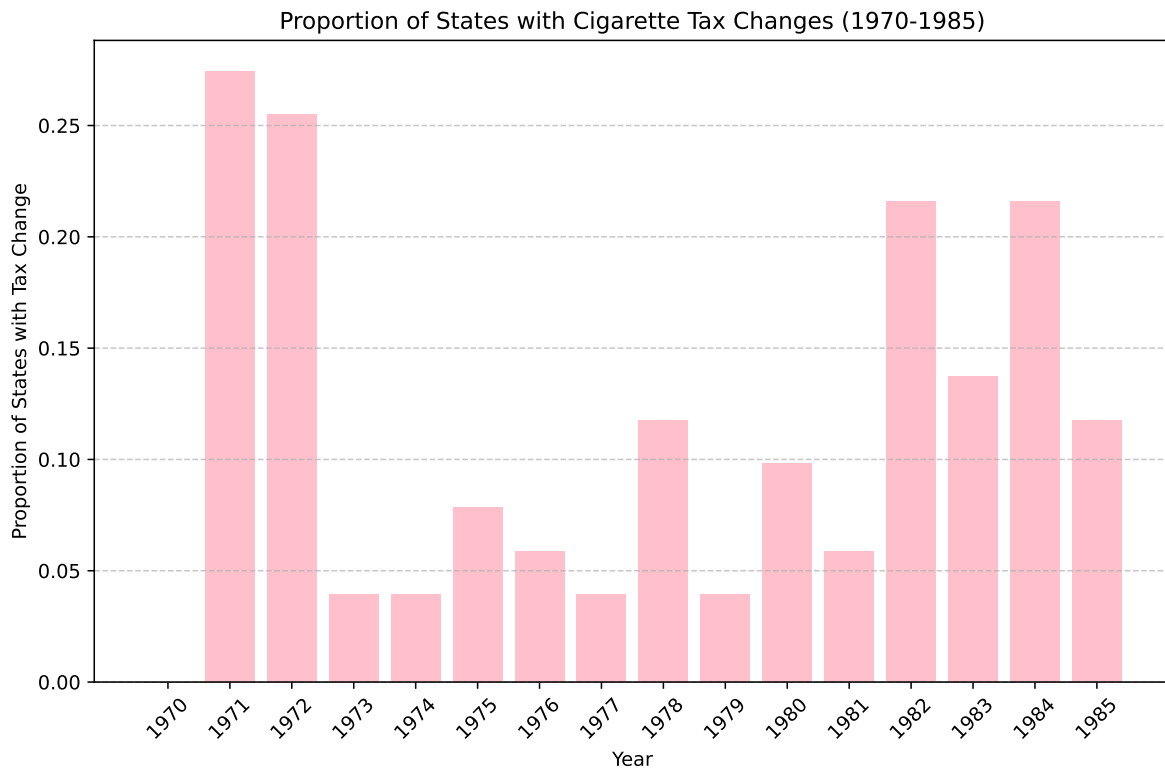


# ECON 470 Homework 3

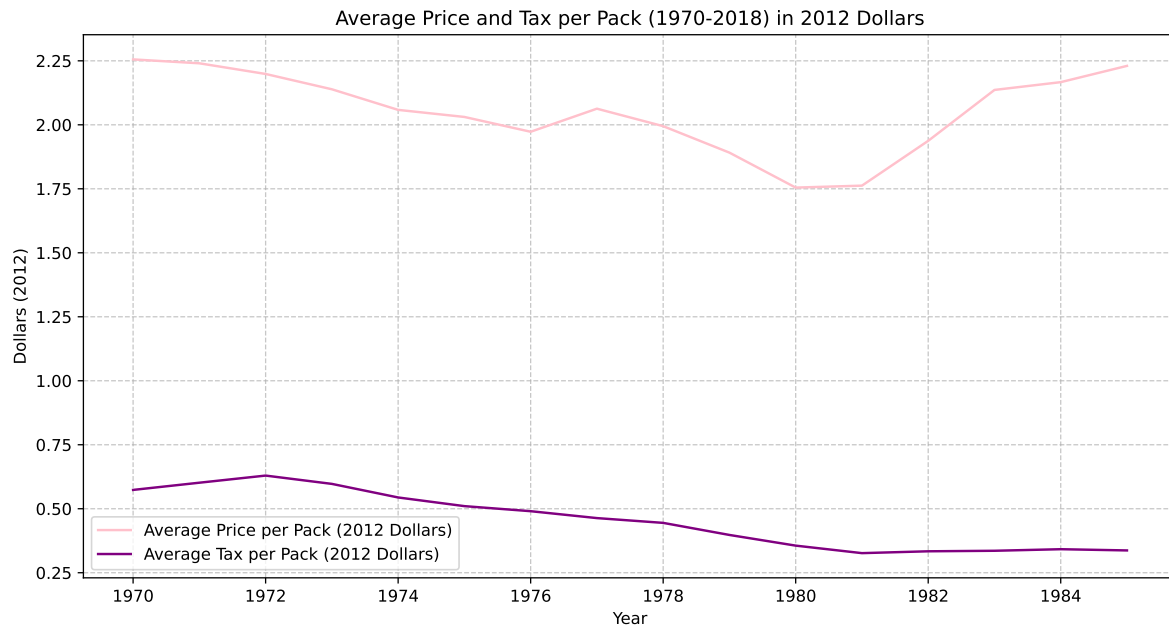
Ellen Wu

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.**

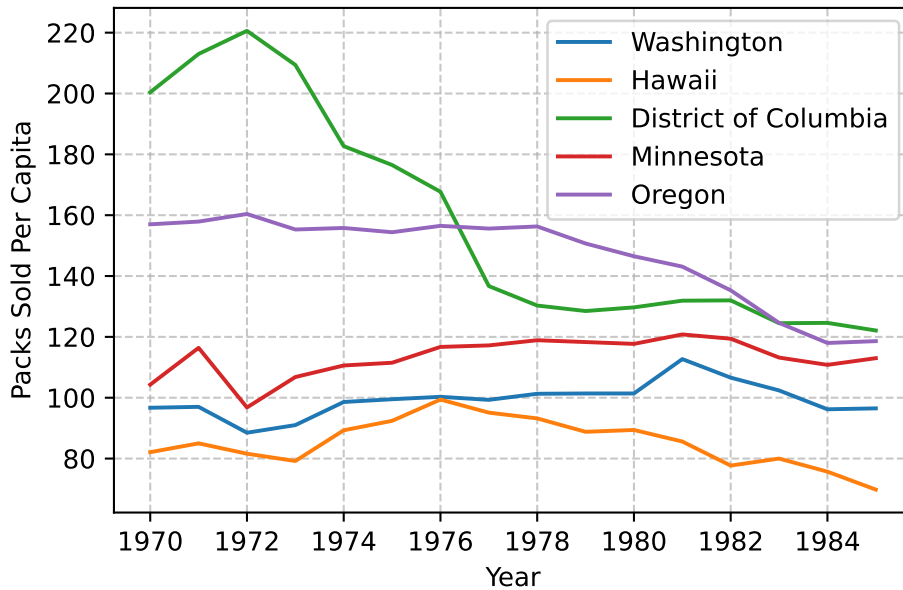


**2. Plot on a single graph the average tax (in 2012 dollars) on cigarettes and the average price of a pack of cigarettes from 1970 to 2018.**

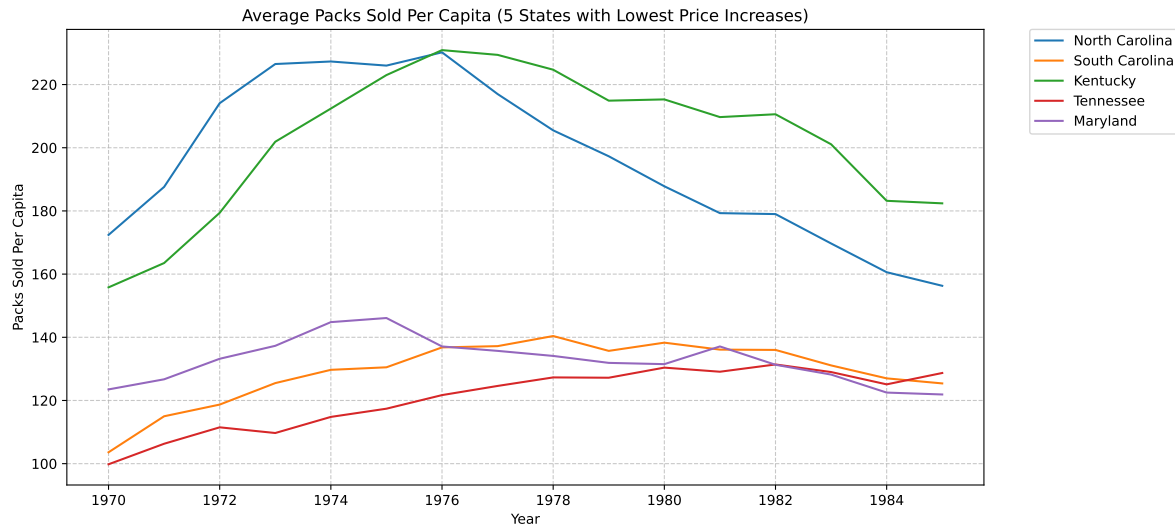


**3. Identify the 5 states with the highest increases in cigarette prices (in dollars) over the time period. Plot the average number of packs sold per capita for those states from 1970 to 2018.**

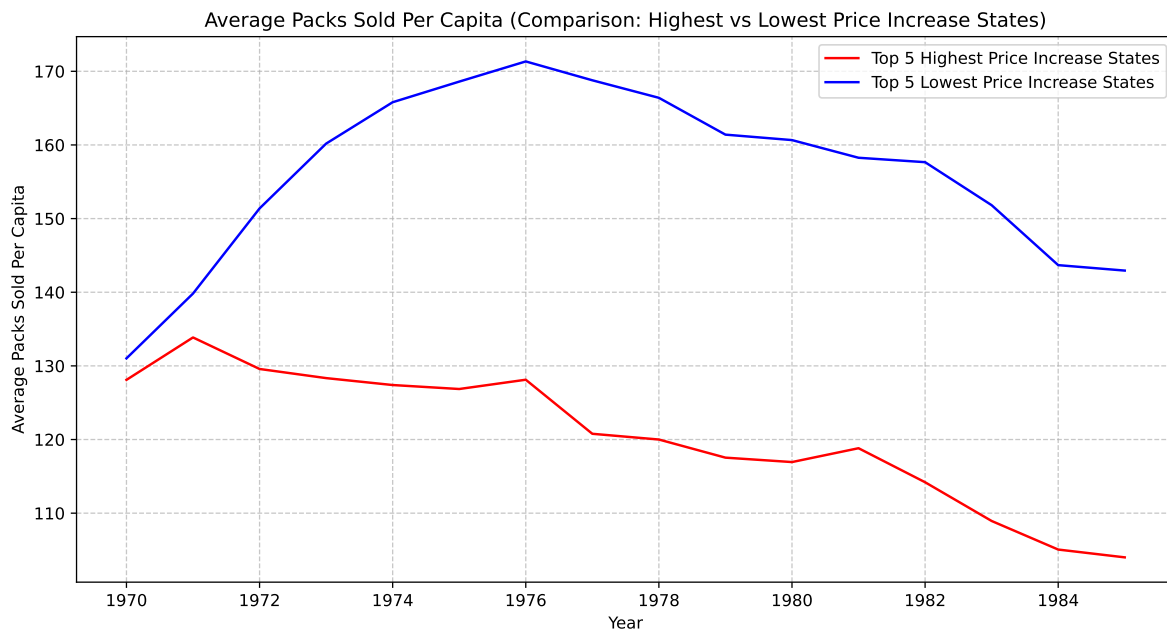
Average Packs Sold Per Capita (Top 5 States with Highest Price Increases)



**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.**



**5. Compare the trends in sales from the 5 states with the highest price increases to those with the lowest 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.**

OLS Regression Results						
=====						
Dep. Variable:	log_sales_per_capita		R-squared:	0.023		
Model:	OLS		Adj. R-squared:	0.021		
Method:	Least Squares		F-statistic:	18.82		
Date:	Wed, 05 Mar 2025		Prob (F-statistic):	1.62e-05		
Time:	16:23:37		Log-Likelihood:	116.37		
No. Observations:	816		AIC:	-228.7		
Df Residuals:	814		BIC:	-219.3		
Df Model:	1					
Covariance Type:	nonrobust					
=====						
	coef	std err	t	P> t	[0.025	0.975]
-----						

const	4.8011	0.014	344.661	0.000	4.774	4.828
log_price_per_pack	-0.0929	0.021	-4.338	0.000	-0.135	-0.051

---

Omnibus:	88.176	Durbin-Watson:	0.150
Prob(Omnibus):	0.000	Jarque-Bera (JB):	241.716
Skew:	0.556	Prob(JB):	3.25e-53
Kurtosis:	5.424	Cond. No.	3.89

---

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
Estimated Price Elasticity of Demand: -0.09

**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?**

#### IV-2SLS Estimation Summary

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Dep. Variable:	log_sales_per_capita	R-squared:	-0.0501
Estimator:	IV-2SLS	Adj. R-squared:	-0.0514
No. Observations:	816	F-statistic:	79.982
Date:	Wed, Mar 05 2025	P-value (F-stat)	0.0000
Time:	16:23:37	Distribution:	chi2(1)
Cov. Estimator:	robust		

---

#### Parameter Estimates

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	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	4.7090	0.0149	315.62	0.0000	4.6798	4.7383
log_price_per_pack	-0.2596	0.0290	-8.9433	0.0000	-0.3165	-0.2027

---

Endogenous: log\_price\_per\_pack  
Instruments: tax\_dollar  
Robust Covariance (Heteroskedastic)  
Debiased: False

Instrumented Price Elasticity of Demand: -0.26

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

First Stage Regression Results:

OLS Regression Results						
Dep. Variable:	log_price_per_pack		R-squared:	0.583		
Model:	OLS		Adj. R-squared:	0.582		
Method:	Least Squares		F-statistic:	1138.		
Date:	Wed, 05 Mar 2025		Prob (F-statistic):	1.00e-156		
Time:	16:23:37		Log-Likelihood:	71.316		
No. Observations:	816		AIC:	-138.6		
Df Residuals:	814		BIC:	-129.2		
Df Model:	1					
Covariance Type:	nonrobust					
	coef	std err	t	P> t	[0.025	0.975]
const	-1.4340	0.027	-52.581	0.000	-1.488	-1.380
tax_dollar	3.9366	0.117	33.728	0.000	3.708	4.166
Omnibus:	45.486		Durbin-Watson:	0.445		
Prob(Omnibus):	0.000		Jarque-Bera (JB):	35.777		
Skew:	0.423		Prob(JB):	1.70e-08		
Kurtosis:	2.420		Cond. No.	15.8		

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Reduced Form Regression Results:

OLS Regression Results			
Dep. Variable:	log_sales_per_capita	R-squared:	0.103
Model:	OLS	Adj. R-squared:	0.102
Method:	Least Squares	F-statistic:	93.27
Date:	Wed, 05 Mar 2025	Prob (F-statistic):	5.78e-21
Time:	16:23:37	Log-Likelihood:	151.30

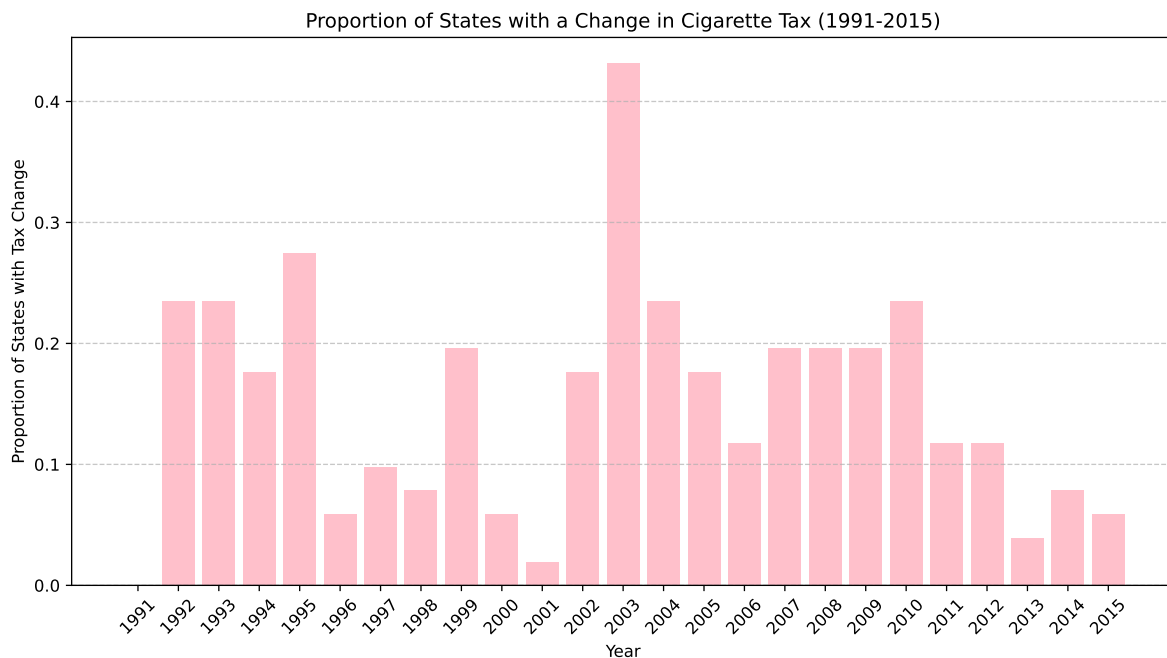
No. Observations: 816 AIC: -298.6  
Df Residuals: 814 BIC: -289.2  
Df Model: 1  
Covariance Type: nonrobust

	coef	std err	t	P> t	[0.025	0.975]
const	5.0813	0.025	205.508	0.000	5.033	5.130
tax_dollar	-1.0219	0.106	-9.657	0.000	-1.230	-0.814
Omnibus:	79.495	Durbin-Watson:	0.187			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	317.645			
Skew:	0.367	Prob(JB):	1.06e-69			
Kurtosis:	5.967	Cond. No.	15.8			

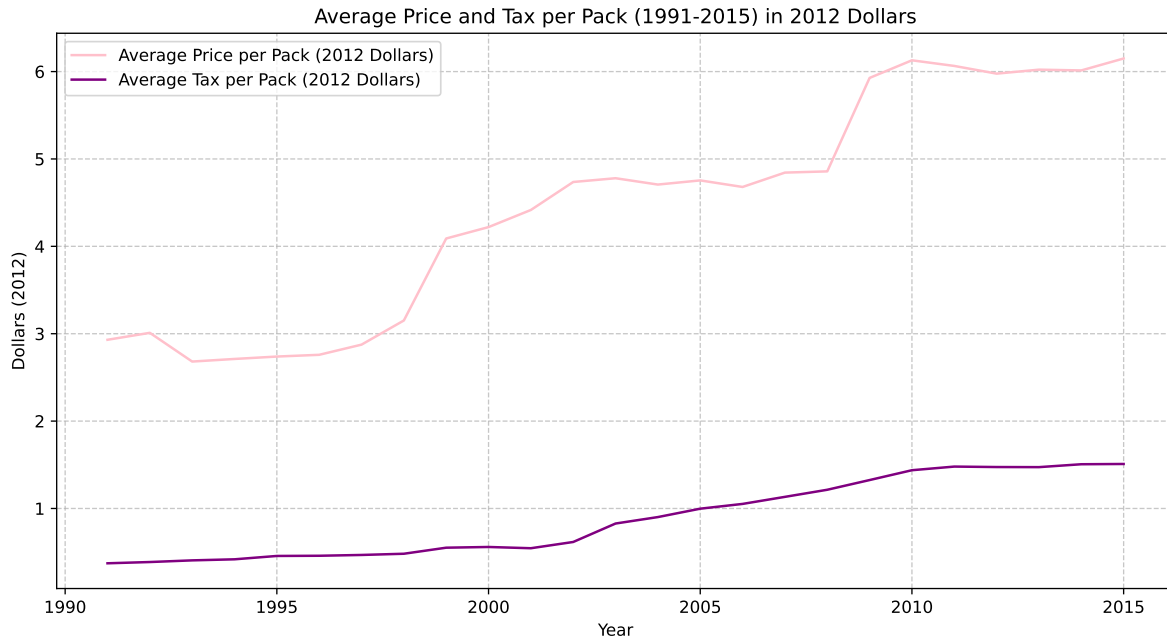
Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

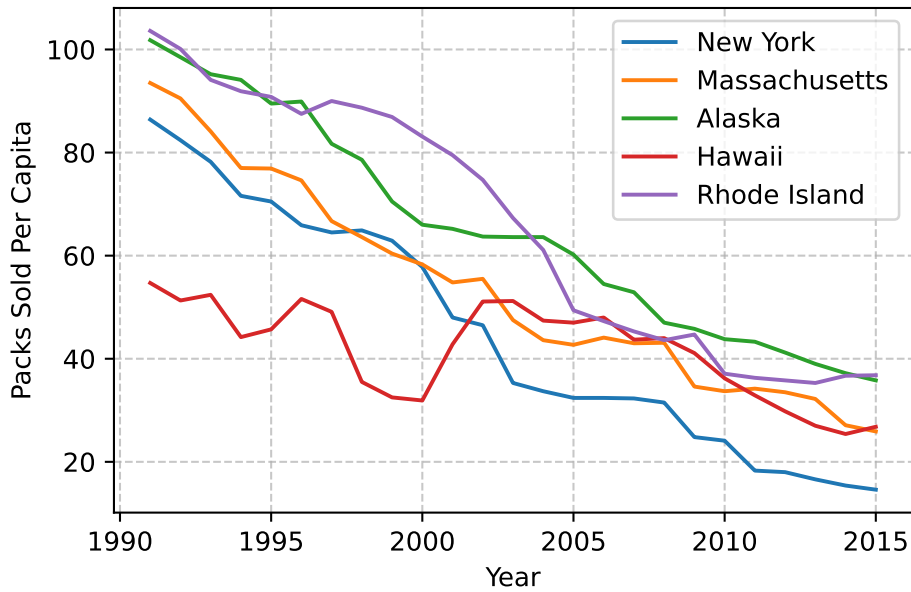
## 9. Repeat questions 1-3 focusing on the period from 1991 to 2015.







Average Packs Sold Per Capita (Top 5 States with Highest Price Increases)



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

OLS Regression Results						
=====						
Dep. Variable:	log_sales_per_capita	R-squared:		0.533		
Model:	OLS	Adj. R-squared:		0.532		
Method:	Least Squares	F-statistic:		1451.		
Date:	Wed, 05 Mar 2025	Prob (F-statistic):		1.52e-212		
Time:	16:23:38	Log-Likelihood:		-296.47		
No. Observations:	1275	AIC:		596.9		
Df Residuals:	1273	BIC:		607.2		
Df Model:	1					
Covariance Type:	nonrobust					
=====						
	coef	std err	t	P> t	[0.025	0.975]
-----						
const	5.0395	0.023	219.934	0.000	4.995	5.084
log_price_per_pack	-0.6656	0.017	-38.094	0.000	-0.700	-0.631
=====						
Omnibus:	19.351	Durbin-Watson:		0.158		
Prob(Omnibus):	0.000	Jarque-Bera (JB):		33.046		
Skew:	0.064	Prob(JB):		6.67e-08		
Kurtosis:	3.778	Cond. No.		5.37		
=====						

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
 Estimated Price Elasticity of Demand: -0.67