The rules for problem sets in this course are that [1] you should feel free to discuss the problems with others, but [2] in the end you must write up your own results.

This problem set is due Monday, Oct. 1, at the beginning of lecture. No late assignments accepted.

1. Give your name, the name of your Teaching Fellow and the time of your assigned section.

2. Define
   (a) Marginal Rate of Substitution
   (b) Perfect Complement
   (c) Income Effect of a Price Change

3. Say that the Connecticut Department of Transportation (DOT) has done a study and concluded that the dollar benefit of constructing $x$ miles of road is given by the function $B(x)$. You can assume diminishing marginal benefits of road-miles. The total cost of constructing those miles of road is $tx$, where $t$ is the per-mile cost of roads.
   (a) Draw a graph that illustrates the optimal miles of road to construct (on your graph, put $x$ on the horizontal axis and dollars on the vertical axis.)
   (b) Show how the optimal $x$ changes if $t$ increases.

4. George W., a student at Yale, consumes beer and textbooks, and nothing else.
   (a) Show George’s optimal consumption bundle on an indifference curve graph. Label this (and all other graphs) carefully.
   (b) Show how George’s consumption will change if the price of beer increases. Draw the graph so that the goods are substitutes.

5. Suppose that Jane divides her time between study and sleep. Boring as she is, she does nothing else.
   (a) Denote hours of sleep as $x_1$ and hours of study as $x_2$. Noting that there are 24 hours in the day, what is Jane’s “budget line” for the choice between hours of study and hours of sleep? What is the slope of this curve?
(b) Suppose that Jane’s marginal utility of sleep is

\[ MU_1 = \frac{1}{x_1} \]

and her marginal utility of study is

\[ MU_2 = \frac{2}{x_2} \]

How many hours will Jane sleep? How many hours will she study? (Show how you get your answer.)

6. Considering what we have learned from consumption theory

(a) What leads to a large “substitution effect”?
(b) What factors lead demand to be more elastic?
(c) What factors could, in theory, lead to an upward sloping demand curve?
(d) What factors lead two goods to be complements in demand?