Week 1: Recap

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Lecture Refresher

Predictive vs Prescriptive Analytics

Predictive analytics

- Uses variables to predict outcome
- Only cares about *correlation*
- Isn't interested in changing outcome, but predicting what the outcome will be, so strategies can be used to exploit it
- e.g. I want to predict tomorrow's stock price so that I know whether to buy or sell shares. I'm not interested in what actually caused the stock price change.

Prescriptive analytics

- Looks at underlying causal relationship between x and y
- Not just correlation, but *causality*
- Making a *prescription* on how to change outcome, very useful in economic policy
- e.g. Does forcing people to stay in school for longer increase their wage?

Types of data

- At a disadvantage when compared to most sciences, don't usually have access to experimental data, only observational
- Very difficult to draw conclusions about causality, need to be very careful
- Cross-sectional: variablesmultiple indivdiuals/firms/countires at a single point in time
- Time-series: observe variables for one entity across time
- Panel: cross-sectional data, but obvserved across time
- Cross-sectional vs time-series: unordered vs ordered, independent vs dependent

Modelling

- Where theories from economics and finance can be quantified using data
- Regression models will be used heavily in this unit

Tutorial refresher

EViews

- Viewing variables
- Histograms and descriptive statistics
- Correlations and scatter plots
- Linear regression and prediction
- How to save output into Word

Matrix algebra

- How matrices can be used to simplify our regression equations
- Rows vs columns of a matrix
- Transpose operator

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}' = \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{bmatrix}$$

- How to multiply matrices

Week 2 Tutorial: Part A

Vlookup

- Formula to search a table for a piece of information
- First specify the lookup value, this will be usually some sort of code which identifies a particular individual, country, product, stock etc.
- Then select the table in which you wish to conduct the lookup, the item code should always be the first column of the table
- Next, select the variable you are interested in, this is given by the column number of the table
- Last argument, set as FALSE for our purposes

Week 2 Tutorial: Part B

Question 1

1.

- Open up your Part A excel file in EViews
- Obtain summary statistics and histogram of GDPPC, in groups of 4 discuss what you notice
- If a different set of countries were sampled would the summary statistics be the same?
- https://flux.qa/LDPPHD

Question 1

2.

- Create scatterplot between co2pc and gdppc
- What sort of relationship is there?
- Use a log transformation on gdppc and draw a new scatterplot, what do you see?

Question 2

- Visit www.ausmacrodata.org and download the wage price index csv
- Keep first two columns and delete everything else, open up in Eviews

1.

- Plot as line graph
- What do we learn from the plot?

2.

- Given this data set, what do you think is the best way to predict next quarter's wage price index?
- https://flux.qa/LDPPHD

Question 2

3.

- Very difficult to see other features of the time series because the trend is very strong
- Can look at growth rates instead
- Today's growth rate is

$$g_t = 100 \times \frac{wpi_t - wpi_{t-1}}{wpi_{t-1}}$$

- e.g. Share price yesterday is 50, today it is 52, the growth rate (as a percentage) is

$$100 \times \frac{52 - 50}{50} = 4\%$$

- Known as the simple return

Question 2

3. continued

- Can also calculate log return

$$g_t = 100 \times \Delta \log(wpi_t) = 100 \times (\log(wpi_t) - \log(wpi_{t-1}))$$

- Using the same example, the log return is

$$100 \times (\log(52) - \log(50)) = 3.922071\%$$

- In EViews type wpi_log_returns = dlog(wage) to create a series of log returns on the wage price index
- Open up the new series, why is the first value NA?

Question 2

4.

- Plot the series as a line graph and hover your mouse over the peaks
- What do you notice?

5.

- Now instead of selecting "line and symbol" select the specific option as "seasonal plot"
- There are two further options in the seasonal type box, "Paneled lines & means" and "Multiple overlayed lines", try both
- Comparing the two plots, what do you see?

Question 2

6. Discussion
   - Is this bad?
   - What other information do we need?

Part C: How to use MoVE

The basics

- Install Citrix receiver
- Login to MoVE
- Open and edit files in EViews
- Import files locally

Part D: More matrix algebra

Inverse of a matrix

- Note, we can only multiply matrices together, not divide them
- Instead, what we do is multiply by its inverse
- The inverse is only defined for square matrices

$$\mathbf{A}^{-1}\mathbf{A} = \mathbf{I}$$

An example, solving for the matrix $\mathbf{A}$

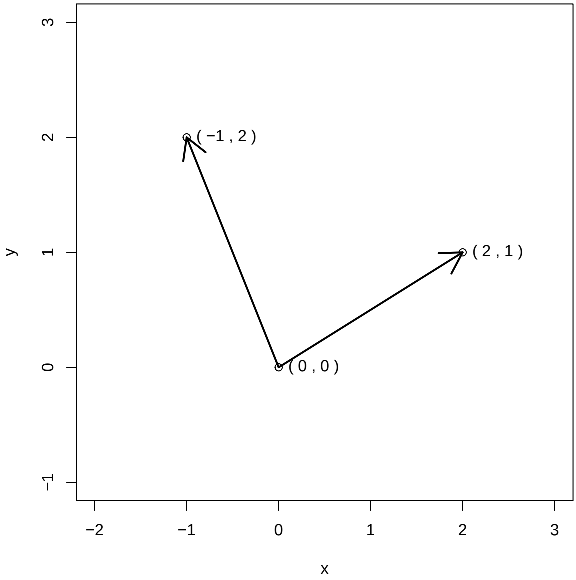
$$\mathbf{B}\mathbf{A} = \mathbf{C}$$

$$\mathbf{B}^{-1}\mathbf{B}\mathbf{A} = \mathbf{B}^{-1}\mathbf{C}$$

$$\mathbf{I}\mathbf{A} = \mathbf{B}^{-1}\mathbf{C}$$

$$\mathbf{A} = \mathbf{B}^{-1}\mathbf{C}$$

Drawing vectors



Orthogonality

- Two vectors are orthogonal, if they are perpendicular
- Difficult to visualise in more than three dimensions, but can be verified mathematically
- Given two column vectors $\mathbf{u}$ and $\mathbf{v}$, if $\mathbf{u}'\mathbf{v} = 0$, then the vectors are orthogonal

Example

$$\mathbf{u} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}, \mathbf{v} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

$$\mathbf{u}'\mathbf{v} = -1 \times 2 + 2 \times 1 = 0$$

Linear combinations of vectors

Vectors of the same dimension can also be combined to create another vector of the same dimension, by adding and subtracting multiples of given vectors e.g.

$$\begin{bmatrix} -1 \\ 4 \\ 3 \end{bmatrix} = 2 \times \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} - 3 \times \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$$

More generally,

$$\mathbf{v} = \sum_{j=1}^{k} a_j \mathbf{u}_j$$

Where the a_j are scalar constants and the $\mathbf{u}_j$ are vectors of the same dimension.

Exercises

Question 1.

Given

$$\mathbf{A} = \begin{bmatrix} -4 & 0 \\ 0 & 9 \\ 3 & 0 \end{bmatrix}, \mathbf{v} = \begin{bmatrix} 3 \\ 0 \\ 4 \end{bmatrix}$$

Show that each of the columns of $\mathbf{A}$ are orthogonal to $\mathbf{v}$

Exercises

Question 2.

Substitute

$$\hat{\mathbf{u}} = \mathbf{y} - \mathbf{X}\hat{\beta}$$

into

$$\mathbf{X}'\hat{\mathbf{u}} = \mathbf{0}$$

and solve for $\hat{\beta}$.

Exercises

Question 3.

Given

$$\mathbf{v} = \begin{bmatrix} 2 \\ 1 \\ -10 \end{bmatrix}, \mathbf{u}_1 = \begin{bmatrix} 2 \\ 0 \\ -3 \end{bmatrix}, \mathbf{u}_2 = \begin{bmatrix} 2 \\ -1 \\ 4 \end{bmatrix}$$

Show that $\mathbf{v}$ is a linear combination of $\mathbf{u}_1$ and $\mathbf{u}_2$ i.e. solve for a_1 and a_2 so that

$$\mathbf{v} = a_1\mathbf{u}_1 + a_2\mathbf{u}_2$$

is true.