What drives crime in the U.S. ?

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May 10, 2023

Presentation Overview

What drives crime in the U.S. ?

- What influences crime rates in the US ?
- Does police presence increase those ?

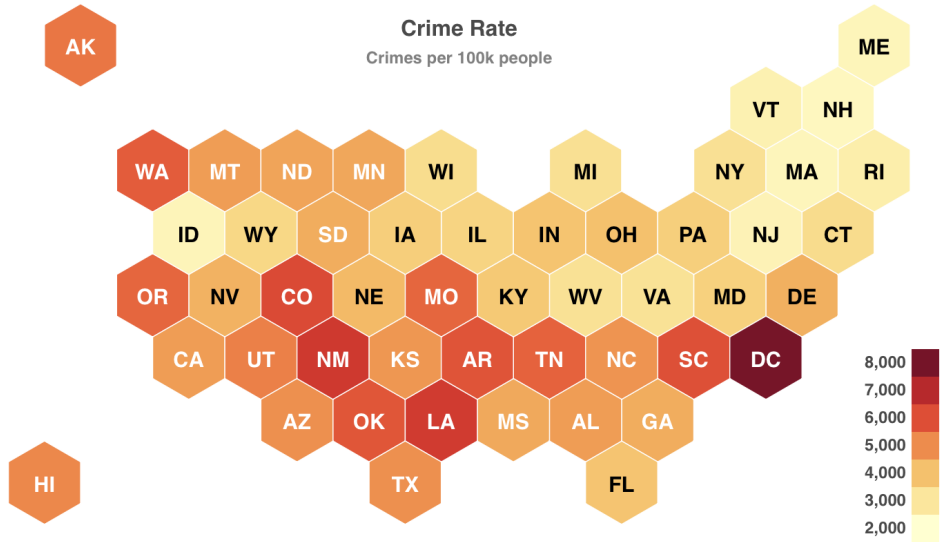


Figure: Crime per 100k people in 2022 in the US, by state

Data Collecting

- US Bank Data Base
- US Government Data Base

Procedure

Cross-sectionnal Model

- 50 states + District of Columbia
- 1 year : 2021

Time-series Model

- 3 states : California, New York, Texas
- 22 years : from 2000 to 2021

Panel Model

- 50 states + District of Columbia
- 11 years : from 2011 to 2021

Cross-sectionnal Data

Variables	Nicknames	Unit	Expected sign
AFRICAN-AMERICAN-POP	afr	% of black	+
BACHELOR-POP	bachelor	% of bachelor	-
HISPANIC-POP	hisp	% of hispanic	+
DEATH-PENALTY	pen	dummy	?
POLICE-OFFICERS	police	per 100k people	-
UNDER-POVERTY-LINE	poverty	% of poor people	+
WEAPON-ALLOWED	weapon	dummy	+
WHITE-POP	white	% of white	-

Table: Cross-sectionnal variables expected signs

First "naive" equation

- Modelization of crime rate per state on a given time (2021)
- We modelled (1):

$$cr_i = \beta_0 + \beta_1 afr_i + \beta_2 hisp_i + \beta_3 white_i + \beta_4 pen_i + \beta_5 police_i + \beta_6 poverty_i + \beta_7 weapon_i + \beta_8 bachelor_i + u_i \quad (1)$$

Equation (1) results

Equation: EQ01 Workfile: CROSS-SECTONNIAL::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: CR
Method: Least Squares
Date: 04/13/23 Time: 17:11
Sample: 1 51
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3053.974	3030.034	1.007901	0.3193
AFR	-2773.531	2548.810	-1.088167	0.2827
HISP	-1912.617	2160.118	-0.885423	0.3810
WHITE	-4501.350	1685.630	-2.670426	0.0107
PEN	697.5634	370.2608	1.883978	0.0665
POLICE	-3.604547	2.013894	-1.789840	0.0807
POVERTY	25533.51	8662.132	2.947717	0.0052
WEAPON	699.3395	571.4125	1.223879	0.2278
BACHELOR	6530.984	3613.741	1.807264	0.0779

R-squared	0.448744	Mean dependent var	4359.824
Adjusted R-squared	0.343743	S.D. dependent var	1254.463
S.E. of regression	1016.236	Akaike info criterion	16.84438
Sum squared resid	43374925	Schwarz criterion	17.18530
Log likelihood	-420.5318	Hannan-Quinn criter.	16.97466
F-statistic	4.273708	Durbin-Watson stat	2.487297
Prob(F-statistic)	0.000803		

Sign comparaison

Nicknames	Unit	Expected sign	Sign
afr	% of black	+	/
hisp	% of hispanic	+	/
white	% of white	-	-
pen	dummy	?	+
police	per 100k people	-	-
poverty	% of poor people	+	+
weapon	dummy	+	/
bachelor	% of bachelor	-	+

Table: Equation (1) coefficients signs

Correlation

	AFR	BACHELOR	CR	HISP	PEN	POLICE	POVERTY	WEAPON	WHITE
AFR	1.000000								
BACHE...	0.159367	1.000000							
CR	0.314029	-0.006751	1.000000						
HISP	-0.123214	0.101319	0.180792	1.000000					
PEN	0.111560	-0.517098	0.293805	0.035045	1.000000				
POLICE	0.291927	-0.089813	-0.074667	0.117962	-0.136942	1.000000			
POVERTY	0.516963	-0.449708	0.448285	0.078586	0.373266	0.221536	1.000000		
WEAPON	-0.247504	-0.356258	-0.082755	-0.335408	0.085480	-0.075819	-0.119520	1.000000	
WHITE	-0.484421	-0.225448	-0.404889	-0.572008	0.047098	-0.397524	-0.293137	0.390666	1.000000

Figure: Correlation Matrix

Tests

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	2.594979	Prob. F(2,40)	0.0872
Obs*R-squared	5.857227	Prob. Chi-Square(2)	0.0535

Figure: Breusch-Godfrey Correlation LM Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.189186	Prob. F(8,42)	0.3285
Obs*R-squared	9.418658	Prob. Chi-Square(8)	0.3082
Scaled explained SS	4.565661	Prob. Chi-Square(8)	0.8028

Figure: Breusch-Pagan-Godfrey Heteroskedasticity Test

Tests

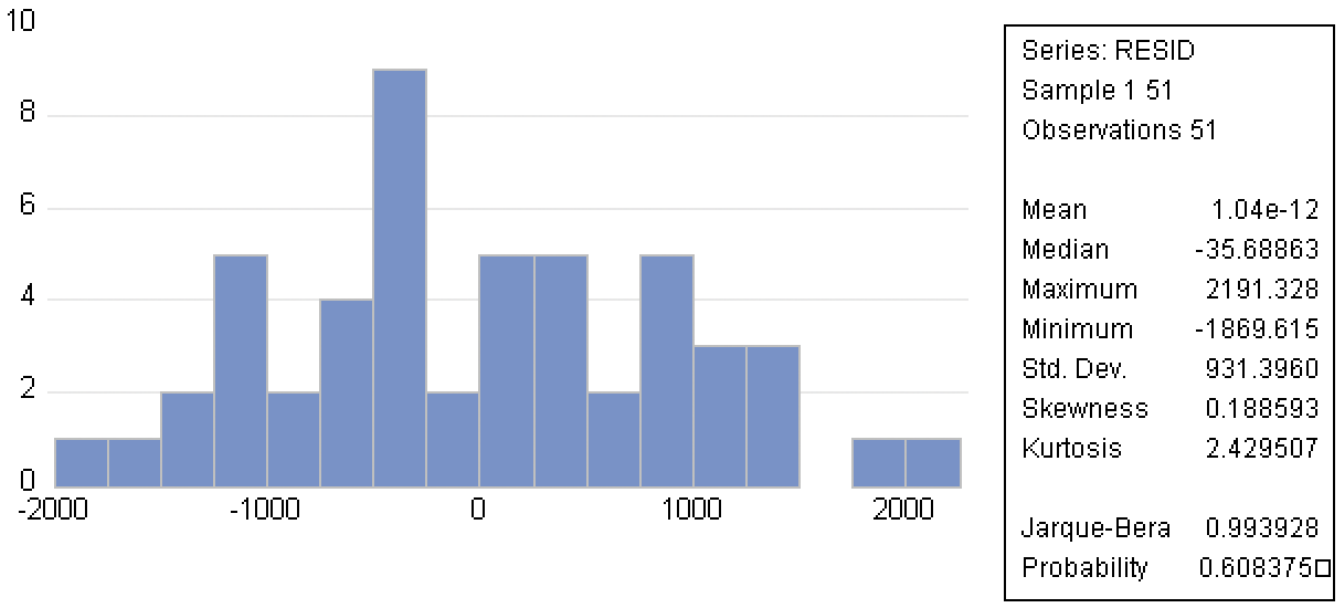


Figure: Residuals

Second equation

- Modelization of crime rate per state on a given time (2021), but improved
- We modelled (2):

$$cr_i = \beta_0 + \beta_1 weapon_i + \beta_2 pen_i + \beta_3 police_i + \beta_4 police_i^2 + \beta_5 poverty_i + \beta_6 afr * police_i + \beta_7 afr * poverty_i + \beta_8 hisp * police_i + \beta_9 hisp * poverty_i + u_i \quad (2)$$

Equation (2) results

Equation: EQ02 Workfile: CROSS-SECTONNIAL::Untitled\

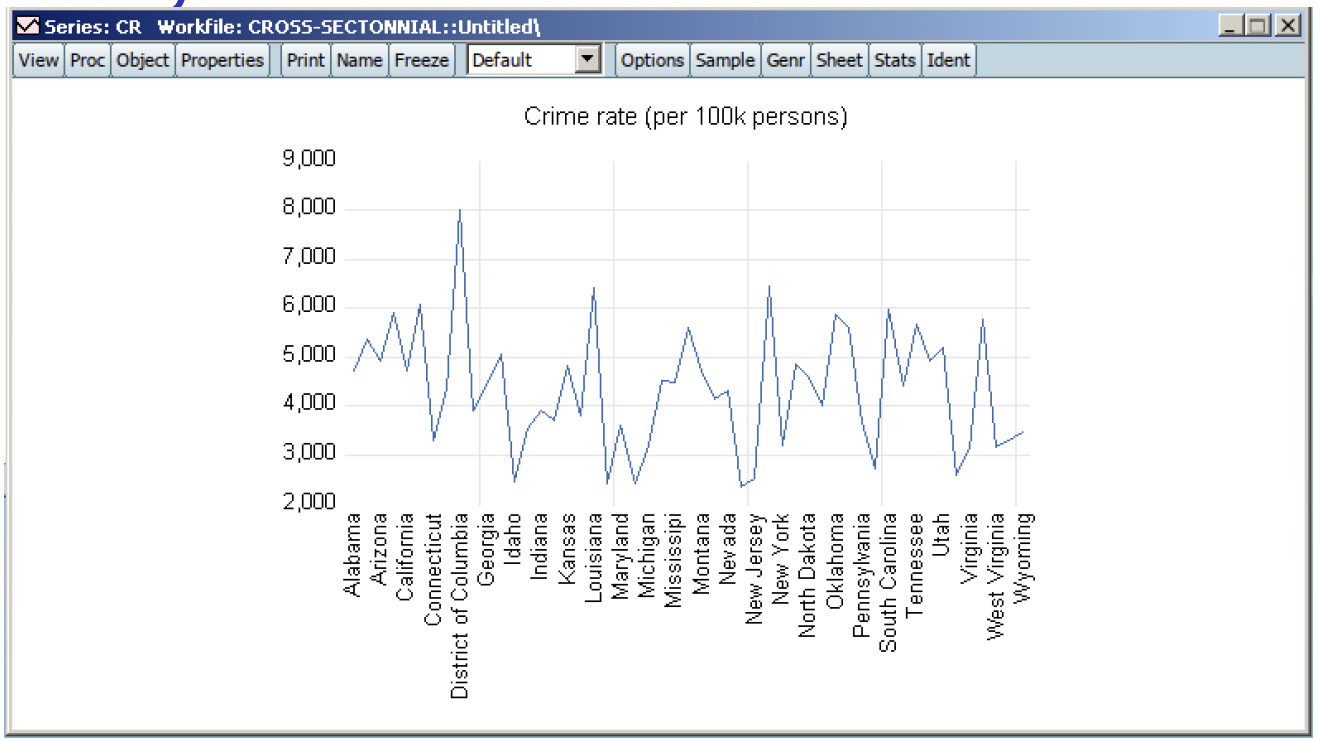
View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: CR
Method: Least Squares
Date: 04/20/23 Time: 10:38
Sample: 1 51
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9305.063	3397.320	2.738942	0.0091
WEAPON	519.4750	578.0089	0.898732	0.3740
PEN	566.2472	339.1168	1.669771	0.1026
POLICE	-24.33697	15.53351	-1.566740	0.1249
POLICE^2	0.031888	0.016961	1.880048	0.0672
POVERTY	-14894.33	12670.58	-1.175506	0.2466
AFR*POLICE	-26.36409	12.39949	-2.126224	0.0396
AFR*POVERTY	104588.9	38956.39	2.684769	0.0104
HISP*POLICE	-30.94582	20.42093	-1.515397	0.1373
HISP*POVERTY	122518.3	63659.46	1.924590	0.0612

R-squared	0.445410	Mean dependent var	4359.824
Adjusted R-squared	0.323670	S.D. dependent var	1254.463
S.E. of regression	1031.661	Akaike info criterion	16.88963
Sum squared resid	43637281	Schwarz criterion	17.26842
Log likelihood	-420.6856	Hannan-Quinn criter.	17.03438
F-statistic	3.658718	Durbin-Watson stat	2.254864
Prob(F-statistic)	0.001975		

Crime rate by state in 2021



Conclusion

- States very different (population, police presence)
- Strong effects from Poverty, Police, African, Hispanic

Time-series Data

Variables	Unit	Expected sign
NB-OFFICERS	number of police officers	?
PER-AFRICAN	% of african	+
PER-BACHELOR	% of bachelor	-
PER-HISPANIC	% of hispanic	+
PER-POVERTY	% of poor people	+
PER-URBAN	% of urban-living people	-
PER-18MORE	% of 18 y.o. people	+

Table: Time-series variables expected signs

Characteristics of the model

- Modelization of crime rate per year on given states (California, New York, Texas)
- We modelled (3):

$$RATE_t = \beta_0 + \beta_1 NBOFFICERS_t + \beta_2 PERAFRICAN_t + \beta_3 PERBACHELOR_t + \beta_4 PERHISPANIC_t + \beta_5 PERPOVERTY_t + \beta_6 PERURBAN_t + \beta_7 PER18MORE_t + u_t \quad (3)$$

- We then modelled (4):

$$D(RATE_t) = \gamma_0 + \gamma_1 D(NBOFFICERS_t) + \ldots + \gamma_7 D(PER18MORE_t) + v_t \quad (4)$$

Equation (3) results

Variables	California	New York	Texas
NB-OFFICERS	- (90%)	- (99%)	+ (99%)
PER-AFRICAN	+ (99%)	/	/
PER-BACHELOR	/	/	- (95%)
PER-HISPANIC	/	- (95%)	/
PER-POVERTY	+ (99%)	+ (95%)	+ (90%)
PER-URBAN	/	/	/
PER-18MORE	/	/	/
Observations	22	22	22
R^2	0.965	0.983	0.942
Adjusted R^2	0.947	0.974	0.912
F-statistic	55.08 (99%)	114.25 (99%)	32.26 (99%)

Table: Comparaison between 3 states in (3)

Equation (4) results

Variables	California	New York	Texas
D(NB-OFFICERS)	/	- (90%)	/
D(PER-AFRICAN)	+ (95%)	/	/
D(PER-BACHELOR)	/	/	- (99%)
D(PER-HISPANIC)	/	/	/
D(PER-POVERTY)	- (95%)	/	/
D(PER-URBAN)	/	/	/
D(PER-18MORE)	/	/	/
Observations	21	21	21
R^2	0.633	0.380	0.702
Adjusted R^2	0.476	0.046	0.0.541
F-statistic	4.03 (95%)	1.14	4.37 (99%)

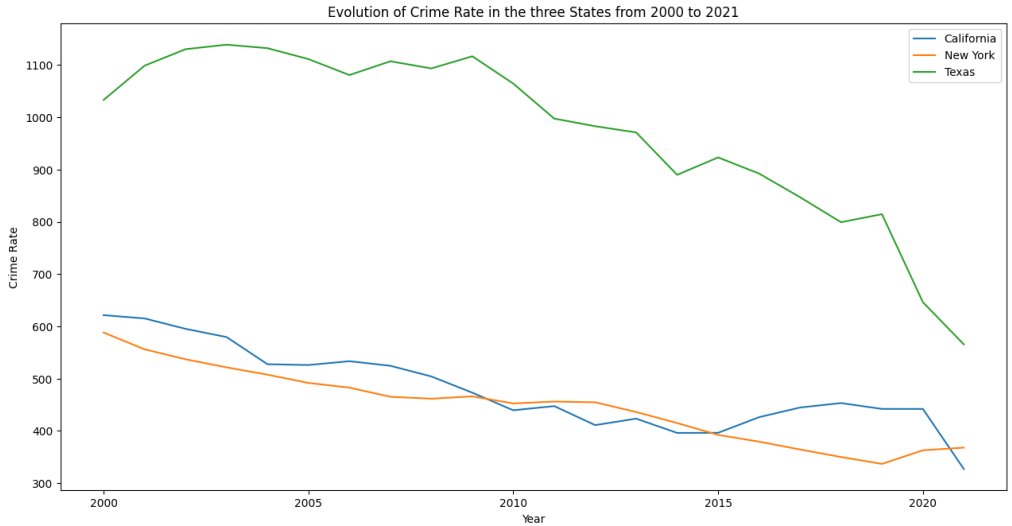
Table: Comparaison between 3 states in (4)

Tests on (3)

	California	**New York**	**Texas**
R^2	Very High	Very High	Very High
Normality in the error ?	Yes	Yes	Yes
Homoskedasticity	Yes	Yes	No (90%)
Autocorrelation	Yes (90%)	Yes (90%)	No

Table: Comparaison tests between 3 states in (3)

Crime rate for 3 states by time



Conclusion

- The three states have different crime rates through time
- Strong effect from percentage of population living under the line of poverty

Panel Data

Variables	Unit	Expected sign
AFRICAN-AMERICAN-POP	% of african	+
BACHELOR-POP	% of bachelor	-
DEATH-PENALTY	dummy	?
POLICE-OFFICERS	number per 100k people	?
UNDER-POVERTY-LINE	% of poor people	+
WEAPON-ALLOWED	dummy	+

Table: Panel variables expected signs

Panel equation

- We modelled (5):

$$\begin{aligned} cr_{it} = \beta_0 + \beta_1 AFRICANAMERICANPOP_{it} \\ + \beta_2 BACHELORPOP_{it} + \beta_3 DEATHPENALTY_{it} \\ + \beta_4 POLICEOFFICERS_{it} + \beta_5 UNDERPOVERTYLINE_{it} \\ + \beta_6 WEAPONALLOWED_{it} + u_{it} \end{aligned} \tag{5}$$

Equation (5) results

Equation: UNTITLED Workfile: PANEL::Panel\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: CRIME_RATE__PER_100K_PERSONS_
Method: Least Squares
Date: 04/22/23 Time: 22:36
Sample: 1 561
Included observations: 561

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-195.9629	74.77677	-2.620638	0.0090
AFRICAN_AMERICAN_POP	2.029394	0.732812	2.769323	0.0058
BACHELOR_POP	9.145953	1.451692	6.300200	0.0000
DEATH_PENALTY	10.62312	14.90854	0.712552	0.4764
POLICE_OFFICERS_PER_100K_PER...	0.196837	0.066137	2.976200	0.0030
UNDER_POVERTY_LINE	21.77029	2.521838	8.632708	0.0000
WEAPON_ALLOWED	-20.05978	23.77081	-0.843883	0.3991

R-squared	0.275128	Mean dependent var	384.9576
Adjusted R-squared	0.267277	S.D. dependent var	173.9140
S.E. of regression	148.8690	Akaike info criterion	12.85641
Sum squared resid	12277742	Schwarz criterion	12.91044
Log likelihood	-3599.223	Hannan-Quinn criter.	12.87750
F-statistic	35.04549	Durbin-Watson stat	1.933676
Prob(F-statistic)	0.000000		

Sign comparaison

Variables	Unit	Expected sign	Sign
AFRICAN-AMERICAN-POP	% of african	+	+
BACHELOR-POP	% of bachelor	-	+
DEATH-PENALTY	dummy	?	/
POLICE-OFFICERS	number per 100k people	?	+
UNDER-POVERTY-LINE	% of poor people	+	+
WEAPON-ALLOWED	dummy	+	/

Table: Equation (5) coefficients signs

Tests

Equation: UNTITLED Workfile: PANEL::Panel\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	11.72523	Prob. F(6,554)	0.0000
Obs*R-squared	63.21299	Prob. Chi-Square(6)	0.0000
Scaled explained SS	102.1556	Prob. Chi-Square(6)	0.0000

Equation: UNTITLED Workfile: PANEL::Panel\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

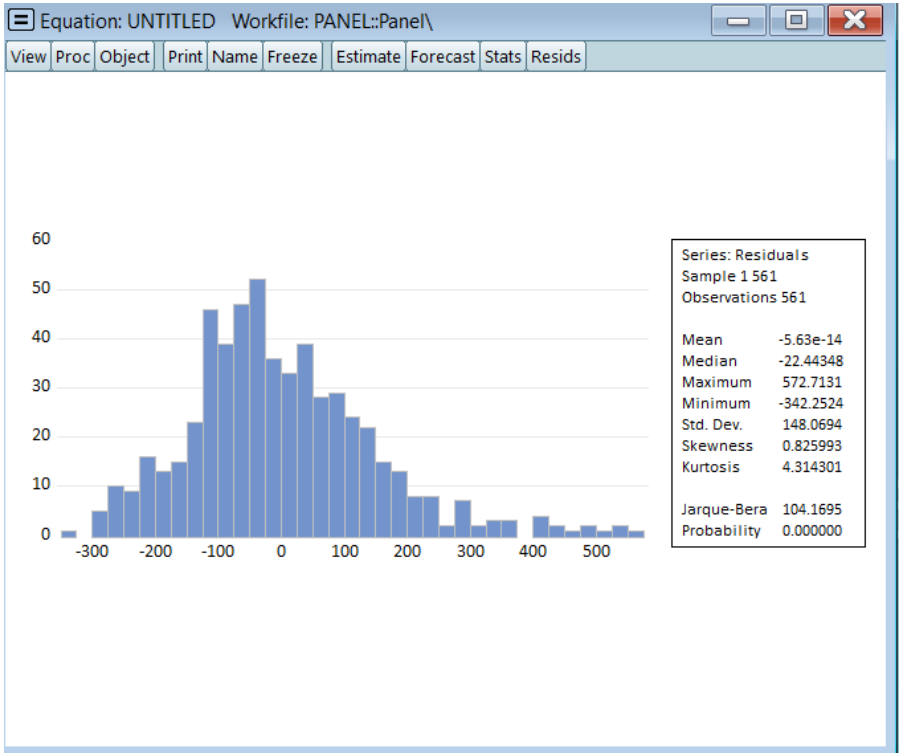
Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	1.357983	Prob. F(2,552)	0.2580
Obs*R-squared	2.746734	Prob. Chi-Square(2)	0.2533

Interpretation

- Heteroskedasticity
- No autocorrelation

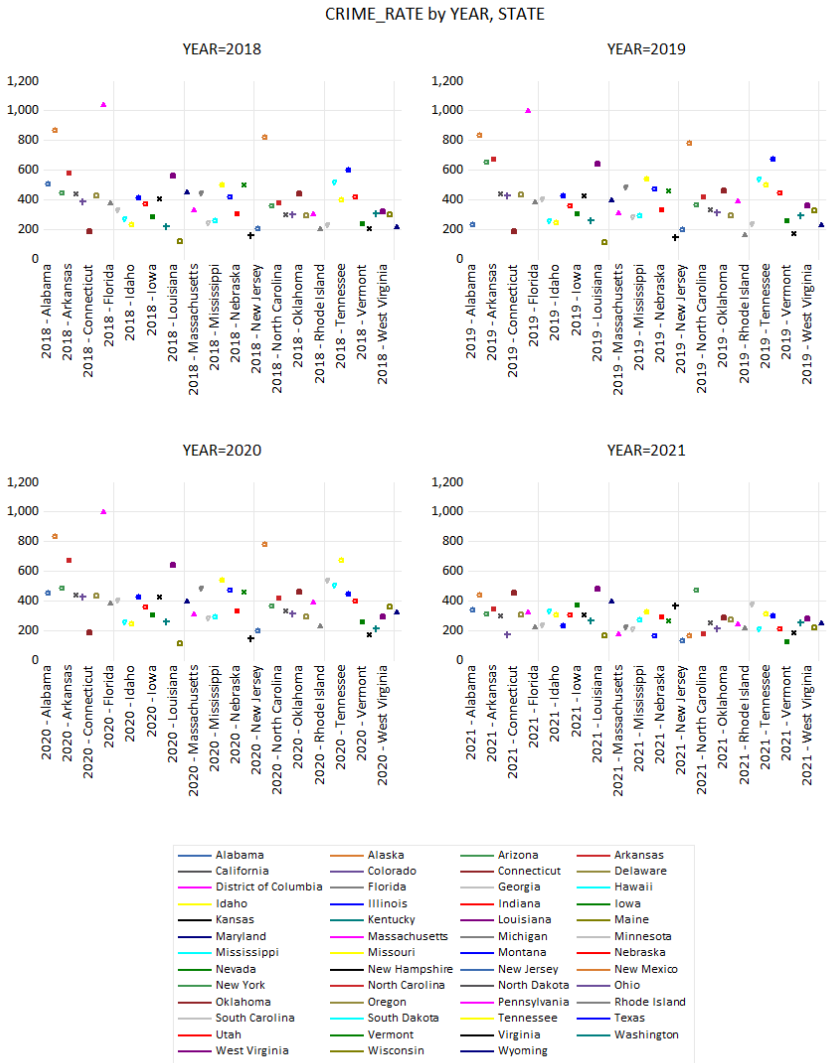
Residuals



Interpretation

- No normality in the errors

Crime rate for each state by time



Conclusion

- Different models for different interpretation
- Strong effect from Poverty, Minorities and Police
- Take into account the U.S. particularity : death penalty, Second Amendement

References

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Questions? Comments?