Instructions: This examination consists of six questions. You must answer the first question and you must answer four of the remaining five questions (i.e. you must answer four of the questions numbered 2-6). Each question answered (five in total) has a weight of 20% in the final examination score. Please read through the entire examination before making a decision on the particular set of five questions you actually answer. The examination proctor will review the content of the exam at the beginning of the time period (9:00 am). She/He will answer general questions for the entire set of students writing this prelim. You have until 1:15 pm to complete the exam. Good Luck!
1. In 1972, the U.S. Federal Trade Commission (FTC) charged the four largest U.S. manufacturers of ready-to-eat breakfast cereal (RTE cereal) with several antitrust violations, including conspiring through brand proliferation and differentiating similar products to prevent entry into the industry. Although the FTC failed to win its case, this argument is theoretically interesting.

Schmalensee (1978) and Scherer (1979) used localized competition to explain the FTC arguments. In such models, consumers choose cereals based on product characteristics, such as sweetness and “mouth feel.” Each brand is located in a characteristic space. A given brand must compete for consumers with other nearby brands located in the product space. A company owning that brand can surround it with other similar brands of its own to prevent entry. For example, Kellogg’s Corn Flakes and Special K may be very close substitutes. In the early 1970s, however, “health” cereals started selling well. Because existing firms had not located in this area of product space, new firms (which included such giants as Colgate, International Multifoods, Pet, and Pillsbury) were able to enter.

a. Use Salop’s circle model to discuss what happens when firms cannot costlessly relocate as new entry occurs.

b. Suppose a unit circle representing the dimension of “mouth feel” in RTE cereals has 200 consumers spread uniformly along it. A customer’s location, \( r^* \), represents his favorite mouth feel. The pleasure a consumer gets from his favorite mouth feel is \( u \) per package. Consumers incur disutility \( c=200 \) from each unit distance by which a brand deviates from their favorite mouth feel. All consumers buy either one package of cereal a week or none at all. Instead of buying one of the brands of RTE cereal, the consumer may decide to buy bread if it gives more pleasure for a given amount of money. Suppose a consumer’s surplus (pleasure less the price) from eating the bread is \( v=20 \).

(i) Derive the demand facing cereal makers. Distinguish the monopolistic and competitive segments.

(ii) Calculate the equilibrium price, firm output and number of firms under free entry if the cereal makers’ costs are \( C(q)=128+4q \)?

(iii) Calculate the equilibrium price, firm output and number of firms if fixed costs fall to 100.
2. Recent research in economics, agricultural economics, and business has focused attention on probability forecasts of relevant economic variables, e.g. prices and yields (see for example Elliot, Granger and Timermann, *Handbook of Economic Forecasting*, Elsevier Science 2006).

   a. Why might one consider a probability forecast in agricultural economics? Make the case that it is a useful form for communicating some types of economic information.

   b. Describe probability calibration and the use of the probability integral transform.

   c. Describe proper scoring rules (what are they?) and their possible uses in motivation and evaluation of probability forecasts.

   d. Discuss reasons why some prefer proper scoring rules to probability calibration for forecast evaluation?
3. For an estimated vector autoregression (VAR) it is common (Sims *Econometrica* 1980) to provide results in an equivalent moving average representation (MAR) form.

a. What does it mean to say the VAR form and the MAR form are equivalent? Illustrate mathematically.

b. Discuss three ways the moving average representation may provide us information on the dynamic relationships present in the vector autoregression. Be precise on how these alternatives differ from one another. For what kinds of market information questions might these methods be useful?
4. The prevalence of overweight/obesity among American children has increased dramatically over the past few decades. Some believe that the rise in childhood obesity coincides with a rise in labor force participation of women with children. Between 1975 and 2008, the labor force participation rate of women with children under the age of 18 rose from 44.7% to 71.2% (U.S. Department of Labor, 2009). Time constraints usually imply that maternal employment lead to decrease in time spent with children which then affect child’s health outcomes.

a. You were asked to evaluate the link between maternal employment and childhood obesity. Describe the ideal dataset you will need to answer this question? Be specific, list and describe all your dependent and independent variables, unit of observations and unit of measurements.

b. Specify the model that will best fit the data and question in part (a). Discuss your estimation method and challenges that you will encounter in estimating this model.

c. What is sample selection? Is it possible to run into a sample selection problem while answering the question in part (a)? If so, how?

d. What is endogeneity? Are there any endogenous variables in the model you have specified in part (b)? If so, list these variables and estimation techniques to address this problem.
5. Suppose an outcome $Y$ variable is given by the following linear function:

$$Y_i = X_i \beta + e_i,$$

where $X_i$ is a vector of observed explanatory variables, $e_i$ is an iid error with mean zero and finite variance, and $\beta$ is a vector of unknown parameters of interest. Suppose also that $Y_i$ is observed only if a latent variable $Y_i^*>0$. The latent variable is governed by the following process:

$$Y_i^* = Z_i \gamma + v_i,$$

where $Z_i$ is a vector of observed explanatory variables and $v_i$ is an iid error with mean zero and finite variance.

a. Suppose we estimate $\beta$ by the OLS using only observations with $Y$ variable observed. Under what condition(s) is the OLS estimate consistent?

b. Suppose the consistency condition given in Part 1 is violated, one can instead use Heckman’s sample selection correction method. Describe the necessary steps to implement Heckman’s estimator.

c. Heckman’s estimator is known to be consistent in the absence of an exclusion restriction; this is the so called ‘identification based on functional form’. Explain the limitation of this identification strategy.

d. In linear regressions with endogenous explanatory variables, instrumental variables are usually required to obtain consistent estimates. Explain why ‘identification based on functional form’ is not possible in linear IV regressions.

e. Heckman’s sample selection estimator and the propensity score estimators can share a common first stage that estimates the probability of a certain event (or treatment) using the Probit estimator. Explain the conceptual differences between Heckman’s model and propensity score method.
6. Florida orange growers (producers) have advertised (generic) orange juice products since the 1960’s. Industry leaders want to know if this advertising is a good use of their scarce resources. They have contracted with you to study whether such advertising is effective. Propose a model to inform us on the likely effects of such advertising. What information would you need to know in order to carry out an economic analysis? Discuss data requirements, model specification and tests that might offer evidence on this concern of the industry.