Industrial Organization and Data Science

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Course Assignments & Reading

Course assignments should be printed (code, output and descriptive answers) and turned in at the start of class unless otherwise noted. Feel free to work in groups but everyone is required to turn in their own work with answers written in your own words. In both calculations and complex ideas, write down each step of logic used in reaching your conclusion. Keep in mind that in most cases a good answer is one precise sentence; quality is heavily favored over quantity. This will be graded on a full credit, half credit and no credit basis. All work must be typed

Discussion questions do not need be written out ahead of time. At the beginning of each class the professors will lead a discussion around these questions. Students will be called on, potentially at random, to add their insight. This part of class will contribute heavily to your course participation grade.

Week 4, due April 27

Assignment to be turned in. Please turn in typed out answers. Math with pen/pencil OK. R code and bolded output where relevant.

1) Define what a player or firm's "Best Response" (BR) is to another player's action.
    a. How is this different from a BR function?
    b. If a player or firm has a complete BR function defined for all states of the world and actions, will anything surprise the firm? Why or why not?
    c. If a player or firm has a complete BR function, will they have preferences about what the other player does? Why or why not?
    d. How is a BR function different from Nash Equilibrium (NE)?
2) For this question assume that two firms are competing Bertrand in prices.
    a. What is the BR of firm 2 if firm 1 charges a price P?
    b. What is the BR of firm 1 if firm 2 charges $P = MC_1 < MC_2$?
    c. What are NE profits of a high cost firm when competing on prices?
3) What is the BR of a firm competing Cournot if all other firms produce zero quantity? What are their profits? Is this a NE? Why or why not?
4) What is a dominant strategy in game theory?
    a. Is there a dominant strategy in Cournot competition? Why or why not?
    b. What about Bertrand competition? Why or why not?
    c. What about for a monopolist? Why or why not?

5) Consider a market in which the seller of a product knows there are two types of consumers, a high and a low preference type, which are indistinguishable from one another. The firm can produce along a product quality spectrum, such as with cars.
    a. If the firm decides to offer a low quality good, what risk do they run?
    b. What two options do they have to mitigate this risk?
    c. How much would the firm be willing to pay to identify each type of consumer and price discriminate accordingly?
6) Show that if there is a low and high quality good with utility specified as in lecture that if $\frac{s2}{p2} > \frac{s1}{p1}$ then all consumers purchase high quality good if they purchase.
7) Assume that we're in a Hotelling linear city model but that firm 1 is located at location .25 rather than location 0. Assume that the "neighbor" firm on the RHS is charging P_n. Find the optimal price of firm 1 given they have some cost c.
8) **Empirical portion:** There is a dataset called rjv.csv which you'll use for this problem set. RJVs are collaborations between firms and can include universities, national labs, foreign firms, government agencies, etc… The idea is that firms collaborate on research and share the gains. There is also a program paid for by the US government's National Institute of Standards and Technology (NIST) which matches resources firms spend in a collaboration dollar for dollar.

    Here is the description for the relevant variables, although others are present:

    nummemb = Number Members in the Research Joint Venture
    nist = 1 if the RJV received NIST funding
    prodproc = describes whether the research was for a new product (prod) or a process (proc). proc implies that the RJV was initiated to reduce costs.
    fedlab = 1 if the RJV included a national laboratory
    univ = 1 if the RJV included a university
    year = year when RJV was approved by the federal government.
    tech = Sector of the RJV. Here are the descriptions:

    *AUT=factory automation BIO=biotechnology CHE=chemicals COM=computer hardware
    *DEF=defense ENR=energy ENV=environmental MAN=manufacturing equipment
    *MAT=advanced materials MED=medicals PHA=pharmaceuticals PHO=photonics
    *SOF=computer software SUB=subassemblies and components TAM=test and measurement
    *TEL=telecommunications TRN=transportation IT=information technology N/A= not available

    The goal of this portion of the assignment is to try to identify the causal impact of applying for and receiving government funding on the size of the RJV. For example, do firms try to appropriate those funds and RJVs get smaller or does this leverage extant funds leading to larger collaborations?

    You'll need to install a new package called "Matching" for this assignment which has a description here: http://sekhon.berkeley.edu/papers/MatchingJSS.pdf

    ```
    install.packages("Matching")
    library(Matching)
    ```

    a. **Plot size against year.** Do you notice any trends?

b. Run a regression of size on indicator variables for each year (use as.factor()), indicator variables for each sector, prodproc, nist, fedlab and university indicator variables. **Report the results summary. What are the take aways from the results? Interpret the coefficient on nist.**
c. Rerun (b) but exclude year and tech indicators. **Do your results on nist change?**
d. Now let's try to control for self-selection and endogeneity of funding. Run a logit model with nist as the dependent variable with the same RHS variables as (b) making sure to exclude nummemb. Save the output as "predicted". **What predicts being funded?**
    i. This will automatically create fitted values (e.g., predictions for the likelihood of being funded) for each observation.
    ii. The next step will use these fitted values in an attempt to make an apples to apples comparison of RJVs which look similar in their probability of being funded (e.g., their fitted value) but we and were not in fact funded.
        1. That difference is "closer" to a causal impact of funding on size.
e. Use the Match() function to compare the closest RJVs in terms of predicted likelihood of funding but were and were not in fact funded.
    i. `rr1 <- Match(Y = rjv$nummemb, Tr = rjv$nist, X = predicted_funded$fitted)`
    ii. **What is the "treatment" of getting funded now? What is the number of observations in the matched control group and the matched treated group? Is that a cause for concern?**
f. Let's investigate why that occurs by looking at how the "matched control group".
    i. Use the following command to look at differences in RHS variables between the matched treatment and control groups:
    ii. `MatchBalance(nist ~ prodproc + fedlab + univ, match.out = rr1, nboots = 1000, data = rjv)`
    iii. **What do you notice as the most striking difference between the matched and unmatched control group? Why might this be the case? Can you infer anything about this government policy as a result?**