Public Economics 2
Problem Set 3
Suggested solutions

1 Police and Body Cameras (50pts)

1. With data from one year, and with an assignment rule with a sharp cut, the best method would be a regression discontinuity design, comparing counties with crime rates just below 0.65 with counties where the crime rate is just above 0.65 at allocation.

   The model would be:
$$B_i = \alpha + \delta C_i + f(H_i) + \varepsilon_i \tag{1}$$

2. This model requires the assumption that the expected value of the outcome is continuous as it approaches the threshold from both below and above, meaning that no sorting around around $H_i = 0.65$ can be observed. The only thing changing is assumed to be treatment status (C_i).

3. The estimate acquired is a local treatment effect applicable for counties with a crime rate around 0.65. While it is unbiased for these counties, the effect is not necessarily directly possible to generalize for counties with a lower crime rate.

4. This policy invalidates the assumptions, as it does not evolve smoothly over the threshold. We will not be able to separate the effect of body cameras from the effect of armored police cars. Using the same method as above, with data from times around the introduction of the previous policy, it can be tested if the policy had any effect. If the effect is zero, it is not a problem here.

   Bonus: We could also use a difference-in-difference-design to estimate the effect of body cameras, as this allows for possible differences between the groups.

5. If the cutoff is announced long before the treatment starts, randomness can not be assumed. Some counties might manipulate their crime rates to end up in the most beneficial group (in their opinion). To be able to use the estimator, we must test for bunching at the threshold.

2 Optimal Income Tax Evasion (50pts)

1. The optimal choice X^* is the value of X maximizing the following problem.

$$\max_X (1-p) \cdot ln(W - \theta X) + p \cdot ln(W - \theta X - \pi(W - X))$$

   Taking the derivative with respect to X gives the FOC:

$$\frac{-\theta(1-p)}{W-\theta X} + \frac{p(\pi-\theta}{W-\theta X-\pi(W-X)} = 0$$
$$\Leftrightarrow \frac{\theta(1-p)}{W-\theta X} = \frac{p(\pi-\theta}{W-\theta X-\pi(W-X)}$$

Solving for X, we get the optimal amount of income to declare.

$$X = \frac{p\pi-\theta+\theta\pi-\theta p\pi}{\theta\pi-\theta^2}W$$

Assigning $\delta(p,\pi)$ the following value,

$$\delta(p,\pi) = \frac{p\pi-\theta+\theta\pi-\theta p\pi}{\theta\pi-\theta^2}$$

we have now showed that

$$X^* = \delta(p,\pi)W$$

2. The taxpayer will report $X > 0$ when $\delta > 0$. In other words

$$\frac{p\pi-\theta+\theta\pi-\theta p\pi}{\theta\pi-\theta^2} > 0$$

This simplifies to

$$\pi > \frac{\theta}{p(1-\theta)+\theta}$$

From which it is clear that $\pi > \theta$. This result is intuitive, as the penalty must be higher than the tax rate for it to make sense to pay the tax.

As p increases, the extent to which π must be larger than θ decreases. If you are more likely to have to pay the penalty, the penalty can be smaller.

3. When p increases, δ increases. If the probability to be caught increases, the fraction of income reported will increase. The same holds for π. A larger potential penalty will increase the fraction reported (decrease tax evasion). On the other hand, an increase in θ will cause an increase in tax evasion, implying a decrease in δ.

This could be shown analytically, but an arguing answer is enough for full points.

4. Setting $\delta = 1$ we get the following:

$$\frac{p\pi-\theta+\theta\pi-\theta p\pi}{\theta\pi-\theta^2} = 1$$
$$\Leftrightarrow p\pi-\theta+\theta\pi-\theta p\pi = \theta\pi-\theta^2$$
$$\Leftrightarrow p\pi(1-\theta) = \theta(1-\theta)$$
$$\Leftrightarrow p\pi = \theta$$

So, if the expected penalty equals the tax, there is no reason to evade and report less than the actual earnings.