Ec 5043   Prof. Le Wang
Managerial Economics II

Homework #3

March 5, 2018

Instruction: Do all the following empirical exercises using R. Turn in your answer with tables and graphs, if any, (along with your program and output files appended at the end of document). Refer to the output file whenever appropriate when discussing your results.

Note that for all simulation exercises, set the seed number to 123456 to ensure the reproducibility of your results.

1. **Question 1. [Tree Model and Prediction]**

   Use the data **titanic.csv** on Canvas for this question. The data contain all the information on Titanic passengers:

   1. **Survived** Survival (0 = No; 1 = Yes)
   2. **pclass** Passenger Class (1 = 1st; 2 = 2nd; 3 = 3rd)
   3. **name** Name
   4. **sex** Sex
   5. **age** Age
   6. **sibsp** Number of Siblings/Spouses Aboard
   7. **parch** Number of Parents/Children Aboard
   8. **ticket** Ticket Number
   9. **fare** Passenger Fare
   10. **cabin** Cabin
   11. **embarked** Port of Embarkation (C = Cherbourg; Q = Queenstown; S = Southampton)

   Answer the following questions:

   1. The prediction using these predictors, Pr[Survival|Pclass, Sex], is simply a function of Pclass,Sex. Use R to calculate survival predictions for each combination of Pclass,Sex values. **This question corresponds to the example of "gender,race, and age" in our slides. The only difference is that we need to repeat this process for all combinations of the conditioning variables.**

      (a) Write out this function using your answer in (1)
      (b) Write out this function in ONE equation using your answer in 1.a with the help of an indicator function.
      (c) (Optional) Draw a tree model for your results in (a).

2. Question 2. [Interpreting the Medical Test (I)]

Say you wake up with spots all over your face. You rush to the doctor and he says that 90 percent of the people (!) who have smallpox have the symptoms you have. Since smallpox is often fatal, your first inclination may be to panic. But your doctor would tell you that the probability you have smallpox is only 1.1 percent (or 0.011), so you do not have to panic. Your doctor's statements seem contradictory to each other. How to reconcile it? Is your doctoring just comforting you? Or, is there any scientific reason to explain the seemingly contradictory statements that you doctor made? This is sort-of an essay question, but you can definitely give some numerical examples to support your argument. **This question corresponds to Bayes' Rule in our slides.**

3. Question 2. [Interpreting the Medical Test (II)]

A well-known story of the *Phyysicists's Twins:* Thanks to onograms, a physicist found out she was going to have **twin boys**. "What is the probability my twins will be ***Identical***, rather than ***Fraternal***?" she asked. The doctor answered that one-third of twin births were Identicals, and two-thirds Fraternals. A crucial fact is that identical twins are always same-sex while fraternals have probability 0.5 of same or different. Apply Bayes' rule to answer the physicist's question. **This question corresponds to Bayes' Rule in our slides.**

4. Question 3. [Bayes' Rule and Hiring Decisions]

Hiring decisions are an important part of the managerial decisions. Despite its importance, people often rely on their intuition to hire, but not necessarily the past data to evaluate the optimality of the decision. For example, one may often rely heavily on the interview performance of a candidate. However, the value of an interview is often overstated. Consider the following data from one company of 1000 employees; 800 of them are qualified workers, while 200 of them are not. Among qualified workers, 90 percent interviewed well. Among unqualified workers, 20 percent interviewed well. Now, based on this data, what is the probability of a job candidate who interviewed well being a qualified worker? Note that this is an incredibly naive example of actual practices, and that many assumptions are imposed on the data, but it at least gives us some sense of how things should be done. **This question corresponds to Bayes' Rule in our slides.**