Project – Putting the "Fun" in Functions
Example: Estimating Household Mileage

Note: I am choosing this topic as an example in part because no one has chosen it. It would be a rather odd coincidence to see this topic and data appear in others' work.

Part 1: Defining your model.

$$Miles = f(\overset{(-)}{price}, \overset{(+)}{income}, \overset{(+)}{\#work}, \overset{(+)}{sub})$$

Miles	is the total number of miles driven per household.
price	is the average price of gas per mile for each household.
income	is the (approximate) income for that household.
#work	is the number of workers in the household.
sub	is a substitution variable that is equal to 1 if the household has multiple types of vehicles and is equal to 0 if they only have one type.

I am estimating total household miles driven as a function of the price of gas, household income, number of workers in the household and a substitution variable. I want to know how the price of driving ultimately impacts how much we drive.

Part 2: Collecting the Data.

All of my data come from the 2002 National Household Travel Survey. I have inputted my data into an Excel worksheet below.

Household	Miles	Price Per Mile	Income	#Workers	Substitute
1	1000	0.0940189	22499.5	0	0
2	150	0.0881741	22499.5	0	0
3	4270	0.0772479	12499.5	0	0
4	21450	0.0553118	72499.5	2	0
5	12000	0.0798373	89999.5	1	0
6	24000	0.0939289	89999.5	2	0
7	9600	0.0865235	47499.5	2	0
8	5500	0.0658889	89999.5	3	0
9	11000	0.0710188	77499.5	2	1
10	6908	0.0415233	12499.5	1	0
11	35000	0.0861227	47499.5	1	0
12	8000	0.1241788	12499.5	0	0
13	36100	0.0759971	77499.5	2	1
14	25000	0.0798167	89999.5	1	0
15	10000	0.0711124	27499.5	1	0
16	27000	0.0827312	47499.5	0	1
17	25000	0.0663171	27499.5	2	1
18	32500	0.063606	12499.5	0	0
19	12500	0.0886566	32499.5	2	1

Each row represents a household. For example: household 1 drove 1000 miles, with an average price per mile of 9 cents, had total income of approximately $22,500, no workers and only one type of vehicle.

Part 3: Describe Your Model.

In the state of Oregon, the Department of Transportation is looking at alternatives to the fuel tax. The state's funding for the maintenance of highways is not keeping up with the needs of the state. One alternative is to switch from the fuel tax to a per-mile tax. One question they need to answer is: What will that switch do to total miles driven?

Fuel Tax: The state gets approximately 18.3 cents for every gallon sold.
Per-Mile Tax: The state gets some amount for every mile driven.

In my model, I believe there is a…

…negative relationship between the price per mile and miles driven. As the price to drive a mile increases, I'll drive fewer miles.

…positive relationship between income and miles driven. If I make more money, I can afford to drive more.

…positive relationship between the number of workers and miles driven. Workers have to drive to work, so as the number of workers increases, so will the miles driven.

…positive relationship between the substitution variable and miles driven. If a household has multiple types of vehicles, such as an SUV and a compact car, they (I think) will be more likely to drive, relative to households without multiple types of vehicles.

Part 4: Estimate Your Function.

In Excel, there is a regression analysis option, which will make this very simple to do.

	Coefficients
Intercept	14674.06851
Price Per Mile	-135300.8913
Income	0.060612908
#Workers	5831.373704
Substitute	6994.101493

(We will go over how to do this in Excel at a later time.)

Part 5: Interpret Your Results.

I can use the results from Part 4 to write an equation as follows:

$$Miles = 14{,}674 - 135{,}300\,price + 0.06\,income + 5{,}831\,work + 6{,}994\,Sub$$

The relationships between my dependent variable, *miles* and the independent variables are all as I expected. There is a negative relationship between the price, and a positive relationship between miles and each of the other variables.

The intercept, 14,674 tells me, ignoring all other variables, I have to drive at least 14,674 miles per year. If the price per mile increases by $1, I will drive 135,300 fewer miles per year. It's unlikely anyone drives that many miles in a year, as it usually takes about 10 years to reach that kind of mileage, but it is also unlikely that it will cost $1 to drive one mile. It may make more sense to think of the price variable in cents, rather than dollars.

For every $1 increase in my household's income, I will drive approximately 0.06 more miles annually. As I make more money, I will be able to afford to drive more. Said another way, if my income decreases, I will cut back on my driving. For every dollar my income decreases, I will drive 0.06 fewer miles.

Every worker in the household adds an additional 5,831 miles to the total annual household mileage count.

Households with multiple vehicle types drive approximately 6,994 more miles than those with a single type of vehicle.

Conclusion:

The change from a fuel tax to a per-mile tax will change the cost of driving for certain households more than others. Mainly, those with fuel efficient vehicles (who save at the gas pump) will see an **increase** in the cost of driving a mile. Those with fuel inefficient vehicles will see a **decrease** in the cost of driving.

Those who see an increase in the cost of driving (the variable, *price* increases) will decrease miles driven and this will decrease the money collected by the government. Similarly, those who see a decrease in the cost of driving (the variable, *price* decreases) will increase miles driven as it becomes cheaper to drive. This will increases the money collected by the government.

You can use this model to predict how much the government will actually collect given their new policy. You can do this by first estimating how many miles EVERY household will drive, multiplied by the average price per mile under the fuel tax. And compare this to the total miles driven under the per-mile tax multiplied by that average price per mile.