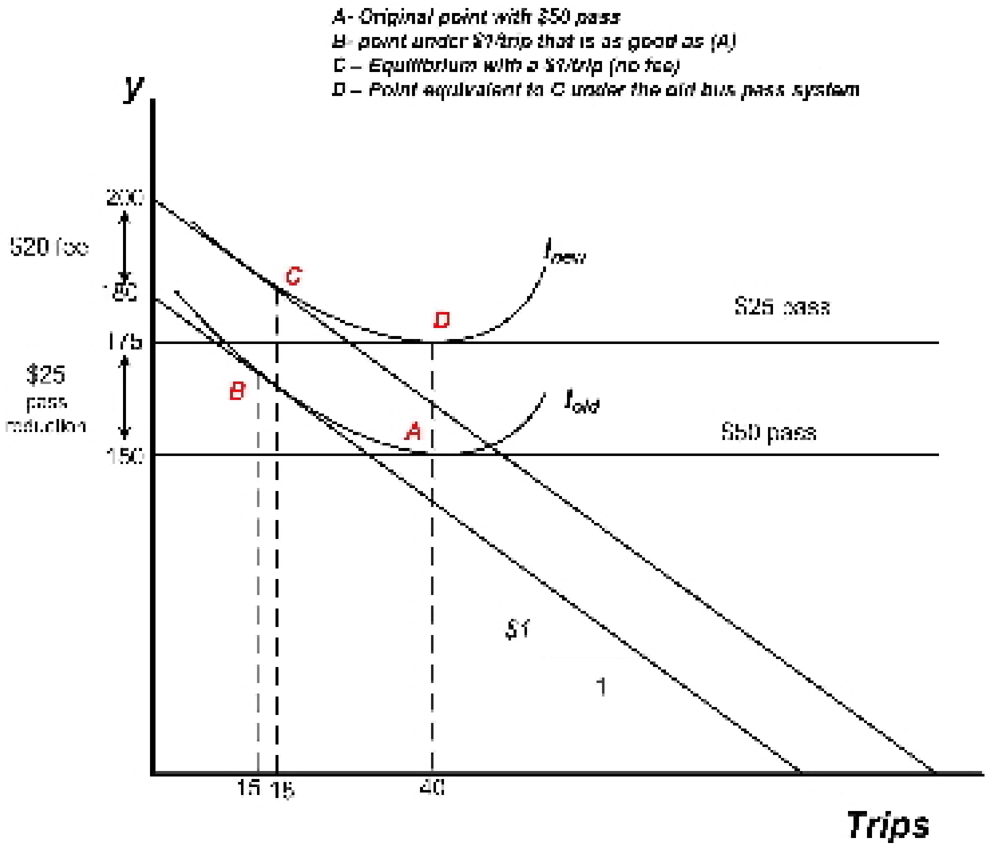

Figure 1: Graph for Question 3

ECON 460 Winter 2015
Assignment 2: CV-EV NPV KEY

1. Myrtle has $200 per month to spend on Transit (X) and all other goods (Y). She currently buys a bus pass for $50 and rides 40 times per month.If she didn't buy the pass, bus rides would cost $2/ride. Myrtle is offered to join a Transit program that would allow her to pay a membership fee and then could ride the bus for $1 per trip. The most Myrtle would pay for the membership is $20. and then she would ride 15 times a month. If she were given the membership for free, she would ride the bus 18 times per month. Myrtle also reveals that she would be indifferent between a free membership (and $1 per ride) versus simply having the traditional bus pass reduced to $25 per month (flat rate), where she would again choose to ride the bus 40 times a month.

   (a) Using all the information provided, draw all the relevant budget constraints and indifference curves. Be sure to label all equilibrium points and have a legend that explains each point (in one or two sentences).

   (b) Calculate her CV (compensating variation) Two answers acceptable $20 fee; or $30 difference between the Pass ($50), and the most she would pay for $1 rides ($20)

   (c) Calculate her EV (equivalent variation)-25$

2. Skippy has the following utility function: $u = \sqrt{xy}$ and faces the budget constraint: $M = p_x x + p_y y$. Her associated marginal rate of substitution is $MRS = \frac{y}{x}$

   (a) Use the $MRS = p_x/p_y$ and the budget constraint to find Skippy's demand functions.

$$x = \frac{M}{2p_x}, y = \frac{M}{2p_y}$$

indirect utility function is

$$v = \sqrt{\left(\frac{M}{2p_x}\right)\left(\frac{M}{2p_y}\right)} = \frac{M}{2\sqrt{p_x p_y}}$$

v tells you the utility number for any given budget and prices. The expenditure function is

$$B = 2\sqrt{p_x p_y}u$$

(b) Suppose $M = 48$, $P_y = 1$ and $P_x = 4$. What is Skippy's optimal x, y and utility number? If the price of x was lowered to 2 what would be her x, y and utility number

$$\begin{aligned} x_{old} &= 15, y_{old} = 60, u_{old} = 12 \\ x_{new} &= 30, y_{new} = 60, u_{new} = 16.97 \end{aligned}$$

(c) What is the most Skippy would pay to have P_x lowered to 2? **USE EXPENDITURE (old U new price)**

$$\begin{aligned} B &= 2\sqrt{p_x p_y}u \\ p_x &= 2, p_y = 1, u = 12 \\ B &= 33.94 \\ CV &= 48 - 33.94 \\ CV &= 14.6 \end{aligned}$$

(d) Suppose $M = 120$, $P_y = 1$ and $P_x = 4$. How much additional income would Skippy need to be as well off as if the price of x had fallen to 2? **USE EXPENDITURE (new U, old price)**

$$\begin{aligned} B &= 2\sqrt{p_x p_y}u \\ p_x &= 4, p_y = 1, u = 16.97 \\ EV &= 19.88 \end{aligned}$$

	Millions	
CS (Benefit)	$8.16	Benefit
VC Plant	$1.70	
FC Plant	$13.00	
interest	5%	
Ban costs/yr	$7.00	

Comparison

	5yr	10yr
Ban minus Plant	**$8.23**	**-$13.68**
Cells C5 - J17 or J22		

Option 1 **Pesticide Ban**

(CS-Ban)/r = **$ 23.20**

Option 2 **Treatment Plant**

Year	Benefit	Cost	Net Benefit	Disc NB	SUM NPV
0	$0.00	$13.00	-$13.00	-$13.00	-$13.00
1	$8.16	$1.70	$6.46	$6.15	-$6.85
2	$8.16	$1.70	$6.46	$5.86	-$0.99
3	$8.16	$1.70	$6.46	$5.58	$4.59
4	$8.16	$1.70	$6.46	$5.31	$9.91
5	$8.16	$1.70	$6.46	$5.06	**$14.97**
6	$8.16	$1.70	$6.46	$4.82	$19.79
7	$8.16	$1.70	$6.46	$4.59	$24.38
8	$8.16	$1.70	$6.46	$4.37	$28.75
9	$8.16	$1.70	$6.46	$4.16	$32.92
10	$8.16	$1.70	$6.46	$3.97	**$36.88**
11	$8.16	$1.70	$6.46	$3.78	$40.66
12	$8.16	$1.70	$6.46	$3.60	$44.26
13	$8.16	$1.70	$6.46	$3.43	$47.68
14	$8.16	$1.70	$6.46	$3.26	$50.95
15	$8.16	$1.70	$6.46	$3.11	$54.05

From CS page	***$8,160,000***
or, in millions:	***$8.16***

Question 2

Ban > 5 yr plant by **$8.23** million

Question 3

10 yr Plant > Ban **$13.68** million

Question 4

Ban = 5 yr plant if r = **10.21%**

Question 5

Ban = 10 yr plant if r = **38.90%**

Part 3: Congestion and the optimal toll

There are 840 people who travel from A to B each day in order to get to work. There are two routes that are available. Route 1 is the faster route but has limited capacity. Route two is slower but has much greater capacity. If travel time is measured in minutes, and is also a function of the number of cars on the road, then the average travel time for each route is:

$$\begin{aligned} AUC_1 &= 30 + 0.5Q_1 \\ AUC_2 &= 60 + 0.1Q_2 \end{aligned}$$

where AUC_i is the average user cost and Q_i is the number of cars on route i (where $Q_1 + Q_2 = 840$). Further, the value of time is calculated to be $12 per hour.

1. (a) In the absense of any tolls, what is the equilibrium number of cars per day on each route? SOLVE

$$\begin{aligned} 30 + 0.5Q_1 &= 60 + 0.1Q_2 \\ & \quad and \\ Q_1 + Q_2 &= 840 \\ & \quad getting \\ Q_1 &= 190, Q_2 = 650 \\ AUC_1 &= AUC_2 = 125 \end{aligned}$$

(b) What is the total time cost, (or social cost) per day

$$TC = 840 \times 610$$

(c) What is the socially optimal number of cars on each route? SOLVE

$$\begin{aligned} MUC_1 &= 30 + Q_1 \\ MUC_2 &= 60 + 0.2Q_2 \\ MUC_1 &= MUC_2 \\ 30 + Q_1 &= 60 + 0.2Q_2 \\ & \quad and \\ Q_1 + Q_2 &= 840 \\ Q_1 &= 165, Q_2 = 675 \end{aligned}$$

(d) What is the total time cost per day at the social optimum?

$$\begin{aligned} AUC_1 &= 112.5 \\ AUC_2 &= 127.5 \\ Diff &= 15 \end{aligned}$$

How much would be saved when compared to your answer to (b)? ANSWER: Total time difference is 375 minutes

(e) What would be the toll needed to achieve the social optimum?

$$\begin{aligned} & 12/hr \\ & or \\ \frac{12}{60} &= 0.2/\min \\ 15 \times 0.2 &= \$3 \end{aligned}$$