PLCY 2455 and 2460

Lab Exercise #1
Summer 2017
Due WEDNESDAY 6/14/2017, at 1:00pm

Last Name: Sarcone

First Name: Krystal

*** NOTE: To support our lab discussion on June 14, please bring:**

1. **A copy of the case study**
2. **An extra copy of your Question 1 solution.**

Group members you worked with:

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Michael Gong

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Mike Fubini

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Please use this as cover page and remember to:

Read the case study "Providing Public Housing: Targeting Housing Grants," and download the accompanying datasets.

(1) Calculate the leakage and undercoverage rates for each of the two options. Show your calculations and report the final results in a table such as the one below:

	Leakage	Undercoverage
Option 1: Less than HS Education	**66.49%**	**78.96%**
Option 2: Live in Poor Neighborhood	**69.16%**	**31.10%**

(2) The proposed appropriation for this program is $10,000,000. Please check whether the option evaluated above will fit inside this budget. If not, please provide updated estimates of the leakage and undercoverage for each option.

	Leakage	Undercoverage
Option 1: Less than HS Education	**Under Budget**	**Under Budget**
Option 2: Live in Poor Neighborhood	**Same**	**70.43%**

(3) It is important that the program be able to find willing landlords for all individuals who are accepted into the program. Use the data from your survey of landlords to assess the feasibility and efficiency of your preferred option. Propose a different size rent level if you think this would improve your preferred option and analyze leakage and undercoverage under your new proposal.

At $750 per voucher, landlords would only be willing to supply 8,500 apartments total, which falls short of covering the total number of eligible households in Option 1 (8,730 households). In order to incentivize landlords to cover these additional 230 households, we calculated the new optimal voucher value (using instantaneous rate of change between the number of apartments supplied at $750 and at $1,000) at $773. At this value, all eligible households should in theory be able to access a supplied apartment. Furthermore, although this higher value does bump the overall budget to $6,748,290, it remains well below the proposed appropriation of $10,000,000 and does not boost the leakage or undercoverage rates.

(4) Taking everything above into account, write a short memo (one paragraph) to the Governor recommending an approach to targeting the Pension program. Justify your recommendation using the advantages and disadvantages you identified above. The memo should be written in a language that someone not formally trained in economics and statistics can understand.

In order to most effectively and efficiently advance your goal of providing affordable housing assistance to those in need, our team recommends the selection of Option 1 as our eligibility criteria – households headed by someone with less than a high school education. Under this criterion, all 8,730 eligible households (in the population) can be covered, favorably distinguishing it from Option 2, whose over-inclusive criteria would force us to exclude over 17,000 of the 31,000 eligible households from the program given the $10M appropriation. This inevitable random exclusion would be extremely difficult to justify to potential recipients, advocacy groups, and ultimately the legislature, and would likely be politically disastrous. Option 1 by comparison not only allows us to cover all eligible households, but does so for significantly less than the proposed appropriation. This difference (of almost $3.5M dollars) allows us to actually boost the grants from $750 to $773, ensuring that landlords will have sufficient economic incentive to provide enough affordable housing units to all eligible recipients. Although the leakage rates for this option are relatively high, meaning around 66% of eligible program participants are not technically poor (which somewhat undermines your commitment to ensuring only those "in need" receive grants), this rate is actually less than the leakage rate of Option 2. Furthermore, the criteria in Option 1, though perhaps not as effective at pinpointing the poor population, does have the benefit of being measured and directly quantifiable. For each household, we know based on our survey the education status of the head of household. For the criteria in Option 2 on the other hand, we do not have a granular breakdown of neighborhood income – inevitably this introduces some uncertainty into our modeling and limits our ability to monitor and tweak this program moving forward.

(5) Based your answer to (4), identify either Option 1 or 2 as your preferred option. Enter your answer on the course website using the pre-lab online exercise.

Completed Individually.

Total Households	126,810
Multiplier	45

Households **2,818**

Option 1		
	Total	%
Poor	309	10.97%
Less than HS Education	194	6.88%
Not Poor AND Less Than HS Education	129	4.58%
Poor and MORE than HS Education	244	8.66%
Poor and Less than HS Education	65	2.31%

"Leakage"		
	Total	%
P(Not Poor|Less than HS Education)	X	**66.49%**
"Undercoverage"		
P(More than HS Education | Poor)	X	**78.96%**

Budget
Per Household
Total Households
Households To Be Covered
% covered
Out of the 296, 204 will be leakage
People in need
Would have been covered, lost now
In Budget, people that were undercounted
Total in need but uncovered

% of households live in low-income neighborhoods	24.50%
% of poor households live in low-income neighborhoods	68.90%

Option 2		
	Total	%
Households in Low Income Neighborhood	690.41	24.50%
Households that are poor and low income neighborhoods	212.90	7.56%
Households that are not poor and low income neighborhood	477.51	
Poor and Live in Low Income Neighborhood	96.10	
"Leakage"		
	%	Total
P(Not Poor | Live in Low Income Neighborhood)	**69.16%**	477.51
"Undercoverage"		
P(Not Living in Low Income Neighborhood | Poor)	**31.10%**	
"Undercoverage With Constraint"		
New Rate	**70.43%**	

10000000	
750	
13,333.33	Apply to leakage
296.30	
42.92%	
204.93	
91.37	
121.53	
96.10	
217.63	

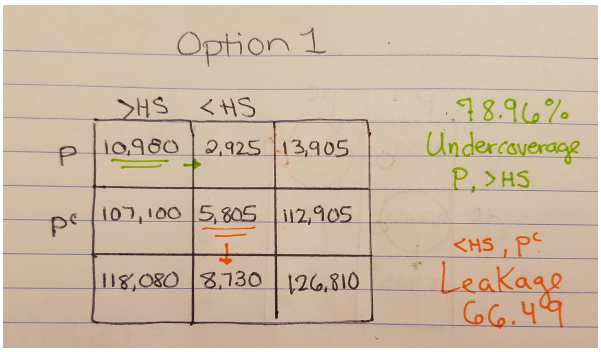
Rent	Total Apartments Supplied
$ 100	150
$ 250	3,000
$ 500	6,500
$ 750	8,500
$1,000	11,000
$1,250	13,000
$1,500	15,000
$1,750	15,500
$2,000	16,000

	Option 1	
	Sample Households Eligible	194
	Population Households Eligible	8,730
	Budget Per Household	$ 750.00
	Total Option Cost	$ 6,547,500.00
*	Instantaneous Rate of Change	10%
	Additional Budget/Apartment Needed	$ 23.00
	Optimal Voucher Value	$ 773.00
	Optimal Budget	**$ 6,748,290.00**

Under Coverage	
More than a high school education and Poor	78.96%

Leakage / Over Coverage	
Less than a high school education and NOT Poor	66.49%

Using ONLY information between the $750 - $1,000

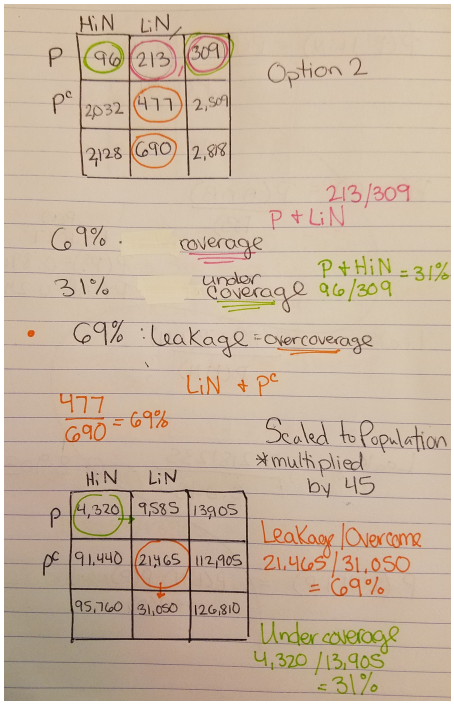


OPTION 1

	> HS Education	< HS Education	
Poor	10,980	2,295	13,905
Not Poor	107,100	5,805	112,905
	118,080	8,730	126,810

Undercoverage = Poor with > HS Education = 10,980 / 13,905 = 78.96%

Leakage / Overcoverage = < HS Education but NOT Poor = 5,805 / 8,730 = 66.49%

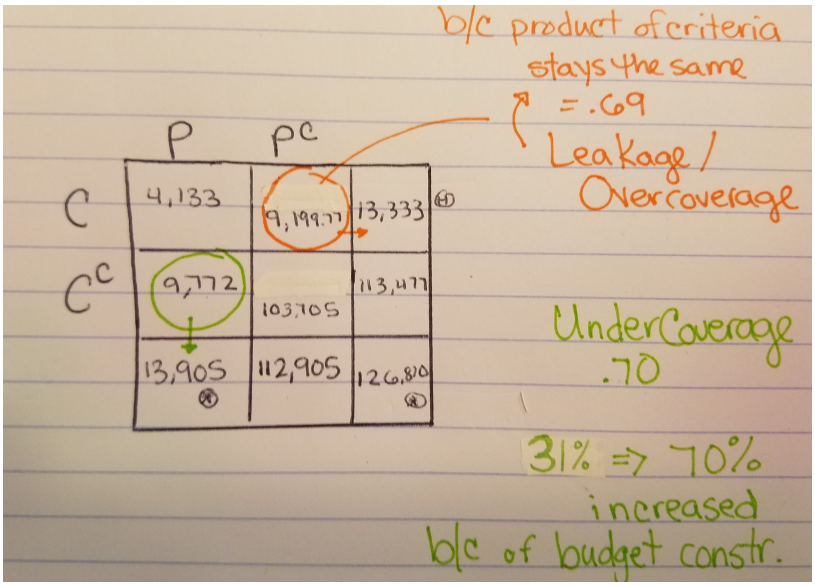


OPTION 2

	Live in HIGH In NB	Live in LOW In NB	
Poor	4,320	9,585	13,905
Not Poor	91,440	21,465	112,905
	95,760	31,050	126,810

Undercoverage = Poor but Live in High Income Neighborhood = 4,320 / 13,905 = 31%

Leakage / Overcoverage = Live in LOW Income Neighborhood but NOT Poor = 21,465 / 31,050 = 69%



Covered

	Poor	Not Poor	
Covered	4,133	9,200	13,333
Not Covered	9,772	103,705	113,477
	13,905	112,905	126,810

Undercoverage = Poor but NOT covered = 9,772 / 13,905 = 70%

Changes because of budget restraints, we can't cover as many people as our original criteria because of funds, we now able to cover fewer poor people. This undercoverage goes up which makes sense.

Leakage / Overcoverage = NOT Poor but Covered = 9,200 / 13,333 = 69%

Same rate because product of criteria

Part I: Background: Obesity in the U.S.

Read the paper ("Prevalence of Child and Adult Obesity in the United States, 2011-2012 and read the case study "Combatting Obesity with Policy: Taxes versus Labeling," and download the accompanying datasets.

(1) This question refers to Table 6 of "Prevalence of Child and Adult Obesity in the United States, 2011-201

a. In the first row of the table below the headers, in the column below "2003-2004," you will see the numbers "9.5 (7.1 to 12.7)." Describe what these numbers are to your statistics professor who has not seen the paper.

This paper (Ogden et al., 2014) set out to provide updated estimates, on a national level, for childhood obesity and analyzed childhood obesity trends between 2003 and 2012. The research considered age, gender, and race. The research reported data on three age groups but the figure of interest in Table 6 (reporting linear trends) pertains only to infants and toddlers from birth to 2 years.

Within this age group, where weight for recumbent length at or above the 95th percentile, according to the Centers for Disease and Prevention (CDC) sex-specific growth charts, indicated obesity, it was found that 9.5% were obese. Essentially, 9.5% of the group were at or above the 95th percentile of sex-specific CDC weight for recumbent length growth charts.

With a confidence interval of 7.1 to 12.7, the results indicate that there is a 0.95 probability that the true parameter of obesity in this population falls within these bounds.

However, a possible limitation in the instrument and measures used was acknowledged as the CDC growth charts were recognized to produce different percentiles and crude results when compared to growth charts utilizing the World Health Organization's (WHO) standards. Also the decision to start analysis in 2003, as opposed to earlier years in which obesity was shown to rise, may have also influenced the overall finding that the change in child obesity between 2003-2004 and 2011-2012 of -1.4% was not statistically significant, with a p-value of 0.72.

b. Describe the take-away message from the results in this table to a person who is well educated in health and obesity issues but not formally trained in statistics.

The take-away message of Table 6 is that though two individual values in subsets of age groups do notice statistically significant changes, overall changes in obesity between 2003-2004 and 2011-2012 in all three age groups (less than two years, 2-19 years, and 20 or older) were not statistically significant. And though the research further evaluated differences by gender and race those findings are not

reported in Table 6. Though this article couldn't conclude significant findings for overall changes in obesity rates for people in the US when they looked at three age groups (babies less than two years old, and children between two and twenty years old, and adults 20 years or older) they did reported two significant findings when looking at smaller brackets of age groups. First, between 2003 and 2012 the obesity of kids between the ages of two and five years has gone down about 5.5% and between that same period of time obesity in adults older than 60 years was actually seen to go up by 4.4%.

Part II: Assessment of Policy Option #1: Soda Tax

(2) Draw a diagram to represent the effect of a soda tax on the market for soda. Then, using your diagram, generate a formula for the effect of the soda tax on calories consumed via soda in terms of the price elasticity of demand (ε_d), the elasticity of supply (ε_S), and the total calories consumed at baseline from soda.

%Change Q = ED * (ES / (|ED| + ES)) * Tax

a. Rewrite this formula without the elasticity of supply but with the "pass through fraction", ρ, which is defined as the share of the tax paid by consumers.

%Change Q = ED * ρ * Tax

(3) Use the dataset from Mexico to assess the parameters you need for your formula in (2) empirically.

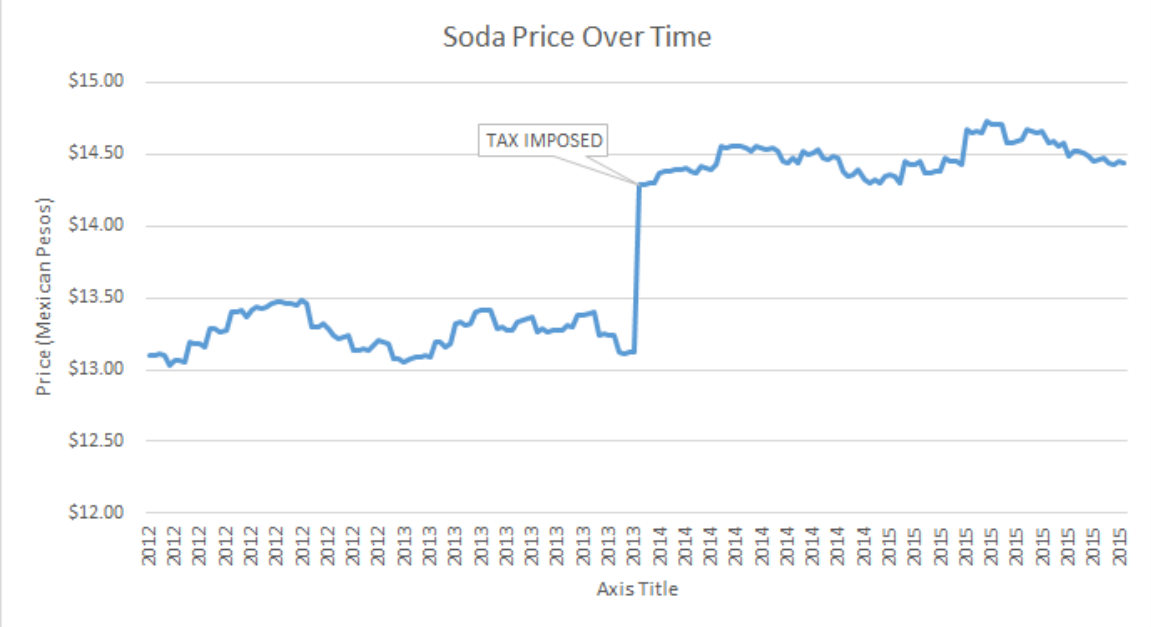
a. Using the dataset on the soda tax, calculate the information necessary to fill in the table below and, for each column, conduct a hypothesis test of the null hypothesis of no change from before to after the new policy was implemented. (You may submit your answers in whatever format you like).

	Soda Price	Soda Quantity	Bottled Water Price	Bottled Water Quantity
Mean before Soda Tax				
Mean after Soda Tax				
Difference in Means				
SE of Difference				
t-stat for Difference				
p-value				
95% Confid. Interval				

Note: To fill out the table, you should use all data from before and after the soda tax implementation that the dataset provides (i.e., you should not use just one year, or some other short period, before and after the tax).

	Soda Price	da Quantity	ater Price	ater Quantity
Before Soda Tax AND After Tax	96	96	96	96
ean before Soda Tax	$13.26	1,639,894,406.25	$5.51	539,372,310.42
ean after Soda Tax	$14.48	1,547,396,291.67	$5.34	584,534,059.38
fference in Means	$1.22	-92,498,114.58	$0.17	(45,161,748.96)
ndard Deviation Before Tax	$0.13	34,859,002.26	$0.09	12,766,636.55
ndard Deviation After Tax	$0.11	37,422,624.68	$0.10	38,924,108.80
of Difference	0.0171	5,219,757.0148	0.0139	4,180,900.589
tat for Difference	71.20	-17.72	12.16	-10.80191887
value	0%	0%	0%	0%
% Confidence Interval (Lower)	$1.18	$82,267,390.83	$0.14	$(53,356,314.11)
% Confidence Interval (Upper)	$1.25	$102,728,838.33	$0.20	$(36,967,183.80)

b. Use the data on prices to construct a graph that convincingly demonstrates the effect of the tax on prices to a reader unfamiliar with statistics. In particular, think about what graph you would produce to convince your readers that it was the soda tax, and not some other more gradual change over time, that drives the changes in price that you estimate in (3a)



c. Using your results from the table, please calculate the following:

i. How large is the soda price increase for consumers?

1.22

ii. Knowing that the soda tax instituted in Mexico was $1.00, what share of this tax is borne by consumers?

Given the fact that mean price actually decreased by an amount <u>more than</u> the amount of the tax (1.22 compared to 1) we must conclude that over 100% of the tax burden is borne by consumers (122%).

iii. Perform a hypothesis test for whether the change in the price of soda is equal to the full amount of the tax.

H_0: $\mu_2 - \mu_1 = 1$
H_a: $\mu_2 - \mu_1 \neq 1$

t-statistic = - 129.70
P value Approaches 0

Based on this data, we find that we definitely reject the null hypothesis because the negligible P value is significantly smaller than the significance value of 0.05.

iv. What is the elasticity of demand for soda based on this price

change?

-0.6614

d. Calculate the total calories from soda at baseline in Providence from information in the Case Study.

288

e. Finally, use your parameter estimates from (3c) and (3d) and your formula from (2) to calculate the effect of the proposed 1.5% soda tax on calories consumed from soda.

%Change Q = ED * ρ * Tax

%Change Q(calories) = -0.6614 * 122% * 1.5% = -1.21%

Baseline Calories Per Person = 288

Change in Calories Per Person = 288 *- 1.21% = -34.85

We calculate the per person effect of the soda tax to be a 1.21% reduction, or a 34.85 calorie reduction per person on average.

Part III: Assessment of Policy Option #2: Calorie Labeling

(4) Use the dataset on the calorie labeling policy to calculate:

a. Your estimate of the effect of calorie labeling on calories consumed.

We estimated that the calorie labelling, on average, reduced calories consumed by 28.85

b. A hypothesis test of the null hypothesis that the calorie labeling policy had no effect. (You should produce all of the information in the table above, but you may submit your answers in whatever format you like.)

	Calories Consumed
N Before Tax	618
N After Tax	687
Mean before Soda Tax	797.37
Mean after Soda Tax	768.53
Difference in Means	28.85
Standard Deviation Before Tax	306.13
Standard Deviation After Tax	291.19
SE of Difference	16.5853
t-stat for Difference	1.74
p-value	**0.082**
95% Confidence Interval (Lower)	(3.66)
95% Confidence Interval (Upper)	61.35

H_0: $\mu_1 - \mu_2 = 0$
H_a: $\mu_1 - \mu_2 \neq 0$

Given the low P value (p > 0.08) we must fail to reject the null hypothesis given the standard of comparing it to 0.05 significance level.

Part III: Policy Recommendation

(5) Present the total implied change in calories from baseline for each of the options in a table like the one below.

	Soda Tax	**Calorie Labeling**
Calorie Baseline	288	960
Effect of Policy in Calories (Per Person)	-34.85	-28.85
fect of Policy in Calories (%)	-12.1%	-3.01%
P-value of Effect	< 0.001	0.082

(6) Write a short (1 page) memo to the Mayor describing your findings and your recommendation. The memo should be written in a language that a layperson can understand.

As obesity and growing rates of non-communicable and cardiovascular diseases (NCDs and CVDs) rise to pan- and endemic magnitudes, it is critical that decision makers consider not only the health of communities, but also the impact of such conditions on the costs of health endured not just by individuals, but by hospitals, cities and states. There is no question that conditions such as obesity, which closely correlate with high rates of diabetes and CVDs, is extremely costly both in financial terms but also in the quality and years of life lost on a population and individual level. Though the two options on the table would help to combat this growing health crisis, given our empirical analyses of the efficacy of the two options, as well as a broader political assessment, we have determined a 1.5% tax on all soda sold in Providence to be the most prudent option. Though calorie labeling seems like a simpler and somewhat less controversial option for dealing with high calorie consumption and the growing rates of obesity, real world case-studies have provided compelling evidence that soda taxation wins out in terms of both its revenue generating capabilities and its effectiveness in reducing calorie consumption.

Our empirical analysis shows, with a very high level of statistical confidence, that the soda tax is effective at increasing the actual price of soda and, subsequently, reducing the amount of soda consumed overall. We found that a 1.5% soda tax could effectively reduce the calories consumed in Providence by about 12%, an average reduction in daily calorie intake of about 35 per person. Calorie labeling on the other hand had a more limited effect with a much lower level of statistical confidence - we calculated a 3% overall reduction which translates to an average daily reduction of about 29 calories per person. In many ways these results speak for themselves - not only does it seem that the soda tax reduces average calorie intake by a greater amount, but we can say with far more confidence that this reduction will actually occur than we can of the reductions calculated for calorie labeling.

Further, the revenue stream that such taxation could provide the city should be considered as an opportunity to implement related programs around obesity. The problem of obesity is complex as factors of obesogenic environments, physical activity, and nutrition all play a dynamic role. And since the bodies of women and men physiologically respond differently to activity levels and food consumption when it comes to weight gain and weight loss, the revenue from the taxation could be put towards addressing other infrastructural opportunities to have an impact on this growing costly problem.

Though we recognize that soda taxation may disproportionately impact people of lower socio-economic status (the demographics more likely to consume cheap sugary beverages), so too does the burden and cost of NCDs. What may seem

discriminatory could be more accurately considered targeted intervention to the most vulnerable populations. Further, when considering the alternative, calorie labelling, it is important to consider the assumptions surrounding health literacy. Taxation requires no new learned competencies on the part of the consumer. However, if we were to mandate calorie labelling and assume it would equitably combat the health crisis among all populations, we would be assuming health literacy to be ubiquitous, which is likely not the case. It is likely that health-literacy, which would make calorie labelling effective in the first place, is a more common trait of wealthier and more highly educated individuals than for the demographics at high risk for developing obesity and NCDs.

We know that populations with lower incomes and less education bear more of the NCD and obesity burden nationally and globally - the LMI community is more likely to obtain calories from soda, and fast food, which creates a higher chance of getting these diseases. Further, they are also sadly more likely to die of their disease and die earlier than those with high incomes. These factors combined with lower levels of health literacy make it likely that the very populations the mayor is most interested in helping in the first place - given his focus on the wellfare implications of the policy - would see limited health gains as a result of calorie labelling. Though a soda tax is susceptible to being criticized for being patronizing - much like cigarette taxes - these have both been found to be efficacious at reducing the consumption of the dangerous good in question (in this case excessive sugar).

Lastly, the concern for political acceptability is valid and more pressing in this preferred option of taxation as other cities have faced lawsuits and opposition. However, with the welfare of our city in mind, and the success of fellow pioneer cities- taxation, though the harder choice is the better choice.