1. Which of the following income streams has the highest NPV? Assume the interest rate is 50%.

$$PV = \frac{FV}{(1+r)^n}$$

a. \$300 payment one year from now

$$NPV = \frac{300}{(1+\frac{1}{2})^1} = \frac{300}{(\frac{3}{2})} = \frac{300}{1} \times \frac{2}{3} = \frac{600}{3} = \$200$$

b. \$250 payment today

$$NPV = \$250$$

c. \$150 payment today, \$60 payment one year from now, and \$90 payment two years from now

$$NPV = 150 + \frac{60}{(\frac{3}{2})^1} + \frac{90}{(\frac{3}{2})^2} = 150 + \left[\frac{60}{1} \times \frac{2}{3}\right] + \left[\frac{90}{1} \times \frac{4}{9}\right] = 150 + 40 + 40 = \$230$$

d. \$60 payment today, \$120 payment one year from now, and \$270 payment two years from now

$$NPV = 60 + \frac{120}{(\frac{3}{2})^1} + \frac{270}{(\frac{3}{2})^2} = 60 + \left[\frac{120}{1} \times \frac{2}{3}\right] + \left[\frac{270}{1} \times \frac{4}{9}\right] = 60 + 80 + 120 = \$260$$

2. My goal is to save \$100. Using the following information, determine what m_1 must equal for me to reach my savings goal.

- $c_1^* = [(1 + \rho)m_1 + m_2] / 2(1 + \rho)$
- $c_2^* = [(1 + \rho)m_1 + m_2] / 2$
- $\Pi = 50\%$
- $r = 100\%$
- I will earn as much money in period 2 as I do in period 1

$$S = m_1 - C_1$$

$$100 = m_1 - C_1$$

$$C_1^* = \frac{(1+\rho)m_1 + m_2}{2(1+\rho)}$$

$$m_1 = m_2$$

$$\frac{1+r}{1+\pi} = 1+\rho$$

$$\frac{1+1}{1+\frac{1}{2}} = 1+\rho$$

$$\frac{2}{(\frac{3}{2})} = 1+\rho \rightarrow 1+\rho = \frac{4}{3}$$

$$C_1^* = \frac{\frac{4}{3}m_1 + m_1}{2(\frac{4}{3})}$$

$$= \frac{\frac{7}{3}m_1}{\frac{8}{3}}$$

$$= \frac{7m_1}{\cancel{3}} \times \frac{\cancel{3}}{8}$$

$$C_1^* = \frac{7m_1}{8}$$

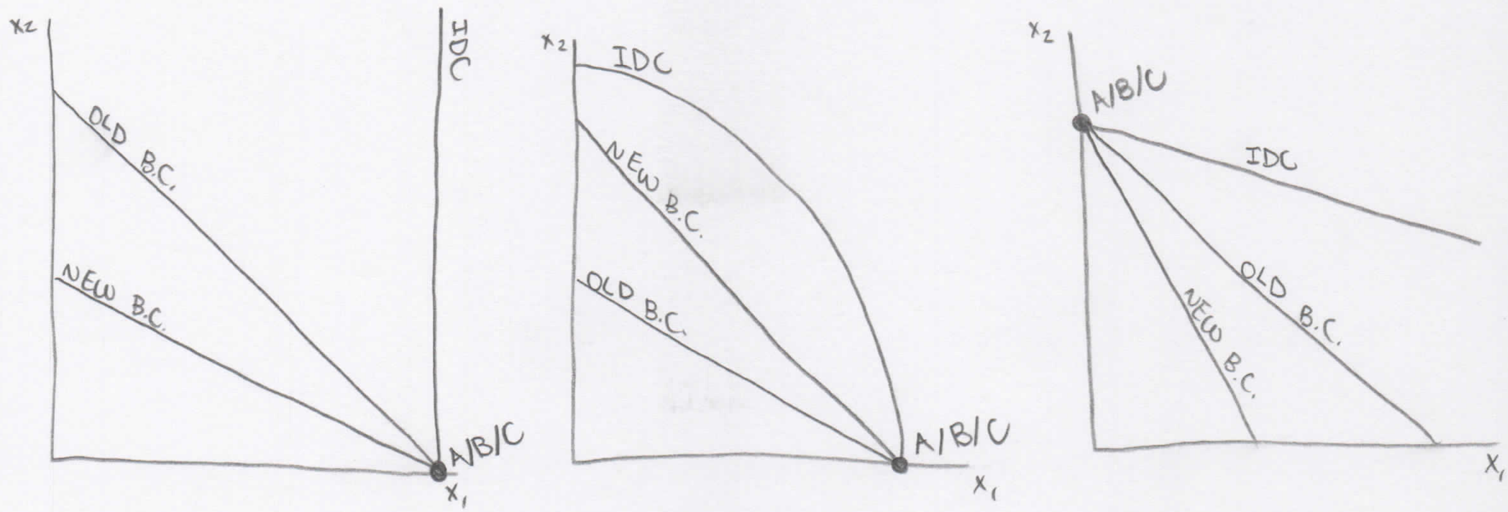
$$100 = m_1 - \frac{7m_1}{8}$$

$$100 = \frac{m_1}{8}$$

$$\boxed{m_1 = \$800}$$

3. Determine whether the following statement is true or false. It is impossible for a price change to cause no substitution, income, or total effects. If you believe the statement is false, sketch a graph demonstrating how a price change could cause no substitution, income, or total effects. $\boxed{\text{FALSE}}$

Examples



4. Which of the following is false?
   a. A person who is risk neutral would definitely choose a gamble with an expected value of $100 over a guaranteed payment of $95

   Risk neutral → always choose highest expected value
   Exp. val. gamble > Exp. val. guar pay → definitely choose gamble

   b. A person who is risk averse would definitely choose a guaranteed payment of $100 over a gamble with an expected value of $95

   Statement is true; would definitely choose guar payment

	Guar pay	Gamble
risk averse	✓	
higher E[C]	✓	

   c. A person who is a risk lover would definitely choose a gamble with an expected value of $95 over a guaranteed payment of $100

   Statement is false; might choose gamble, might choose guaranteed payment; can't say for sure without utility function

	Guar pay	Gamble	
higher E[C]	✓	✓	risk lover

   d. A person who is risk averse might choose a gamble with an expected value of $100 over a guaranteed payment of $95

   Statement is true; the gamble has a higher expected value, so they might choose it

	Guar pay	Gamble	
risk averse	✓	✓	higher E[C]

e. A person who is a risk lover would definitely choose gamble with an expected value of $100 over a guaranteed payment of $100

Statement is true; would definitely choose a gamble

Guar pay	Gamble	
	✓	risk lover
same E[c] ✓	✓	same E[c]

5. After a wage increase, the SE on Recreation is -5 and the IE on Recreation is 3. Find the TE on Labor due to the wage increase (if there is enough information provided to determine the answer).

	R		L
SE	-5	→	5
+ IE	+3	→ +	-3
TE	-2	→	2

$\boxed{TE_L = 2}$

$\bar{L} = R + L$

↳ Time is always constant so Recreation and Labor must move in opposite directions

6. $E[u(c_b, c_g)] = \frac{1}{2} c_b^2 + \frac{1}{2} c_g^2$ $m = 12$ $L = 8$ $\Upsilon = 0.5$

Find c_b^*, c_g^* and K^*. Assume the maximum amount of coverage I can buy is $8.

$MRS = \frac{c_b}{c_g}$

	$c_b \uparrow$	$c_g \downarrow$
MRS↓	X	X

MRS is increasing → IDC is concave

★ concave → consumer will either choose full insurance or none

If full insurance

$K^* = L = 8$

$c_b^* = m - L - \Upsilon K + K = 8$

$c_g^* = m - \Upsilon K = 8$

$u(8,8) = \frac{1}{2}(8^2) + \frac{1}{2}(8^2)$

$= \frac{1}{2}(64) + \frac{1}{2}(64)$

$u(8,8) = 64$

If no insurance

$K^* = 0$

$c_b^* = m - L = 4$

$c_g^* = m = 12$

$u(4,12) = \frac{1}{2}(4^2) + \frac{1}{2}(12^2)$

$= \frac{1}{2}(16) + \frac{1}{2}(144)$

$= 8 + 72$

$u(4,12) = 80$

Choose no insurance

$\boxed{K^* = 0 \quad c_b^* = 4 \quad c_g^* = 12}$

Notice that this consumer is a risk lover, thus they choose one of the extremes

7. I own a car, which is worth \$10 (this is my only wealth). There is a 20% chance that my car will get stolen and I will be left with no wealth. Usually, my insurance company charges \$0.20 for every dollar of coverage I buy, but today they are having a sale and will only charge me \$0.10 for every dollar of coverage I buy. I am allowed to buy coverage up to the amount of my loss (i.e. if my loss is \$5, I can buy a maximum of \$5 of coverage). If $E[u(c_b, c_g)] = 0.2\, c_b + 0.8\, c_g$ how much insurance coverage will I buy? In addition, what are my levels of consumption in the good state and in the bad state?

$$MRS = \frac{\left(\frac{2}{10}\right)}{\left(\frac{8}{10}\right)} = \frac{1}{4} \qquad \frac{\gamma}{1-\gamma} = \frac{\frac{1}{10}}{1-\frac{1}{10}} = \frac{\frac{1}{10}}{\frac{9}{10}} = \frac{1}{9}$$

$m = 10$

$L = 10$

$\gamma = 0.1$

$MRS > \frac{\gamma}{1-\gamma} \rightarrow$ choose all good 1 (c_b^*)

$K^* = L = 10$

$c_b^* = m - L - \gamma K + K = 10 - 10 - 0.1(10) + 10 = 9$

$c_g^* = m - \gamma K = 10 - 0.1(10) = 9$

* Notice that this consumer is risk neutral, thus they choose the highest expected payout

8. $U(x_1, x_2) = x_1 + (\frac{1}{2})x_2$

OLD: $p_1 = 3$ $p_2 = 2$ $m = 12$

NEW: $p_1 = 5$ $p_2 = 2$ $m = 12$

$MRS = \frac{1}{(\frac{1}{2})} = 2$

Find the numerical SE, IE, and TE on x_1 and x_2

	B.C. variables p_1	p_2	m	which good chosen?	Demands x_1^*	x_2^*	U
A	OLD 3	2	12	$2 > \frac{3}{2} \rightarrow$ all x_1	$\frac{m}{p_1} = 4$	0	4
B	NEW 5	2	X	$2 < \frac{5}{2} \rightarrow$ all x_2	0	8	4
C	NEW 5	2	12	$2 < \frac{5}{2} \rightarrow$ all x_2	0	$\frac{m}{p_2} = 6$	

$U(4,0) = 4 + \frac{1}{2}(0)$

$U_B = x_1 + \frac{1}{2}x_2$

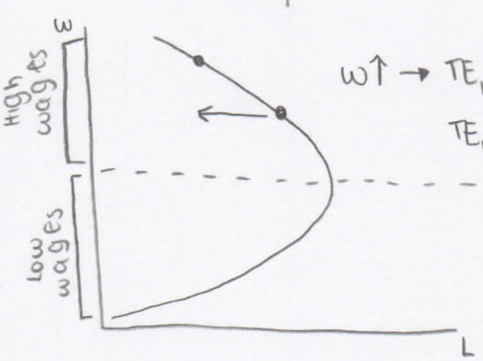
$4 = 0 + \frac{1}{2}x_2$

$x_2 = 8$

	x_1	x_2
SE = B − A	0 − 4 = −4	8 − 0 = 8
IE = C − B	0 − 0 = 0	6 − 8 = −2
TE = C − A	0 − 4 = −4	6 − 0 = 6

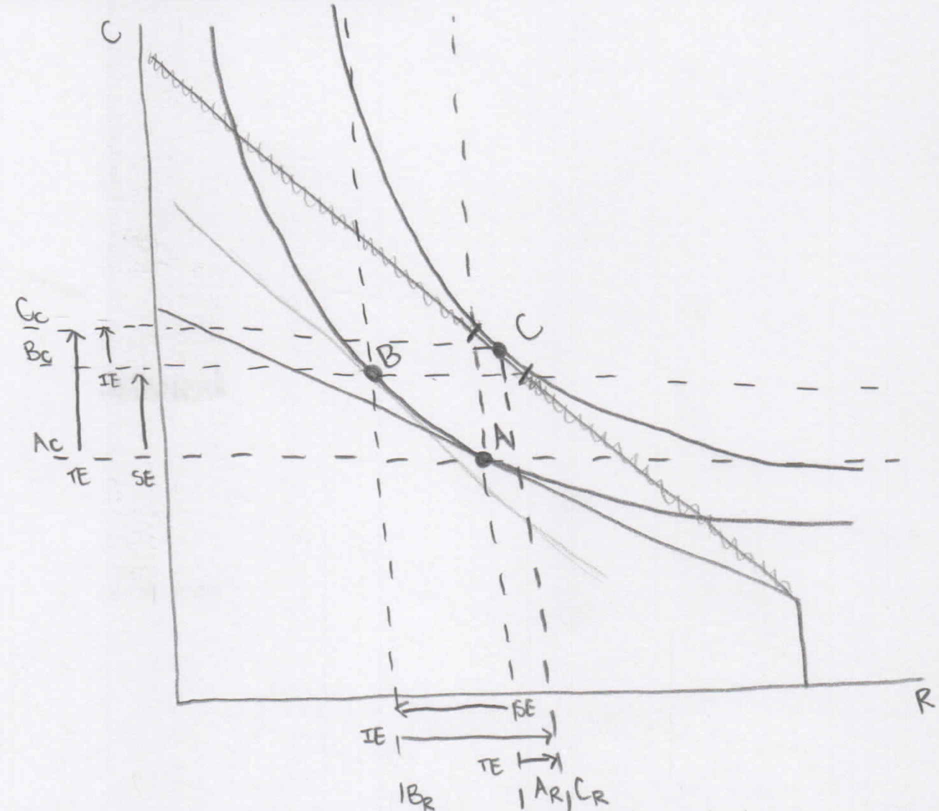
9. Graph the substitution, income, and total effects on ~~Leisure~~ Rec and ~~Income~~ Consumption due to a wage increase. Assume the consumer starts at high wages and has a backwards-bending Labor supply curve.

	R	C	
SE	↓	↑	
IE	↑	↑	P.P. ↑
TE	↑	↑	



$w\uparrow \rightarrow TE_L \downarrow$

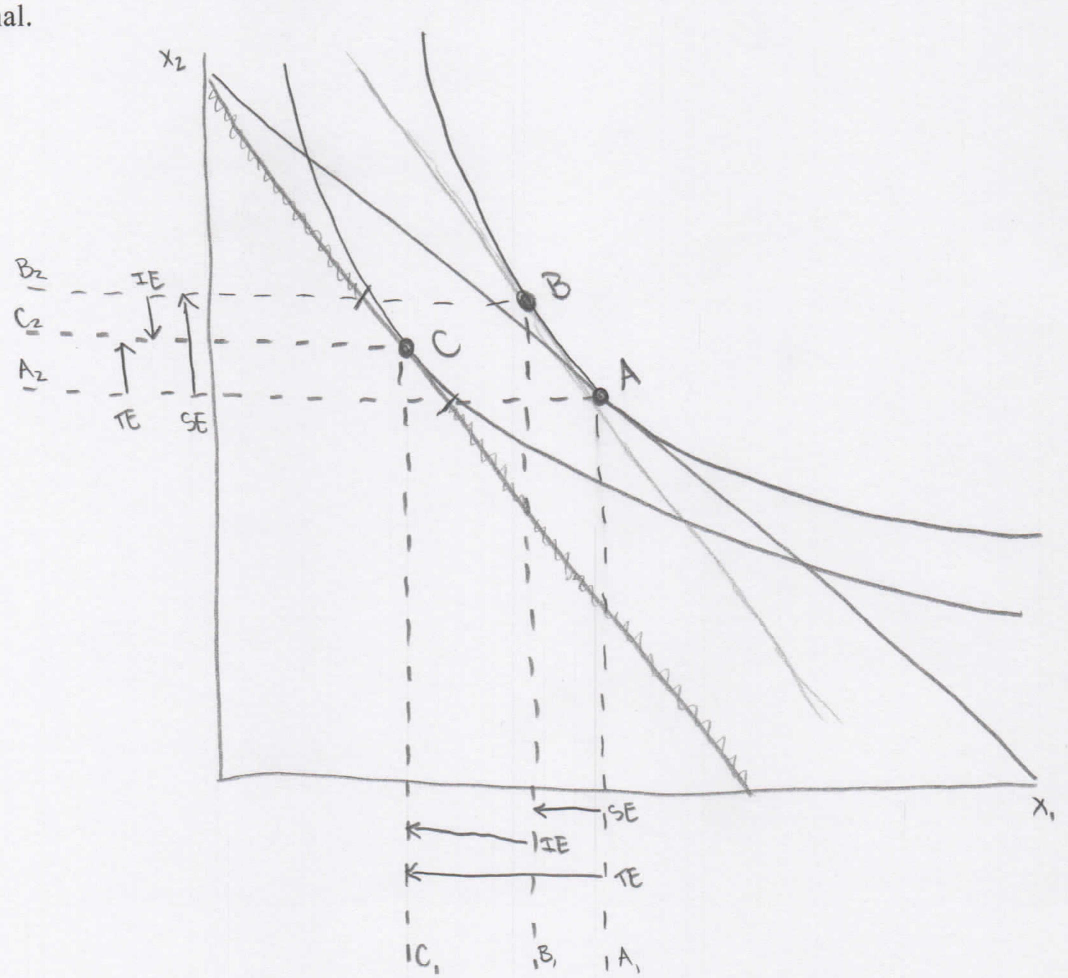
$TE_R \uparrow$



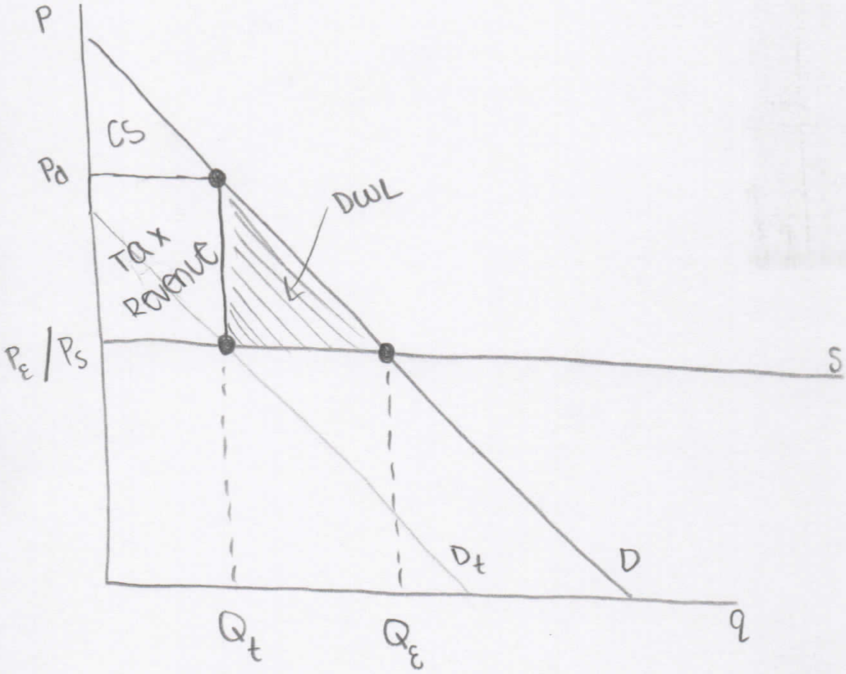
10. Graph the substitution, income, and total effects on x_1 and x_2 due to a p_1 increase. Assume x_2 is a substitute for x_1 and both goods are normal.

	x_1	x_2	
SE	↓	↑	
IE	↓	↓	P.P. ↓
TE	↓	↑	

sub: $p_1 \uparrow \rightarrow x_2 \uparrow$

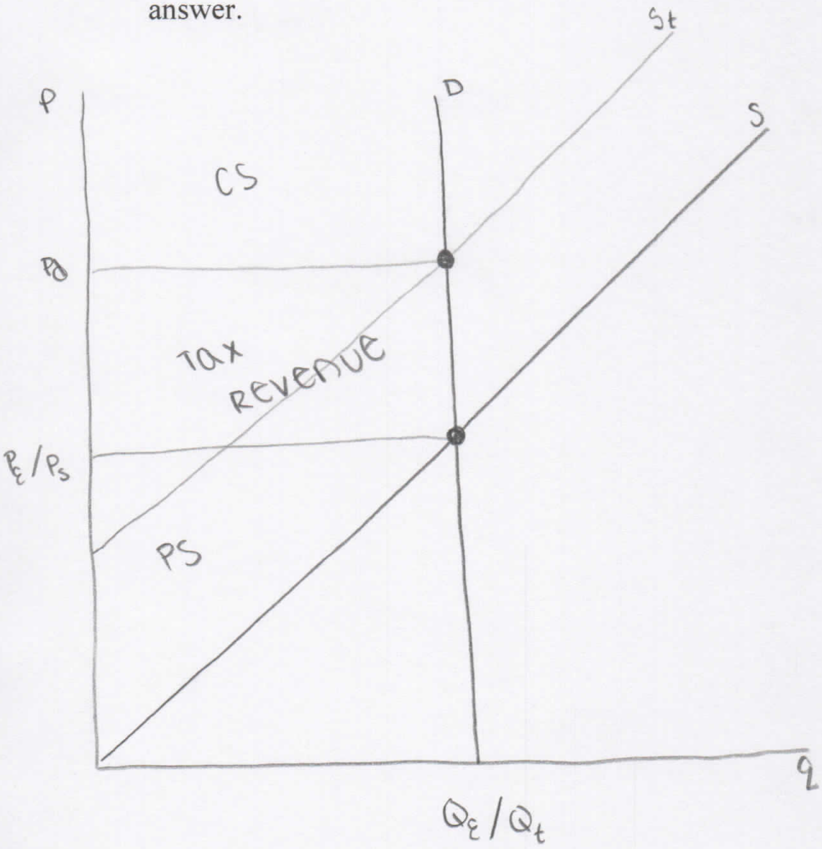


11. Describe the effect that a per-unit tax would have on producers, consumers, and society as a whole. Assume demand is linear and downward sloping; assume supply is perfectly elastic. Use a graph to support your answer.



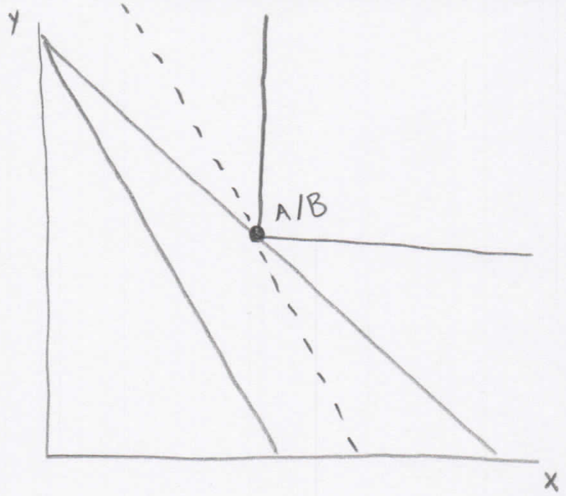
Quantity decreases. Consumers pay a higher price than before and their surplus is lower (because q decreases and p rises). Producers receive the same price as before. Even though the quantity is lower, PS is unchanged (it's zero before and after). Total welfare decreases (the tax causes a deadweight loss).

12. Describe the effect that a per-unit tax would have on producers, consumers, and society as a whole. Assume supply is linear and upward sloping; assume ~~supply~~ demand is perfectly inelastic. Use a graph to support your answer.



Quantity is unchanged. Consumers pay a higher price than before, thus their surplus is lower. Producers receive the same price as before, thus their surplus is unchanged (because both q and P are unchanged). Total welfare remains the same (there is no deadweight loss, and the increase in government revenue makes up for the loss in consumer surplus).

13. $U(x, y) = \min[5x, y]$. The price of y is \$1 and income is \$64. The price of x is initially \$3, but then it rises to \$7. Find the numerical substitution effects on x and y.



perf comps → A and B are always the same point

$$\boxed{SE = B - A = 0}$$

14. $u(x, y) = 4x^{1/2} + y$

a. Find the reservation price of the first unit of x (assume y is unknown but represents all income not spent on good x). Round your answer to the nearest tenth, if necessary.

$r_1 = u(1, y) - u(0, y)$

$= [4(1)^{1/2} + y] - [4(0)^{1/2} + y]$

$\boxed{r_1 = 4}$

* Notice that because the consumer has quasilinear utility, y does not affect the reservation price for x

b. Find the reservation price of the second unit of x (assume y is unknown but represents all income not spent on good x). Round your answer to the nearest tenth, if necessary.

$r_2 = u(2, y) - u(1, y)$

$= [4(2)^{1/2} + y] - [4(1)^{1/2} + y]$

$= 5.7 - 4$

$\boxed{r_2 = 1.7}$

c. Find the reservation price of the third unit of x (assume y is unknown but represents all income not spent on good x). Round your answer to the nearest tenth, if necessary.

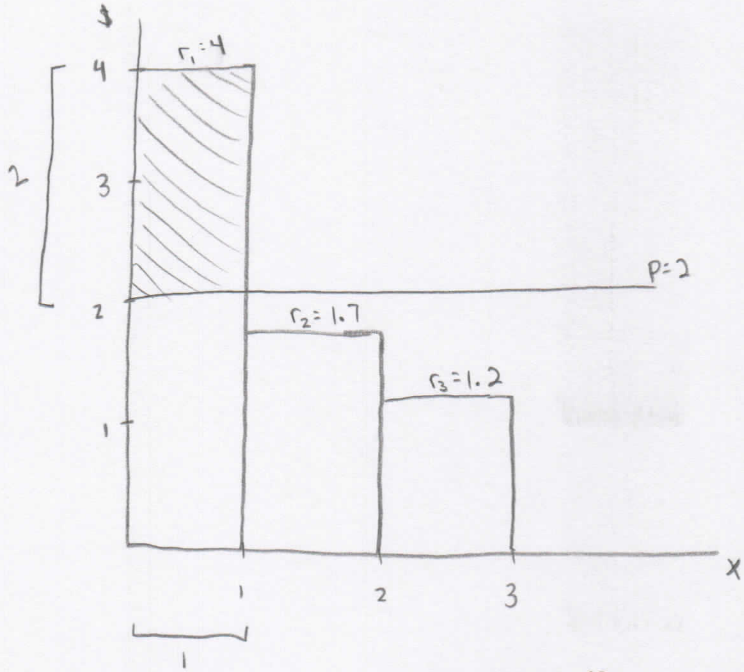
$r_3 = u(3, y) - u(2, y)$

$= [4(3)^{1/2} + y] - [4(2)^{1/2} + y]$

$= 6.9 - 5.7$

$\boxed{r_3 = 1.2}$

d. Assume price is \$2. How many units will the consumer buy and what is their consumer surplus?



$\boxed{Q = 1}$

$CS = (4-2)(1)$

$\boxed{CS = \$2}$

15. Which of the following could be true if m_1 increased?

a. A saver becomes a borrower

b. A borrower becomes a saver

c. The SE on c_1 is positive

d. Multiple answers above are correct

e. None of the above

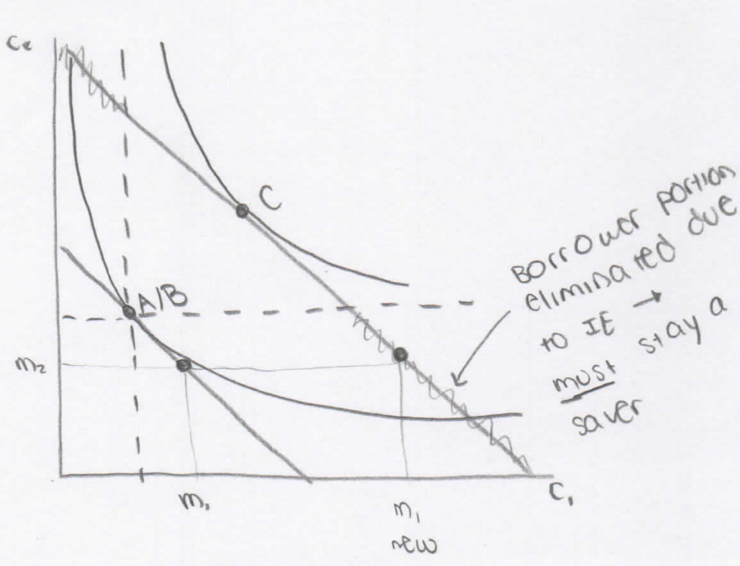
SAVER $m_1 \uparrow \rightarrow$ P.P. $\uparrow$

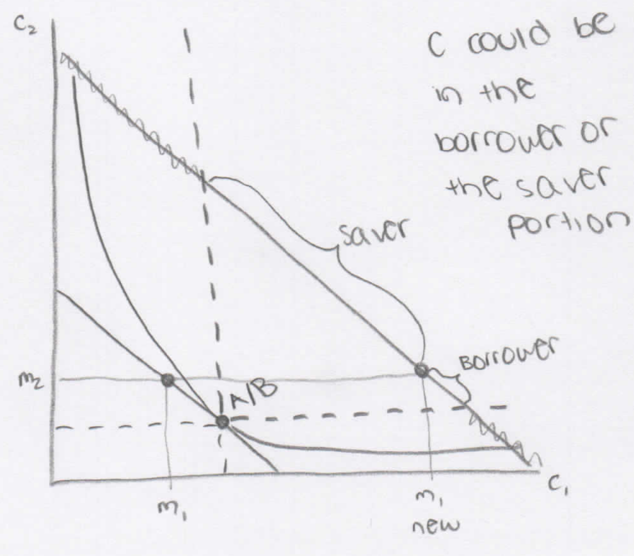
	C_1	C_2
SE	—	—
IE	↑	↑
TE	↑	↑

★ If just income changes, then SE = 0

BORROWER $m_1 \uparrow \rightarrow$ P.P. $\uparrow$

	C_1	C_2
SE	—	—
IE	↑	↑
TE	↑	↑





16. Anne currently lives and works in New York City. Anne earns $400 per week from rental properties she owns, and she earns $100 per hour at her job. Anne is considering relocating to Chicago. If Anne relocated, her moving costs would be covered by her company, and she would earn $60 per hour at her new job in Chicago. However, because of her lack of proximity to her rental properties, Anne would have to hire a property manager, and she would only earn $120 per week from her rental properties. Anne has also done research on the cost of living in each city and has determined that New York City is twice as expensive as Chicago (thus, you can assume that the price of consumption in Chicago is $1 and the price of consumption in New York City is $2). Each week, Anne has 100 hours to allocate between working and recreation. If Anne's utility function is U(R, C) = RC, where R is the number of hours of recreation per week and C is the dollars of consumption per week, should Anne move to Chicago?

① $U(R,C) = RC$

② $MRS = \frac{C}{R}$

③ $\frac{C}{R} = \frac{w}{p}$

④ $C = \frac{wR}{p}$

⑤ $wR + pC = M + w\bar{L}$

$wR + p\left(\frac{wR}{p}\right) = M + w\bar{L}$

$2wR = M + w\bar{L}$

$\boxed{R^* = \frac{M + w\bar{L}}{2w}}$

⑥ $C = \frac{w}{p}(R)$

$C = \frac{w}{p}\left(\frac{M + w\bar{L}}{2w}\right)$

$\boxed{C^* = \frac{M + w\bar{L}}{2p}}$

New York City

$M = \$400$ $w = \$100$

$\bar{L} = 100$ $p = \$2$

$R^* = \frac{400 + (100 \times 100)}{(2 \times 100)} = 52$

$C^* = \frac{400 + (100 \times 100)}{(2 \times 2)} = 2600$

$U(R,C) = RC$

$U(52, 2600) = 52 \times 2600$

$= \underline{135{,}200}$

Chicago

$M = \$120$ $w = \$60$

$\bar{L} = 100$ $p = \$1$

$R^* = \frac{120 + (60 \times 100)}{(2 \times 60)} = 51$

$C^* = \frac{120 + (60 \times 100)}{(2 \times 1)} = 3060$

$U(R,C) = RC$

$U(51, 3060) = 51 \times 3060$

$= \underline{156{,}060}$

Anne should move to Chicago because $U(\text{Chicago}) > U(\text{NYC})$

17. Zach is choosing how many hours to work this month. Zach earns $20 per hour at his job, and the price of consumption is $1. Each month, Zach can allocate 400 hours between working and recreation. A few years ago, Zach won the lottery and he chose to receive his winnings in equal monthly installments. Zach's monthly installments total $120,000 each year. Zach's utility function is U(R, C) = R * C^5, where R is the number of hours of recreation per month and C is the dollars of consumption per month. How many hours will Zach choose to work?

① $U(R,C) = RC^5$

② $MRS = \frac{C^5}{5RC^4} = \frac{C}{5R}$

③ $\frac{C}{5R} = \frac{w}{p}$

④ $C = \frac{5Rw}{p}$

⑤ $wR + pC = M + w\bar{L}$

⑤ $wR + \cancel{p}\left(\frac{5Rw}{\cancel{p}}\right) = M + w\bar{L}$

$6wR = M + w\bar{L}$

$$\boxed{R^* = \frac{M + w\bar{L}}{6w}}$$

⑥ $C = \frac{5w}{p}(R)$

$C = \frac{5\cancel{w}}{p}\left(\frac{M + w\bar{L}}{6\cancel{w}}\right)$

$$\boxed{C^* = \frac{5(M + w\bar{L})}{6p}}$$

$w = \$20/\text{hour}$ *

$p = \$1$

$\bar{L} = 400$ hours/month * ✓

$M = \$120{,}000$/year ✗

→ $10,000/month ✓

Make sure all units match up – wage units should match total time units; non-wage income units should match total time units; total time units must match R and C units. Must adjust M to match $\bar{L}$ (and R and C)

$R^* = \frac{10000 + (20 \times 400)}{(6 \times 20)} = 150$

$C^* = \frac{5(10000 + (20 \times 400))}{(6 \times 1)} = 15{,}000$

$$\boxed{R^* = 150 \quad C^* = 15{,}000}$$