ECON 470 Homework 3

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The link to my repository: https://github.com/ellenwu-git/homework3

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 Change in Cigarette Tax (1970-1985)
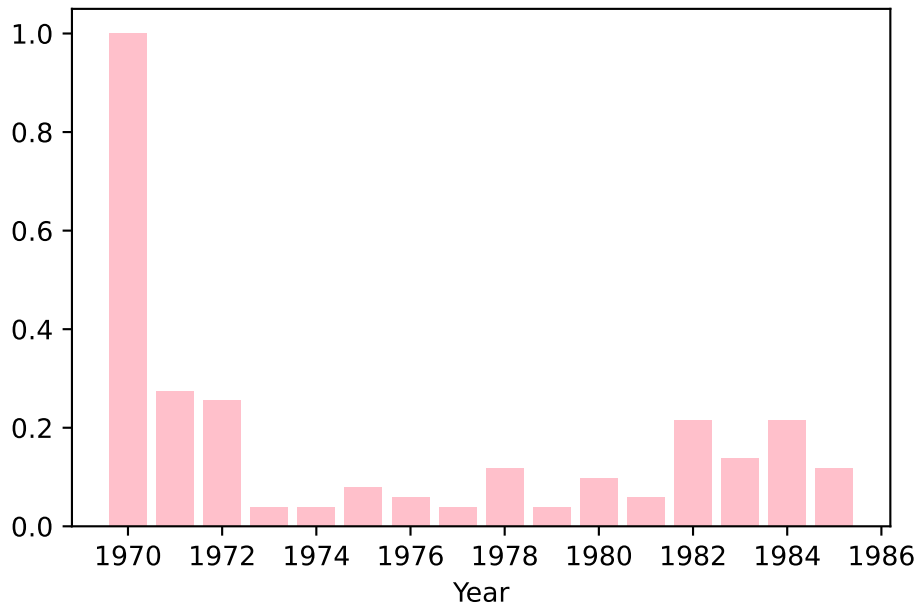
2. Plot on a single graph the average tax (in 2012 dollars) on cigarettes and the average price of a pack of cigarettes from 1970 to 2018.

Average Price and Tax per Pack (1970-2018) in 2012 Dollars
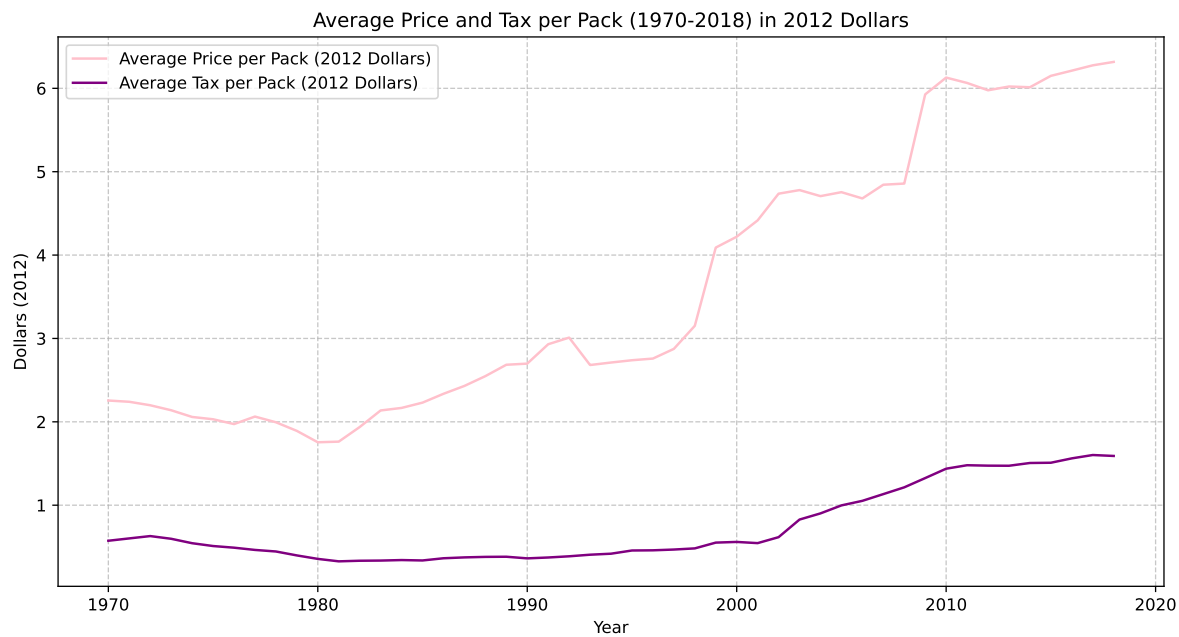
3. Identify the 5 states with the highest increases in cigarette prices (in dollars) over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.
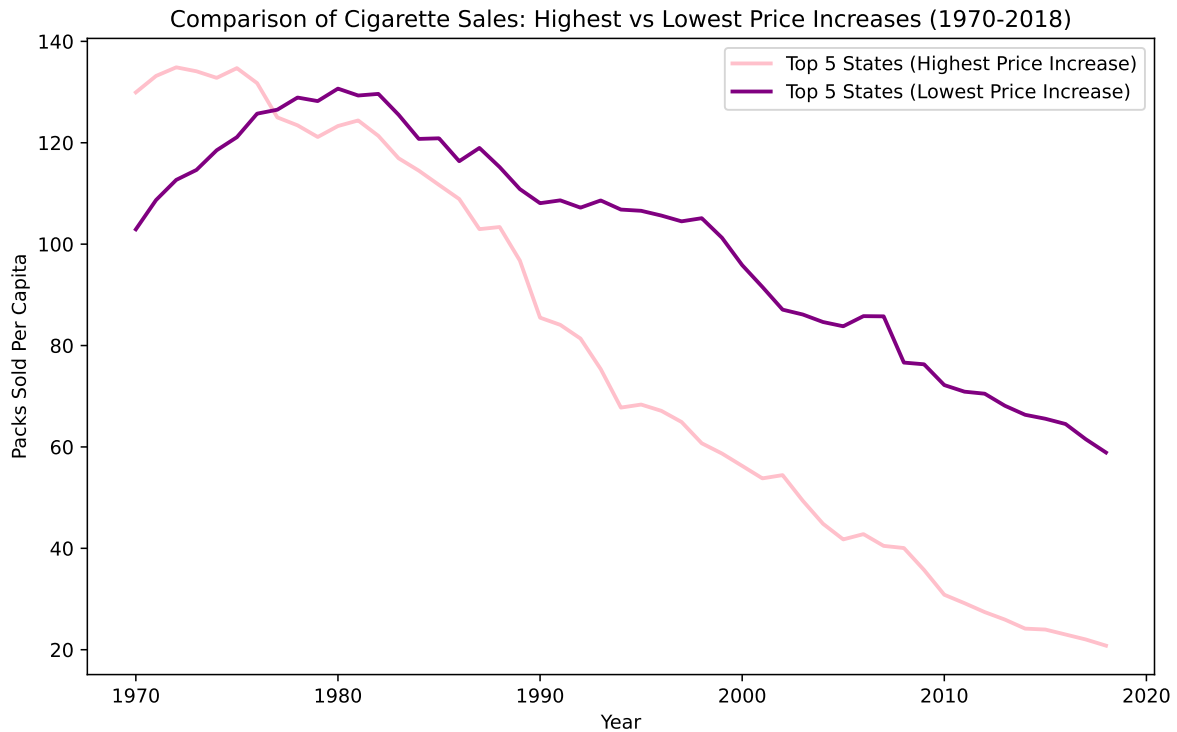
Average Packs Sold Per Capita (Top 5 States with Highest Price Increases)
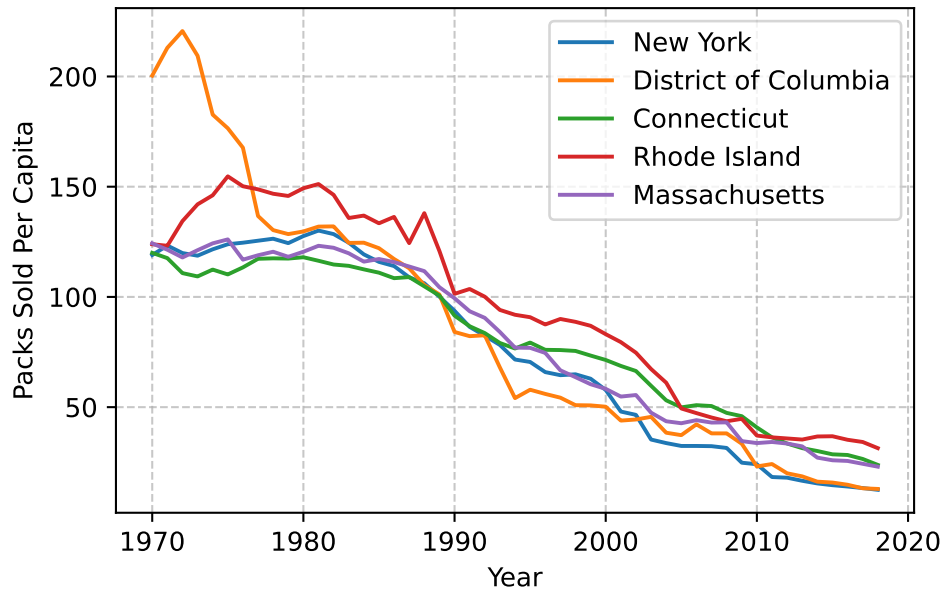
4. Identify the 5 states with the lowest increases in cigarette prices over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.

Average Cigarette Packs Sold Per Capita (Bottom 5 States with Lowest Price Increase, 1970–2018)
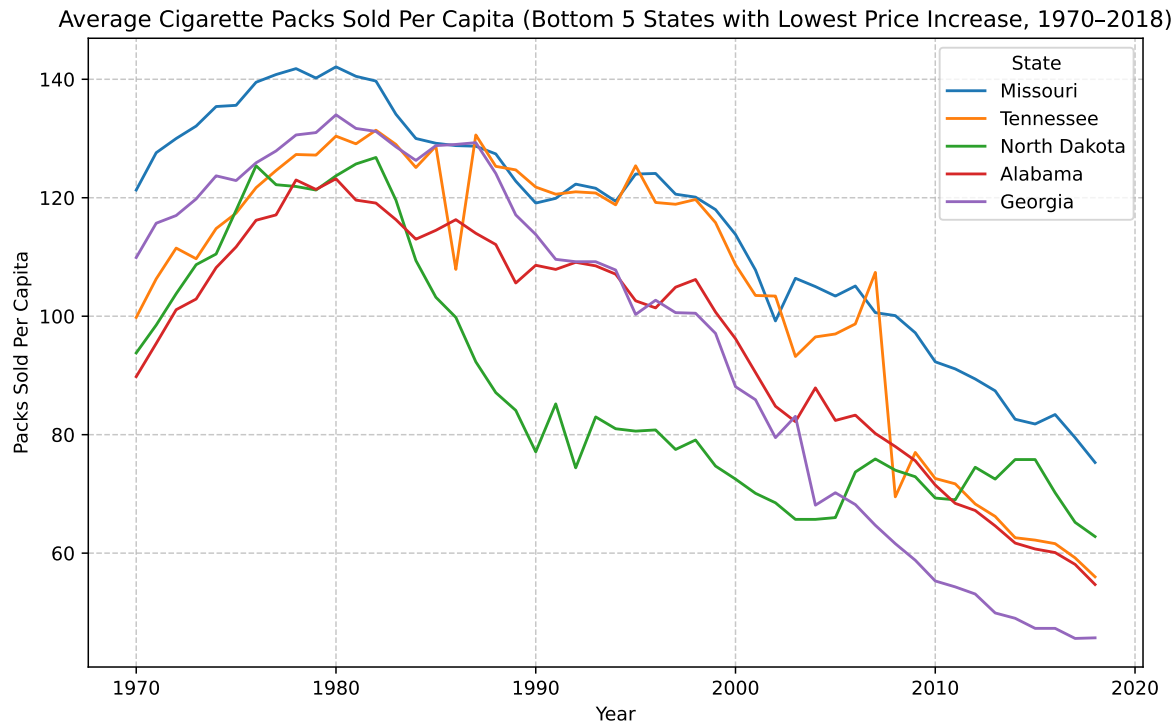
5. Compare the trends in sales from the 5 states with the highest price increases to those with the lowest price increases.

Comparison of Cigarette Sales: Highest vs Lowest Price Increases (1970-2018)

Based on the graph, states with the highest price increases experienced a steeper decline in average cigarette packs sold per capita over time compared to states with the lowest price increases. The states with the lowest price increases initially had higher per capita sales and, while they also saw a decline, the decline was more gradual. This suggests that higher cigarette prices are associated with sharper reductions in cigarette consumption, supporting the idea that cigarette demand is responsive to price increases.

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.

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?

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

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

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

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=== Elasticity Estimates ===
      Period Method  Log Price Coefficient  Std Error     N         R2
0  1970-1990    OLS              -0.809438   0.038366  1071   0.293983
1  1970-1990     IV              -0.923078   0.050789  1071   0.236061
2  1991-2015    OLS              -0.996814   0.024692  1275   0.561445
3  1991-2015     IV              -1.112943   0.025063  1275   0.607682


=== Reduced Form Results ===
      Period  Log Tax Coefficient  Std Error     N         R2
0  1970-1990            -0.307190   0.016902  1071   0.236061
1  1991-2015            -0.480477   0.010820  1275   0.607682


=== First Stage Results ===
      Period  Log Tax Coefficient  Std Error     N         R2
0  1970-1990             0.332789   0.008012  1071   0.617437
1  1991-2015             0.431717   0.004713  1275   0.868263
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The OLS estimate of price elasticity for 1970-1990 is -0.809, indicating that a 1% increase in price is associated with a 0.81% decrease in cigarette sales. This suggests that demand for cigarettes during this period was inelastic but responsive to price changes. When using the total cigarette tax as an instrument for price (IV estimation), the price elasticity becomes -0.923, slightly more negative than the OLS estimate. This suggests that the OLS estimate may have been biased due to endogeneity—likely caused by simultaneity or measurement errors in price. The first-stage regression shows that log tax is a strong predictor of log price, with a coefficient of 0.333 and an R^2 of 0.617. This confirms that cigarette taxes explain a significant portion of price variation. The reduced-form regression reveals a negative relationship between log tax and log sales, with a coefficient of -0.307 and an R^2 of 0.236, suggesting that higher cigarette taxes indirectly reduce cigarette consumption. The OLS estimate for 1991-2015 is -0.997, showing that demand became more elastic compared to the earlier period. This suggests

that consumers were more responsive to price changes in this later period. The IV estimate is -1.113, which is even more elastic than the OLS estimate. The larger magnitude suggests that failing to account for endogeneity in OLS leads to an underestimation of the true price elasticity. The first-stage regression again shows that log tax is a strong instrument for log price, with a coefficient of 0.432 and an R^2 of 0.868 (higher than in the earlier period). This suggests that taxes played an even stronger role in determining cigarette prices in the later period. The reduced-form regression shows a stronger negative relationship between log tax and log sales (-0.480), with an R^2 of 0.608, indicating that tax increases had a larger effect on reducing cigarette consumption in this period. Demand for cigarettes became more elastic over time. The OLS elasticity estimate shifted from -0.809 (1970-1990) to -0.997 (1991-2015), and the IV estimate became even larger in magnitude (-0.923 to -1.113). This suggests that price sensitivity increased in the later period. One possible reason for this increase in elasticity is that smoking became less socially acceptable, with stronger public health campaigns, smoking bans, and alternative nicotine products (like vaping) emerging. Consumers in 1991-2015 may have had more substitutes available, making them more responsive to price changes. The IV estimates are more negative than OLS in both periods, reinforcing the idea that OLS underestimates the true price elasticity due to endogeneity. Overall, these results suggest that cigarette demand became more price-sensitive over time. The instrumental variable approach corrects for endogeneity, revealing a stronger negative relationship between price and cigarette consumption than the OLS estimates suggest. The first-stage and reduced-form results confirm that cigarette taxes significantly affect both price and consumption.