Econ306 – Intermediate Microeconomics
Solutions to Problem Sets 1 & 2

Question 1 (*1 point*)

(i) (*0.5 points*) The intercept with the "food" axis is given by the quantity of food that could be bought if all the income were spent only on food: $\frac{\$300}{\$30} = 10$ units. Similarly, the intercept with the "all other goods" axis is $\frac{\$300}{\$10} = 30$ units. Finally, the slope of the budget line is given by the negative of the price ratio (suppose food is on the horizontal axis): $-\frac{30}{10} = -3$.

Figure 1: Budget line, food versus all other goods

(ii) (*0.5 points*) At the optimal consumption bundle, the following must hold:

$$\frac{MU_{food}}{MU_{og}} = \frac{p_{food}}{p_{og}} \quad \Rightarrow \quad \frac{5}{MU_{og}} = \frac{30}{10} \quad \Rightarrow \quad \boxed{MU_{og} = \frac{5 \cdot 10}{30} = 1.67 \text{ utils}}$$

Question 2 (*1.5 points*)

When the price of a mile changes, so does the slope of the budget constraint. First, note that the intercept with the "all other goods" axis is equal to $\frac{\$5,000}{\$0.1} = 50,000$ units. Starting from this point, which corresponds to zero miles bought, and up until the consumer buys $30,000$ miles, the slope of the budget set is given by the ratio of the full price of a mile and the price of all other goods: $-\frac{\$0.1}{\$0.1} = -1$. When the consumer buys between 20,000 and 30,000 miles, the price of a mile is reduced to \$0.08, meaning that the slope of the budge line falls to $-\frac{\$0.08}{\$0.1} = -0.8$. Finally, when the consumer buys more than 50,000 miles, the price per mile falls to \$0.05 and the slope of the budget line becomes $-\frac{\$0.05}{\$0.1} = -0.5$. Note that the intercept with the "miles" axis is at $\frac{\$5,000}{\$0.05} = 100,000$ miles.

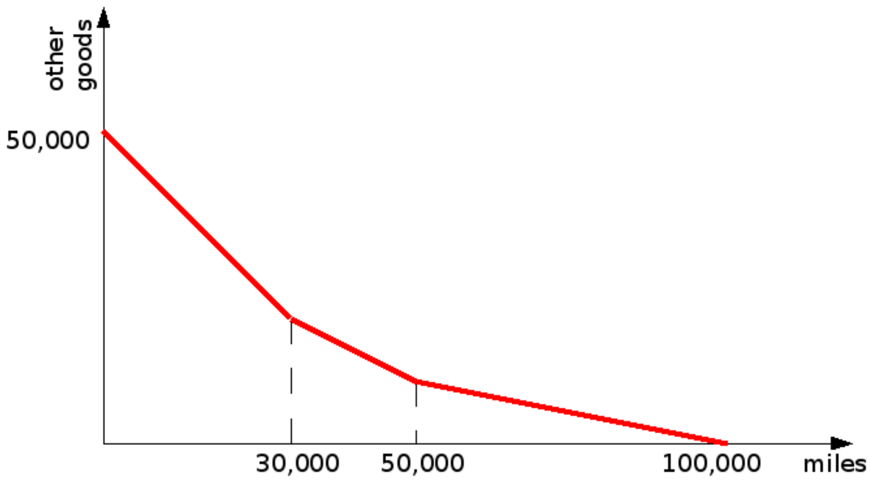


Figure 2: Budget line, miles versus all other goods

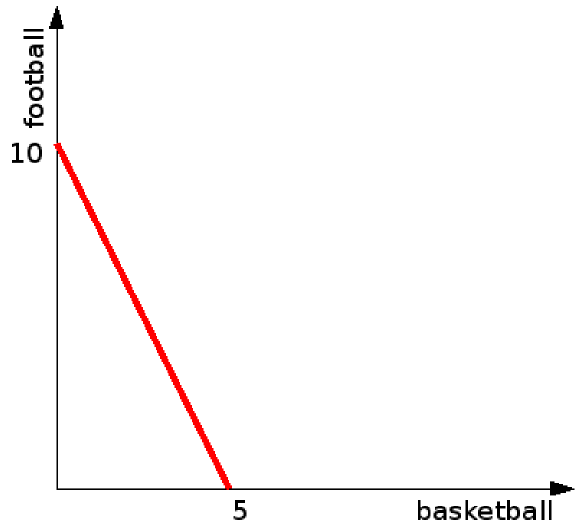
Question 3 (*1 + extra 1 points*)

(i) (*0.5 points*) Suppose football games are represented on the vertical axis and basketball games on the horizontal axis. The two intercepts are then: $\frac{\$50}{\$5} = 10$ football games and $\frac{\$50}{\$10} = 5$ basketball games. The slope of the budget line is $-\frac{\$10}{\$5} = -2$, as you can see in figure 3(a).

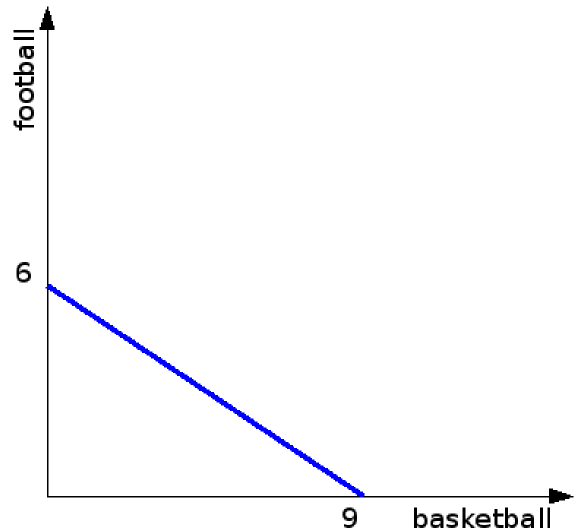
(ii) (*0.5 points*) When the constraints are expressed in terms of time, the intercepts and the slope change. The two intercepts are $\frac{18hrs}{3hrs} = 6$ football games and $\frac{18hrs}{2hrs} = 9$ basketball games, and the slope of the budget line is $-\frac{2}{3} = -0.67$. The new situation is shown in figure 3(b).

(iii) (*extra 1 point*) When both constraints are taken into account, the two budget lines need to be combined. As a general rule, the lower budget constraint is the binding one. Hence, for high consumption of football games, the time constraint (blue line) is binding. For high consumption of basketball games, the money constraint (the red line) is binding. The final budget line is represented by the solid line in figure 3(c).

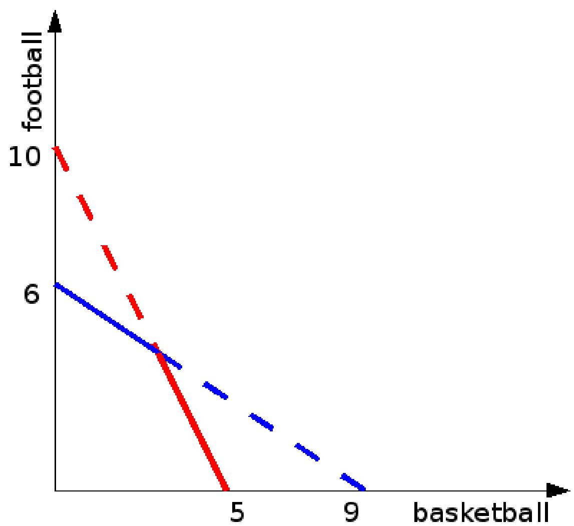
Normally (i.e., at an interior optimum), the marginal rate of substitution at the optimal consumption point is equal to the price ratio, because the budget line is tangent to the indifference



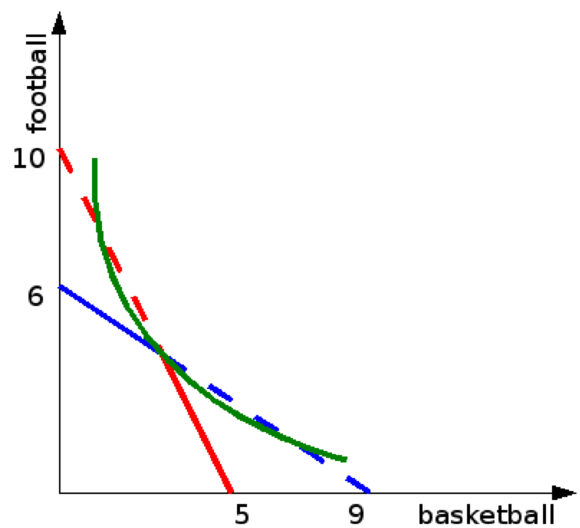
(a) Money constraint



(b) Time constraint



(c) Time and money constraints



(d) Optimal consumption point at kink

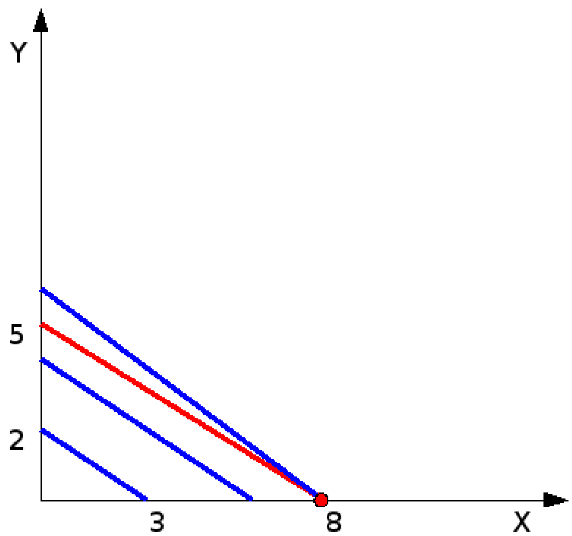
Figure 3: Budget line, football versus basketball

curve. If the optimal consumption point is on the two straight segments, this will hold in the case of a kinked budget line as well. If the optimal consumption point occurs at the kink, however, this does not necessarily hold anymore: the kinked budget line is not "tangent" to the indifference curve, as it is obvious from figure 3(d).

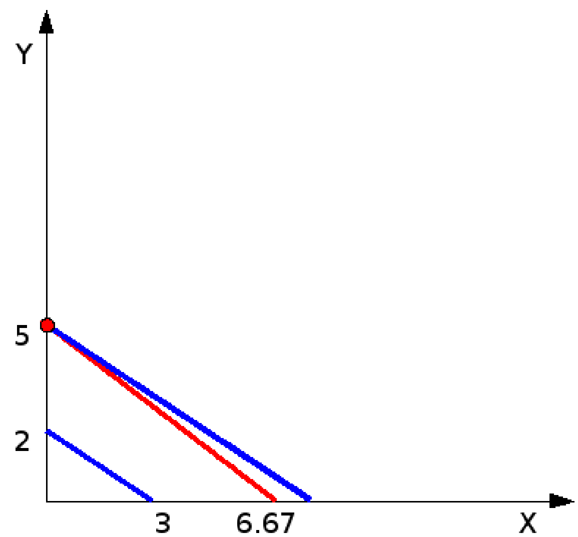
Question 4 (*1.5 points*)

(i) (*0.5 points*) Since X and Y are perfect substitutes, the indifference curves will be straight lines with slope equal to the negative of the marginal rate of substitution, i.e., $\frac{2}{3} = -0.67$. The slope of the budget line, as before, is given by the negative of the price ratio: $-\frac{\$5}{\$8} = -0.625$. The indifference curves are represented in figure 4(a) by the blue lines, while the budget line is represented by the red line. Note that the intercepts for the budget line are $\frac{\$40}{\$5} = 8$ units on the X axis and $\frac{\$40}{\$8} = 5$ units on the Y axis.

(ii) (*0.5 points*) As you can see in figure 4(a), the indifference curves are steeper than the budget line, even if slightly. In this case, the highest attainable indifference curve will only have in common with the budget line one point, the X intercept. This means, in conclusion, that Jones will choose to consume only X (8 units) and no Y (zero units).



(a) Initial setup



(b) After the price change

Figure 4: Jones's indifference map and budget line

(iii) (*0.5 points*) When the price of good X changes, the slope of the budget constraint changes as well, becoming $-\frac{\$6}{\$8} = -0.750$ (note that the X intercept also changes, to $\frac{\$40}{\$6} = 6.67$). Since the budget line is now steeper than the indifference curves (higher slope in absolute value), the optimal consumption point will become the Y intercept, as shown in figure 4(b). Thus, in this case Jones will choose to consume only Y (5 units) and no X (zero units).

Question 5 (*1 point*)

The elasticity gives us the percentage change in quantity demanded corresponding to a 1% change in price. In other words, if the price of theater tickets fellby 1%, the number of theater tickets demanded would increase by 1.73%. Since the price fell by 10%, the quantity demanded increased by $10 \cdot 1.73\% = 17.3\%$.

Now let us analyze total revenue. Intuitively, although the price of tickets went down by 10%, the number of tickets sold increased by much more than that (17.3%), meaning that total expenditure should have increased. To see that algebraically, let p_0 and Q_0 be the initial price and quantity demanded, and $E_0 = p_0 Q_0$ be the initial total expenditure. After the price change, the new price is $p_1 = 90\% \cdot p_0 = 0.9p_0$ and the new quantity demanded is $Q_1 = 117.3\% \cdot Q_0 = 1.173Q_0$. The new total expenditure is then

$$E_1 = p_1 Q_1 = (0.9p_0) \cdot (1.173Q_0) = 0.9 \cdot 1.173 \cdot p_0 \cdot Q_0 = 1.0557 \cdot (p_0 Q_0) = 1.0557E_0.$$

This means that total expenditure increased by 5.57% even though the price fell by 10%.

Question 6 (*1.5 points*)

(i) (*0.5 points*) The point elasticity of demand is

$$\epsilon_p = -\frac{\Delta\% X}{\Delta\% p} = -\frac{\Delta X}{\Delta p} \cdot \frac{p_0}{X_0}.$$

The change in quantity demanded is $\Delta X = 305 - 300 = 5$ and the change in price is $\Delta p = 4.95 - 5 = -0.05$. Hence, the point elasticity of demand is

$$\boxed{\epsilon_p = -\frac{5}{-0.05} \cdot \frac{5}{300} = 1.67.}$$

(ii) (*0.5 points*) The arc elasticity of demand is

$$\epsilon_a = -\frac{\Delta X}{\Delta p} \cdot \frac{\overline{p}}{\overline{X}}.$$

The change in quantity demanded is $\Delta X = 200 - 300 = -100$, the change in price is $\Delta p = 6 - 5 = 1$, the average quantity demanded is $\overline{X} = \frac{200 + 300}{2} = 250$ and the average price is $\overline{p} = \frac{5+6}{2} = 5.5$. Thus, the arc elasticity of demand is

$$\boxed{\epsilon_a = -\frac{-100}{1} \cdot \frac{5.5}{250} = 2.2.}$$

(iii) (*0.5 points*) The cross-elasticity of demand is (note there is no negative sign)

$$\epsilon_c = \frac{\Delta\% X}{\Delta\% p} = \frac{\Delta X}{\Delta p} \cdot \frac{p_0}{X_0}.$$

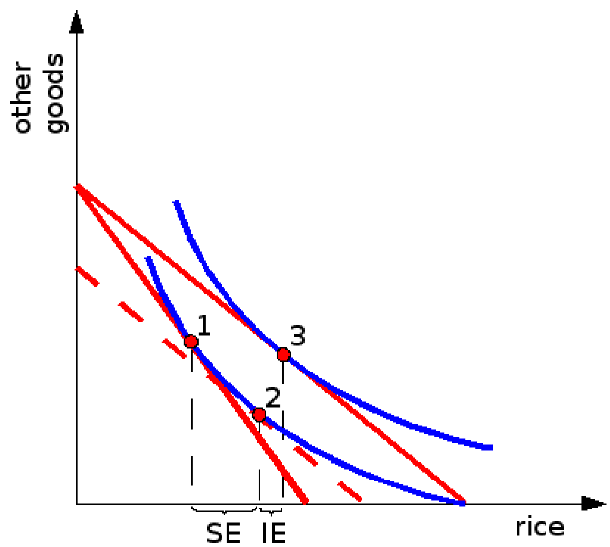
The change in quantity demanded is $\Delta X = 305 - 300 = 5$ and the change in price is $\Delta p = 5.05 - 5 = 0.05$. Hence, the point elasticity of demand is

$$\boxed{\epsilon_c = \frac{5}{0.05} \cdot \frac{5}{300} = 1.67.}$$

Since the elasticity is positive, it means that the two goods are *substitutes*: consumers switch from the good which became relatively more expensive (oranges) to the one which is relatively cheaper (apples).

Question 7 (*1 point*)

Import restrictins artificially keep the quantity supplied low and thus keep the price higher than its equilibrium level. Once the restrictions are relaxed, the quantity supplied increases and thus the price falls. Assuming that rice is a normal good, this implies that a consumer would decide to consume more rice. This decision can be decomposed into the following two effects (which can also be seen in the diagram below):



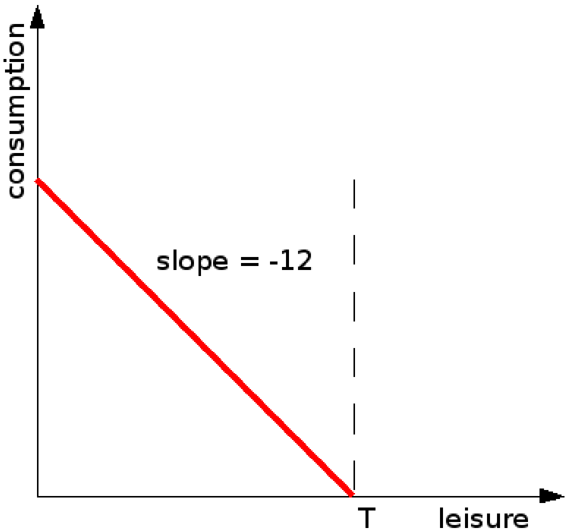
- *substitution effect* (1 → 2): rice is relatively cheaper now, so individuals would choose to increase their consumption of rice because it is a cheaper way to increase utility;
- *income effect* (2 → 3): people need to spend less money on rice now that its price fell, so they can buy more of all goods, including rice.

Question 8 (*1.5 points*)

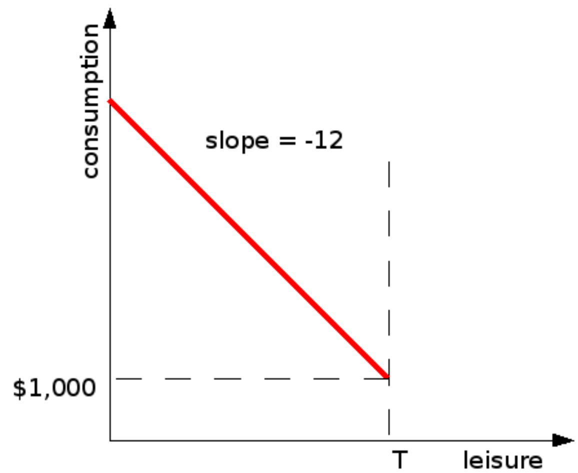
(i) (*0.5 points*) Suppose Teddy has a total time endowment of T hours. The slope of the budget line is given by the negative of the wage rate, \$12. The budget line will then look like in figure5(a).

(ii) (*0.5 points*) If Teddy gets \$1,000 for any amount of work he decides to put in, then the budget line is shifted up by this extra income and the new budget set looks like in figure 5(b).

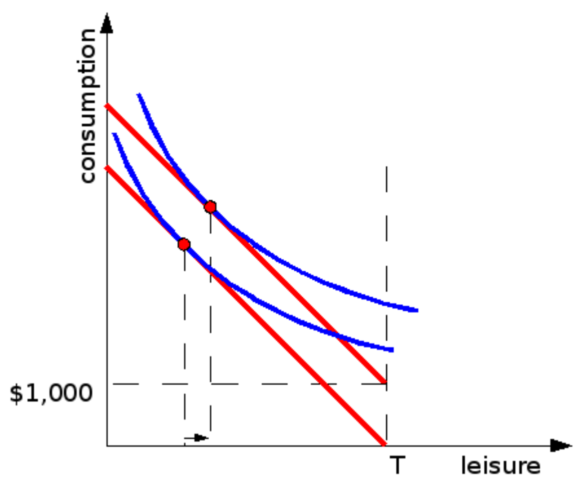
(iii) (*0.5 points*) Since Teddy has now more income for any number of hours of work, he can afford his previous consumption even if he works less ("purchases more leisure"). Hence, he will choose to work less. (You can think of this situation as one where there is no substitution effect, only the income effect: Teddy can afford to consume more of both goods—consumption and leisure—, and doing so means working less).



(a) Initial budget line



(b) Budget line with allowance from rich uncle



(c) Work decision

Figure 5: Teddy's budget line and decision to work