1. (16 points) In the snowy town of Skinny Atlas, the demand curve for driveway snow plowing is

\[ P = 40 - \frac{1}{5}Q_D \] 

and the supply curve is 

\[ P = \frac{3}{5}Q_S, \] 

where \( Q_D \) is the quantity of snow plowed driveways demanded and \( Q_S \) is the quantity of snow plowed driveways supplied.

a. What is the equilibrium quantity and price in this market?

\[ P^* = 30 \quad Q^* = 50 \]

b. At the equilibrium price, what is the price elasticity of demand for snow plowing? Is it elastic or inelastic? Does this fit your expectations for whether snow plowing should be elastic or inelastic? Defend your answer by showing that you know what determines elasticity.

\[ \eta = \frac{1}{slope}\frac{P}{Q} = \frac{1}{-\frac{1}{5}} \frac{30}{50} = -5 \frac{3}{5} = -3 \]

This is an elastic demand. A one percent change in price leads to a 3 percent change in quantity demanded.

If there are lots of substitutes for snowplowing (shoveling yourself, snow blower, not shoveling at all!), then we would expect this to be an elastic good. Or, if it is a large part of your budget. If Skinny Atlas is a high income town, this will not be the case and we would expect an inelastic demand.

c. Suppose the newly elected mayor places a tax of $8/driveway plowed on suppliers of snow plowed driveways. What is the new equilibrium price and quantity in the market? Show this graphically.

\[ P^* = 32 \quad Q^* = 40 \]
d. Who bears the burden of this tax? That is, what share of the tax is borne by consumers and producers? Be precise in your answer.

\[
\text{Burden borne by consumers: } \frac{32 - 30}{8} = \frac{2}{8} = \frac{1}{4}
\]

Producer’s share: \( 1 - \frac{1}{4} = \frac{3}{4} \)

e. What is the tax revenue raised by this tax?

\[ 8 \times 40 = 320 \]

f. If the cross price elasticity between snow plowing and Thermafleece jackets is 1, what will be the effect of the snow plowing tax on the demand for Thermafleece jackets?

The cross price elasticity is

\[
\frac{\%\Delta Q_{\text{thermafleece}}}{\%\Delta P_{\text{snowplowing}}} \]

which equals 1.

Because the cross price elasticity is positive, these 2 goods are substitutes and an increase in the price of snowplowing due to the tax leads to an increase in the demand for jackets. Therefore, the 6.7\% = 0.067 = (32 - 30)/30 increase in the price of snowplowing results in a 6.7\% increase in the quantity demanded of Thermafleece jackets.

g. The town council argues that the residents of Skinny Atlas who consume the snow plowing are wealthy and the snow plowers are not. Therefore, they should place a $12/snowplow tax on consumers and a $4/snowplow subsidy on producers. The subsidy is the opposite of a tax. Without doing more calculations, intuitively explain how your answer to part d would change.

No difference, the net is a $8 tax and elasticity determines the burden, not who the subsidy/tax is on.
2. (10 points) Please answer the following questions true, false or uncertain and completely explain your answer.

a. **True, false or uncertain** Suppose that Lucy has a utility function of 2M, where M is income. She will accept a gamble whose expected value is greater than zero (more than fair), no matter what her income is.

Lucy is risk neutral because her utility function is linear with respect to income (which is the same as saying her marginal utility of income is constant). Therefore, she will always accept a gamble whose expected value is greater than zero.

b. As we discussed in class, College X has an admission policy where applicants are not required to submit their SAT scores. However, they can voluntarily disclose their SAT scores on their application if they like. Of the 3,710 applicants, 958 (24 percent) did not disclose their SAT scores to College X.

**True, false or uncertain** If disclosure is costless for the applicant, economic theory predicts that such a large fraction of applicants would not submit their scores.

If disclosure is costless, economic theory predicts only those with the very worst scores would not reveal/submit their scores to the school. The reason is that the school’s expectation of a student’s score conditional on not submitting would be worse than her actual scores unless the student has one of the very worst scores. Remember that the school’s expectations conditional on not submitting would depend on the other information the student provides in her application (such as high school GPA). This is the unraveling principle discussed in class and in our paper.

**True, false or uncertain** If an applicant scored an 1180 on the SATs, she would be more likely to disclose her SAT score to College X if her high school grade point average is 3.8 compared to a 3.2.

It depends on how the school’s expectation of a student’s score, conditional on the student not submitting, depends on the student’s high school GPA. I would suspect that these expectations would be worse for a student with a high school GPA of 3.2 than a GPA of 3.8. Therefore, I would suspect that the student with the GPA of 3.2 would be more likely to disclose her 1180 SAT score.
3. (14 points) MSU is thinking of offering a student health insurance plan. At MSU there are two groups of people, each with a utility of $U = \sqrt{M}$, where $M = \$100$ is the initial wealth level for every individual. The two groups are of equal size. Each member of the first group faces the possibility of an illness that will cost them $\$75$ with probability of $\frac{1}{5} = 0.2$. That is, their income will fall by $\$75$ if they get ill. Each member of the second group faces the same loss ($\$75$) with probability $\frac{3}{5} = 0.60$.

a. Suppose that MSU students have access to insurance and can pay $P$ for insurance that would cover their entire $\\$75$ in losses in the event of getting sick. That is, they can have income of $\$100 - P$ whether or not they get ill.

i. What is the most the first group of students would be willing to pay for this insurance? Show your work.

The first group is willing to pay for insurance if the utility from having insurance is at least as great as expected utility from not having insurance. Therefore, they are willing to pay $P$ if

$$\sqrt{100 - P} \geq 0.2 \sqrt{100 - 75} + 0.8 \sqrt{100} \text{ or when } P \leq 19$$

Therefore, the maximum they are willing to pay is $\$19$ for insurance.

ii. What is the most the second group of students would be willing to pay? Show your work.

The second group is willing to pay for insurance if the utility from having insurance is at least as great as expected utility from not having insurance. Therefore, they are willing to pay $P$ if

$$\sqrt{100 - P} \geq 0.6 \sqrt{100 - 75} + 0.4 \sqrt{100} \text{ or when } P \leq 51$$

Therefore, the maximum they are willing to pay is $\$51$ for insurance.

b. In part (a) it is impossible for MSU to discover which individual belongs to which group. Assuming that MSU will charge only enough in premiums to cover their expected claim, will it be practical for members of the second group to insure against this loss in a competitive insurance market? Fully show how you know.

The following represent the expected claims from each type:

$$E(\text{Claim})_{\text{first group}} = \frac{1}{5} \times 75 = 15$$

$$E(\text{Claim})_{\text{second group}} = \frac{3}{5} \times 75 = 45$$

50% are from the first group and 50 percent are from the second group, so the expected claims are:

$$E(\text{Claims})_{\text{overall}} = 0.5 \times 15 + 0.5 \times 45 = 30$$

If the insurance agent is only trying to cover their expected claims (0 profit condition), they will charge a premium of $\$30$. In this case, members of the second group will buy it and adverse selection will occur because members of the First Group (less risk group) will not buy insurance. Knowing this, the insurance agent will charge a premium of $\$45$ and only the second group will buy insurance.
4. (10 points) Mike Conlin and Stacy Dickert-Conlin live in East Lansing and are currently looking for a nanny for their son Charlie. Suppose two different types of nannies exist in East Lansing. Type G is a good nanny who will play with Charlie and Type B is a bad nanny who will watch Jerry Springer with Charlie. There are forty good nannies and sixty bad nannies. All good nannies have a reservation value of $25,000 per year and all bad nannies have a reservation value of $15,000 per year. (Therefore, the good nannies are not willing to work as a nanny for less than $25,000 per year and the bad nannies are not willing to work as a nanny for less than $15,000 per year. Perhaps the reason good nannies have a higher reservation value is because they can obtain jobs as teachers or at day care facilities.)

All potential employers of nannies in East Lansing are willing to pay $30,000 for a good nanny and $20,000 for a bad nanny. Assume there are thousands of risk-neutral potential employers of nannies who cannot differentiate between a good nanny and a bad nanny, but they know that there are forty good nannies and sixty bad nannies.

a. Depict the supply and demand curves for nannies on the graph below. In equilibrium, how many nannies are employed in East Lansing and how much are they paid? SHOW CALCULATIONS.

If the wage is at least $25,000, then both the good and bad nannies are willing to take the job. All potential employers are willing to pay

\[ 30,000 \times \frac{40}{100} + 20,000 \times \frac{60}{100} = 24,000. \]

Therefore, no buyer will pay a nanny over $25,000 (the quantity demanded of nannies is 0 at wages over $25,000). At wages between $20,000 and $25,000, the quantity demanded of nannies is also zero because buyers know only the bad nannies are willing to take the job. The demand curve is as depicted above because all buyers are willing to pay a wage of $20,000 for a bad nanny.

b. Mike and Stacy are different than the other potential employers of nannies. Because Mike and Stacy think Charlie is well above average, they are willing to pay a good nanny $60,000 per year and a bad nanny only $10,000 per year. If this is the case, what salary should Mike and Stacy offer a nanny? Explain why in detail. (This is what two economists talk about at home.)

Mike and Stacy are willing to pay a nanny

\[ 60,000 \times \frac{40}{100} + 10,000 \times \frac{60}{100} = 30,000 \]

when both types of nannies are willing to accept their wage. Mike and Stacy know that good nannies are willing to accept $25k and bad nannies $15k. Therefore, Mike and Stacy should offer a wage of $25k and whether they end up with a good or bad nanny will be based on luck.
5. (4 points) The average variable cost (AVC) for a firm if it produces 5 units of a good is $10 and the firm’s total fixed cost (TFC) is $30. Suppose the marginal cost (MC) associated with the 5th unit is $17 and the marginal cost associated with the 4th unit is $12. Based on this information, what is the average total cost (ATC) for the firm if it produces 3 units? SHOW CALCULATIONS.

The total variable cost of producing 5 units is $10 \times 5 = 50 (AVC \times Q)$ so the total cost of producing 5 units is $50 + 30 = 80 (TVC+TFC)$. If the marginal cost of producing the 5th unit is 17, the total cost of producing 4 units is $80 - 17 = 63$. If the marginal cost of producing the 4th unit is 12, the total cost of producing 3 units is $63 - 12 = 51$ and, therefore, the average total cost of producing 3 units is $51/3 = 17 (TC/Q)$.

6. (6 points) The graph below depicts the isoquant curves for a particular firm (along with the output, in units, associated with each isoquant) where K denotes units of capital and L denotes units of labor.

Suppose the cost of capital is $1 per unit and the cost of labor is $6 per unit.

a. On the graph above, identify how much capital and labor a profit maximizing firm will employ in the long-run if the firm produces an output of 100 units? EXPLAIN. (Depict the appropriate isocost curve on the graph above. The isocost curve does not have to be exact but it should reflect the cost of capital and the cost of labor.)

The isocost depicted above corresponds to a total cost of $24. It is tangent to the isoquant associated with 100 units of output. Therefore, the firm cost minimizing manner in which a firm can produce 100 units of output is with (approximately) 12 units of capital (K) and 2 units of labor (L).

b. What is the firm’s long-run average total cost associated with producing 100 units of output? SHOW CALCULATIONS.

The total long-run cost of producing 100 units is $24 (12 \times 1 + 2 \times 6 = 24)$ based on the isocost depicted. Therefore, the long run average total cost is $24/100 = .24$. 