

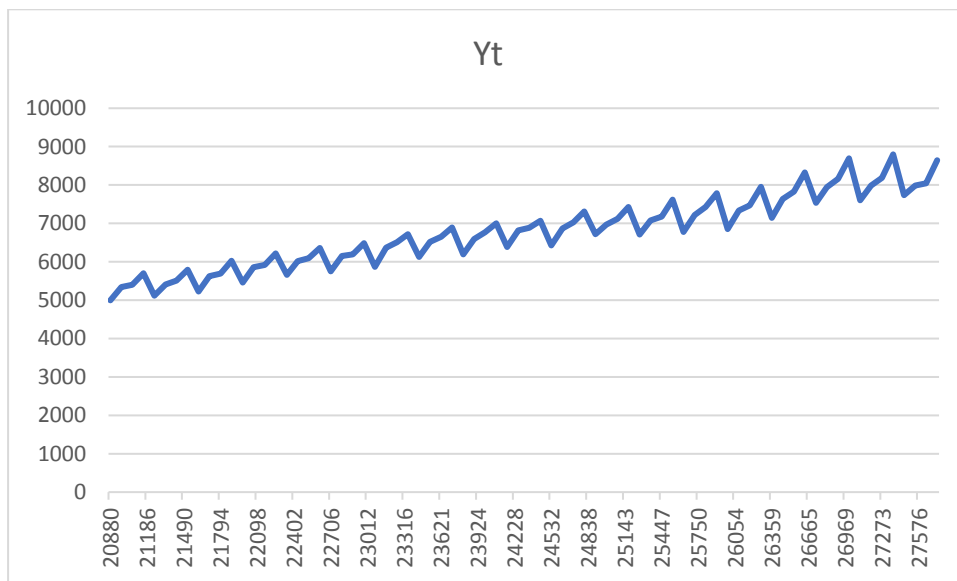
Practical Session 8

Time series and index numbers

In this session, we shall see how to illustrate and decompose a time series and how to calculate index numbers.

1. Illustrating a time series.

In class we looked at time series data on consumer expenditure. We can graph this data using the line plot option in Excel. Note that the x-axis data are in **Date** format. When we do the initial graph, it will look like this:



Various things are wrong: we have no axis titles, there is too much blank space at the bottom of the y-axis and the x-axis labels are wrong.

The axis labels can easily be added using standard plot functions. To change the axis format, we can click on the axis and format it. A pop up window like the graph we see on the next page will appear in Excel 2016 (for the x axis). (Sorry but you have to see this in Spanish!).

In the case of the y-axis we could change the lower limit to e.g. 3000 to remove the blank space. In the case of the x-axis, we can see above that the dates look like numbers. We can change this to date format by using the **Number (Número)** option at the bottom.

If you draw the graph like this, it will be dated correctly as we see in the graphs we have in the class slides but the x-axis labels will not be regular in time (because we have axis units of 10 months and data measured every three months). To make the graph labels regular, we could change the x-axis units to 12 months.

Dar formato al eje

Opciones del eje ▾ Opciones de texto

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▲ Opciones del eje

Tipo de eje

- Seleccionar automáticamente en función de los datos
- Eje de texto
- Eje de fecha

Límites

Mínimo Automát

Máximo Automát

Unidades

Mayor Automát

Menor Automát

Base Automát

El eje vertical cruza

- Entre fechas
- En la fecha
- En la fecha máxima

Posición del eje

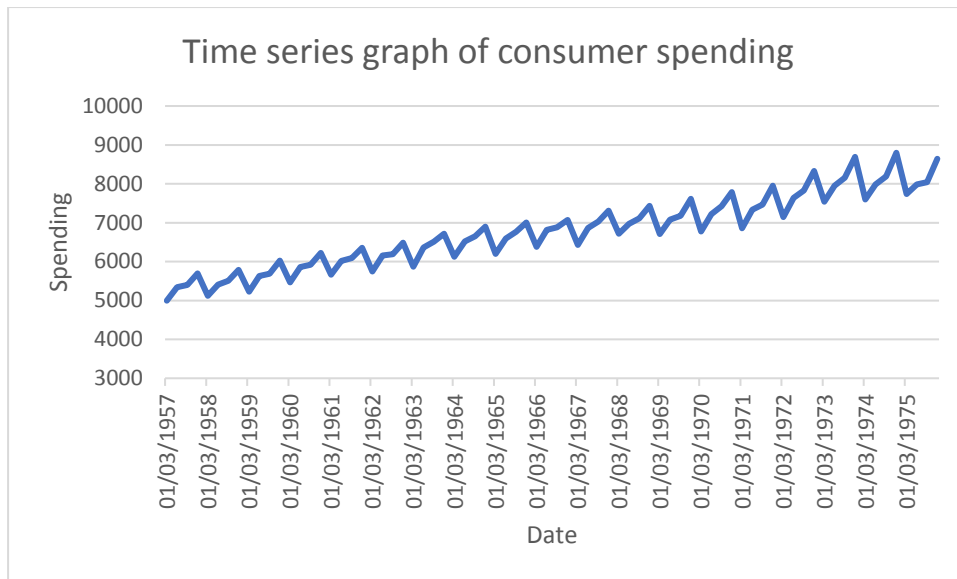
- En marcas de graduación
- Entre marcas de graduación
- Fechas en orden inverso

▶ **Marcas de graduación**

▶ **Etiquetas**

▶ **Número**

If you do this correctly, you should get a graph something like the following.



2. Calculating a moving average

Under the specialist data analysis options, Excel has a function to calculate a moving average. However, it is easier to do this ourselves.

The idea of a moving average is to say that the trend at time t is an average of the values around and including time t . For instance, if we had a series with daily data, such as we see on the next series, we could use a moving average of order 7 to average out the effects of different days of the week.

If we are on Thursday 26th January, the moving average for this day would be the average of the values for Monday 23rd, Tuesday 24th, Wednesday 25th, Thursday 26th, Friday 27th, Saturday 28th and Sunday 29th.

We see an example like this on the next page.

Note that we lose some information when we make a moving average, We do not have enough data to calculate a moving average at the start and end of the series.

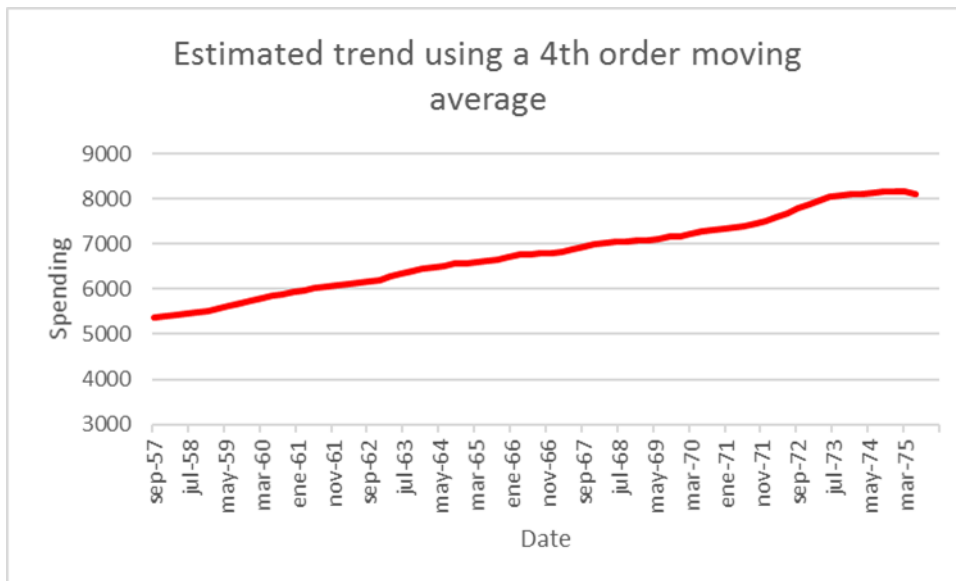
| Date | y | MA(7) |
|------------|-------|-------|
| 23/01/2018 | 10.00 | |
| 24/01/2018 | 15.00 | |
| 25/01/2018 | 27.00 | |
| 26/01/2018 | 31.00 | 24.29 |
| 27/01/2018 | 42.00 | 22.86 |
| 28/01/2018 | 32.00 | 20.86 |
| 29/01/2018 | 13.00 | 17.00 |
| 30/01/2018 | 0.00 | 13.29 |
| 31/01/2018 | 1.00 | 8.29 |
| 01/02/2018 | 0.00 | 5.00 |
| 02/02/2018 | 5.00 | 4.71 |
| 03/02/2018 | 7.00 | 8.29 |
| 04/02/2018 | 9.00 | 12.57 |
| 05/02/2018 | 11.00 | 16.86 |
| 06/02/2018 | 25.00 | 19.71 |
| 07/02/2018 | 31.00 | 20.29 |
| 08/02/2018 | 30.00 | 19.71 |
| 09/02/2018 | 25.00 | 18.29 |
| 10/02/2018 | 11.00 | |
| 11/02/2018 | 5.00 | |
| 12/02/2018 | 1.00 | |

In the case of quarterly data, when we want to use a moving average of order 4 to cancel out the effects of different seasons, it is a little more complicated. Suppose we are in Summer 2018. Then we could average Winter 2017, Spring 2017, Summer 2018 and Autumn 2018, (or Spring 2018, Summer 2018, Autumn 2018 and Winter 2018), but where in time should we position this average?

You can see the trick in the Excel file. At time t , we take an average of the values for time $t-2$, $t-1$, t and $t+1$. This should be centred at time $t-\frac{1}{2}$. Then we can take an average of the MA values at time $t-\frac{1}{2}$ and time $t+\frac{1}{2}$ to centre ourselves at time t again.

The above procedure is a similar to what we did when we calculated the median. For an odd number of data there is no problem in calculating a central value. For an even number, we need to take an average.

The trend estimate should look something like the following.



3. Detrending the series.

This is done by simply dividing the original series values by the estimated trend, or in the case of an additive model, subtracting the trend from the original data.

4. Estimating the seasonal effects.

Here, to estimate the seasonal effect for Summer, we have to take an average of every summer value in the detrended series. This is not so trivial in Excel, but you could try to see how you can use the **AVERAGEIFS** function to do this by searching in Google.

5. Index Numbers

These are straightforward to calculate by dividing each entry of the time series by the value in the base year (which needs to be fixed using the dollar trick so that you can drag the formula down. Then, you can format the index column as **Percentage** to display the results this way.