Assignment 3

Due: Start of Class, Friday, November 13th

Instructions:

Group Work: I encourage all of you to work on the problem set in groups, but each member of the group must write up his or her own solutions and perform his or her own analysis. Problem sets that are verbatim copies will receive a zero.

To submit your solutions, include your answers to these questions and your log file (or other supporting documentation) and submit it to the Assignment on Canvas.

Assignment:

This assignment studies road congestion with real traffic data from two dectectors along I-290, just west of Chicago (https://www.google.com/maps/@41.8769335,-87.6551367,13.5z). One detector measures Eastbound traffic and the other measures Westbound traffic. The monitor data is collected by the Illinois Department of Transportation and reports the number of cars on road as well as the speed of the vehicles.

Variable Name	Description
Date	Date
Hour	Hour of day (0-23)
Dow	Day of week (0 = Sunday, 1 = Monday, etc.)
fieldDeviceID	Name of monitor
direction	Traffic direction
speed	Traffic speed (mph)
volume	Traffic volume (cars per hour)
latitude	Latitude of detector
longitude	Longitude of detector

1. Open a log file to keep a record of your analysis. Click "File → Log → Begin" and give it a name that will be easy to remember.
2. Open the dataset and summarize the data..
3. We might expect that weekends are different than weekdays for a variety of reasons. Generate a dummy variable for weekdays (i.e., Monday – Friday). Calculate average speed by hour, direction for weekdays. Present the averages either as a scatter plot or as a table. What do they suggest about weekday traffic?
4. Adjust your code and replicate the graphs / tables from part 3 for weekend days, rather than weekday days. What do we learn about weekend traffic?
5. Now let's develop a model for weekday -Westbound traffic speeds at this location. To do this, run a regression that accounts for the hourly differences that occur on weekdays and weekends. To do this, you need to create dummy variables for each hour of the day.

   Stata makes this quite easy. HINT: **xi: reg speed i.hour if weekday==1 & direction=="Westbound"**

How much of the variation in traffic speeds does our model explain? Report and interpret the coefficient for 5pm on weekdays (_Ihour_17). (Hint: The constant term gives the speed for midnight)

6. What factors might influence average traffic speeds but are omitted from the model that only uses hour of the day to predict speeds?

7. Now, let's think about the external cost of congestion starting with the equation below covered in class earlier in the semester.

$$MPC = \frac{P_g}{MPG} + \frac{P_t}{MPH} + pV_L$$

Assume that the price of gasoline is $3.00 and your car gets 30 mpg. Further assume that your value of time is $20/hr and pV_L = $0.05/mi.

Using the constant term and coefficient for 5pm from the regression in part 5 to calculate the marginal private cost per mile driven over this stretch of highway for an average weekday at 5pm.

8. Now, the cool part. We are going to calculate the congestion externality created by adding an additional driver to this section of highway. First, we need to understand how speed varies with the number of vehicles on the road.

The number of vehicles on the road is "density" measured in vehicles per mile.

Calculate density as traffic volumes (i.e., vehicles/hour) divided by speed (i.e., miles per hour).

9. To estimate the relationship between speed and density, we want to also control for factors that would affect vehicle speed. Add density to the regression equation from part 5 above.

Interpret the coefficient on the density variable. In addition, interpret the change in the R-squared of the regression and the change of the hourly coefficients relative to the regression in part 5.

10. Plot the relationship between traffic volumes and traffic density.
Because we care about aesthetics, let's give the variable density a nice label / variable name first:

label var density "Traffic Density (cars per mile)"

From the graph, what is the critical density of the westbound portion of I-290?

11. Calculate the externality creates by the last westbound driver at 5pm on a weekday. To do this use the formula for the marginal external cost of congestion given in lecture. Assume a value of time of $20/hr.

Recall from class that marginal external cost = $(n-1)*(P_t/MPH_n - P_t/MPH_{n-1})$

To do this, you first need to calculate average density (i.e., the number of vehicles (n))) on the road for an average weekday at 5pm. Then use the results from 8 to calculate speed (at 5pm) before and adding one additional vehicle.

Finally, calculate the MEC.

12. Calculate the externality created by the marginal westbound driver at 6am on a weekday. Does this suggest anything about policies attempting to price congestion in Chicago?

13. Don't forget to close your log file! Go to "File → Log → Close."