1. Suppose we want to do a rigorous cost-benefit analysis to evaluate a project which will lower the price of commodity $x$. Considering the argument due to Kay for distorting taxes, would you advocate using the compensating or equivalent variation measure?

(Hamilton's Answer) We had discussed in class the infeasibility of the compensation that is implicit in the Diamond-Mirrlees use of the CV (compensating variation) based measure of excess burden. For a price decrease, it is the EV (equivalent variation) based measure that uses infeasible compensation. Look at the indifference curve diagram to see that--which one lies outside all budget lines. Another way to view this is that the CV and EV are inverses of each other (the CV for a price increase is the EV for the price cut). Since the EV measure is preferred for a tax increasing the price, the CV measure should be preferred for a price decrease.
2. Compare consumer surplus, equivalent variation, and compensating variation for a tax on an inferior good. Just drawing the diagrams will be enough.

Inferior good is usually defined as one for which an increase in income lowers demand. What’s actually happening is that the income effect is the opposite sign as the substitution effect. In the extreme case (Giffen good), the income effect outweighs the substitution effect so an increase in price actually increases demand (i.e., demand slopes upward). Since we are looking at compensated demands, another way to say this is that an increase in utility lowers compensated demand (i.e., if $u_0 > u_1$, $D^c(p,u_0)$ will be below (to the left of) $D^c(p,u_1)$). The result form the graphs is that CV is actually less than EV, which is the opposite of the normal good case ($|EV| < |CV|$). Note that in both cases (normal and inferior goods), $\Delta CS$ is still between EV and CV.
3. Convert the Harberger approximation for excess burden for small taxes (the double summation) to a measure which uses the own- and cross-elasticities of compensated demand. Interpret the component terms in your double summation.

Elasticity: \( \varepsilon_{ij} = \frac{q_i}{x_j} \frac{\partial x_j^c(q,u_i)}{\partial q_i} \Rightarrow \frac{\partial x_j^c}{\partial q_i} = \frac{x_j}{q_i} \varepsilon_{ij} \)

Harberger's Formula: \( \bar{L} = -\frac{1}{2} \sum_i \sum_j t_i t_j \frac{\partial x_j^c(q,u_i)}{\partial q_i} \)

Break up own- and cross-derivatives: \( \bar{L} = -\frac{1}{2} \left[ \sum_i t_i^2 \frac{\partial x_i^c(q,u_i)}{\partial q_i} + \sum_j \sum_i t_i t_j \frac{\partial x_j^c(q,u_i)}{\partial q_i} \right] \)

Substitute elasticity: \( \bar{L} = -\frac{1}{2} \left[ \sum_i t_i^2 \frac{x_i}{q_i} \varepsilon_{ii} + \sum_j \sum_i t_i t_j \frac{x_j}{q_i} \varepsilon_{ij} \right] \)

**Own Effect**

\( t_i^2 \geq 0 \)

\( \frac{\partial x_i^c}{\partial q_i} = \frac{x_i}{q_i} \varepsilon_{ii} < 0 \) (compensated demand curves always slope down)

Consider the \(-1/2\) in front and this means the own effect of a tax is an increase in excess burden, regardless of whether the tax is positive or negative (i.e., a subsidy).

**Cross Effect** - the arrows below show the change in excess burden from the cross effect, not the end result of the change in excess burden. The cross effect will magnify the increase in excess burden from the own effect if both goods are taxed and they are complements or if one good is taxed and the other is subsidized and they are substitutes. (Basically, these combinations increase the distortion of the tax). Other situations shown below offset the increase in excess burden (i.e., counter the distortion) or will have no net effect because one of the goods is not taxed.

\[
\begin{array}{lcc}
\text{tax at most 1} & \text{tax both} & \text{tax one and subsidize other} \\
\varepsilon_{ij} < 0 & \text{no change} & \bar{L} \uparrow \\
\varepsilon_{ij} > 0 & \text{no change} & \bar{L} \downarrow \\
\end{array}
\]

Break up tax terms: \( \bar{L} = -\frac{1}{2} \left[ \sum_i (t_i x_i) \left( \frac{t_i}{q_i} \right) \varepsilon_{ii} + \sum_j \sum_i (t_j x_j) \left( \frac{t_j}{q_i} \right) \varepsilon_{ij} \right] \)

The double summation has the tax revenue of good \( j \) times the tax rate of good \( i \) (with respect to the consumer price) times the cross-elasticity of compensated demand between goods \( i \) and \( j \). The bigger any of these terms are (in absolute value), the more likely the cross effect will magnify (or offset) the own-effect.
4. A consumer has the utility function:

\[ U(x_1, x_2) = -\frac{1}{x_1} - \frac{1}{x_2} \]

let \( x_1 \) be the numeraire, and let the consumer's lump-sum income equal \( y \).

a) Find the expenditure function.
b) What is the excess burden of a specific tax on good 2 (\( t_2 \))?
c) What is the marginal excess burden of a specific tax on good 2 (using \( u = v(q, y) \)) where \( q = (1, p_2 + t_2) \) --the post-tax price vector--in the expenditure function?)

**a) Consumer problem:**

\[ \max_{x_1, x_2} U(x_1, x_2) = -\frac{1}{x_1} - \frac{1}{x_2} \quad \text{s.t.} \quad q \cdot x = y \]

Lagrangian:

\[ \ell = -\frac{1}{x_1} - \frac{1}{x_2} - \gamma (q_1 x_1 + q_2 x_2 - y) \]

\[ \frac{\partial \ell}{\partial x_1} = \frac{1}{x_1^2} - \gamma q_1 = 0 \Rightarrow \gamma = \frac{1}{q_1 x_1^2} \]

\[ \frac{\partial \ell}{\partial x_2} = \frac{1}{x_2^2} - \gamma q_2 = 0 \Rightarrow \gamma = \frac{1}{q_2 x_2^2} \]

Set these equal to each other:

\[ \frac{1}{q_1 x_1^2} = \frac{1}{q_2 x_2^2} \Rightarrow \frac{1}{x_1} = \frac{1}{x_2} \frac{q_2}{q_1} \]

Plug this into the budget constraint:

\[ q_1 x_1 + q_2 x_2 = y \]

\[ x_2 \left( \sqrt{q_1 q_2} + q_2 \right) = y \Rightarrow x_2 = \frac{y}{q_2 + \sqrt{q_1 q_2}} \]

Sub into \( x_1 \):

\[ x_1 = \left( \frac{y}{q_2 + \sqrt{q_1 q_2}} \right) \frac{q_2}{\sqrt{q_1}} = \left( \frac{q_2}{q_2 + \sqrt{q_1 q_2}} \right) \frac{y}{\sqrt{q_1 q_2} + q_1} \Rightarrow x_1 = \frac{y}{q_1 + \sqrt{q_1 q_2}} \]

Now solve for \( v(q, y) = U(x(q, y)) \):

\[ -\frac{1}{x_1} - \frac{1}{x_2} = -\left( \frac{q_1 + \sqrt{q_1 q_2}}{y} \right) - \left( \frac{q_2 + \sqrt{q_1 q_2}}{y} \right) \Rightarrow \]

\[ v(q, y) = -\frac{1}{y} \left( q_1 + q_2 + 2\sqrt{q_1 q_2} \right) \]

To get the expenditure function use \( v(q, E(q, u_0)) = u_0 \) and solve for \( E(q, u_0) \)
\[ v(q, E(q, u_0)) = -\frac{1}{E(q, u_0)} (q_1 + q_2 + 2\sqrt{q_1q_2}) = u_0 \]

\[ E(q, u_0) = -\frac{1}{u_0} (q_1 + q_2 + 2\sqrt{q_1q_2}) \]

If we let good 1 be a numeraire \((q_1 = 1)\), the expenditure function simplifies to:

\[ E(q, u) = -\frac{1}{u} (1 + q_2 + 2\sqrt{q_2}) \]

**Other Way:** (This is the "hard way" according to Prof Hamilton because we need to find \(v(q, y)\) later anyway.)

Expenditure function: \( E(q, u) = \min_x q \cdot x \text{ s.t. } U(x) \geq u \)

Standard form: \( E(q, u) = \max_x -q \cdot x \text{ s.t. } -U(x) + u \leq 0 \)

Lagrangian: \( L = -q \cdot x - \lambda (-U(x) + u) = -q_1x_1 - q_2x_2 - \lambda \left( \frac{1}{x_1} + \frac{1}{x_2} + u \right) \)

KT Conditions:

(i) \( \frac{\partial L}{\partial x_1} = -q_1 + \lambda \frac{1}{x_1^2} \leq 0 \) (strictly if \( x_1 > 0 \))

(ii) \( \frac{\partial L}{\partial x_2} = -q_2 + \lambda \frac{1}{x_2^2} \leq 0 \) (strictly if \( x_2 > 0 \))

(iii) \( -\frac{\partial L}{\partial \lambda} = \frac{1}{x_1} + \frac{1}{x_2} + u \leq 0 \) (strictly if \( \lambda > 0 \))

These will all hold as equalities because we have a well behaved utility function. (There will be no corner solutions since we can't have \( x_1 = 0 \) or \( x_2 = 0 \))

Solve (i) and (ii) for \( \lambda \) and set them equal to each other:

\( \lambda = q_1x_1^2 = q_2x_2^2 \Rightarrow x_1 = x_2 \sqrt{\frac{q_2}{q_1}} \)

Substitute this into (iii):

\( \frac{1}{x_2} \sqrt{\frac{q_1}{q_2}} + \frac{1}{x_2} = -u \Rightarrow x_2 = -\frac{1}{u} \left( 1 + \sqrt{\frac{q_1}{q_2}} \right) \)

Solve for \( x_1 \):

\( x_1 = -\frac{1}{u} \left( 1 + \sqrt{\frac{q_1}{q_2}} \right) \sqrt{\frac{q_2}{q_1}} = -\frac{1}{u} \left( 1 + \sqrt{\frac{q_2}{q_1}} \right) \)
Plug \( x_1 \) and \( x_2 \) into the expenditure function:

\[
E(q,u) = q_1 \left[ \frac{-1}{u} \left( 1 + \sqrt{\frac{q_2}{q_1}} \right) \right] + q_2 \left[ \frac{-1}{u} \left( 1 + \sqrt{\frac{q_1}{q_2}} \right) \right] = \frac{-1}{u} \left( q_1 + q_2 + 2\sqrt{q_1q_2} \right)
\]

To get the indirect utility function use \( E(q,v(q,y)) = y \) and solve for \( v(q,y) \)

\[
E(q,v(q,y)) = \frac{-1}{v(q,y)} \left( q_1 + q_2 + 2\sqrt{q_1q_2} \right) = y
\]

\[
\therefore v(q,y) = \frac{-1}{y} \left( q_1 + q_2 + 2\sqrt{q_1q_2} \right)
\]

b) Excess burden (Kay’s definition): \( \bar{L} = E(q,u_i) - E(p,u_i) - (q - p) \cdot x \)

Use the expenditure function from (a) and break out the tax term

\[
\bar{L} = -\frac{1}{u_i} \left( q_1 + q_2 + 2\sqrt{q_1q_2} \right) + \frac{1}{u_i} \left( p_1 + p_2 + 2\sqrt{p_1p_2} \right) - (q_1 - p_1)x_1 - (q_2 - p_2)x_2
\]

Since the tax is only on good 2, we have \( q_1 = p_1 \) and \( q_2 = p_2 + t_2 \)

\[
\bar{L} = -\frac{1}{u_i} \left( p_1 + p_2 + t_2 + 2\sqrt{p_1(p_2 + t_2)} \right) + \frac{1}{u_i} \left( p_1 + p_2 + 2\sqrt{p_1p_2} \right) - t_2x_2
\]

\[
\bar{L} = -\frac{1}{u_i} \left( t_2 + 2\sqrt{p_1(p_2 + t_2)} - 2\sqrt{p_1p_2} \right) - t_2x_2
\]

\[
\bar{L} = \frac{2}{u_i} \left( \sqrt{p_1p_2} - \sqrt{p_1(p_2 + t_2)} \right) - t_2 \left( \frac{1}{u_i} + x_2 \right)
\]

If we let good 1 be a numeraire \( (q_1 = 1) \), the formula simplifies to:

\[
\bar{L} = \frac{2}{u_1} \left( \sqrt{p_2} - \sqrt{p_2 + t_2} \right) - t_2 \left( \frac{1}{u_1} + x_2 \right)
\]

Here’s another way...

\[
\bar{L} = \frac{y}{q_1 + q_2 + 2\sqrt{q_1q_2}} \left( q_1 + q_2 + 2\sqrt{q_1q_2} \right) + \frac{-y}{q_1 + q_2 + 2\sqrt{q_1q_2}} \left( p_1 + p_2 + 2\sqrt{p_1p_2} \right) - (q_1 - p_1) \left( \frac{y}{q_1 + \sqrt{q_1q_2}} \right) - (q_2 - p_2) \left( \frac{y}{q_2 + \sqrt{q_1q_2}} \right)
\]

\[
\bar{L} = -y \frac{p_1 + p_2 + 2\sqrt{p_1p_2}}{q_1 + q_2 + 2\sqrt{q_1q_2}} - (q_1 - p_1) \left( \frac{y}{q_1 + \sqrt{q_1q_2}} \right) - (q_2 - p_2) \left( \frac{y}{q_2 + \sqrt{q_1q_2}} \right)
\]

Since the tax is only on good 2 and good 1 is numeraire, we have \( q_1 = p_1 = 1 \)

\[
\bar{L} = -y \frac{1 + p_2 + 2\sqrt{p_2}}{1 + q_2 + 2\sqrt{q_2}} - (q_2 - p_2) \frac{y}{q_2 + \sqrt{q_2}}
\]
\[ \bar{L} = y \left[ 1 - \frac{1 + p_2 + 2\sqrt{p_2}}{1 + q_2 + 2\sqrt{q_2}} - \frac{(q_2 - p_2)}{\sqrt{q_2 (1 + \sqrt{q_2})}} \right] \]
\[ \bar{L} = y \left[ 1 + q_2 + 2\sqrt{q_2} - 1 - p_2 - 2\sqrt{p_2} \right] - \frac{(q_2 - p_2)}{\sqrt{q_2 (1 + \sqrt{q_2})}} \]
\[ \bar{L} = y \left[ \frac{q_2 + 2\sqrt{q_2} - p_2 - 2\sqrt{p_2}}{1 + \sqrt{q_2}} - \frac{(q_2 - p_2)}{\sqrt{q_2 (1 + \sqrt{q_2})}} \right] \]
\[ \bar{L} = y \left[ \frac{\sqrt{q_2} (q_2 + 2\sqrt{q_2} - p_2 - 2\sqrt{p_2})}{1 + \sqrt{q_2}} - \frac{(1 + \sqrt{q_2}) (q_2 - p_2)}{\sqrt{q_2 (1 + \sqrt{q_2})}} \right] \]
\[ \bar{L} = y \left[ \frac{q_2 \sqrt{2q_2} + 2q_2 - p_2 - 2\sqrt{p_2} - 2\sqrt{q_2} p_2 - q_2 + p_2 (q_2 - p_2) + p_2 \sqrt{q_2}}{\sqrt{q_2 (1 + \sqrt{q_2})^2}} \right] \]
\[ \bar{L} = y \left[ \frac{q_2 - 2\sqrt{q_2} p_2 + p_2}{\sqrt{q_2 (1 + \sqrt{q_2})^2}} \right] \]

(c) Recall from (a): \( \nu(q, y) = -\frac{1}{y} (q_1 + q_2 + 2\sqrt{q_1 q_2}) \)

\[ \therefore \frac{\partial \nu(q, y)}{\partial q_2} = -\frac{1}{y} \left( 1 + \frac{q_1}{\sqrt{q_2}} \right) \]

Also from (a): \( x_2 = \frac{y}{q_2 + \sqrt{q_1 q_2}} \)

\[ \therefore \frac{\partial x_2}{\partial q_2} = -\frac{y}{(q_2 + \sqrt{q_1 q_2})^2} \left( 1 + \frac{1}{2} \frac{q_1}{\sqrt{q_2}} \right) \]

Use \( \nu(q_2) \) for \( u_1 \) in (b) for excess burden

\[ \bar{L} = -\frac{1}{\nu(q, y)} \left( q_1 + q_2 + 2\sqrt{q_1 q_2} \right) + \frac{1}{\nu(q, y)} \left( p_1 + p_2 + 2\sqrt{p_1 p_2} \right) - (q_1 - p_1) x_1 - (q_2 - p_2) x_2 \]

Combine the terms with \( \nu(q, y) \) to make the derivative easier

\[ \bar{L} = -\frac{1}{\nu(q, y)} \left( q_1 + q_2 + 2\sqrt{q_1 q_2} - p_1 - p_2 - 2\sqrt{p_1 p_2} \right) - (q_1 - p_1) x_1 - (q_2 - p_2) x_2 \]

Now take the derivative wrt \( q_2 \)

\[ \frac{\partial \bar{L}}{\partial q_2} = -\frac{1}{\nu} \left( 1 + \frac{q_1}{\sqrt{q_2}} \right) + \frac{\partial \nu}{\partial q_2} \left( q_1 + q_2 + 2\sqrt{q_1 q_2} - p_1 - p_2 - 2\sqrt{p_1 p_2} \right) - (q_1 - p_1) \frac{\partial x_1}{\partial q_2} - (0) x_1 - (q_2 - p_2) \frac{\partial x_2}{\partial q_2} - (1) x_2 \]
Realize that both of the \( x \) terms drop out (the first because \( q_i = p_i \); the second because the derivative of \( (q_i - p_i) \) wrt \( q_2 \) is zero). Use the terms above for \( v(q, y) \), \( \partial v(q, y)/\partial q_2 \), \( x \), and \( \partial x / \partial q_2 \):

\[
\frac{\partial L}{\partial q_2} = \left( \frac{y}{q_1 + q_2 + 2\sqrt{q_1 q_2}} \right) \left( 1 + \frac{q_1}{\sqrt{q_2}} \right) + \\
\left( \frac{y^2}{q_1 + q_2 + 2\sqrt{q_1 q_2}} \right) \left( 1 + \frac{q_1}{\sqrt{q_2}} \right) \left( q_1 + q_2 + 2\sqrt{q_1 q_2} - p_1 - p_2 - 2\sqrt{p_1 p_2} \right) - \\
(q_2 - p_2) \left( \frac{y}{q_2 + \sqrt{q_1 q_2}} \right) \left( 1 + \frac{q_1}{2\sqrt{q_2}} \right) - \frac{y}{q_2 + \sqrt{q_1 q_2}}
\]

In an attempt to make simplifying simpler, evaluate at \( q = (1, p_2 + t_2) \) and remember good 1 is a numeraire so \( p_1 = 1 \):

\[
\frac{\partial L}{\partial q_2} = \left( \frac{y}{1 + q_2 + 2\sqrt{q_2}} \right) \left( 1 + \frac{1}{\sqrt{q_2}} \right) - \\
\left( \frac{y}{1 + q_2 + 2\sqrt{q_2}} \right) \left( 1 + \frac{1}{\sqrt{q_2}} \right) \left( q_2 + 2\sqrt{q_2} - p_2 - 2\sqrt{p_2} \right) + \\
(q_2 - p_2) \left( \frac{y}{q_2 + \sqrt{q_2}} \right) \left( 1 + \frac{1}{2\sqrt{q_2}} \right) - \frac{y}{q_2 + \sqrt{q_2}}
\]

One option: factor out \( y \) so it appears the change in excess burden from a change in the price of good 2 (i.e., a tax on good 2) is proportional to the consumer's money income

\[
\frac{\partial L}{\partial q_2} = y \left[ \text{Stuff} \right]
\]

Second option: keep trying to simplify

Trick: \( 1 + q_2 + 2\sqrt{q_2} = (1 + \sqrt{q_2})^2 \)

Trick: \( 1 + \frac{1}{\sqrt{q_2}} = \frac{1 + \sqrt{q_2}}{\sqrt{q_2}} \)

\[
\frac{\partial L}{\partial q_2} = \left( \frac{y}{1 + \sqrt{q_2}} \right) \left( 1 + \sqrt{q_2} \right) - \left( \frac{y}{1 + \sqrt{q_2}} \right) \left( \frac{1 + \sqrt{q_2}}{\sqrt{q_2}} \right) \left( q_2 + 2\sqrt{q_2} - p_2 - 2\sqrt{p_2} \right) + \\
(q_2 - p_2) \left( \frac{y}{q_2 + \sqrt{q_2}} \right) \left( 1 + \frac{1}{2\sqrt{q_2}} \right) - \frac{y}{q_2 + \sqrt{q_2}}
\]
This really isn't getting any better. At one point on the board in MAT 120, we had this at

\[
\frac{\partial \bar{L}}{\partial q_2} = - \frac{y}{q_2 + \sqrt{q_2}} \left[ \frac{q_2^2 + 2q_2 \sqrt{q_2} + q_2 = q_2 (1 + 2 \sqrt{q_2} + q_2) = q_2 (1 + \sqrt{q_2})^2} \right]
\]

We got excited because this turned out to have \( x \) and the tax rate (wrt consumer price), but we couldn't figure out what the other term meant. At one point we managed to torture that term enough to get an \( x \) in it, but that didn't make sense either.

I have no life, so I tried to use the second measure of excess burden from (b)

\[
\bar{L} = y \left[ \frac{q_2 - 2\sqrt{q_2}p_2 + p_2}{\sqrt{q_2} (1 + \sqrt{q_2})^2} \right] = y \left[ \frac{\sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + 2\sqrt{q_2} + q_2)} \right]
\]
\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ -\frac{\sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + 2\sqrt{q_2} + q_2)^2} \left( \frac{1}{\sqrt{q_2}} + 1 \right) + \frac{1}{2\sqrt{q_2}} \right]
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{\sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + \sqrt{q_2})^4} \left( \frac{1}{\sqrt{q_2}} + 1 \right) + \frac{1}{2\sqrt{q_2}} \right] - \frac{p_2}{2q_2 \sqrt{q_2}}
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{1 - 2\sqrt{p_2} + p_2 / \sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + \sqrt{q_2})^4} + \frac{1}{2\sqrt{q_2}} \right]
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{\sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + \sqrt{q_2})^4} \left( \frac{1}{\sqrt{q_2}} + 1 \right) + \frac{1}{2\sqrt{q_2}} \right] - \frac{p_2}{2q_2 \sqrt{q_2}}
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{\sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + \sqrt{q_2})^4} \left( \frac{1}{\sqrt{q_2}} + 1 \right) + \frac{1}{2\sqrt{q_2}} \right] - \frac{p_2}{2q_2 \sqrt{q_2}}
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{2\sqrt{p_2} - 2p_2 / \sqrt{q_2} - 2\sqrt{p_2} + p_2 / \sqrt{q_2}}{(1 + \sqrt{q_2})^4} \right]
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{4\sqrt{p_2} / q_2 - 4\sqrt{q_2} p_2 - q_2^2 / \sqrt{q_2}}{2q_2 \sqrt{q_2}} + \frac{4q_2 \sqrt{p_2} / q_2 - 3q_2 p_2 / q_2 - q_2 - p_2}{2q_2 \sqrt{q_2}} \right]
\]

\[
\frac{\partial \bar{L}}{\partial q_2} = y \left[ \frac{4\sqrt{p_2} / q_2 - 4\sqrt{q_2} p_2 - q_2^2 / \sqrt{q_2}}{2q_2 \sqrt{q_2}} + \frac{4q_2 \sqrt{p_2} / q_2 - 3q_2 p_2 / q_2 - q_2 - p_2}{2q_2 \sqrt{q_2}} \right]
\]

I give up.
Prob 1. I managed this one on my own. JC made some comments that confused me, but made me reword the second paragraph.

Prob 2. Prof Hamilton clarified the part about switching the compensated demand curves. He also caught an error in the graph of a non-Giffen inferior good. He drew this same graph in class so my correction mirrors what he did.

Prob 3. I worked out the first part of this problem with Josh, Christine, and Katie (talking about changes in excess burden based on the signs of the different terms). Prof Hamilton told us in class to break up the double summation into three terms and talk about magnitudes.

Prob 4. Christine and I compared answers to part (a). We both solved the expenditure function problem directly, but then Prof Hamilton said we did it the hard way. I solved the utility maximization problem with Josh (we thought the algebra made this the hard way). Prof Hamilton said $q_2$ entered the excess burden equation in four places for part (c). Josh, Christine, and I wasted several hours of our lives trying to figure this out together. We literally used all 4 grease boards in Mat 120 in a futile effort that wasn't worth replicating here.