Notes: The analyses for this test are to be performed using Stata. In answering all questions, note what commands you used (if any) including the variables included and any options specified. Write your answers to each question in the space provided. If necessary, use space on the back of the page, clearly identifying which question is applicable and noting under the question itself that the answer continues elsewhere. You may use Stata help files, but you may not use any internet help for the Stata commands. You may use your text, class notes, problem sets (including my logs and do files if you have previously printed them out), but you may not use any internet resources. You may only use the internet to access the datasets as indicated below.

There are two sections to this exam. Section one, containing questions 1-5, is potentially worth 50 points in total, and each question is potentially worth 10 points. Section two, containing questions 6-9, is also potentially worth 50 points in total, and each question is potentially worth 12.5 points.
Section I

For the questions in this section, use the dataset available at http://www.law.upenn.edu/fac/jklick/test2.txt which contains the following variables for Burger King restaurants in the Midwestern states of the US:

fran: the number of restaurants in the state in a given year that are franchised (i.e., Burger King gives the trademark to an individual to use subject to a number of contractual stipulations in return for an upfront payment and a share of the profits from the restaurant).

owned: the number of restaurants in the state in a given year that Burger King runs itself.

In 1992, Iowa passed a law restricting the ability of franchisors (i.e. Burger King) to punish franchisees who do not maintain quality standards through the termination of the franchising agreement. That is, in other states (and in Iowa before 1992), Burger King could sever its contractual relationship with a franchisee “at will” (essentially, without litigating the matter), but the Iowa law requires that the franchisor provide legal justification for terminating an existing relationship (essentially requiring the franchisor to go to court to make a claim that the franchisee was not performing up to its contractual obligations in some way). Burger King and other franchisors claim that such a law makes it difficult to control agency costs on the part of franchisees and will lead them to engage in less franchising in Iowa in the future.

1) Estimate a model that plausibly isolates the causal effect of the Iowa law on franchising.  
   1a) Describe the model you run, 1b) state the relevant estimated coefficient, 1c) discuss the statistical significance of the coefficient, 1d) discuss what the relevant coefficient represents at a conceptual level, and 1e) discuss the assumptions under which the coefficient represents the causal effect of the law’s passage.
2) Examine a graph of just the Iowa franchise time series. Reproduce the graph below (doesn’t need to be exact; just close enough to communicate the trajectory of franchising in Iowa). Given what the graph shows, how can it be consistent with your findings in Question 1?

3) Assume that Iowa legislators only care about how many Burger Kings are located in their state, regardless of their ownership structure (and assume they want to see more of them since that will lead to more jobs). Given this assumption, how would you evaluate the effect of the Iowa franchising law (make sure you provide details regarding the basis of your evaluation)?
4) Although the dataset only includes data for the 12 Midwestern states (i.e., states in the same geographic region as Iowa), you could perform the same analyses on a dataset containing data on Burger King’s operations in all 50 US states. In what way(s) would the larger dataset be helpful in drawing conclusions about the effect of the Iowa franchising law? Is there any reason(s) to restrict attention to these 12 states?

5) Choose one question from this section (Questions 1-4) to count double.
Section II

6) Assume that you wish to model $y$ as a function of a vector of exogenous covariates $V$ and a single endogenous variable $x$. Assume you use two instruments $z_1$ and $z_2$ in a two stage least squares estimation, but both of these variables are conditionally orthogonal (that is, are statistically independent of $x$ and $y$ after $V$ is partialed out) to both $x$ and $y$. Conceptually, what problem(s) will this cause for you in estimating the causal effect of $x$ on $y$?

7) Provide the intuition behind the test of over-identifying restrictions as a test of the orthogonality criterion for valid instruments. Discuss why this test is implemented as an $F$ test, as well as a discussion of how the associated $p$ value is used to determine whether the test is “passed” or not. Finally discuss why this test is useful for rejecting “bad” instruments, but not as useful for accepting “good” instruments.
8) If you wish to model \( y \) as a function of a vector of exogenous variables \( V \) and endogenous variables \( x_1 \) and \( x_2 \), and you have a valid (i.e., the instrument generates a strong first stage and is unrelated to \( y \), except through its effect on \( x_1 \), once \( V \) is partialed out) instrument for \( x_1 \) but NOT for \( x_2 \), what should you do and why?

9) Choose one question from this section (Questions 6-8) to count double.