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Sheet 2

Exercises in Empirical Industrial Organization and Consumer Choice

(Presentation: Tuesday, 2018-05-08T14:15 [2:15 p.m.], He18 R120)

All R Code presented here can be downloaded via moodle for a better Copy & Paste Experience. It is recommended, that you to solve these exercises, so that encountered problems can be discussed in class. The solution is given by a separate document, downloadable via moodle.

Exercise 2 - A different model

After having sold her ice cream truck, Emma decides to go into selling paper-clips. Ice cream in our model has the property, that, given a certain amount of people, weather and other factors, there is a certain maximal demand for it. This is modelled via the parameter a_t, which gives us an upper bound of demand, even if the price is set to 0. On the other hand everybody loves paper-clips and you can't have enough of them (or so Emma assumes). Consequently she decides to use a different model than before:
Assume the sales in period t are given by the following demand function

$$q_t = A \cdot p_t^\alpha \cdot \exp(\varepsilon_t) \text{ with } \varepsilon_t \overset{\text{iid}}{\sim} N(0, \sigma_\varepsilon^2),$$

i.e. ε_t being independent, identically and normally distributed with mean 0 and standard deviation σ_ε. To keep things simple and since the paper-clip resources market is rather competitive, we assume

$$c_t \overset{\text{iid}}{\sim} N(\mu, \sigma_c^2)$$

to be the costs Emma faces per paper-clip. To keep it realistic, the parameters are assumed to be sensible, i.e.

$$A > 0,\ \alpha < -1,\ \sigma_\varepsilon > 0 \ \&\ \sigma_c > 0 \text{ but sufficiently small}, \mu \gg \sigma_c \text{ with } \mathrm{P}(c_t \leq 0) \approx 0.$$

(a) Which price should Emma chose, assuming she is aware of all parameters?

(b) Why do we require $\alpha < -1$ and $\mu \gg \sigma_c$ with $\mathrm{P}(c_t \leq 0) \approx 0$.?

(c) Simulate the model in R by generating q_t and π_t (Emmas profit) and plot profits $[\pi_t]$ and output $[q_t]$, respectively, in regard to the prices $[p_t]$ by setting the prices

i. randomly within a reasonable range.

ii. in a profit maximizing fashion.

Hint: Nice parameters are $T = 1000$, $A = 1000$, $\mu = 5$, $\sigma_c = 0.05$, $\sigma_\varepsilon = 0.15$, $\alpha = -2$.

(d) How could you transform the data, so that linear regression can be used to estimate the parameters? Which of the two data sets from above is probably the better choice for an implementation? Write a program in R which estimates the parameters with linear regression.

Bonus - Exercise - Be thorough in your data examination

This exercise will probably not be topic of the presentation and is not relevant for the exam. You are encouraged to solve it though for your own benefit.

Let's have a look at this rather complicated function which is executed on the data set *anscombe*, provided by R:

```
somestatistics <- function(data){
  #Definition
  ncols <- ncol(data)
  nrows <- 2

  #Build up Matrix
  res1 <- array(rep(NA,nrows*ncols),dim=c(nrows,ncols))
  res1 <- as.data.frame(res1, row.names=c("mean", "variance"))
  colnames(res1) <- colnames(data)

  #Fill Matrix
  res1["mean",] <- format(apply(data,MARGIN=2,mean),digits=4)
  res1["variance",] <- format(apply(data,MARGIN=2,var),digits=4)

  res2 <- list()

  for (i in 1:(ncols/2)){
    lm <- lm(data[,ncols/2+i] ~ data[,i])
    res2[[i]] <- data.frame(
      Covariance=cov(data[,i],data[,ncols/2+i]),
      Intercept=coef(lm)[1],
      Regressor=coef(lm)[2])
    rownames(res2[[i]]) <- NULL
  }
```

```

  res <- list(vectorspecific=res1,combination=res2)

  return(res)
}
```

It expects a data frame whose columns have the logic $(x_1, ..., x_n, y_1, ..., y_n)$ with x_i and y_i defining a two-dimensional dataset (e.g. "sold quantities given prices" or "number of passengers given train miles"). Consequently the variable n is the number of our datasets; four in the case of *anscombe*.

(a) Try to understand the function:

   i. What does it do?
   (Hint: When you dissect a function it is helpful to work with restorepoint*s.)*

   ii. What could be the intend behind certain constructs?

(b) Interpret the output of the function. What does it tell you about the data sets?

(c) Would you say the four data sets are similar?

(d) Plot each of the data sets.