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Customer and Marketing Analytics

Introduction to assignment 1

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Different types of data

- Aggregation level:
  - At which level is the observation collected?
    - Aggregated
    - Disaggregated: individual data

- Time series versus cross-sectional
  - Periodicity of observations

Elasticities

Percentage change in output when the input increases with a particular percentage:

$$Elasticity = \frac{Fraction\ change\ in\ q}{Fraction\ change\ in\ p} = \frac{(q_1 - q_0)/q_0}{(p_1 - p_0)/p_0}$$

Interpretation of price elasticities

Return = sales * price

-1

Unit elasticity:

- percentage increase in sales = percentage decrease in price
- Price decreases have no effect on revenues

Interpretation of price elasticities

Return **= sales * price**

Elastic demand:
- Percentage increase in sales > percentage decrease in price
- Price decreases increase revenues

-1

Unit elasticity

Interpretation of price elasticities

Return **= sales * price**

Inelastic demand:
- Percentage increase in sales < percentage decrease in price
- Price decreases decrease revenues

-1

Unit elasticity

Why use elasticities?

- Unit free:
  - Independent of the industry
  - Independent of the size of the variables

- Interesting direct economic interpretation

- Can also be used for other input variables!

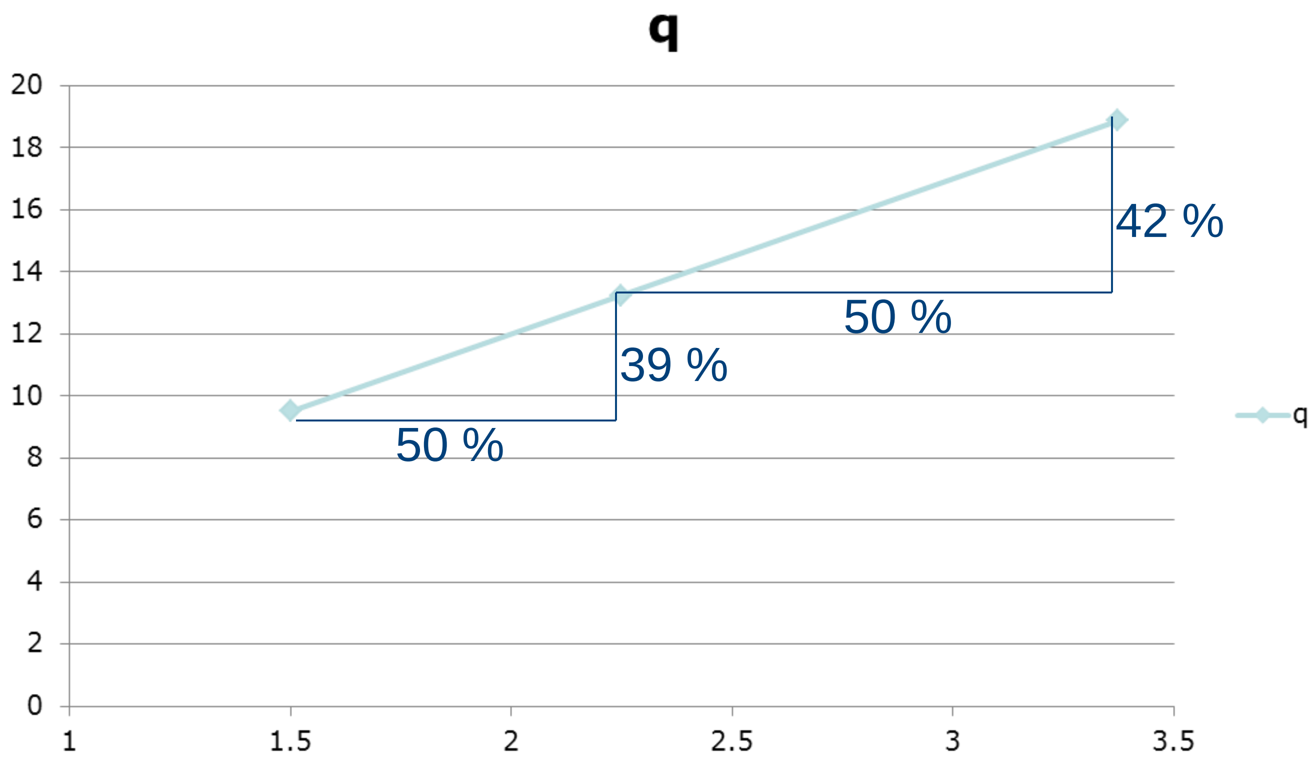
How to estimate an elasticity?

- Market response model that links an input variable to an output variable

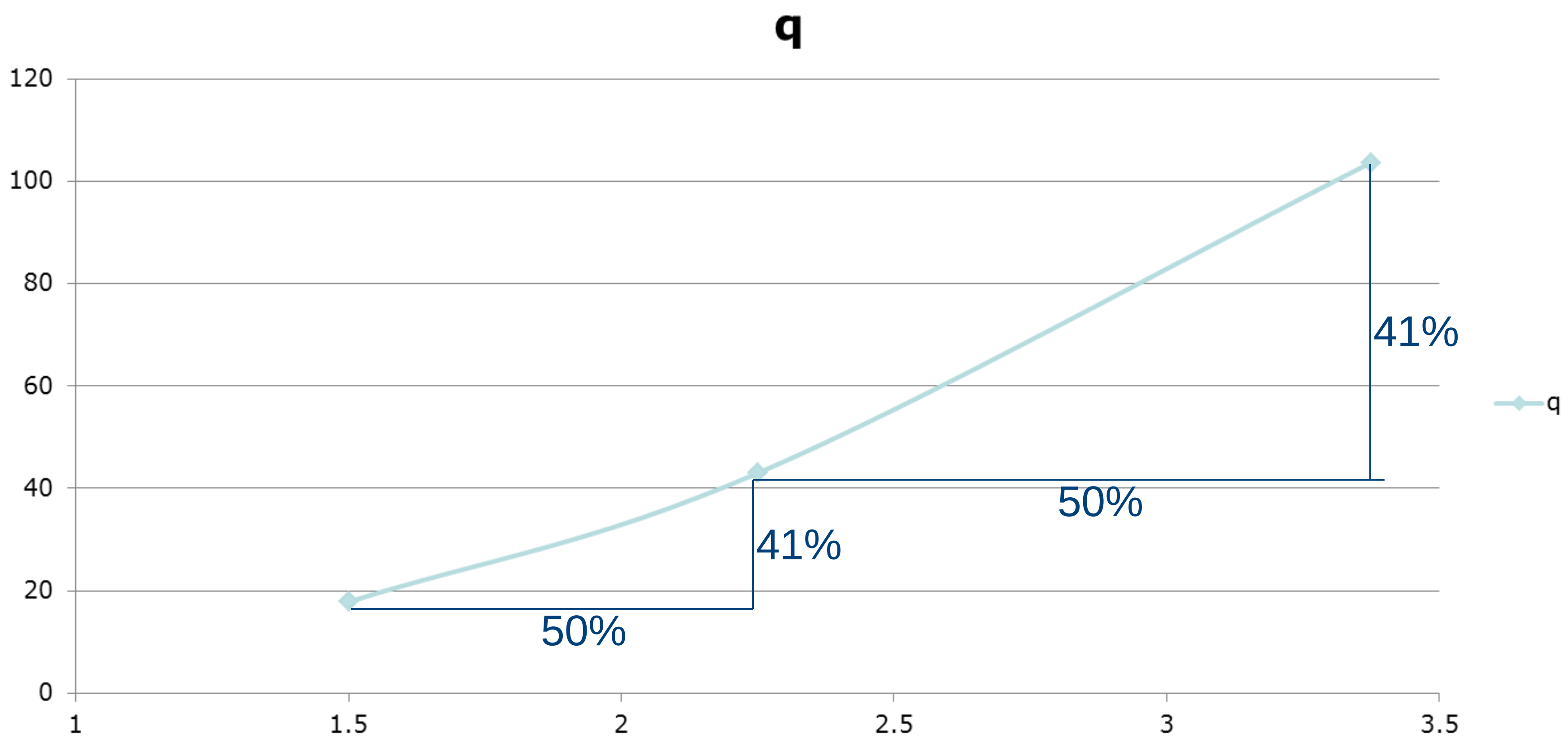
- Linear model:
  - Constant change in output
  - Elasticity is dependent on the size of the input variable given that we look at a percentage change

- Log-log model:
  - Curvilinear relationship
  - Constant elasticity

Linear model: sales=2+5*input



Log-log model: log(sales)=2+5*log(input)



How to estimate an advertising elasticity?

- Regress log(sales) on log(advertising):

$$log(sales) = \beta_0 + \beta_1 \log(advertising) + \varepsilon_t$$

- Parameter of log(advertising) is the elasticity

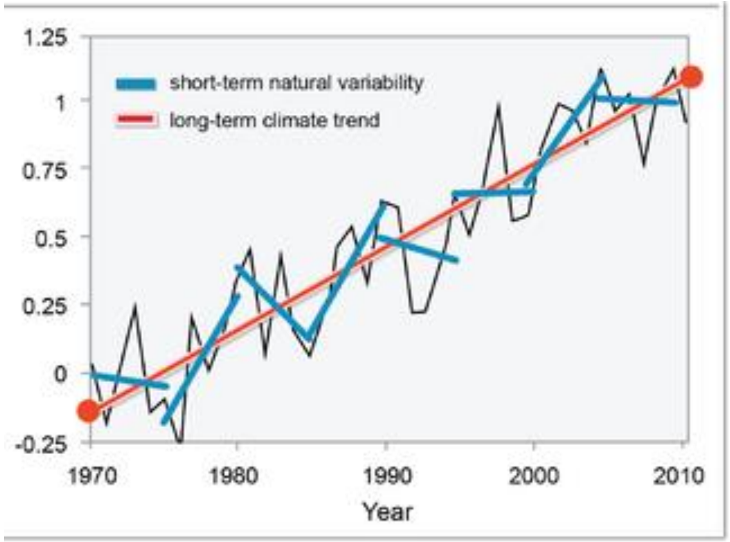
Add environmental factors

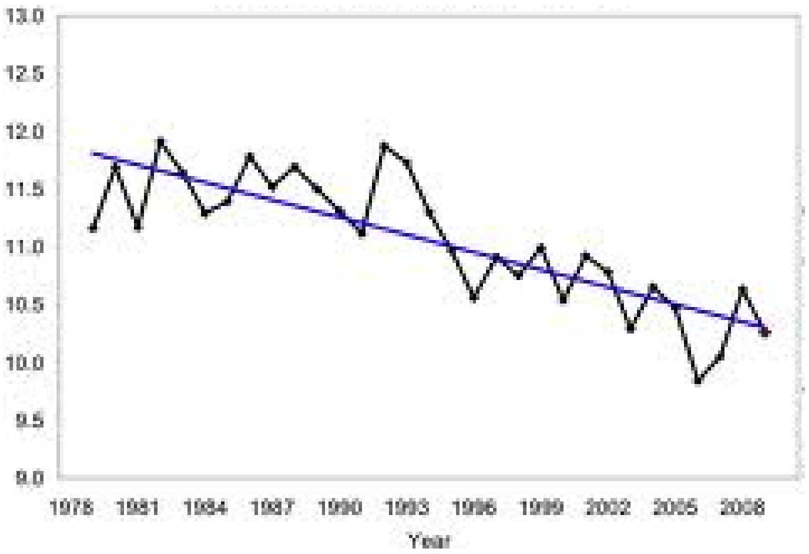
- Not the focus of the model but:
  - Improve the fit of the model (don´t forget “simpler is better”)
  - Improve the estimation of the elasticities
  - Provide extra insights into the effect of the control variables
  - Extra validity checks

Specific time series controls

- Long-term trend
- Season

Long-term trend





Control for the long-term trend

- Add a trend variable to the model:
  - Create a variable that indicates the period of the observation:
    - Trend = 1 for the first observed period
    - Trend = 2 for the second observed period
    - …
    - Trend = N for the last observed period

- This is a linear trend

Season effect

Controlling for the effect of the season

- Create dummy variables to control for:
  - Season
  - OR month
  - OR trimester
  - OR …

- Only for datasets for which the periodicity is smaller than one year!

Adding dynamic effects

- Static model: “contemporaneous” relations
- Adding dynamic effects:
  - X influences sales in the future
  - X influences sales in the past

Adding dynamic effects

- Adding leads and lags
- Working with a predefined distribution of dynamic effects

Lags

- Controlling for input from the past:

$$Output_t = \beta_0 + \beta_1 Input_t + \beta_2 Input_{t-1} + \varepsilon_t$$

Contemporaneous effect

Lagged effect

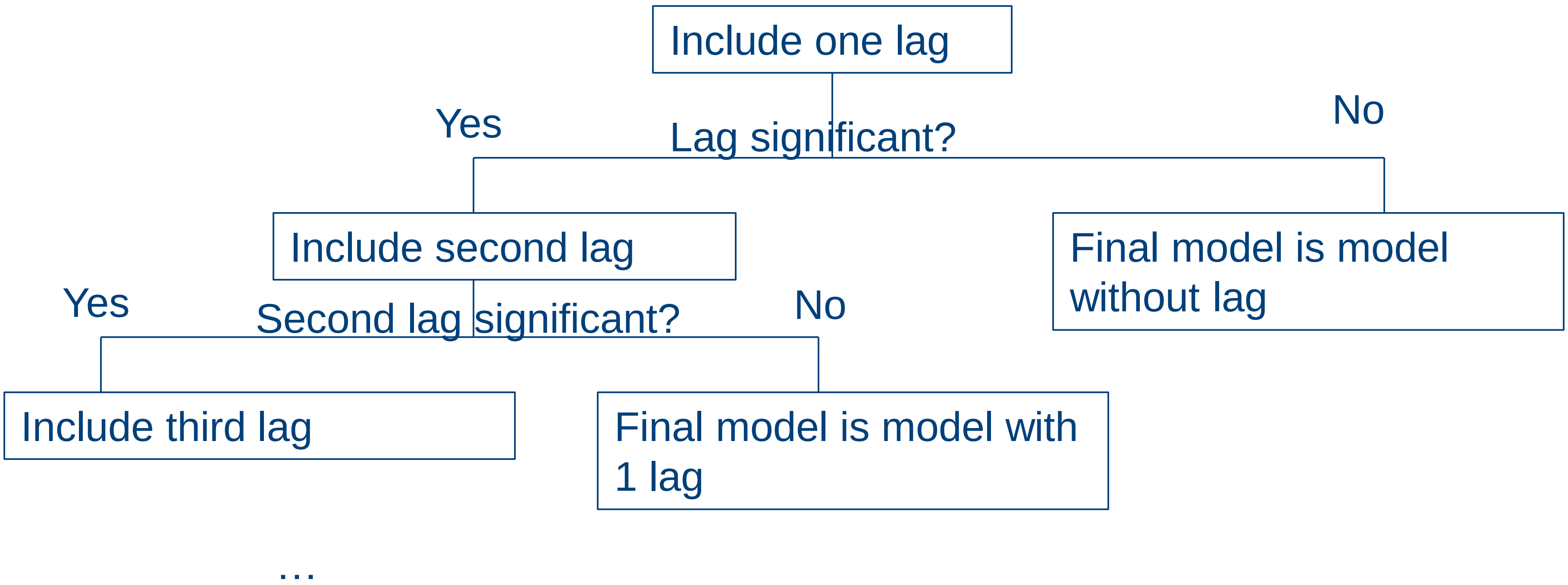
Creating lagged variables

Period	Input_t	Input_{t-1}	Input_{t-2}
1	100		
2	200	100	
3	300	200	100
4	400	300	200
5	500	400	300
6	600	500	400
7	700	600	500
8	800	700	600
9	900	800	700

Be careful!

- Make sure the dataset is correctly sorted
- Look at the missing values!

Deciding on the number of lags



Leads

- Controlling for the influence of input in the future:

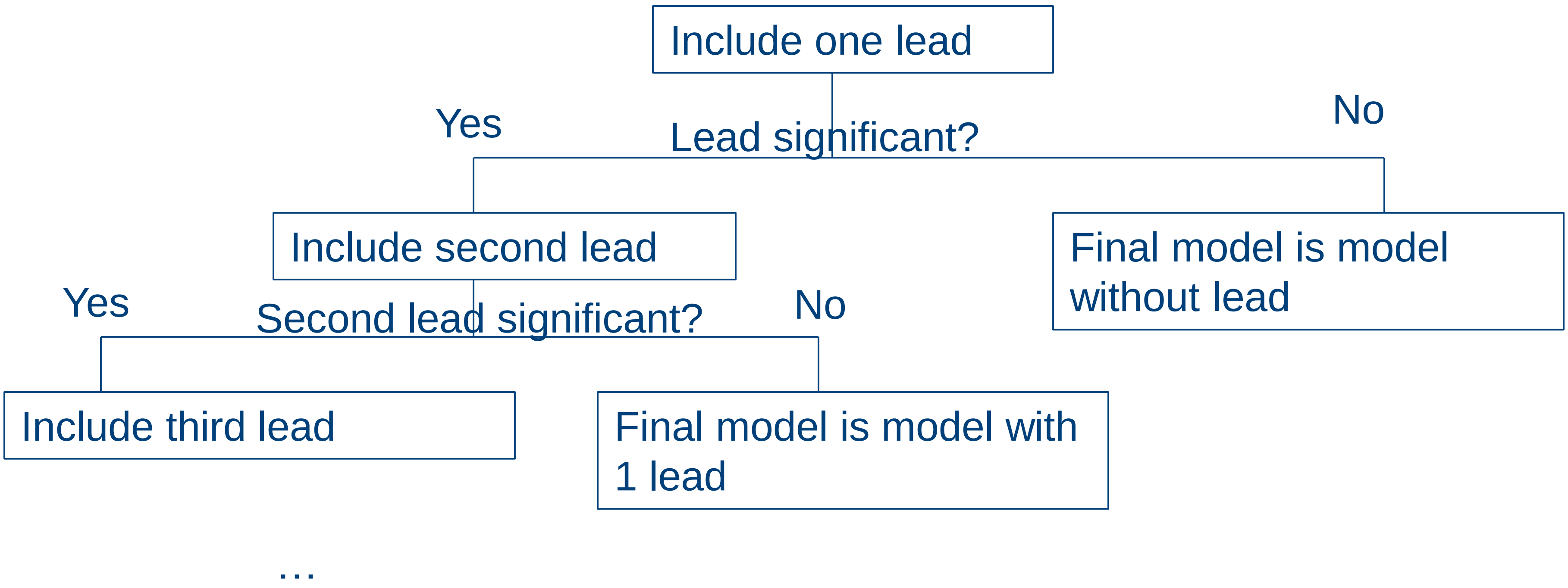
$$Output_t = \beta_0 + \underbrace{\beta_1 Input_t}_{\text{Contemporaneous effect}} + \underbrace{\beta_2 Input_{t+1}}_{\text{Lead effect}} + \varepsilon_t$$

- Forward looking

Creating lead variables

Period	$Input_t$	$Input_{t+1}$	$Input_{t+2}$
1	100	200	300
2	200	300	400
3	300	400	500
4	400	500	600
5	500	600	700
6	600	700	800
7	700	800	900
8	800	900	
9	900		

Deciding on the number of leads



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Leads and lags

- Combination of leads and lags in one model is possible
- Very flexible way to control for dynamic effects
- Does not always lead to a simple model
- Interpretation can be hard

Stock variables

$$Stock_t = \alpha \, Input_t + (1 - \alpha) \, Stock_{t-1}$$

- Stock of input variable

- Effect of input dependent on:
  - Level of input in the same period
  - Stock of the previous period

- Weight of both components is determined by alpha

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Predetermined distribution of values from the past

$$Stock_t = \alpha\ Input_t + (1-\alpha)\ Stock_{t-1}$$

$$Stock_t = \alpha\ Input_t + (1-\alpha)\ (\alpha\ Input_{t-1} + (1-\alpha)\ Stock_{t-2})$$

$$Stock_t = \alpha\ Input_t + \alpha\ (1-\alpha)\ Input_{t-1} + (1-\alpha)^2 Stock_{t-2}$$

$$\dots$$

$$Stock_t = \alpha\ Input_t + \alpha\ (1-\alpha)\ Input_{t-1} + \cdots + \alpha\ (1-\alpha)^{n-1} Input_{t-n-1}$$

Interpretation of alpha

$$Stock_t = \alpha \; Input_t + (1 - \alpha) \; Stock_{t-1}$$

- Alpha is the contemporaneous effect of the input
- 1 – alpha is the carryover of the stock

Calculating the stock variable

Period	$Input_t$	$Stock_t$ $\alpha = 0.1$	$Stock_t$ $\alpha = 0.9$
0		0	0
1	300	30	270
2	0	27	27
3	0	24.3	2.7
4	100	31.87	90.27
5	0	28.683	9.027
6	400	65.8147	360.9027
7	0	59.23323	36.09027
8	0	53.30991	3.609027
9	0	47.97892	0.360903

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9	0	47.97892	0.360903

=0.1*300+0.9*0

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Period	$Input_t$	$Stock_t$ $\alpha = 0.1$	$Stock_t$ $\alpha = 0.9$
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=0.9*100+0.1*2.7

Calculating the stock variable

Period	Input_t	Stock_t $\alpha = 0.1$	Stock_t $\alpha = 0.9$
0		0	0
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Deciding on the correct value of alpha

- Estimate different models with stock variables on the basis of different values of alpha

- Select the model with the highest fit

Using stock variables to control for dynamic effects

- Number of parameters to estimate is limited (one coefficient and one alpha)

- Model is simple

- Interesting interpretation of alpha

- Assumes a fixed distribution of a decreasing impact

Assignment 1

- Measure and discuss the effectiveness of advertising expenditures of two brands after a product-harm crisis
- Build a market response model step by step
- Think about which variables to include and the implication of adding variables to the model
- Focus is on interpretation!

Different steps

1. Take a look at the data
2. Estimate the advertising elasticities
3. Add control variables
4. Add competition
5. Add dynamic effects
6. Critical reflection

Document to hand in

- Word document of maximum 15 pages (all included!)
- Line spacing 1.5; font size 12
- 1 document per team
- Hand in in paper by e-mail to kathleen.cleeren@kuleuven.be on Thursday March 12

Teams

Surname	Name	Team
Amidei	Juvenal Willi	A
Aslanidis	Odysseas	B
Belzaino	Salvatore	C
Bugge	Stephanie Caytlon	D
Cecchini	Oscar	E
Diaz Fraga	Paul Alexander	A
Ekel	Jeremy Mejia	B
Ghiani	Marco	C
Kantipudi	Venkata Sriharsha Chowdary	D
Melucci	Pierfrancesco	E
Awad	Mohamed Alaaeldin Mohamed	A
Pantaleoni	Marco	B
Petruzzelli	Nicola	C
Rendine	Flavio	D
Ronsisvalle	Carlo Manfredi	E
Saarinen	Veli Henrik	A
Tedino	Simone	B
Vattikonda	Prasanth	C
Zalizniak	Valeriia	D
Zolezzi Labarca	Alejandro Andrés	E