MANAGERIAL ECONOMICS

LECTURE 3: ESTIMATING DEMAND

Rudolf Winter-Ebmer
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JOHANNES KEPLER
UNIVERSITY LINZ

Why do you need statistics and regression analysis?

You should be able to

- Read and understand market research papers
- Analyze your own data
- Decide your prices and marketing decisions
- Read and understand scientific research
- (Write a good (or excellent!) thesis!)

NB: I will only present a very short introduction. You are *strongly* encouraged to addend a class in introductory econometrics.

Where do you find data?

- Look at the literature, e.g., wine prices.
- Consumer interviews, loyalty cards, web sites, ...
- Past experience
- Market experiments in different subsidiaries or across time
- Scanner data
  - Sales of single products can be easily tracked
  - Prices are easily changed because of electronic systems
  - Conduct your own experiments easily
- Web scraping

Does advertising work?

To find out, you look at the relationship between past TV ads and sales in different locations:

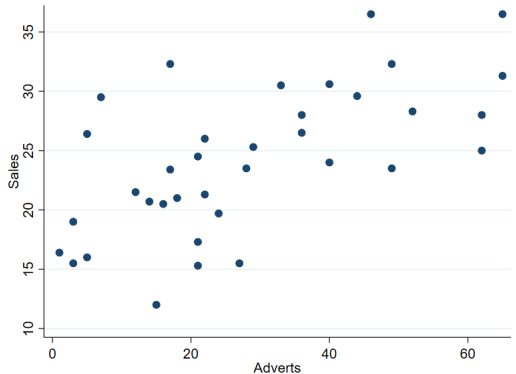
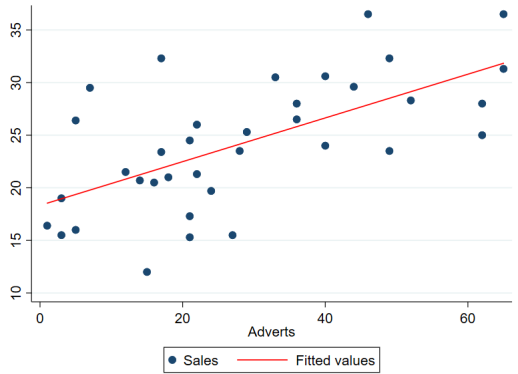


Figure: *Notes*: An example of how ads and sales might be related. Blattberg and Jeuland, Management Science, 1981.

How to best describe a relation?

- Keep it simple: Assume a linear relationship, Sales = a + b Advertising.
- Given the data: What is the **best** line through that cloud? (Many are possible.)
- Best is that line which **minimizes** the overall **distances** of the data points from the line
  - We minimize the *Squared Sums* because negative and positive distances should be considered equally
  - Larger distances get larger weights, be careful with outliers!

What a nice line you have!



Notes: Regression line, Sales = 18.33 + 0.21 Adverts.

Regression analysis

a statistical technique to describe how one variable changes as other variables change

- Used to estimate demand curves — and much, much more!
- Simplest version:
  $LHS = a + b\ RHS_1 + c\ RHS_2 + \cdots + k\ RHS_k$
  [(left hand side) = Intercept + b (right hand side #1) + c (RHS #2) + . . .]

$$\text{Sales}_i = \alpha + \beta \text{Ads}_i + e_i,$$

where e_i is an (unobserved) error term which captures other variables that are not covered in the analysis or pure randomness.

Multiple regression

We may use two or more independent variables:

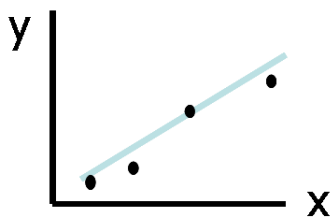
$$\text{Sales}_i = \alpha + \beta_1 \text{Ads}_i + \beta_2 \text{Price}_i + e_i.$$

We assume (implicitly):

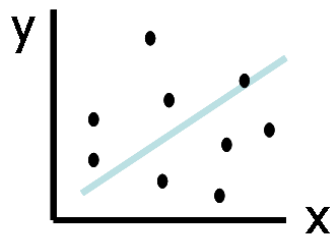
- β_1 or β_1 measures the *independent* effect,
- holding the other variable constant;
- the **partial effect**.

How good is the estimate?

- "R-squared", R^2, (coefficient of determination), measures the goodness of fit of the estimated regression line, $0 \leq R^2 \leq 1$.
- (R^2 is the proportion of the variance of the LHS that is explained by the RHS variables.)



Notes: Regression with very good data.



Notes: Regression with *noisy* data.

The regressions are not always reliable

- Few data: not enough data results in unreliable estimates
- Bad data: the data are measured with error and the results are *biased*, i.e., provide the wrong relationship
- Bad model: the relationship is not linear, but e.g., quadratic.
- Bad model: it is not one, but two relationships!
- et cetera! Advanced Econometrics provides (some) tools to overcome such problems.

Making sense of regressions

- If you cannot do the statistics yourself, you should be able to understand and interpret the results.
- Software (Stata, R, Python, ...) can do the calculations—it's your job to interpret the output!
- Main advantage of regression over other statistical tools (e.g., correlations):
  - Several variables can be used simultaneously
  - *Ceteris paribus*: the coefficient β_1 reports the influence of one variable, *holding all other variables constant*
    - This is what you want to know: if you reduce prices by €1 (holding all other market conditions constant), what is the effect on sales?
    - This is exactly what is done in all economic models!
    - and it is exactly what the CEO wants to hear

Identification problem

How can we identify a demand curve when we only have data on price and sales?

- The problem: The observed data are merely intersections of demand and supply curves.
- Different (P, Q) combinations could arise from a shift of the demand, a shift of the supply or a shift of both!
- Extremely important issue—and very difficult to solve!
- If demand changes quickly, we may fail to estimate the price elasticity of demand!
- To identify demand properly, we need assumptions, i.e., all the different (P, Q) are a consequence of changes in supply only
- Possible problem: movements along the demand curve $\neq$ shifts of the demand curve!

Identification problem

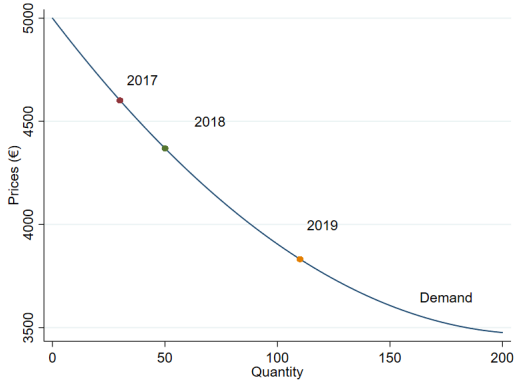
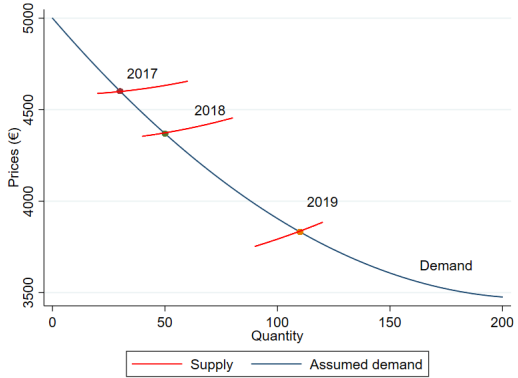


Figure: *Notes*: An example of how TV ads and sales might be related.

Identification problem



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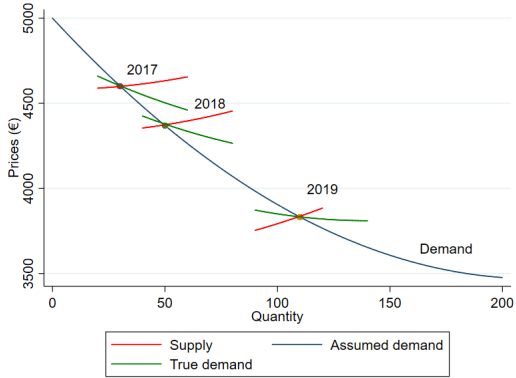

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