# Homework 3
## Research in Health Economics, Spring 2025

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The following is my submission for Homework 3. Note that the setup and analysis for these responses are in a seperate R script. The GitHub repository for this work is available here.

Summarize the Data

Question 1. Present a bar graph showing the proportion of states with a change in their cigarette tax in each year from 1970 to 1985.

Proportion of States with a Change in Cigarette Tax (1970–19
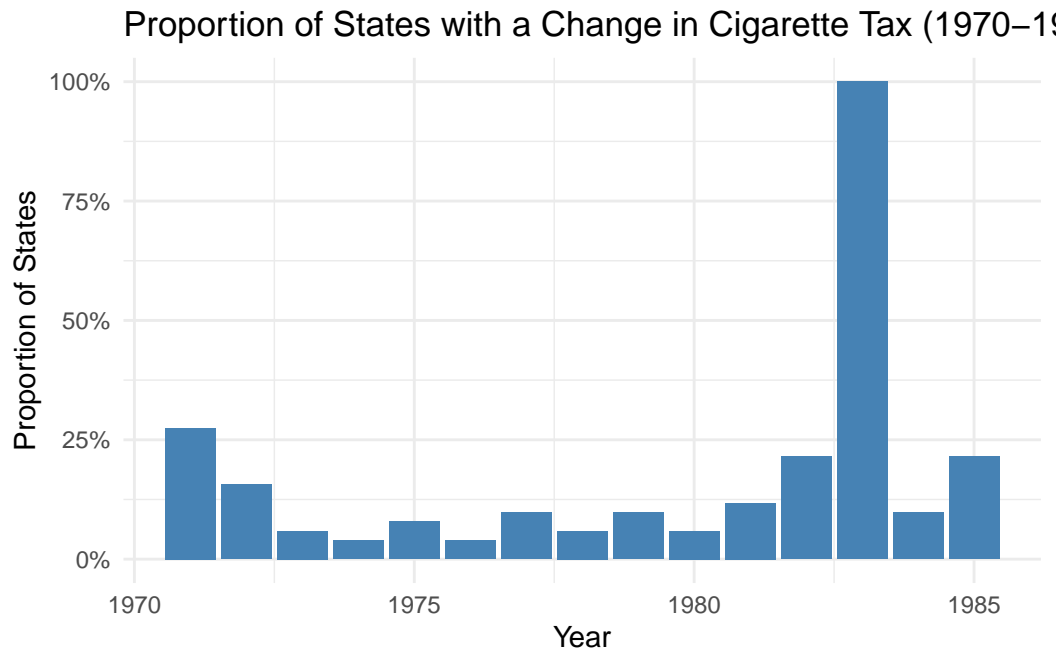
Question 2. Plot on a single graph the average tax (in 2012 dollars) on cigarettes and the average price of a pack of cigarettes from 1970 to 2018.


Average Cigarette Tax and Price
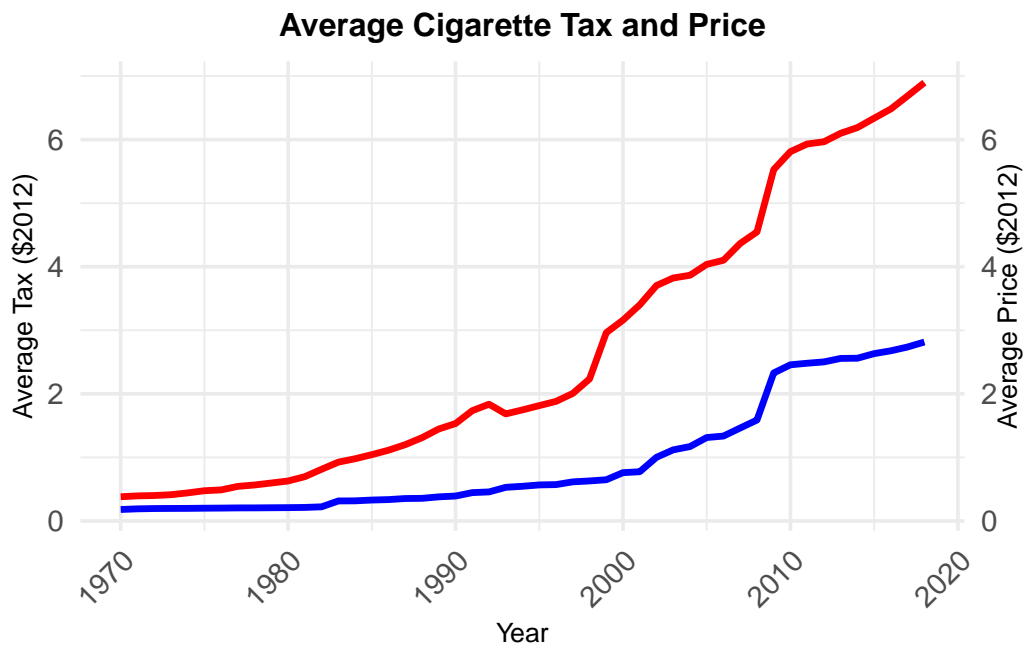
Question 3. Identify the 5 states with the highest increases in cigarette prices (in dollars) over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.

Packs Sold per Capita for 5 Highest Price–Increasing States
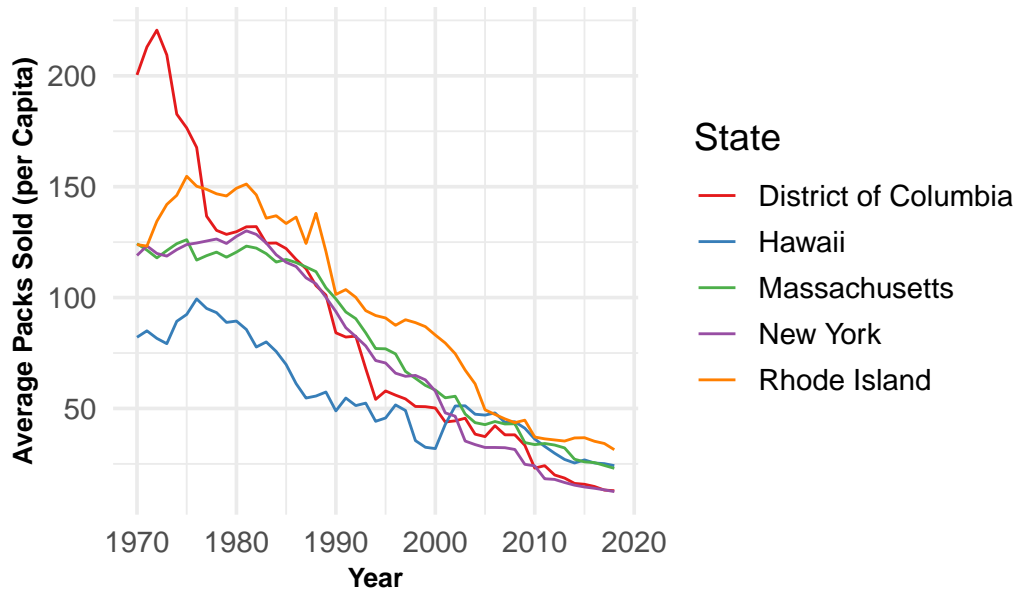
Question 4. Identify the 5 states with the lowest increases in cigarette prices over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.

ge Packs Sold per Capita for 5 Lowest Price–Increasing States
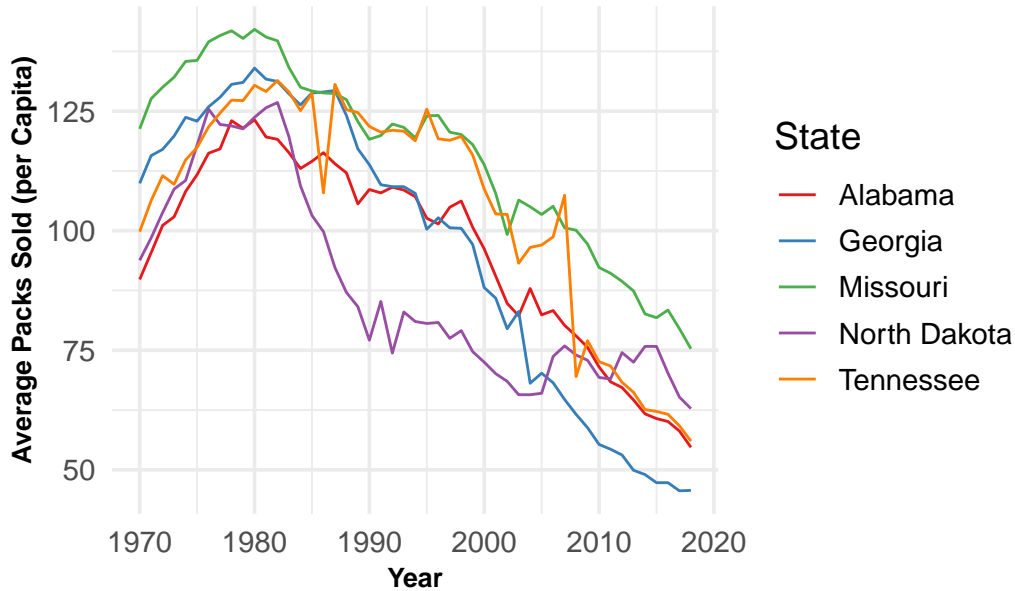
Question 5. Compare the trends in sales from the 5 states with the highest price increases to those with the lowest price increases.

There exists more variety between the states with the lowest price increases than those with the highest. Considering the bottom five states are more rural than their top 5 counterparts, this could demonstrate differences in economic structures and demographics. Sales decline sharply among the highest price states, while lowest price states demonstrate a steady decline. All states sell the most packs around 1980s.

Estimate ATEs

Question 6. Focusing only on the time period from 1970 to 1990, regress log sales on log prices to estimate the price elasticity of demand over that period. Interpret your results.

Table 1: Log Sales on Log Price Regression Results

term	estimate	std.error	statistic	p.value
Intercept	4.750	0.008	585.32	0
2012 Price (log)	-0.172	0.014	-12.40	0

The price elasticity of demand is -0.172; for every 1% increase in price, sales decrease by 0.172%. As expected, price and sales are inversely related and demand is inelastic – a price increase leads to a decrease in sales, but the decrease in sales is smaller than the price increase. Results are statistically significant.

Question 7. Again limiting to 1970 to 1990, regress log sales on log prices using the total (federal and state) cigarette tax (in dollars) as an instrument for log prices. Interpret your results and compare your estimates to those without an instrument. Are they different? If so, why?

Table 2: Log Sales on Log Price Regression with Instrument Results

term	estimate	std.error	statistic	p.value
ln_price_2012	0.059	0.049	1.2	0.235

In this regression, sales and price have a positive but insignificant relationship. An increase in price is only associated with a slight increase in sales of 0.059% for every 1% increase in price. The model suggests that cigarette sales are inelastic with respect to price. The instrument may not capture enough of the variation in price to make a conclusion about the relationship between price and sales.

Question 8. Show the first stage and reduced-form results from the instrument.

Table 3: First Stage Results from Instrument

term	estimate	std.error	statistic	p.value
Intercept	1.179	0.033	35.71	0
2012 Tax (log)	1.080	0.023	47.97	0

Table 4: Reduced-Form Results from Instrument

term	estimate	std.error	statistic	p.value
Intercept	4.375	0.025	176.63	0
2012 Tax (log)	-0.307	0.017	-18.17	0

Question 9. Repeat questions 6-8 focusing on the period from 1991 to 2015.

Table 5: Log Sales on Log Price Regression Results: 1991-2015

term	estimate	std.error	statistic	p.value
Intercept	5.039	0.023	219.93	0
2012 Price (log)	-0.666	0.017	-38.09	0

Table 6: Log Sales on Log Price Regression with Instrument: 1991-2015

term	estimate	std.error	statistic	p.value
ln_price_2012	-0.103	0.058	-1.78	0.077

Table 7: First Stage Results from Instrument: 1991-2015

term	estimate	std.error	statistic	p.value
Intercept	1.207	0.005	242.91	0
2012 Tax (log)	0.630	0.007	91.88	0

Table 8: Reduced Form Results from Instrument: 1991-2015

term	estimate	std.error	statistic	p.value
Intercept	4.237	0.008	540.26	0
2012 Tax (log)	-0.480	0.011	-44.41	0

Question 10. Compare your elasticity estimates from 1970-1990 versus those from 1991-2015. Are they different? If so, why?

Elasticity estimates for both OLS regressions demonstrate a negative effect between price and sales. The results for 1991-2015 suggest a stronger and more statistically significant relationship between tax and sales at -0.666. This difference may be due to different market conditions as consumers became more responsive to price changes.

The elasticity estimates using the IV model differ between periods – with elasticaity becoming weaker, although still not significant. In both cases, however, the price effect on sales is weak and not statistically reliable. This suggests that the relationship between price and sales may be overestimated in the OLS model due to endogeneity.