Homework 3

ECON 470, Spring 2025

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Here is a link to my repository: {https://github.com/ctcasta/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 Cigarette Tax Changes
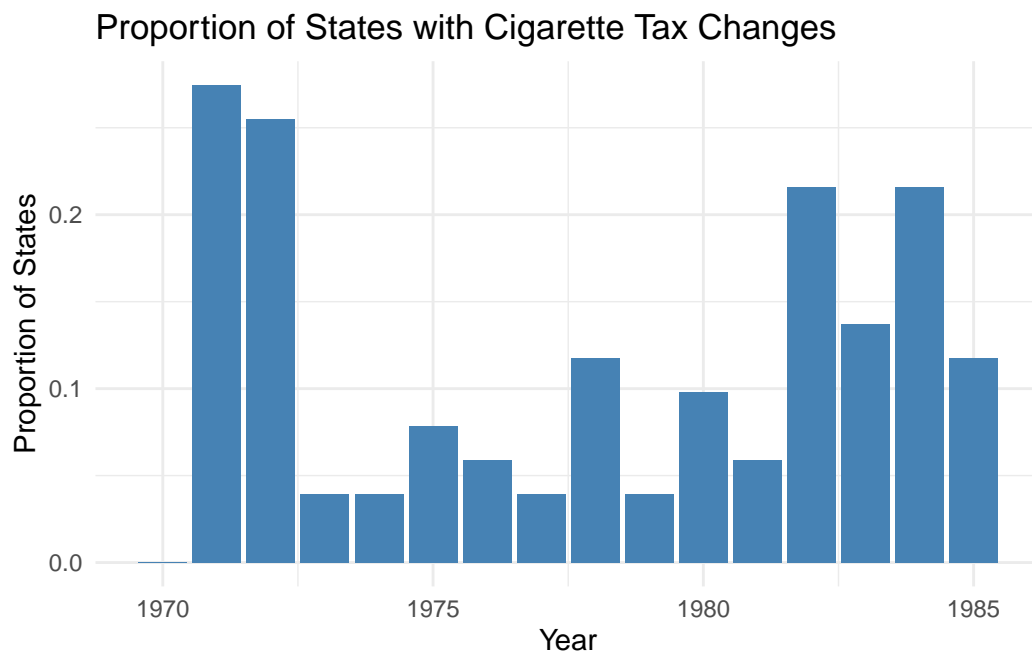
2. Plot on a single graph the average tax (in 2012 dollars) on cigarettes and the average price of a pack of cigarettes from 1970 to 2018.

Average Tax and Price of Cigarettes (in 2012 dollars)
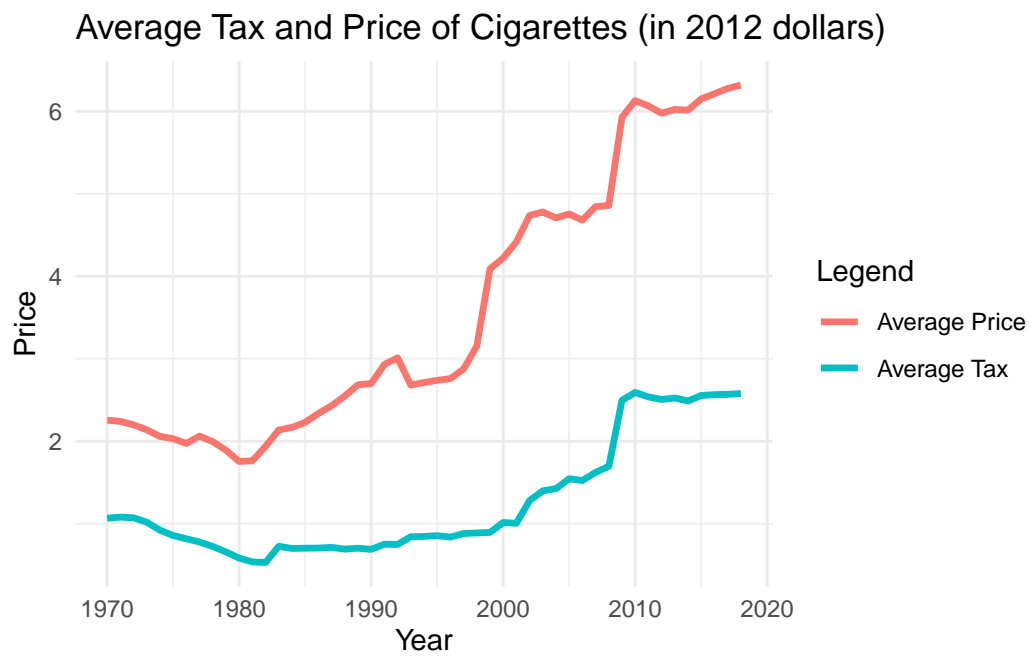
3. Identify the 5 states with the highest increases in cigarette prices (in dollars) over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.
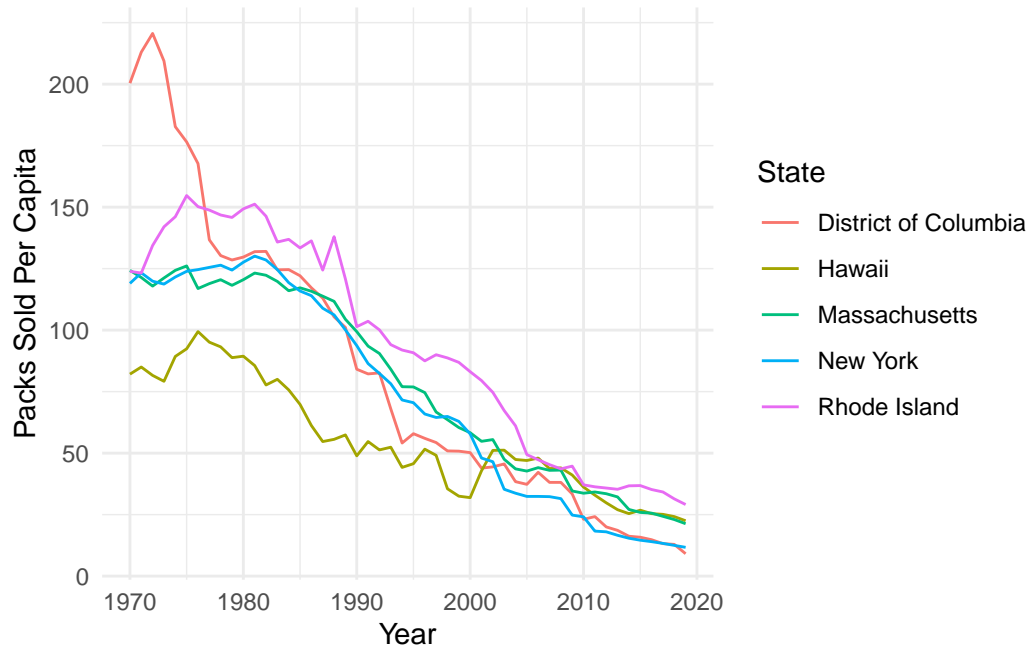
4. Identify the 5 states with the lowest increases in cigarette prices over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.
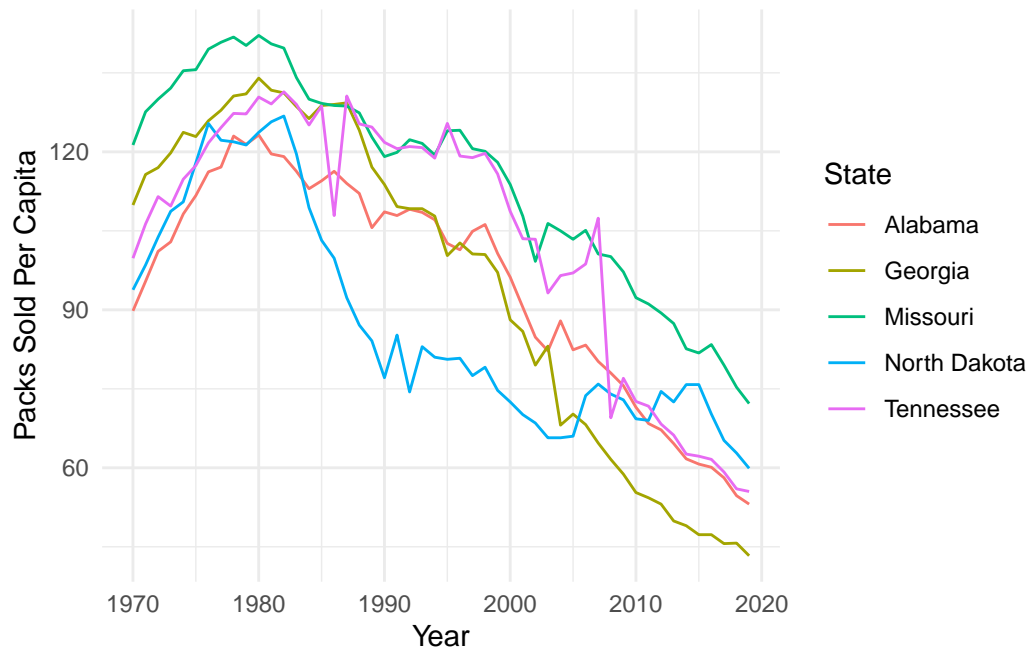
5. Compare the trends in sales from the 5 states with the highest price increases to those with the lowest price increases.
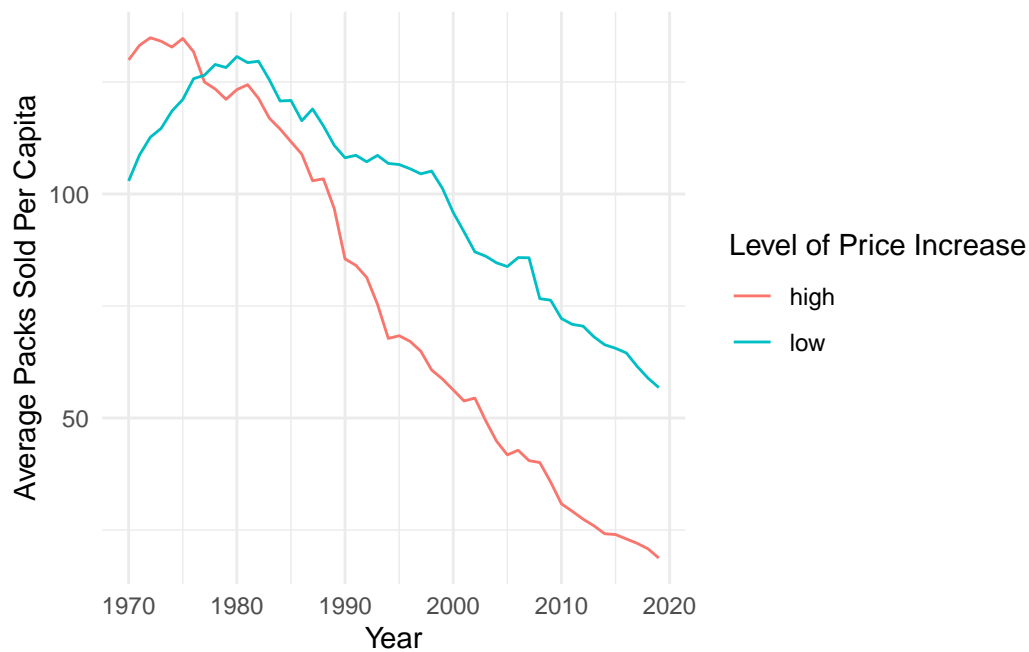
The following is focused on data from the years 1970-1990

6.1 Regress log sales on log prices to estimate the price elasticity of demand over that period. Interpret your results.

```
OLS estimation, Dep. Var.: log_sales
Observations: 1,071
Standard-errors: IID
             Estimate Std. Error  t value  Pr(>|t|)
(Intercept)  5.428812   0.029818 182.0649 < 2.2e-16 ***
log_price   -0.809438   0.038366 -21.0980 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.189214   Adj. R2: 0.293322
```

7.1 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?

```
TSLS estimation - Dep. Var.: log_sales
                  Endo.    : log_price
                  Instr.   : log_total_tax
Second stage: Dep. Var.: log_sales
Observations: 1,071
Standard-errors: IID
              Estimate Std. Error  t value  Pr(>|t|)
(Intercept)   5.418202   0.054619  99.1996 < 2.2e-16 ***
fit_log_price -0.795524   0.071235 -11.1676 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.189226   Adj. R2: 0.293235
F-test (1st stage), log_price: stat = 436.8     , p < 2.2e-16 , on 1 and 1,069 DoF.
                   Wu-Hausman: stat =   0.053709, p = 0.816775, on 1 and 1,068 DoF.
```

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

```
OLS estimation, Dep. Var.: log_price
Observations: 1,071
Standard-errors: IID
              Estimate Std. Error  t value  Pr(>|t|)
(Intercept)   0.840953   0.005406 155.5591 < 2.2e-16 ***
log_total_tax 0.260060   0.012443  20.9009 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.127093   Adj. R2: 0.289437
```

```
OLS estimation, Dep. Var.: log_sales
Observations: 1,071
Standard-errors: IID
              Estimate Std. Error   t value  Pr(>|t|)
(Intercept)   4.749204   0.009176 517.59262 < 2.2e-16 ***
log_total_tax -0.206884   0.021119  -9.79629 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.215714   Adj. R2: 0.081519
```

9. The following repeats questions 6-8 but is focused on data from the years 1991-2015

6.2

```
OLS estimation, Dep. Var.: log_sales
Observations: 1,275
Standard-errors: IID
              Estimate Std. Error  t value  Pr(>|t|)
(Intercept)  5.661717   0.036427 155.4271 < 2.2e-16 ***
log_price   -0.996814   0.024692 -40.3697 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.295775   Adj. R2: 0.561101
```

7.2

```
TSLS estimation - Dep. Var.: log_sales
                  Endo.    : log_price
                  Instr.   : log_total_tax
Second stage: Dep. Var.: log_sales
Observations: 1,275
Standard-errors: IID
              Estimate Std. Error  t value  Pr(>|t|)
(Intercept)    5.88189   0.040828 144.0658 < 2.2e-16 ***
fit_log_price -1.15008   0.027811 -41.3536 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.300218   Adj. R2: 0.547816
F-test (1st stage), log_price: stat = 5,503.6, p < 2.2e-16, on 1 and 1,273 DoF.
                  Wu-Hausman: stat =   191.5, p < 2.2e-16, on 1 and 1,272 DoF.
```

8.2

```
OLS estimation, Dep. Var.: log_price
Observations: 1,275
Standard-errors: IID
              Estimate Std. Error t value  Pr(>|t|)
(Intercept)   1.315933   0.004390 299.729 < 2.2e-16 ***
log_total_tax 0.513550   0.006922  74.186 < 2.2e-16 ***
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.145512   Adj. R2: 0.811999


OLS estimation, Dep. Var.: log_sales
Observations: 1,275
Standard-errors: IID
               Estimate Std. Error  t value  Pr(>|t|)
(Intercept)    4.368462   0.008448 517.0876 < 2.2e-16 ***
log_total_tax -0.590626   0.013320 -44.3396 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
RMSE: 0.28   Adj. R2: 0.606669
```

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

Still trying to format this into one table