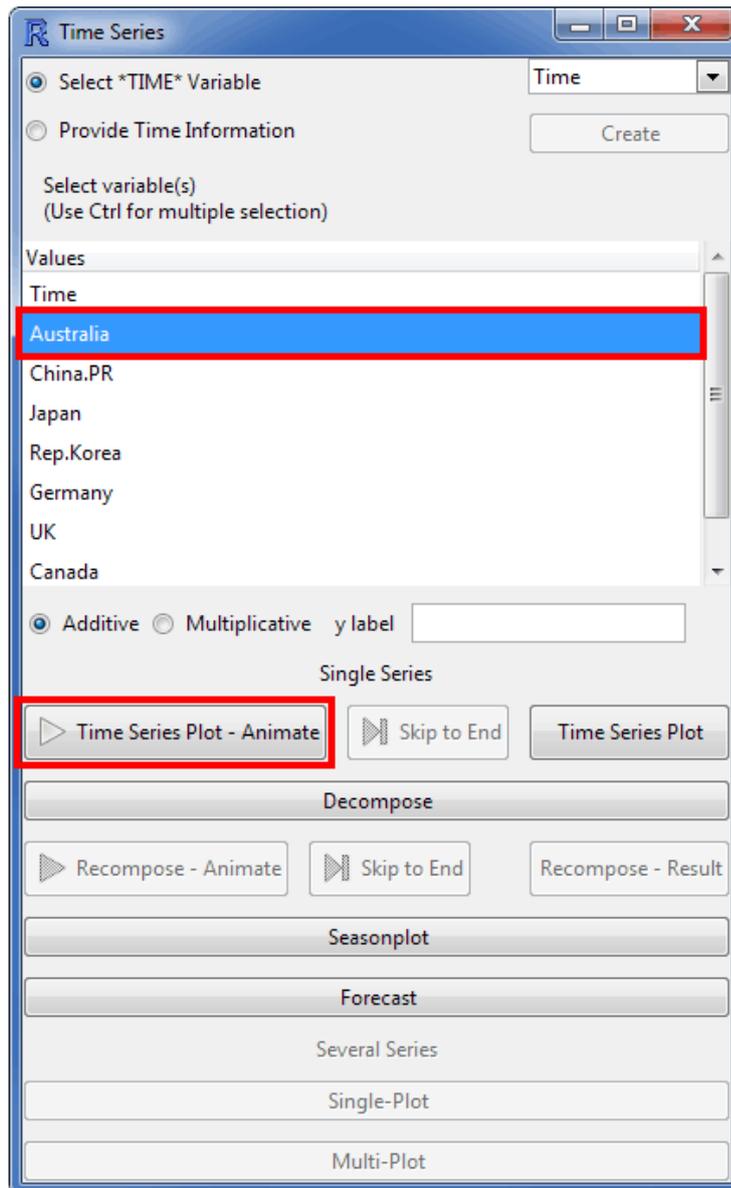
- Click the **Advanced** drop down menu in the top row
- Select **Time Series**.



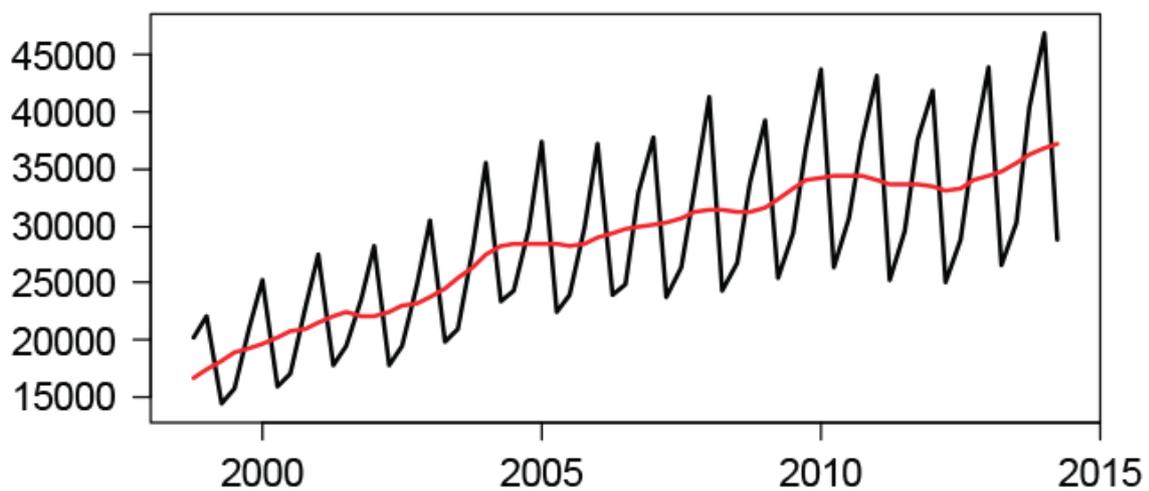
A new window will open. This window is all you need to work with Time Series.

To see the Time Series plot for Australia

- Select **Australia**
- Click **Time Series Plot - Animate**.



Time series plot for Australia



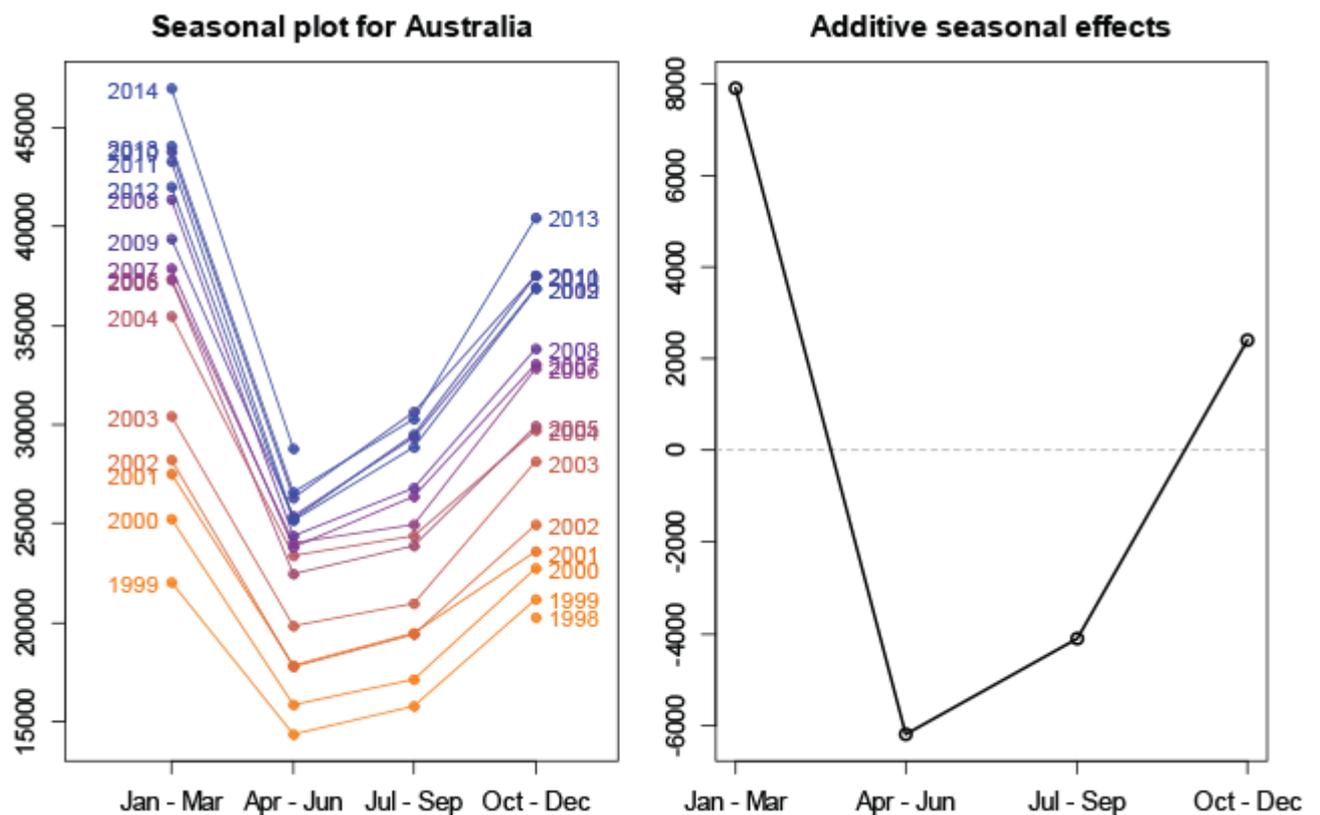
What is happening in the graphics window?

At first the values are demonstrated by single dots, then a black line starts connecting them showing the saw-tooth shape. The red line that appears afterwards is the trend line for the data.

If you don't want to see the process of drawing the plot, use **Time Series Plot** or if you already started the animation, click **Skip to End**.

The Time Series plot shows us that there is a basic pattern that repeats every year. To have a better look at that pattern we can use a Seasonplot.

- Click **Seasonplot**.



[Enlarge image](#)

In the new window we have the **Seasonplot for Australia** on the left. It shows that we were right and there really is a repeated seasonal pattern.

As you can see in the heading, **Additive seasonal effects**, a sum of the patterns for the different years is being generated. For the Multiplicative

seasonal effects select **Multiplicative** in your Time Series window and click **Seasonplot** again.

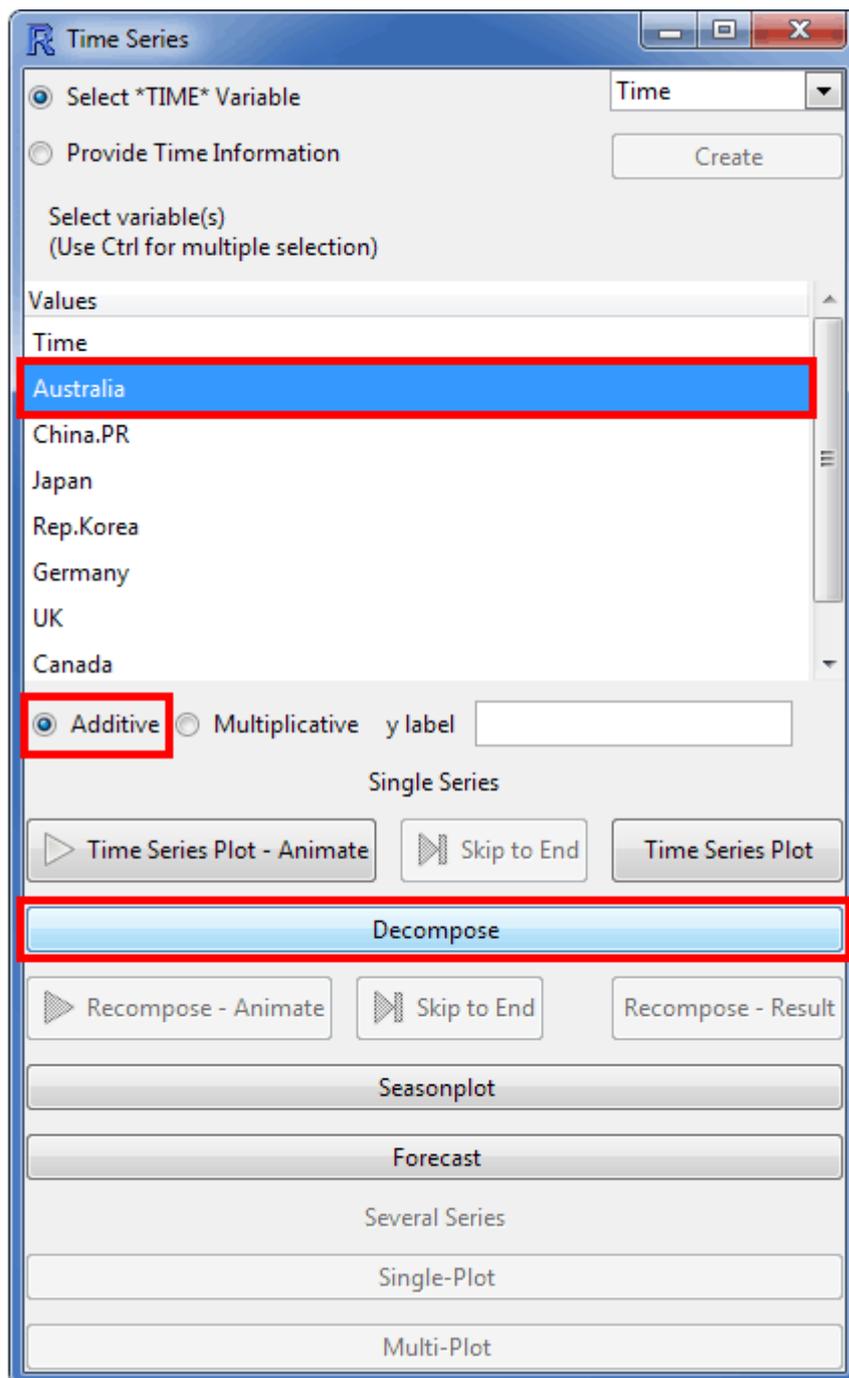
Explore (~5min)

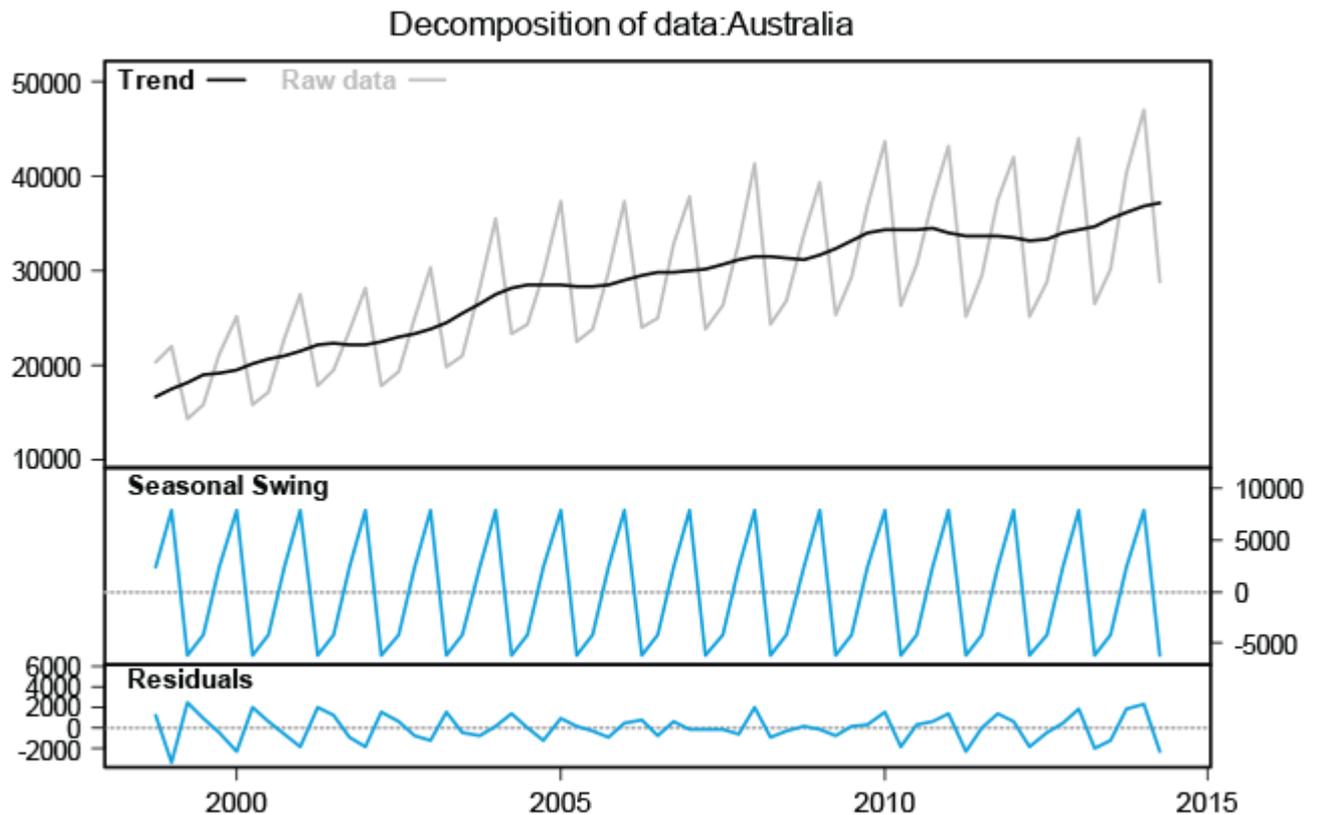
Try this for a few other countries. What similarities or differences can you see between the Additive and Multiplicative seasonal effects? Notice the **y label** option in the Time Series window and type a suitable label. Post a comment if you see something interesting.

Decompose and recompose your time series plot

We will use our Time Series window to get the Decomposition Plot for Australia.

- Select **Australia**
- Choose **Additive**
- Click **Decompose**.

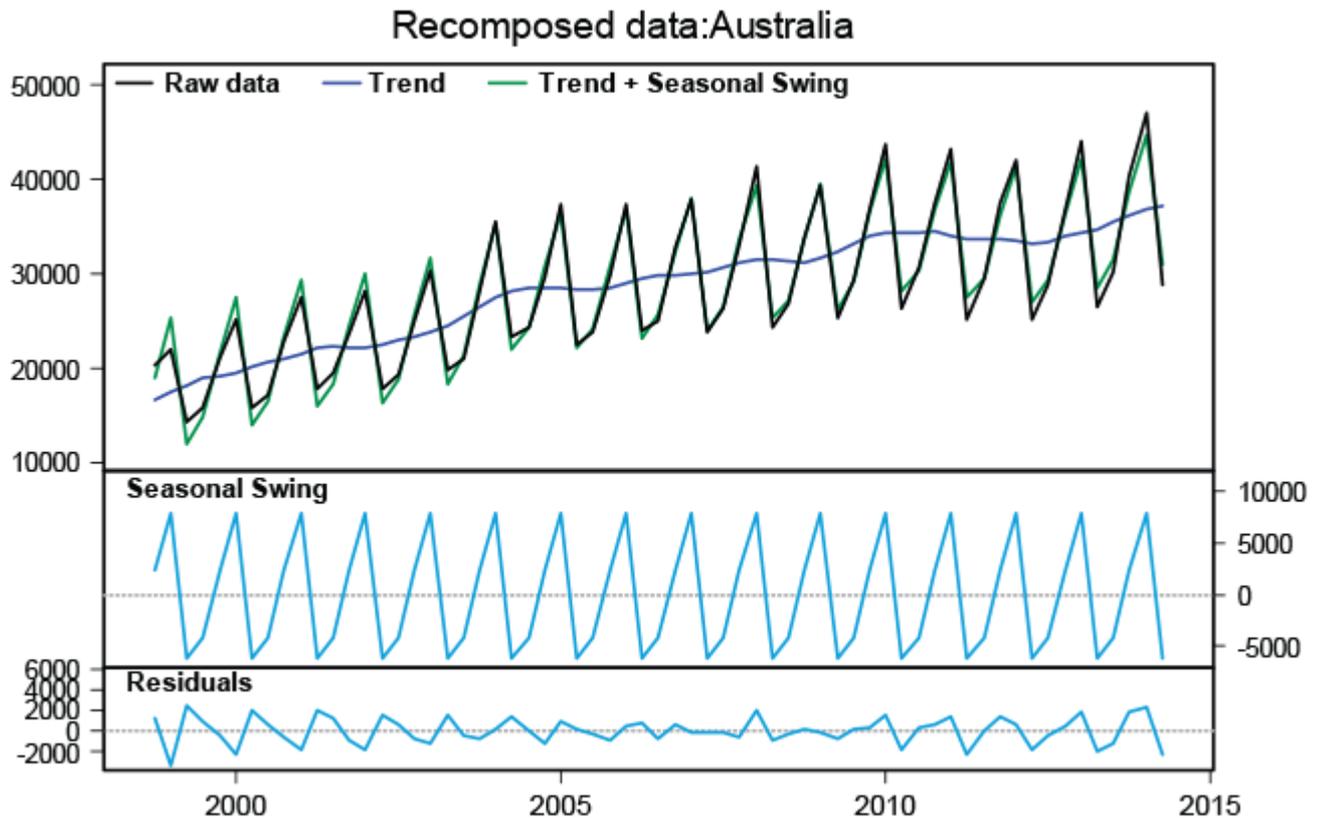




[Enlarge image](#)

The upper part shows the normal Time Series plot as before. Below that is the additive **Seasonal Swing**, which is a repeat of the **Additive seasonal effects** from before. The **Residuals** demonstrates the difference between what you would expect if you add the **Seasonal Swing** to the **Trend** and **Raw data**. To view that plot, click **Recompose - Animate**.

Why do you think the residuals tend to be small in the middle and large toward the edges?



[Enlarge image](#)

What is happening in the graphics window?

At first the **Seasonal Swing** gets added to **Trend** line. The resulting green line shows what would be expected if the seasonal patterns are exactly the same every year. When you add the **Residuals** you get back the **Raw data**, which is shown in black here.

To have a closer look of the difference between **Raw data** and approximation, enlarge your graphics window.

If you don't want to see the process of drawing the plot, use **Recompose - Result** or if you already started the animation, click **Skip to End**.

Do you now know why the residuals tend to be small in the middle and large toward the edges?

Explore (~5min)

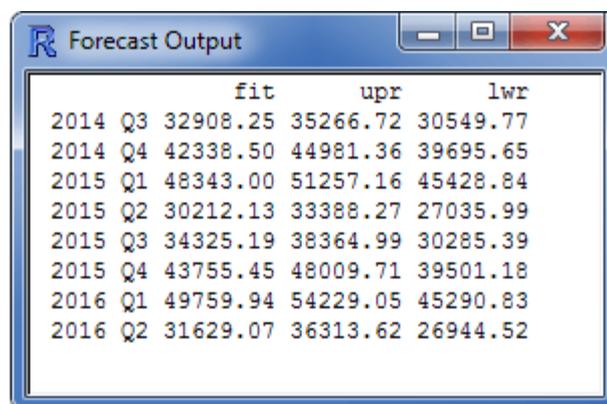
Try and do the same with a **Multiplicative Seasonal Swing**. Which

approximation is the better one? Don't forget to remember the units when you look at the **Residuals**. Post a comment and share your thoughts.

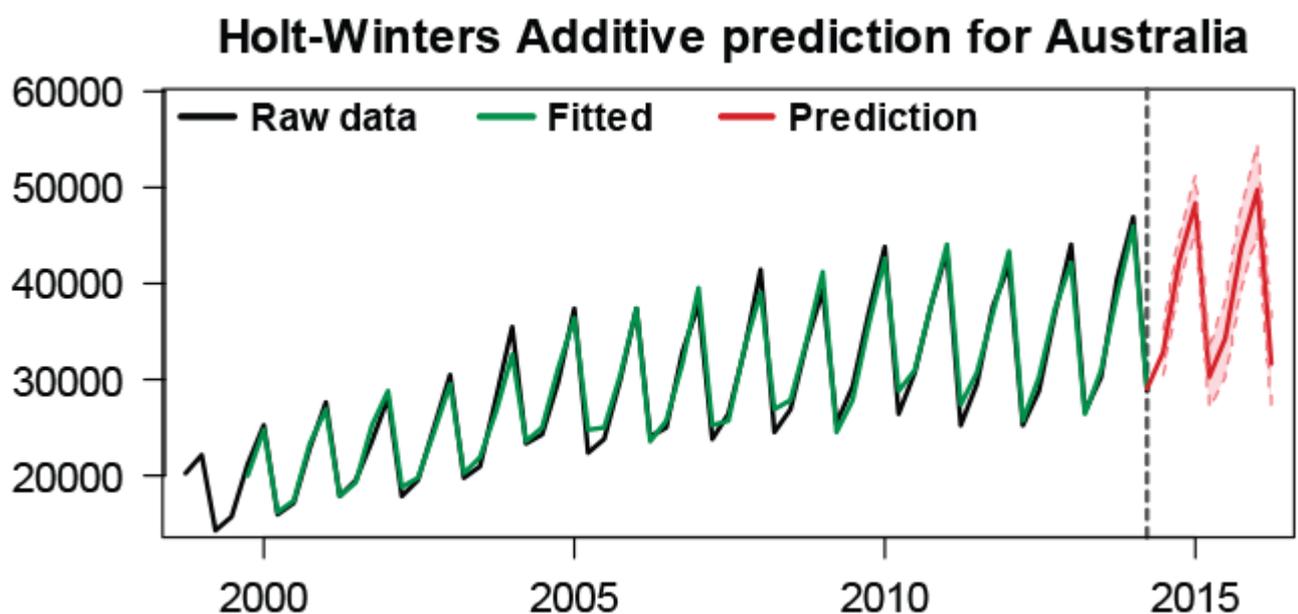
Calculate a Forecast for the future

We want to know how many visitors from Australia will be in New Zealand in the upcoming years.

- Select **Australia**
- Choose **Additive**
- Click **Forecast**.



		fit	upr	lwr
2014	Q3	32908.25	35266.72	30549.77
2014	Q4	42338.50	44981.36	39695.65
2015	Q1	48343.00	51257.16	45428.84
2015	Q2	30212.13	33388.27	27035.99
2015	Q3	34325.19	38364.99	30285.39
2015	Q4	43755.45	48009.71	39501.18
2016	Q1	49759.94	54229.05	45290.83
2016	Q2	31629.07	36313.62	26944.52



What is happening in the graphics window?

You will see two new windows. We will look at the graph first. Additional to the original Time Series plot, it also shows a prediction for the future

(on the right hand side) in red. The light red area around the dark prediction line is the confidence band. The predicted values are calculated with the Holt-Winters method. To get the exact values, check the Forecast Output window.

Explore (~5min)

Try to get the forecast for Australia with a Multiplicative Seasonal Swing. Which forecast is more reliable in this case?

Common questions

Why does the window name say 'ACTIVE' or 'inactive'?

The ACTIVE window is the last one that was opened. Things like the 'Recomposing' refer to the graphs in that window.

The Recompose – Animate button is greyed out.

You may have to click Decompose again to activate the button. You cannot "recompose" unless you have already decomposed.

When I change the size of a window it becomes grey.

If you close your ACTIVE window, the other (inactive) windows become grey when altering their size. Generate any new ACTIVE window, then change the size of the grey one; it will return to normal.

Why is the graph of the Seasonplot for 1998 and 2014 incomplete?

It is due to missing data. They started collecting data at the end of 1998 and the missing data for 2014 will be collected soon.

The animation is not in a separate window, but in the normal iNZight one, but it is blinking the whole time.

If you close the normal animation window before it finishes the animation it continues in the iNZight window. You can just wait or click **Skip to End**.