Homework 3 - Research in Health Economics

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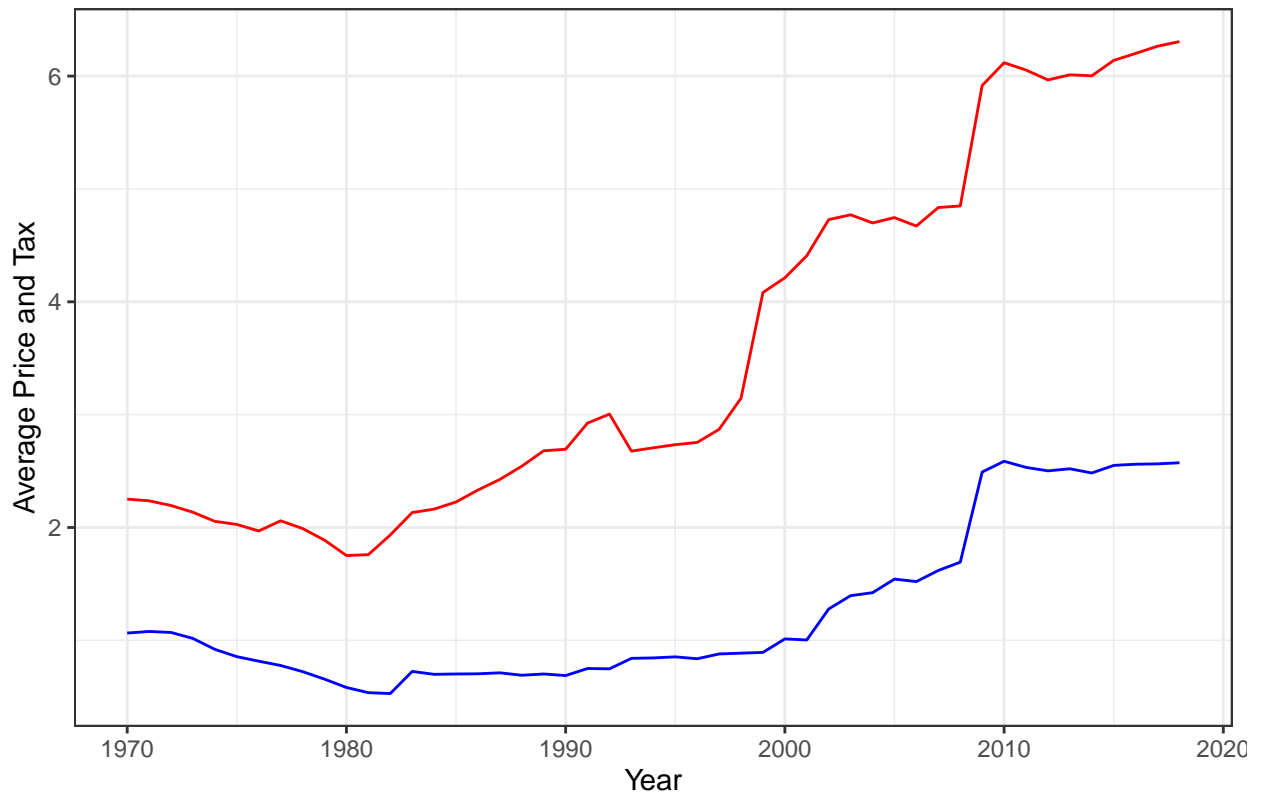
Summarise the Data

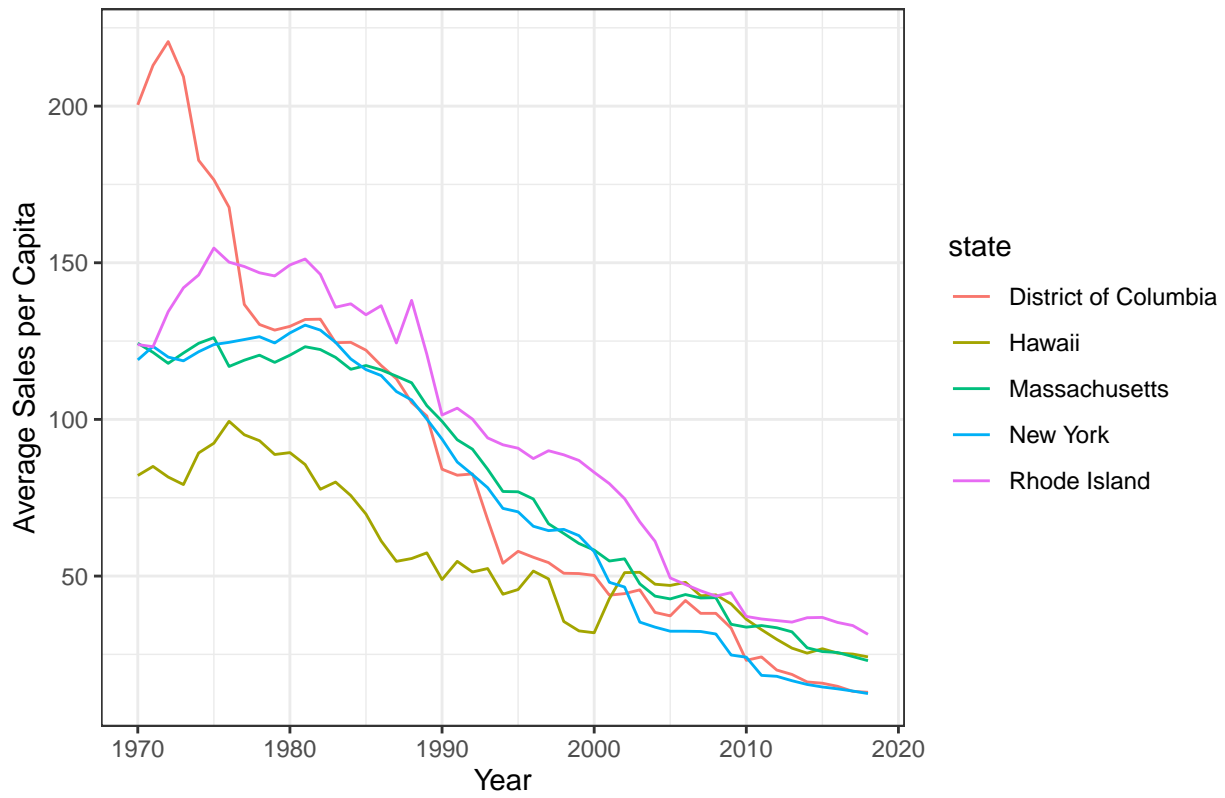**Question 1**

Proportion of States with Change in Tax, 1970–1985
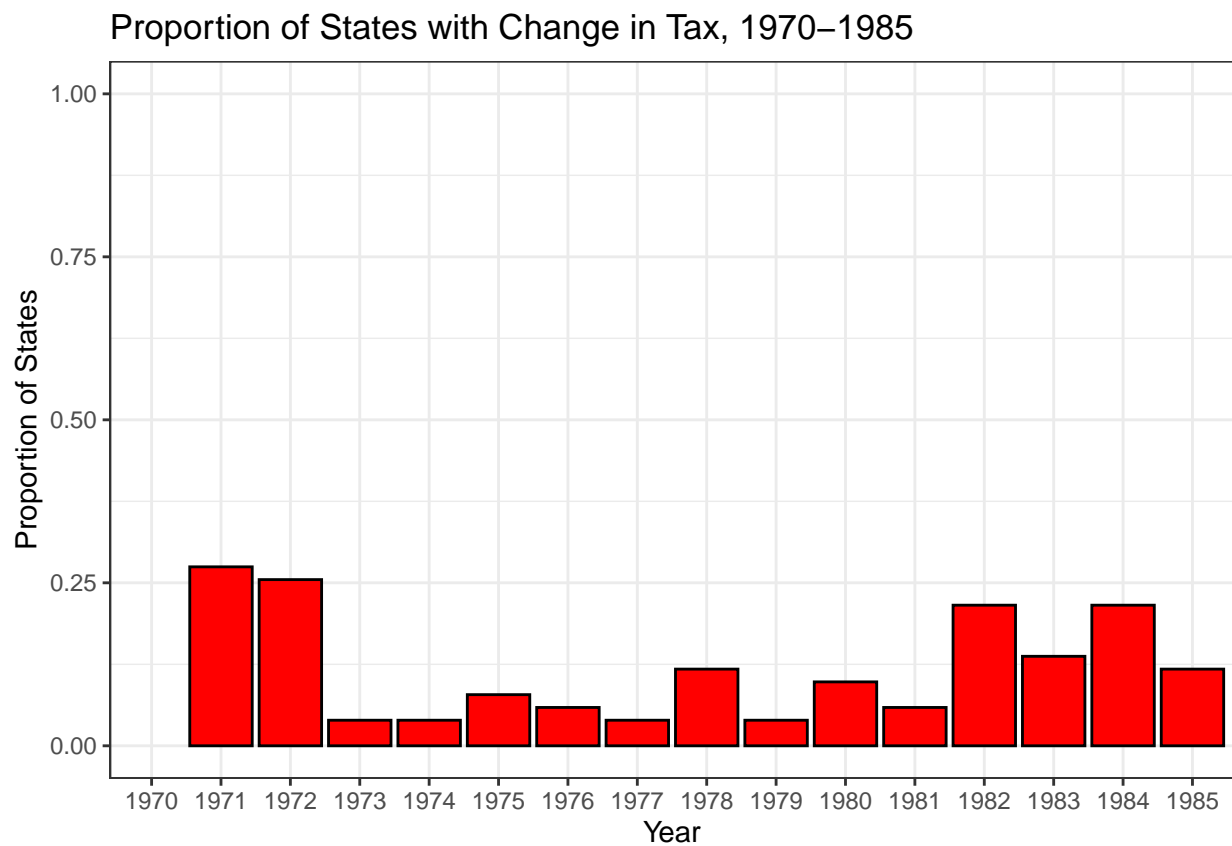
Question 2

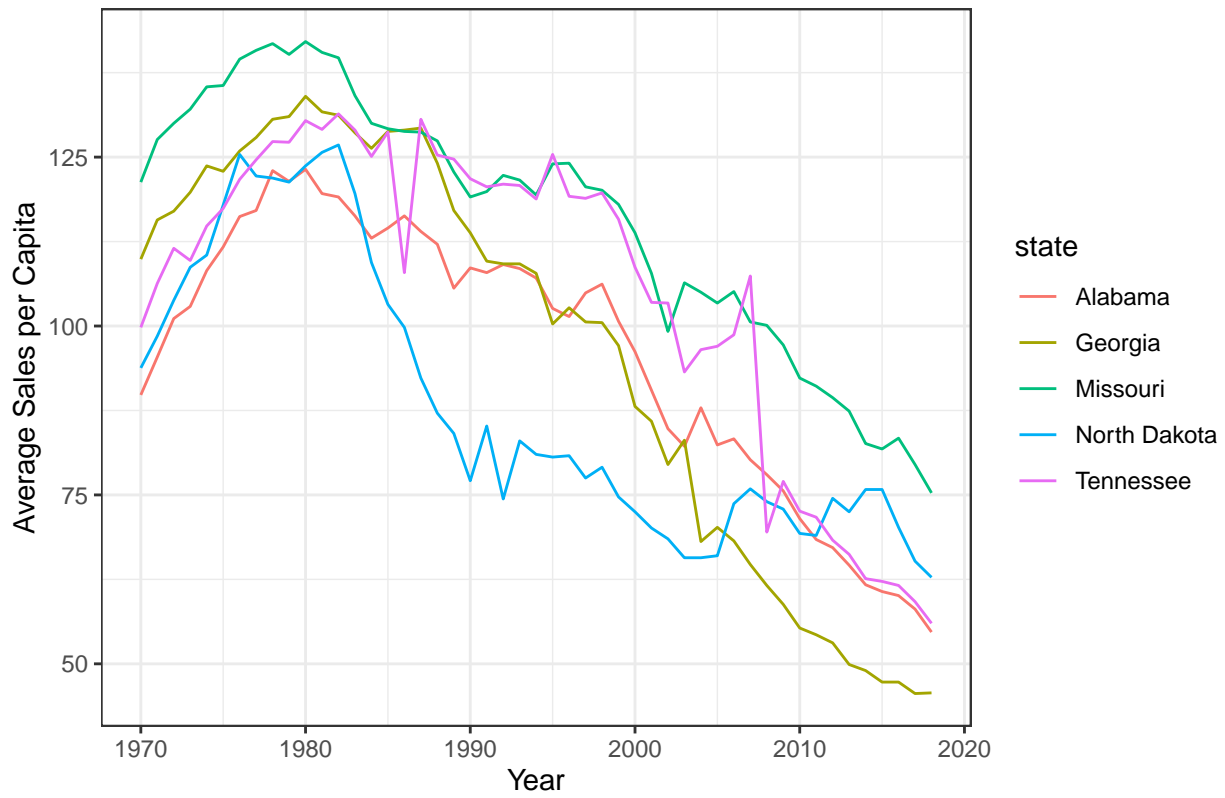## Average Price and Tax from 1970–2018
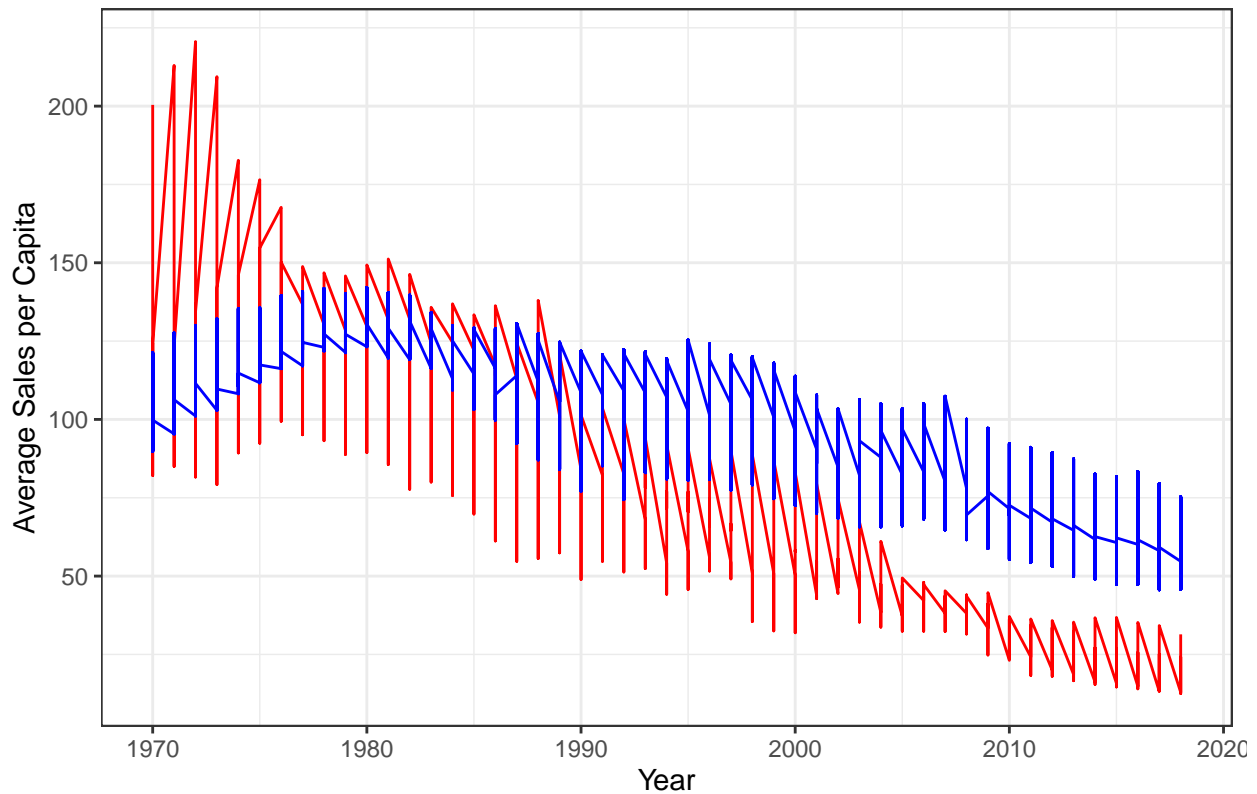
Question 3

Average Sales per Capita

Average Sales per Capita

Question 5

Average Sales in States with Highest and Lowest Tax Increase

Estimate ATEs

Question 1

```
##
## Call:
## lm(formula = log_price ~ log_sales, data = data_6)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.38568 -0.08530 -0.00292  0.08363  0.46538
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.50823    0.08292   30.25   <2e-16 ***
## log_sales   -0.36319    0.01721  -21.10   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1269 on 1069 degrees of freedom
## Multiple R-squared:  0.294,  Adjusted R-squared:  0.2933
## F-statistic: 445.1 on 1 and 1069 DF,  p-value: < 2.2e-16
```

The regression shows that cigarette demand has an elasticity of , which is inelestic, suggesting that cigarette demand is less responsive to changes in price.

Question 2

```
## TSLS estimation, Dep. Var.: log_sales, Endo.: log_price, Instr.: tax_cpi
## Second stage: Dep. Var.: log_sales
## Observations: 1,071
## Standard-errors: IID
##               Estimate Std. Error  t value  Pr(>|t|)
## (Intercept)    5.371519   0.057450 93.49862 < 2.2e-16 ***
## fit_log_price -0.736000   0.075141 -9.79490 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## RMSE: 0.189538   Adj. R2: 0.2909
## F-test (1st stage), log_price: stat = 378.7    , p < 2.2e-16 , on 1 and 1,069 DoF.
##                      Wu-Hausman: stat =   1.29837, p = 0.254767, on 1 and 1,068 DoF.
```

The IV regression shows that cigarette demand has a price elasticity of whihc is inelastic but it is more elastic compared to the previous regression without an instrument.

Question 3

First Stage:

```
##
## Call:
## lm(formula = log_price ~ tax_cpi, data = data_6)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.28837 -0.09008 -0.03291  0.07979  0.49911
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.50751    0.01360   37.32   <2e-16 ***
## tax_cpi      0.32718    0.01681   19.46   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1297 on 1069 degrees of freedom
## Multiple R-squared:  0.2616, Adjusted R-squared:  0.2609
## F-statistic: 378.7 on 1 and 1069 DF,  p-value: < 2.2e-16
```

Reduced Form:

```
##
## Call:
## lm(formula = log_sales ~ tax_cpi, data = data_6)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.87126 -0.10108  0.00590  0.09446  0.94425
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.99799    0.02286  218.61   <2e-16 ***
## tax_cpi     -0.24080    0.02826   -8.52   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Residual standard error: 0.2181 on 1069 degrees of freedom
## Multiple R-squared:  0.06358,    Adjusted R-squared:  0.0627
## F-statistic: 72.58 on 1 and 1069 DF,  p-value: < 2.2e-16
```

Question 4

Regression of Log of Sales on Log of Price:

```
##
## Call:
## lm(formula = log_price ~ log_sales, data = data_9)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.62268 -0.16939  0.02131  0.15449  0.70223
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.81714    0.05934   64.33   <2e-16 ***
## log_sales   -0.56324    0.01395  -40.37   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2225 on 1273 degrees of freedom
## Multiple R-squared:  0.5614, Adjusted R-squared:  0.5611
## F-statistic:  1630 on 1 and 1273 DF,  p-value: < 2.2e-16
```

IV Regression:

```
## TSLS estimation, Dep. Var.: log_sales, Endo.: log_price, Instr.: tax_cpi
## Second stage: Dep. Var.: log_sales
## Observations: 1,275
## Standard-errors: IID
##                Estimate Std. Error   t value  Pr(>|t|)
## (Intercept)     5.89917   0.042095 140.1383 < 2.2e-16 ***
## fit_log_price  -1.16354   0.028744 -40.4791 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## RMSE: 0.301025   Adj. R2: 0.545382
## F-test (1st stage), log_price: stat = 4,129.3, p < 2.2e-16, on 1 and 1,273 DoF.
##                   Wu-Hausman: stat =   167.2, p < 2.2e-16, on 1 and 1,272 DoF.
```

First Stage:

```
##
## Call:
## lm(formula = log_price ~ tax_cpi, data = data_9)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.38796 -0.14118  0.04464  0.13777  0.31985
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.971123   0.008539  113.72   <2e-16 ***
## tax_cpi     0.307545   0.004786   64.26   <2e-16 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1631 on 1273 degrees of freedom
## Multiple R-squared:  0.7644, Adjusted R-squared:  0.7642
## F-statistic:  4129 on 1 and 1273 DF,  p-value: < 2.2e-16
```

Reduced Form:

```
##
## Call:
## lm(formula = log_sales ~ tax_cpi, data = data_9)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.01297 -0.14907  0.02057  0.16103  1.06242
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.769227   0.015081  316.23   <2e-16 ***
## tax_cpi     -0.357841   0.008452  -42.34   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.288 on 1273 degrees of freedom
## Multiple R-squared:  0.5847, Adjusted R-squared:  0.5844
## F-statistic:  1792 on 1 and 1273 DF,  p-value: < 2.2e-16
```

Question 5

The results from regression of log sales on log prices from 1991-2015 show an elasticity of which is inelastic but less inelastic compared to the results from 1970-1990. The IV regression for 1991-2015 show an elasticity of which is elastic. These results indicate that the overall demand for cigarettes have become more elastic between 1991 to 2015 compared to between 1970-1990, indicating a greater responsiveness in quantity demanded due to a change in prce.