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ECON 301 - FINAL

Price Elasticity of Fish Demand

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```
. reg lprice t t2 mon tues wed thurs

      Source |       SS           df       MS      Number of obs   =        97
-------------+----------------------------------   F(6, 90)        =      2.23
       Model |  2.03081336         6  .338468893   Prob > F        =    0.0476
    Residual |  13.6822968        90   .15202552   R-squared       =    0.1292
-------------+----------------------------------   Adj R-squared   =    0.0712
       Total |  15.7131102        96  .163678231   Root MSE        =     .3899

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      lprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.0157773   .0057205    -2.76   0.007    -.0271421   -.0044125
          t2 |   .0001202   .0000565     2.13   0.036     7.91e-06    .0002325
         mon |  -.0119865   .1269225    -0.09   0.925    -.2641403    .2401672
        tues |   .0009034   .1249963     0.01   0.994    -.2474236    .2492304
         wed |   .0379775   .1233313     0.31   0.759    -.2070417    .2829967
       thurs |   .0908549   .1233069     0.74   0.463    -.1541157    .3358255
       _cons |   .1199856   .1449338     0.83   0.410    -.1679507     .407922
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According to results, the explanatory power of the model is not big. Adjusted R-Square is around 7% which states, only 7% of the variation in the price level can be explained by the time and day variables.
In terms of independent variables; effect of day Monday is negatively correlated on price, price of fish is 1.1% lower on Monday as compared to Friday, yet since the t-value is -0.09 (p-value 0.925) this result is not statistically significant.
On other days such as Tuesday, Wednesday and Thursday the effect of days on price is positive. On Tuesday, prices are almost same as the prices on Friday, however since the t-value is 0.01 this is not statistically significant. On Wednesday, prices are 3.8% higher than prices on Friday but again since the t-value is 0.31 result is insignificant. Lastly, on Thursday the average price of fish is 9% higher than the prices on Friday but because of the t-value(0.74) result is not significant.
As a result, it can be said that there is no any systematic variation on prices within a week.

If we look at the affect of time trend, it can be divided into 2 parts. In the first part, until the day 63, time is negatively correlated with average price of fish.In each day, average price of fish decreases by 1.5%. After the day 62, time trend turns out to positive. In each day prices increase by around 0.12%.   Since both t-values of time-trend variables are bigger/smaller than 1.96/-1.96, the effect of time is significant on average fish prices.

2- With the new variables, explanatory power of the model is increased to 30%. According to results, if the average maximum height of the waves in last 2 days increase by 1 meter, it increases the average prices of fish 9%. Since the t-value is 4.29 (greater than 1.96), the effect is statistically significant.
In addition to that, if the average maximum wave height of 3 and 4 day before

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. reg lprice t t2 mon tues wed thurs wave2 wave3

      Source |       SS           df       MS      Number of obs   =        97
-------------+----------------------------------   F(8, 88)        =      6.11
       Model |  5.60842892         8  .701053615   Prob > F        =    0.0000
    Residual |  10.1046813        88  .114825924   R-squared       =    0.3569
-------------+----------------------------------   Adj R-squared   =    0.2985
       Total |  15.7131102        96  .163678231   Root MSE        =    .33886

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      lprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.0133972     .00499    -2.68   0.009    -.0233138   -.0034806
          t2 |   .0001253   .0000492     2.55   0.013     .0000276     .000223
         mon |  -.0194277   .1107063    -0.18   0.861    -.2394332    .2005777
        tues |   .0009585   .1088778     0.01   0.993    -.2154133    .2173303
         wed |   .0491159   .1084457     0.45   0.652    -.1663972    .2646289
       thurs |   .1223422   .1077042     1.14   0.259    -.0916971    .3363816
       wave2 |   .0905067   .0211126     4.29   0.000     .0485499    .1324635
       wave3 |   .0493256   .0202115     2.44   0.017     .0091596    .0894916
       _cons |  -.7287036   .1989664    -3.66   0.000    -1.124108   -.3332996
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the observation increase by 1 meter, then the average price of fish increase by around 5%. Since the t-value of the variable is 2.44, result is statistically significant.
The positive correlation between waves and average price can be explained by supply-demand equilibrium. In the stormy days, fishers most probably can not sail and therefore they can not hunt enough fish. In this condition, since the amount of the fish are lower as compared to equilibrium quantity, prices increase, ceteris paribus.

We can assume that wave variables are exogenous because, they can not be determined by any other determinants of the average price in the model. Since the wave height is given and we are not producing it by the same model that we use to calculate the average price of fish, it can be said that wave variables are exogenous.

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. reg growthprice t t2 mon tues wed thurs wave2 wave3

      Source |       SS           df       MS      Number of obs   =        96
-------------+----------------------------------   F(8, 87)        =      1.98
       Model |  1.59476471         8  .199345589   Prob > F        =    0.0589
    Residual |  8.77654349        87   .10087981   R-squared       =    0.1538
-------------+----------------------------------   Adj R-squared   =    0.0760
       Total |  10.3713082        95  .109171665   Root MSE        =    .31762

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 growthprice |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           t |  -.0040458    .0048301    -0.84   0.405    -.0136462    .0055546
          t2 |   .0000558    .0000474     1.18   0.243    -.0000385    .0001501
         mon |   .1672186    .1055221     1.58   0.117    -.0425181    .3769552
        tues |   .1008136    .1020524     0.99   0.326    -.1020265    .3036537
         wed |   .2019699    .1016756     1.99   0.050    -.0001214    .4040613
       thurs |    .176946    .1009541     1.75   0.083    -.0237112    .3776032
       wave2 |   .0597081    .0197939     3.02   0.003     .0203655    .0990507
       wave3 |   .0063115    .0193373     0.33   0.745    -.0321235    .0447466
       _cons |  -.3873655     .186505    -2.08   0.041    -.7580643   -.0166667
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3- In the new model that we use growth rate of price, there are 3 variables which are statistically significant at 10% significance level. The first one is effect of Wednesday. According to results, growth rate of average fish price on Wednesday is 0.2 percentage point higher as compared to growth rate on Friday. The second significant variable is Thursday effect on growth rate. According to results, growth rate of average price of fish is 0.17 percentage point higher as compared to growth rate on Friday.
The last statistically significant independent variable is average maximum height of the waves in last 2 days. As it can be seen, if maximum height of wave in last 2 days increase by 1 meter, then the growth in average price of fish increase by around 0.06 percentage point on average.
Since all the p-values of the these 3 variables (Wednesday: 0.50, Thursday:0.83,Wave2:0.03) smaller then 10%, results are statistically significant.

In this model, time trend is not statistically significant because p-values are even higher than 10% significance level.

In the first model, we do not consider the possible effect of previous day's price on average price of fish on the observation day. On the other hand, in the second model, since we use the growth rate, we do not omit the possible effect of the previous day's price therefore trend effect on average price became insignificant in the new model.

. reg ltotqty lprice mon tues wed thurs t t2

Source	SS	df	MS
Model	12.9801993	7	1.85431419
Residual	43.1522342	89	.484856564
Total	56.1324335	96	.584712849

Number of obs	=	97
F(7, 89)	=	3.82
Prob > F	=	0.0011
R-squared	=	0.2312
Adj R-squared	=	0.1708
Root MSE	=	.69632

ltotqty	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lprice	-.5983342	.1882466	-3.18	0.002	-.9723762	-.2242922
mon	-.3200239	.2266776	-1.41	0.161	-.7704274	.1303796
tues	-.6740226	.2232265	-3.02	0.003	-1.117569	-.2304763
wed	-.5330649	.220369	-2.42	0.018	-.9709333	-.0951965
thurs	.0730521	.2208725	0.33	0.742	-.3658167	.511921
t	-.0136252	.010639	-1.28	0.204	-.0347647	.0075143
t2	.0001242	.0001035	1.20	0.233	-.0000814	.0003298
_cons	8.496822	.2598158	32.70	0.000	7.980573	9.01307

4- Explanatory power the model is around 17%.
According to results, 1% increase in the average price of fish, decreases the demand for fish by 0.598%. p-value is 0.002 (<0.01), the effect is statistically significant. So the price elasticity is 0.598/1 = 0.598. Since the elasticity is smaller than 1 it can be said that it is inelastic. However, this result may that be true so further investigation is needed to be sure.

There are 2 variables which are statistically significant at 10% level beside price.
First variable is Tuesday. According to results, average demand for fish is 67.4% less than the average demand for fish on Friday. Since the p-value is 0.003 (<0.01) the effect is statistically significant.
Another variable which is statistically significant at 10% level is Wednesday. According to results, demand for fish on Wednesday is 53.3% less than the demand for fish on Friday. Since the p-value is 0.018, result is statistically significant.

If there is a random measurement error in demand, it may not effect the final result of the model. Because demand is dependent variable and any random measurement error on observations may not change the overall result for the observations. Yet, it might change the sample error since the variance is increased due to measurement error. As long as the measurement error is uncorrelated to the values of the explanatory variables, average results will not be affected.

On the other hand, if the measurement error in the price variable which is independent variable, it affects the results drastically. Because, what we found as a result will become biased since the price does not reflect the true value of the observation. Under this circumstances, magnitude of the effect will be attenuated towards zero and incorrect.

5- To use any variable as an instrumental variable 3 conditions must be satisfied:

1- It should not be directly related with the dependent variable in the model. In this context, “wave2” and “wave3" should not be directly related with demand variable. The only channel that “wave2” and “wave3” show their effect is fish price. There should not be any other channels.

2- It should be highly correlated with endogenous variable. In this context, we may consider the average price of fish as an endogenous variable since it might be affected by many other factors beside control variables.

3- It should be uncorrelated with error term.

As it was stated in question 2 , wage is assumed exogenous or uncorrelated with error term. 3rd condition is satisfied.
Since there are not any other possible channel that wage can show its affect on demand except price and this is not directly related, 1st condition is satisfied.
For the 2nd condition, equation in the question 2 can be used. According to findings, wage variables are highly correlated with price and results are statistically significant. Sin-

ce price variable is endogenous and wage variables are remarkably related with it, 2nd condition for being instrumental variable is satisfied as well.

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. reg ltotqty lpricehat mon tues wed thurs t t2

      Source |       SS           df       MS      Number of obs   =        97
-------------+----------------------------------   F(7, 89)        =      3.20
       Model |   11.290185         7  1.61288357   Prob > F        =    0.0045
    Residual |  44.8422485        89  .503845488   R-squared       =    0.2011
-------------+----------------------------------   Adj R-squared   =    0.1383
       Total |  56.1324335        96  .584712849   Root MSE        =    .70982

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     ltotqty |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lpricehat |  -.9469797   .3752769    -2.52   0.013    -1.692647   -.2013124
         mon |  -.3242029   .2311061    -1.40   0.164    -.7834058    .1349999
        tues |  -.6737076   .2275559    -2.96   0.004    -1.125856   -.2215589
         wed |  -.5198242   .2249764    -2.31   0.023    -.9668476   -.0728009
       thurs |   .1047283   .2270546     0.46   0.646    -.3464244    .5558809
           t |  -.0191259   .0119796    -1.60   0.114    -.0429292    .0046774
          t2 |   .0001661   .0001124     1.48   0.143    -.0000571    .0003894
       _cons |   8.538654   .2676665    31.90   0.000     8.006806    9.070502
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6- By using 2SLS method, we can eliminate the endogeneity problem since we use the new price variable which depends on instrumental variables wave2 and wave3.

In the new results, 1% increase in fish prices leads to 0.945% decrease in fish demand on average. Since the p-value is 0.013 the result is statistically significant. As compared to previous results, the prices elasticity of fish demand is now 0.945/1= 0.945. It is still inelastic but now the effect of price on demand is more consistent with our expectations. The difference between the results in question 4 and question 6, might be caused by the endogeneity problem of price. Since price can be influenced by many other factors that also affect the demand, omitted variable bias may occur. In this circumstance, results might be over/underestimated in OLS method. By using instrumental variable method, bias on the price can be eliminated and it can be seen that previous calculated result of effect of price on fish demand is underestimated.

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. ivreg ltotqty mon tues wed thurs t t2 (lprice= wave2 wave3)

Instrumental variables (2SLS) regression

      Source |       SS           df       MS      Number of obs   =        97
-------------+----------------------------------   F(7, 89)        =      3.20
       Model |  11.3170661         7  1.61672372   Prob > F        =    0.0045
    Residual |  44.8153674        89  .503543454   R-squared       =    0.2016
-------------+----------------------------------   Adj R-squared   =    0.1388
       Total |  56.1324335        96  .584712849   Root MSE        =    .70961

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     ltotqty |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lprice |  -.9469797   .3751644    -2.52   0.013    -1.692423    -.201536
         mon |  -.3242029   .2310368    -1.40   0.164    -.7832682    .1348623
        tues |  -.6737076   .2274877    -2.96   0.004    -1.125721   -.2216944
         wed |  -.5198242    .224909    -2.31   0.023    -.9667136   -.0729349
       thurs |   .1047283   .2269865     0.46   0.646    -.3462891    .5557457
           t |  -.0191259   .0119761    -1.60   0.114    -.0429221    .0046703
          t2 |   .0001661   .0001123     1.48   0.143    -.0000571    .0003893
       _cons |   8.538654   .2675862    31.91   0.000     8.006966    9.070342
------------------------------------------------------------------------------
Instrumented:  lprice
Instruments:   mon tues wed thurs t t2 wave2 wave3
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In addition to endogeneity, simultaneity bias also may exits. For instance, when the demand for fish increases price increases, on the other side, when price increases demand decreases. This may also leads to a bias, therefore instrumental variable approach might be useful to eliminate this issue.

7- After eliminating outliers in the sample, price elasticity of fish demand changed drastically. According to new results show that 1% increase in fish price leads to a decrease in fish demand by 1.32% on average. New price elasticity is 1.32/1 = 1.32. Since the new value is greater than 1, it can be said that price elasticity of fish demand is now elastic.

Another approach to eliminate the effects of outliers can be using log transformation on wave2 and wave3. By applying log transformation on wave va-

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. ivreg ltotqty mon tues wed thurs t t2 (lprice= wave2 wave3)

Instrumental variables (2SLS) regression

      Source |       SS           df       MS      Number of obs   =        94
-------------+----------------------------------   F(7, 86)        =      3.33
       Model |  7.41348071         7  1.05906867   Prob > F        =    0.0034
    Residual |  47.8258916        86  .556115019   R-squared       =    0.1342
-------------+----------------------------------   Adj R-squared   =    0.0637
       Total |  55.2393723        93  .593971745   Root MSE        =    .74573

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     ltotqty |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lprice |  -1.327654   .4357373    -3.05   0.003    -2.193872   -.4614374
         mon |   -.403454   .2466969    -1.64   0.106    -.8938712    .0869632
        tues |  -.7084423   .2430651    -2.91   0.005     -1.19164    -.225245
         wed |  -.5335099   .2390388    -2.23   0.028    -1.008703   -.0583164
       thurs |   .1405286   .2391879     0.59   0.558    -.3349612    .6160185
           t |  -.0199943   .0125704    -1.59   0.115    -.0449835     .004995
          t2 |   .0001729    .000118     1.47   0.146    -.0000616    .0004074
       _cons |   8.455177    .285692    29.60   0.000      7.88724    9.023113
------------------------------------------------------------------------------
Instrumented:  lprice
Instruments:   mon tues wed thurs t t2 wave2 wave3
------------------------------------------------------------------------------
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riables the distribution price and wage become more consistent. The price elasticity of fish demand which is calculated by using log values of wave variables is more than 1 which means it is elastic (around 1.024). So the result is consistent with the previous approach's outcome.

Determinants of Crime Rate

Variable	Obs	Mean	Std. Dev.	Min	Max
crmrte	630	.0315876	.0181209	.0018116	.163835
prbarr	630	.3073682	.1712047	.0588235	2.75
prbconv	630	.6886176	1.690345	.0683761	37
prbpris	630	.4255184	.0872452	.148936	.678571
avgsen	630	8.95454	2.658082	4.22	25.83
polpc	630	.0019168	.0027349	.0004585	.0355781
density	630	1.386062	1.439703	.1977186	8.827652
west	630	.2333333	.4232887	0	1
central	630	.3777778	.4852169	0	1
urban	630	.0888889	.2848094	0	1
pctmin80	630	25.71285	16.90354	1.28365	64.3482
wcon	630	245.6661	121.9837	65.62158	2324.598
wtuc	630	406.1028	266.5138	28.8577	3041.958
wtrd	630	192.8231	88.40727	16.87376	2242.747
wfir	630	272.0593	55.76809	3.51568	509.4655
wser	630	224.6705	104.8667	1.843794	2177.068
wmfg	630	285.1701	82.36807	101.83	646.85
wfed	630	403.8959	63.06669	255.4	597.95
wsta	630	296.9075	53.43161	173.02	548
wloc	630	257.9762	41.35802	163.59	388.09
pctymle	630	.0889739	.0243493	.0621577	.2743584

8- In Question 9, I used 20 variables to estimate the model. As it can be seen from the summary statistics table:
- Average crime rate committed per person in North Carolina counties is around 3% on average with standard deviation 0.018.
- Probability that being arrested is around 30% on average with standard deviation 0.17.
- Probability of conviction is 68.8% on average with standard deviation 1.69.
- Probability of prison sentence is 42.5% on average with standard deviation 0.08.
- Average sentence days is around 9 days in overall with standard deviation 2.65 days.
- Police per capita in counties is around 0.002 on average with standard deviation 1.40.
- People per square mile (density) is around 1.4 with standard deviation 1.44 on average.
- Percentage of minorities in 1980 is around 25 on average with standard deviation 16.9.
- Young males in counties is around 0.088 percent on average with standard deviation 0.024.
- Weekly wage of construction workers is around $245.66 on average with standard deviation 121.98.
- Weekly wage of workers in transportation, utilities and communication industry is around $406.1 on average with standard deviation 266.51.
- Weekly wage of workers in finance, insurance and real estate industry is $272 on average with standard deviation 55.76.
- Weekly wage of workers in wholesale and retail trade industry is around $193 on average.
- Weekly wage of workers in service industry is around $225 on average with standard deviation 104.86.
- Weekly wage of workers in manufacturing industry is around $285 on average with standard deviation 82.3.
- Weekly wage of fed employees is around $404 on average with standard deviation 63.06.
- Weekly wage of state employees is around $297 on average with standard deviation 53.43

- Weekly wage of local government employees is around $258 on average with standard deviation 41.35.

9- To be able to find more consistent results, I transformed independent variables (except location variables) and dependent variable into log form. So results can be interpreted as elasticity.

lcrmrte	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lprbarr	-.5373019	.0295517	-18.18	0.000	-.5953387	-.4792651
lprbconv	-.4305394	.021541	-19.99	0.000	-.4728439	-.3882348
lprbpris	-.1158175	.0485	-2.39	0.017	-.2110668	-.0205682
lavgsen	-.0907	.0401314	-2.26	0.024	-.1695142	-.0118858
lpolpc	.3601124	.0222813	16.16	0.000	.316354	.4038708
ldensity	.2994077	.0283729	10.55	0.000	.243686	.3551293
lpctmin80	.1787638	.0195357	9.15	0.000	.1403975	.2171301
lwcon	.0852942	.0545355	1.56	0.118	-.0218084	.1923967
lwtuc	.021606	.0312172	0.69	0.489	-.0397016	.0829136
lwtrd	.0430638	.062275	0.69	0.490	-.0792384	.165366
lwfir	-.0018835	.0446601	-0.04	0.966	-.0895918	.0858248
lwser	-.0265476	.0312174	-0.85	0.395	-.0878556	.0347603
lwmfg	-.079091	.0528722	-1.50	0.135	-.182927	.024745
lwfed	.0842811	.113893	0.74	0.460	-.1393941	.3079563
lwsta	-.201884	.0930241	-2.17	0.030	-.3845745	-.0191935
lwloc	.0554338	.1399882	0.40	0.692	-.2194898	.3303574
lpctymle	-.1447863	.0631831	-2.29	0.022	-.268872	-.0207006
west	-.2287133	.0459447	-4.98	0.000	-.3189445	-.1384822
central	-.1783897	.027608	-6.46	0.000	-.2326092	-.1241702
urban	-.1364731	.0536989	-2.54	0.011	-.2419327	-.0310136
year						
82	-.0014061	.0403917	-0.03	0.972	-.0807315	.0779193
83	-.084797	.0443643	-1.91	0.056	-.1719244	.0023304
84	-.1241425	.0464421	-2.67	0.008	-.2153503	-.0329347
85	-.1114031	.0549531	-2.03	0.043	-.2193258	-.0034804
86	-.0837597	.0631076	-1.33	0.185	-.2076971	.0401777
87	-.0496623	.0708925	-0.70	0.484	-.1888885	.0895639

According to results, there are 13 independent variables which have statistically significance at 10% significance level.

* If the probability of being arrested due to committed crime is increase by 1%, crimes committed per person decrease by 0.53 % on average. Since the p-value is around 0, result is statistically significant.
* If the probability of conviction increase by 1%, crimes committed per person decrease by 0.43% on average. P-value is around 0, so this is statistically significant.
* If the probability of prison sentence increase by 1%, crimes committed per person decrease by 0.11% on average. P-value is 0.017, so this is statistically significant.
* If average sentence days increase by 1%, crimes committed per person decrease by 0.09% on average. Since the t-value is -2.26 (smaller than -1.96), result is statistically significant.
* **If the police per capita increase by 1%, crimes committed per person increase by 0.36% on average, p-value is around 0 so result is statistically significant. In fact, this result is different than my expectation so further investigation might be needed.**
* If people per square mile increase by 1%, crimes committed per person increase by 0.30 % on average, t-value is 10.55 which is bigger than 1.96 so result is statistically significant.
* If the number of minorities increase by 1%, crimes committed per person increase by 0.17% on average, t-value is 9.15 therefore result is statistically significant.
* If weekly wage of state employees increase by 1%, crimes committed per person decrease by 0.201% on average. Since t-value is around -2.17 result is statistically significant.
* **If percent of young males in population increase by 1%, crimes committed per person decrease by 0.144 % on average, p-value is 0.022 so result is significant. However, the sign of the result is no inline with my expectation. Therefore further investigation might be needed.**
* Crimes committed per person in the west side of the North Carolina counties is 22.8% lower as compared to other regions since the p-value is around 0 result is statistically significant.

* Crimes committed per person in the central side of the North Carolina counties is 17.8% lower as compared to other regions since the p-value is around 0 result is statistically significant.
* Crimes committed per person in the urban side of the North Carolina counties is 13.6% lower as compared to other regions since the p-value is around 0 result is statistically significant.
* As compared to base year 1981, in 1983 crime rate is 8% lower, in 1984 12.4% lower and in 1985 11.1% lower. Since both variables' p-value is smaller than 0.10, results are statistically significant.

According to results, most of the significant variables' signs are inline with my expectations. But the signs of police per capita variable and percent of young male variables are not as expected. So the reason for police per capita sign being positive might be the issue of endogeneity. For instance, when the number of crime increases, government may need to increase the number of police. On the other hand, when there are more police officers, reported number of crimes increases as well. Therefore this might be a biased coefficient.
The reason behind the negative sign of percent of young male variable might be rooted from the effects that are constant over the time such as percentage minority or location of the county like west or urban. So there might be perfect collinearity issue.

10-
When the model estimated with Fixed Effect method, some critical changes occurred.

lcrmrte	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lprbarr	-.3548296	.0322049	-11.02	0.000	-.4180978	-.2915614
lprbconv	-.281569	.0211376	-13.32	0.000	-.323095	-.240043
lprbpris	-.173104	.0323027	-5.36	0.000	-.2365644	-.1096436
lavgsen	-.002453	.026119	-0.09	0.925	-.0537652	.0488592
lpolpc	.413162	.0266232	15.52	0.000	.3608593	.4654647
ldensity	.4143876	.2825414	1.47	0.143	-.1406803	.9694555
lpctmin80	0	(omitted)				
lwcon	-.0377918	.0390756	-0.97	0.334	-.1145579	.0389744
lwtuc	.0455253	.0190115	2.39	0.017	.0081761	.0828745
lwtrd	-.0205016	.0404789	-0.51	0.613	-.1000246	.0590215
lwfir	-.0038992	.0282572	-0.14	0.890	-.059412	.0516135
lwser	.0088773	.0191314	0.46	0.643	-.0287074	.046462
lwmfg	-.3598514	.1118352	-3.22	0.001	-.5795578	-.1401451
lwfed	-.309318	.1761642	-1.76	0.080	-.6554022	.0367662
lwsta	.0528862	.1135306	0.47	0.642	-.1701508	.2759232
lwloc	.1816069	.1176542	1.54	0.123	-.0495312	.4127449
lpctymle	.6267484	.3636063	1.72	0.085	-.0875759	1.341073
west	0	(omitted)				
central	0	(omitted)				
urban	0	(omitted)				
year						
82	.0226837	.025931	0.87	0.382	-.0282592	.0736265
83	-.0405144	.0357204	-1.13	0.257	-.110689	.0296603
84	-.0434467	.0464791	-0.93	0.350	-.1347575	.0478641
85	-.0165515	.0634444	-0.26	0.794	-.1411916	.1080885
86	.0347729	.0781033	0.45	0.656	-.1186653	.188211
87	.0997554	.0930563	1.07	0.284	-.0830587	.2825696

First of all, since some variables do not vary over time, these are omitted (Percent of minorities, west ,central and urban areas).

Secondly, some regressors become insignificant with the new results. As compared to previous model, effect of average sentence days lost its significance (p-value was 0.024, in new model p-value is 0.925 which is not significant). Density also lost its significance on the dependent variable at 10% significance level (p-value was around 0, in new model p-value is 0.143 which is not significant at 10% significance level). Weekly wage of state employees also lost its effectiveness on the crime rate(p-value was 0.03, in new model p-value is 0.642 which is not significant).
Lastly, impact of year dummy variables on dependent variable became insignificant with the new method.

Thirdly, by applying Fixed Effect method, we eliminate the variables that are constant over time as a result of this, impact of probability of arrest on crime rate decreased to 0.35%

from 0.53%. Similarly effect of conviction probability on crime rate decreased to 0.28% from 0.43% on average. Effect of weekly wage of workers in transportation, utilities and communication industry on crime rates became significant with p-value 0.017. So according to that 1% increase in weekly wage leads to 0.45% increase in crime rate on average.
Another wage related change is about weekly wage of workers in manufacturing industry. According to new results, 1% increase in weekly wages leads to 0.35% decrease in crime rate on average, since the p-value is 0.001 result is statistically significant event at 5% significance level. In addition, weekly wage of fed employees has also significant effect on crime rate, 1% increase in weekly wage decrease the crime rate by 0.30% with p-value 0.08.

The last significant change that comes with FE method is the change in effect of percent of young male on crime rate. In new results, impact is became positive on crime (It was negative on previous model and suspicious due to perfect collinearity). According to new results, 1% increase of young male percent, increases the crime rate by 0.62 % on average with p-value 0.085 which is statistically significant at 10% significance level.

To sum up, positive side of using FE is it might eliminates the endogeneity issue by dropping the unobserved invariant variable which may correlated with explanatory variables. Therefore as it can be seen from the results, we can fix the underestimation in this case. So using Fixed Effect method is more consistent as compared to OLS estimation.

11-

The reason of endogeneity behind the police per capita might be result from simultaneity bias. For instance, when there are more police per capita reporting the crime may be increase hence crime per capita also increases. On the other side, when the rate crime per capita is high more police is needed therefore it increases the number of police.
Under these circumstances, polpc might be endegenous and biased.
To prevent from this, we may use tax revenue per capita as an instrumental variable. The logic behind using this as instrumental variable is the following: Tax revenue means how much tax federal government gets per person, so people may be willing to pay higher taxes for higher security in their county. Hence, to hire more security power (in this context it is police per capita), federal government may collect more tax from people.

In the context of instrumental variable, 3 conditions must be satisfied:

According to relevance assumption tax revenue per capital should have a casual effect on police per capita. When we run a regression using tax revenue as independent variable and police per capita as dependent variable with control variables, it can be seen that tax revenue has a big impact on police per capita on average with statistically significance.

The second condition, exclusion, is also satisfied since police per capita is the only channel that tax revenue can show its effect on crime rate. And this is not a direct effect.

The third condition, independence assumption, is satisfied as well since there are no any correlation between the error term of crime rate model and tax revenue.

As a result it seems valid to use tax per capita as an instrumental variable.

lcrmrte	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lpolpc	.3473331	.0843652	4.12	0.000	.1816479	.5130184
lprbarr	-.5306976	.0372093	-14.26	0.000	-.6037732	-.457622
lprbconv	-.4240675	.0357648	-11.86	0.000	-.4943061	-.3538289
lprbpris	-.1116797	.0485416	-2.30	0.022	-.2070107	-.0163486
lavgsen	-.0911962	.0404257	-2.26	0.024	-.1705885	-.0118038
ldensity	.297579	.0286892	10.37	0.000	.2412361	.353922
lpctmin80	.1772669	.0208862	8.49	0.000	.1362484	.2182853
lwcon	.079919	.0610594	1.31	0.191	-.039996	.1998339
lwtuc	.0232905	.0316061	0.74	0.461	-.038781	.0853619
lwtrd	.0473707	.0624633	0.76	0.449	-.0753015	.1700428
lwfir	-.0039467	.0452201	-0.09	0.930	-.0927548	.0848614
lwser	-.0278799	.0312796	-0.89	0.373	-.0893101	.0335504
lwmfg	-.0787704	.0585668	-1.34	0.179	-.19379	.0362492
lwfed	.0945845	.131013	0.72	0.471	-.1627128	.3518818
lwsta	-.2171807	.0936002	-2.32	0.021	-.4010027	-.0333587
lwloc	.0585213	.1410652	0.41	0.678	-.2185175	.3355601
pctymle	-.9242078	.5768261	-1.60	0.110	-2.05704	.2086244
west	-.2267908	.0460209	-4.93	0.000	-.3171716	-.13641
central	-.1762738	.0277424	-6.35	0.000	-.2307572	-.1217903
urban	-.1292964	.0650967	-1.99	0.047	-.2571402	-.0014526
_Iyear_82	-.0001838	.040736	-0.00	0.996	-.0801854	.0798178
_Iyear_83	-.0830487	.0449485	-1.85	0.065	-.1713234	.005226
_Iyear_84	-.1201493	.0466828	-2.57	0.010	-.2118298	-.0284687
_Iyear_85	-.1055032	.0553933	-1.90	0.057	-.2142904	.0032841
_Iyear_86	-.0750468	.0634896	-1.18	0.238	-.1997344	.0496408
_Iyear_87	-.0375355	.0707122	-0.53	0.596	-.1764076	.1013367
_cons	-2.330806	1.313883	-1.77	0.077	-4.91115	.2495368

According to new results, there is not a dramatical change in the polpc variable as compared to previous model that does not have instrumental variable. In the new model, 1% increase in police per capita, leads to a 0.34% (it was 0.35% on previous OLS model) increase in crime rate on average with t-value 4.12 which is statistically significance at 5% significance level.

To better off, some other instrumental variables can be used. In this context, *grants for police incentives* might be useful as an instrumental variable. For example, the effect of grants such as Cops Hiring Program (CHP)[1] may have a significant effect on the number of police in counties. Since these grants are not directly related with crime rate but only through the police level, grants might be used as an instrumental variable. In their paper, *"Police levels and crime rates: An instrumental variables approach"*, John L. Worrall and Tomislav V. Kovandzic used this method to eliminate simultaneity between police level and crime rate. According to their data and results, using grant as an instrumental variable has a significant effect of eliminating bias.[2]

12- To see the effect of coronavirus on total death trends between the before and after period of pandemic might be checked. However, in this analysis some other factors may affect the results in a bad way. Therefore, since coronavirus is an exogenous event, difference-in-differences method can be used to see the effect of pandemic on total death and then reported deaths by the government and the real change can be compared to see whether stated numbers are not that real. To use DiD method, the parallel trend assumption must be made. In this context, it can be said that coronavirus is a huge effect on total deaths and without coronavirus pandemic, trend of total deaths are quite similar to each other in separate years.

To build the empirical model, we may use total number of deaths as a dependent variable.
In difference-in-differences method, we need two groups to compare them with each other: control and treatment group. In the context of coronavirus, we may use the data that are between March 2019 to June 2019 as control group (takes 0) and March 2020 to June 2020 as treatment group (takes 1).
Since coronavirus related deaths take 0 before March 2020, we may use coronavirus_death as an after-change variable.
So the final model can be written as the following:

$$total\_death = \beta_0 + \sigma_0 corona\_death + \beta_1 treatment\_group + \sigma_1 corona\_death * treatment\_group + u$$

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[1] https://cops.usdoj.gov/chp

[2] https://www.sciencedirect.com/science/article/abs/pii/S0049089X10000062#:~:text=The%20instrumental%20variables%20(IV)%20approach,locating%20instruments%20for%20police%20levels.&text=We%20found%20fairly%20robust%20inverse,but%20mainly%20in%20large%20cities.

In this model, our main interest is in the interaction term (σ1corona_death*treatment_group). Since the value of σ1 gives the treatment effect, we should interpret its coefficient. The null hypothesis for this coefficient is the following: “Coronavirus pandemic has no effect on total number of deaths in Turkey”. If one can find a statistically significant result for the interaction variable’s coefficient, the change on total death that resulted from the coronavirus can be detected. And this change can be compared with the government’s official reports to check whether death numbers are stated correctly or not.