FMC Report – XIAOYU OUYANG

Task 1

(a) Summary Statistics Table for the overall sample in 2003-2006

	count	mean	std	min	25%	50%	75%	max
estabs_entry_rate	12,667.00	11.15	7.19	0.00	8.62	10.27	12.37	200.00
estabs_exit	12,687.00	206.48	739.78	0.00	20.00	46.00	122.00	23,009.00
net_job_creation_rate	12,855.00	1.87	12.59	-200.00	-1.21	1.52	4.48	200.00
ap	8,796,351.00	10,449.81	275,029.92	0.00	0.00	0.00	759.00	187,517,159.00
n1_4	8,796,351.00	11.00	190.92	0.00	1.00	1.00	4.00	145,039.00
n5_9	8,796,351.00	3.84	59.49	0.00	0.00	0.00	2.00	41,634.00
n10_19	8,796,351.00	2.56	40.92	0.00	0.00	0.00	1.00	28,487.00
n20_49	8,796,351.00	1.75	30.18	0.00	0.00	0.00	1.00	21,273.00
n50_99	8,796,351.00	0.60	10.96	0.00	0.00	0.00	0.00	7,599.00
n100_249	8,796,351.00	0.34	6.35	0.00	0.00	0.00	0.00	4,320.00
n250_499	8,796,351.00	0.09	1.67	0.00	0.00	0.00	0.00	1,054.00
n500_999	8,796,351.00	0.03	0.65	0.00	0.00	0.00	0.00	370.00
n1000	8,796,351.00	0.02	0.47	0.00	0.00	0.00	0.00	227.00
n1000_1	8,796,351.00	0.01	0.20	0.00	0.00	0.00	0.00	91.00
n1000_2	8,796,351.00	0.01	0.16	0.00	0.00	0.00	0.00	73.00
n1000_3	8,796,351.00	0.00	0.11	0.00	0.00	0.00	0.00	48.00
n1000_4	8,796,351.00	0.00	0.07	0.00	0.00	0.00	0.00	41.00

(b) Summary Statistics Table restricted to Louisiana for each separate year in 2003-2006

- Year 2003

	count	mean	std	min	25%	50%	75%	max
estabs_entry_rate	65.00	9.80	1.82	6.27	8.62	9.62	10.66	15.13
estabs_exit	65.00	132.83	225.15	12.00	26.00	46.00	123.00	1,070.00
net_job_creation_rate	65.00	1.81	5.40	-13.76	-0.23	2.22	4.38	19.85
ap	8,796,351.00	10,449.81	275,029.92	0.00	0.00	0.00	759.00	187,517,159.00
n1_4	44,913.00	6.85	62.95	0.00	1.00	1.00	4.00	6,306.00
n5_9	44,913.00	2.87	26.00	0.00	0.00	0.00	2.00	2,587.00
n10_19	44,913.00	1.86	17.43	0.00	0.00	0.00	1.00	1,777.00
n20_49	44,913.00	1.30	12.65	0.00	0.00	0.00	1.00	1,250.00
n50_99	44,913.00	0.44	4.54	0.00	0.00	0.00	0.00	468.00
n100_249	44,913.00	0.22	2.30	0.00	0.00	0.00	0.00	224.00
n250_499	44,913.00	0.05	0.59	0.00	0.00	0.00	0.00	62.00
n500_999	44,913.00	0.02	0.29	0.00	0.00	0.00	0.00	26.00
n1000	44,913.00	0.01	0.22	0.00	0.00	0.00	0.00	19.00
n1000_1	44,913.00	0.01	0.10	0.00	0.00	0.00	0.00	8.00
n1000_2	44,913.00	0.01	0.11	0.00	0.00	0.00	0.00	7.00
n1000_3	44,913.00	0.00	0.05	0.00	0.00	0.00	0.00	4.00
n1000_4	44,913.00	0.00	0.02	0.00	0.00	0.00	0.00	1.00

- Year 2004

	count	mean	std	min	25%	50%	75%	max
estabs_entry_rate	65.00	9.98	2.17	5.72	8.60	9.70	10.31	18.08
estabs_exit	66.00	124.26	214.93	0.00	23.00	45.00	94.25	1,015.00
net_job_creation_rate	66.00	4.45	24.80	-8.79	-2.55	2.38	4.59	197.95
ap	8,796,351.00	10,449.81	275,029.92	0.00	0.00	0.00	759.00	187,517,159.00
n1_4	44,873.00	6.88	63.13	0.00	0.00	1.00	4.00	6,215.00
n5_9	44,873.00	2.90	26.26	0.00	0.00	0.00	2.00	2,677.00
n10_19	44,873.00	1.89	17.53	0.00	0.00	0.00	1.00	1,779.00
n20_49	44,873.00	1.32	12.81	0.00	0.00	0.00	1.00	1,248.00
n50_99	44,873.00	0.45	4.66	0.00	0.00	0.00	0.00	479.00
n100_249	44,873.00	0.22	2.32	0.00	0.00	0.00	0.00	230.00
n250_499	44,873.00	0.05	0.56	0.00	0.00	0.00	0.00	57.00
n500_999	44,873.00	0.02	0.30	0.00	0.00	0.00	0.00	28.00
n1000	44,873.00	0.01	0.21	0.00	0.00	0.00	0.00	20.00
n1000_1	44,873.00	0.01	0.10	0.00	0.00	0.00	0.00	9.00
n1000_2	44,873.00	0.00	0.10	0.00	0.00	0.00	0.00	9.00
n1000_3	44,873.00	0.00	0.06	0.00	0.00	0.00	0.00	6.00
n1000_4	44,873.00	0.00	0.02	0.00	0.00	0.00	0.00	2.00

- Year 2005

	count	mean	std	min	25%	50%	75%	max
estabs_entry_rate	66.00	10.59	8.26	6.44	8.60	9.27	10.53	75.00
estabs_exit	65.00	133.66	226.87	9.00	25.00	47.00	123.00	1,084.00
net_job_creation_rate	66.00	-1.55	6.50	-18.41	-5.27	-1.27	2.17	14.88
ap	8,796,351.00	10,449.81	275,029.92	0.00	0.00	0.00	759.00	187,517,159.00
n1_4	44,965.00	6.89	62.65	0.00	1.00	1.00	4.00	6,154.00
n5_9	44,965.00	2.90	25.89	0.00	0.00	0.00	2.00	2,570.00
n10_19	44,965.00	1.89	17.59	0.00	0.00	0.00	1.00	1,778.00
n20_49	44,965.00	1.27	12.45	0.00	0.00	0.00	1.00	1,218.00
n50_99	44,965.00	0.44	4.64	0.00	0.00	0.00	0.00	490.00
n100_249	44,965.00	0.22	2.35	0.00	0.00	0.00	0.00	223.00
n250_499	44,965.00	0.05	0.53	0.00	0.00	0.00	0.00	46.00
n500_999	44,965.00	0.02	0.29	0.00	0.00	0.00	0.00	29.00
n1000	44,965.00	0.01	0.21	0.00	0.00	0.00	0.00	20.00
n1000_1	44,965.00	0.01	0.10	0.00	0.00	0.00	0.00	9.00
n1000_2	44,965.00	0.00	0.10	0.00	0.00	0.00	0.00	7.00
n1000_3	44,965.00	0.00	0.04	0.00	0.00	0.00	0.00	3.00
n1000_4	44,965.00	0.00	0.03	0.00	0.00	0.00	0.00	2.00

- Year 2006

	count	mean	std	min	25%	50%	75%	max
estabs_entry_rate	66.00	11.02	2.64	0.00	9.53	10.86	12.52	16.49
estabs_exit	65.00	193.51	461.61	7.00	27.00	52.00	140.00	3,078.00
net_job_creation_rate	66.00	1.15	13.51	-78.97	-0.11	4.19	7.16	18.16
ap	8,796,351.00	10,449.81	275,029.92	0.00	0.00	0.00	759.00	187,517,159.00
n1_4	44,828.00	6.98	63.84	0.00	1.00	1.00	4.00	6,423.00
n5_9	44,828.00	2.77	24.23	0.00	0.00	0.00	2.00	2,444.00
n10_19	44,828.00	1.85	16.64	0.00	0.00	0.00	1.00	1,657.00
n20_49	44,828.00	1.25	11.88	0.00	0.00	0.00	1.00	1,240.00
n50_99	44,828.00	0.45	4.43	0.00	0.00	0.00	0.00	484.00
n100_249	44,828.00	0.23	2.32	0.00	0.00	0.00	0.00	243.00
n250_499	44,828.00	0.05	0.52	0.00	0.00	0.00	0.00	56.00
n500_999	44,828.00	0.02	0.26	0.00	0.00	0.00	0.00	28.00
n1000	44,828.00	0.01	0.21	0.00	0.00	0.00	0.00	18.00
n1000_1	44,828.00	0.01	0.11	0.00	0.00	0.00	0.00	7.00
n1000_2	44,828.00	0.00	0.09	0.00	0.00	0.00	0.00	9.00
n1000_3	44,828.00	0.00	0.04	0.00	0.00	0.00	0.00	3.00
n1000_4	44,828.00	0.00	0.03	0.00	0.00	0.00	0.00	2.00

Heatmap of Establishment Exit Rates by county of LA in 2004
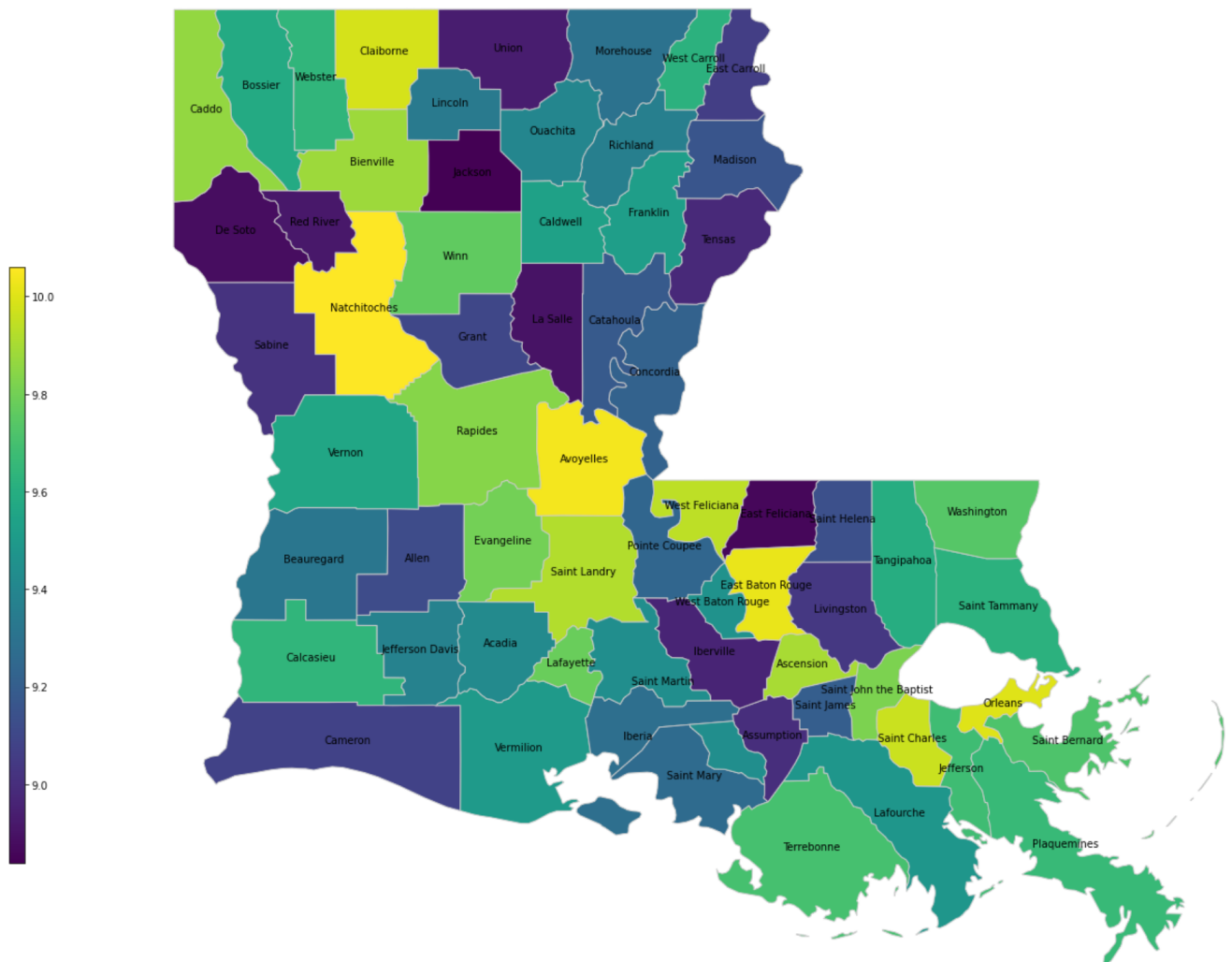
Heatmap of Establishment Exit Rates by county of LA in 2006
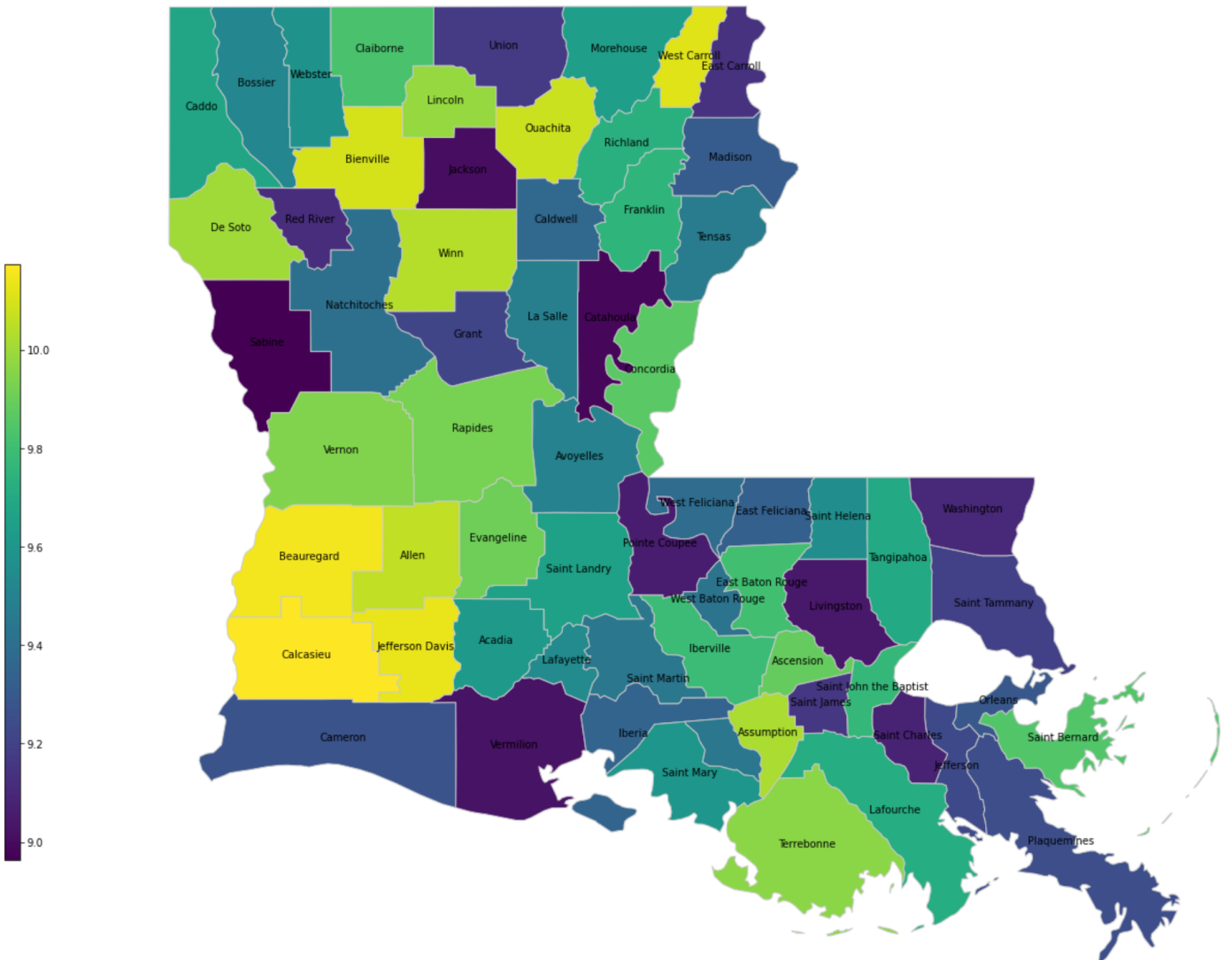
Task 3

To analyze the impact of Hurricane in 2006, I run two regressions with constants for coastal and non-coastal counties respectively. Response variables are Establishment Exit Rates (EER) and Growth in Annual Payroll per Employee ratio ($AP\_per\_EMP\_growth$). The only explanatory variable is the dummy variable representing event $I\{time \geq 2006\}$ which is an indicator of whether Hurricane happened or not. These can be expressed as:

$$EER = \alpha + \beta * I\{time \geq 2006\} + \varepsilon \ (Linear\ Model\ 1)$$

$$AP\_per\_EMP\_growth = \alpha + \beta * I\{t \geq 2006\} + \varepsilon \ (Linear\ Model\ 2)$$

where t is the year and

$$AP\_per\_EMP\_growth = \frac{AP_t}{EMP_t} - \frac{AP_{t-1}}{EMP_{t-1}}$$

(a) Establishment Exit Rates (BDS)

OLS Regression Results of Linear Model 1 for coastal counties

Dep. Variable:	y	R-squared:	0.223
Model:	OLS	Adj. R-squared:	0.204
Method:	Least Squares	F-statistic:	12.05
Date:	Sat, 25 Feb 2023	Prob (F-statistic):	0.00121
Time:	08:01:18	Log-Likelihood:	-168.60
No. Observations:	44	AIC:	341.2
Df Residuals:	42	BIC:	344.8
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	9.1792	1.989	4.614	0.000	5.164	13.194
x1	13.8117	3.979	3.471	0.001	5.782	21.842

Omnibus:	69.449	Durbin-Watson:	2.263
Prob(Omnibus):	0.000	Jarque-Bera (JB):	837.758
Skew:	3.843	Prob(JB):	1.21e-182
Kurtosis:	22.947	Cond. No.	2.48

OLS Regression Results of Linear Model 1 for non-coastal counties

Dep. Variable:	y	R-squared:	0.000
Model:	OLS	Adj. R-squared:	-0.005
Method:	Least Squares	F-statistic:	0.01741
Date:	Sat, 25 Feb 2023	Prob (F-statistic):	0.895
Time:	08:01:19	Log-Likelihood:	-436.24
No. Observations:	212	AIC:	876.5
Df Residuals:	210	BIC:	883.2
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	9.2138	0.151	61.047	0.000	8.916	9.511
x1	0.0398	0.302	0.132	0.895	-0.555	0.635

Omnibus:	27.701	Durbin-Watson:	2.070
Prob(Omnibus):	0.000	Jarque-Bera (JB):	40.631
Skew:	0.774	Prob(JB):	1.50e-09
Kurtosis:	4.484	Cond. No.	2.48

The regression results table (left) indicates that Hurricane Katrina has a significant effect to the Establishment Exit Rates of coastal counties.

- R_squared = 0.223 shows that 22.3% of the change in 'EER' variable can be explained by the Hurricane and this linear model is a good fit to data.

- P>|t| for x1 = 0.001 shows that the event variable is very statistically siginificant as its p-value of the event variable is even smaller than 0.05.
- coef for x1 = 13.8117 shows that after the hurricane happens, the EER increases largely by 13.8117. This is consistent with our expectation that when a disaster strikes, businesses along the coastline are negatively affected and exit those counties.

The table (right) indicates that Hurricane Katrina does not have a significant effect to the Establishment Exit Rates of non-coastal counties.
- R_squared = 0.000 shows that almost none of the change in 'EER' variable can be explained by the Hurricane.
- P>|t| for x1 = 0.895 shows that the event variable is not statistically siginificant as its p-value of the event variable is far above 0.05. This indicates strong evidence for the null hypothesis.
- coef for x1 = 0.0398 shows that after the hurricane happens, the EER increases minimally by 0.0398 in non-coastal counties. This is also consistent with our expectation that when a disaster strikes, businesses not along the coastline are negatively but minimally affected.

To summarize, the Hurricane Katrina has a significant impact on coastal counties and a trivial impact on non-coastal counties in terms of higher Establishment Exist Rates.

(b) Growth in Annual Payroll (ap) per Employee (emp) ratio (CBP)

OLS Regression Results of Linear Model 2 for coastal counties

Dep. Variable:	y	R-squared:	0.378
Model:	OLS	Adj. R-squared:	0.358
Method:	Least Squares	F-statistic:	18.81
Date:	Sat, 25 Feb 2023	Prob (F-statistic):	0.000142
Time:	08:01:22	Log-Likelihood:	-91.661
No. Observations:	33	AIC:	187.3
Df Residuals:	31	BIC:	190.3
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.0038	0.856	1.173	0.250	-0.742	2.749
x1	6.4293	1.482	4.337	0.000	3.406	9.453

Omnibus:	23.203	Durbin-Watson:	2.583
Prob(Omnibus):	0.000	Jarque-Bera (JB):	45.613
Skew:	1.583	Prob(JB):	1.25e-10
Kurtosis:	7.811	Cond. No.	2.41

OLS Regression Results of Linear Model 2 for non-coastal counties

Dep. Variable:	y	R-squared:	0.008
Model:	OLS	Adj. R-squared:	0.002
Method:	Least Squares	F-statistic:	1.267
Date:	Sat, 25 Feb 2023	Prob (F-statistic):	0.262
Time:	08:01:31	Log-Likelihood:	-314.62
No. Observations:	162	AIC:	633.2
Df Residuals:	160	BIC:	639.4
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.3644	0.163	8.351	0.000	1.042	1.687
x1	-0.3185	0.283	-1.126	0.262	-0.877	0.240

Omnibus:	20.426	Durbin-Watson:	1.817
Prob(Omnibus):	0.000	Jarque-Bera (JB):	74.237
Skew:	-0.302	Prob(JB):	7.58e-17
Kurtosis:	6.261	Cond. No.	2.41

The regression results table (left) indicates that Hurricane Katrina has a significant effect to the growth in Annual Payroll per Employee ratio (AP/EMP growth) of coastal counties.

- R_squared = 0.378 shows that 37.8% of the change in 'AP/EMP growth' can be explained by the Hurricane and this linear model is a good fit to data.
- P>|t| for x1 = 0.000 shows that the event variable is very statistically siginificant as its p-value of the event variable is much smaller than 0.05.
- coef for x1 = 6.429 shows that after the hurricane happens, AP/EMP growth increases largely by 6.429. A possible reason is that when a disaster strikes, people along the coastline exit those counties and businesses need to pay higher salaries to retain their employees or attract new talents.

The table (right) indicates that Hurricane Katrina does not have a significant effect to the AP/EMP growth of non-coastal counties.
- R_squared = 0.008 shows that almost none of the change in 'AP/EMP' variable can be explained by the Hurricane.
- P>|t| for x1 = 0.262 shows that the event variable is not statistically significant as its p-value of the event variable is far above 0.05.

To summarize, the Hurricane Katrina has a significant impact on coastal counties and a trivial impact on non-coastal counties in terms of higher growth in Annual Payroll per Employee ratio.

Task 4

The heterogeneity of impact on coastal counties and non-coastal counties by sector on Establishment Exit Rate can be shown in the tables below.

Regression table of different sectors for coastal counties

sector_name	sector_code	coefficient	confidence_interval	p_value
Management of Companies and Enterprises	55	-1.135962	[-8.79, 6.52]	0.757938
Mining, Quarrying, and Oil and Gas Extraction	21	-5.235538	[-14.93, 4.46]	0.279617
Transportation and Warehousing	48-49	2.669736	[-1.39, 6.73]	0.190894
Administrative and Support and Waste Management and Remediation Services	56	4.692798	[-1.74, 11.12]	0.147513
Agriculture, Forestry, Fishing and Hunting	11	45.000000	[-11.2, 101.2]	0.108501
Educational Services	61	9.374922	[1.04, 17.71]	0.029234
Professional, Scientific, and Technical Services	54	8.805367	[1.86, 15.75]	0.014367
Construction	23	6.583881	[1.68, 11.49]	0.009828
Health Care and Social Assistance	62	16.796007	[4.72, 28.87]	0.007769
Arts, Entertainment, and Recreation	71	25.871432	[8.0, 43.74]	0.006110
Wholesale Trade	42	11.169707	[3.49, 18.85]	0.005507
Finance and Insurance	52	11.436011	[3.62, 19.25]	0.005323
Real Estate and Rental and Leasing	53	14.212772	[4.53, 23.9]	0.005149
Accommodation and Food Services	72	23.503633	[7.95, 39.05]	0.004047
Manufacturing	31-33	15.751095	[6.46, 25.05]	0.001612
Other Services (except Public Administration)	81	18.501733	[7.52, 29.48]	0.001512
Information	51	22.336167	[9.55, 35.12]	0.001462
Retail Trade	44-45	24.637247	[12.76, 36.52]	0.000146

sector_name	sector_code	coefficient	confidence_interval	p_value
Information	51	-0.052889	[-3.26, 3.15]	0.973993
Administrative and Support and Waste Management and Remediation Services	56	-0.171139	[-5.04, 4.69]	0.944628
Agriculture, Forestry, Fishing and Hunting	11	0.392911	[-5.91, 6.7]	0.901760
Construction	23	0.149219	[-2.17, 2.47]	0.898949
Management of Companies and Enterprises	55	0.332714	[-3.47, 4.13]	0.861030
Manufacturing	31-33	-0.875830	[-4.33, 2.57]	0.616063
Finance and Insurance	52	-0.700860	[-2.87, 1.47]	0.524540
Professional, Scientific, and Technical Services	54	0.907391	[-1.59, 3.4]	0.473089
Retail Trade	44-45	-0.575236	[-1.95, 0.8]	0.411355
Utilities	22	-0.489602	[-1.66, 0.68]	0.407397
Arts, Entertainment, and Recreation	71	1.609796	[-1.83, 5.05]	0.354836
Health Care and Social Assistance	62	1.387591	[-0.84, 3.61]	0.219681
Mining, Quarrying, and Oil and Gas Extraction	21	-2.684554	[-6.92, 1.55]	0.210699
Real Estate and Rental and Leasing	53	2.295128	[-1.3, 5.89]	0.209153
Other Services (except Public Administration)	81	1.350690	[-0.46, 3.16]	0.141676
Transportation and Warehousing	48-49	-3.139982	[-7.04, 0.76]	0.113363
Educational Services	61	2.386350	[-0.45, 5.22]	0.097466
Accommodation and Food Services	72	-2.257275	[-4.89, 0.38]	0.092397
Wholesale Trade	42	3.082651	[-0.3, 6.46]	0.073674

From the two regression tables above, it is easily observed from the column "p_value" that the Hurricane has a significant impact on the Establishment Exit Rates of 13 out of 19 sectors in coastal counties (p_value<0.05) while it brings no significant impact to all sectors in noncoastal counties. Among all sectors in coastal counties which are significantly affected by the Hurricane, "Agriculture, Forestry, Fishing and Hunting" is affected the most in terms of the highest coefficient and "Construction" sector is affected the least.

Task 5

When merging the two county-industry level datasets, the datapoints which do not merge satisfy "cty code" = 999 or "sector code" = 99, which correspond to establishments which cannot be classified in any county or any other industry.

Correlations of Annual Payroll per Employee ratio and Establishment Exit Rates before and after the hurricane in the Construction sector are 0.12 and 0.22 respectively from the table below. This aligns with the expectation that correlation between two variables increases as they are both significantly affected by the Hurricane.

	Correlation
Time	
Before	0.12
After	0.22

The graphs below are scatterplots of AP_per_EMP versus estabs_exit_rate before and after the Hurricane for construction sector. While both graphs do not have obvious patterns of postive correlation, the second graph shows a more positive correlation as points with greater AP_per_EMP generally have higher estabs_exit_rate.

Scatterplot of AP_per_EMP versus estabs_exit_rate before Hurricane for construction sector
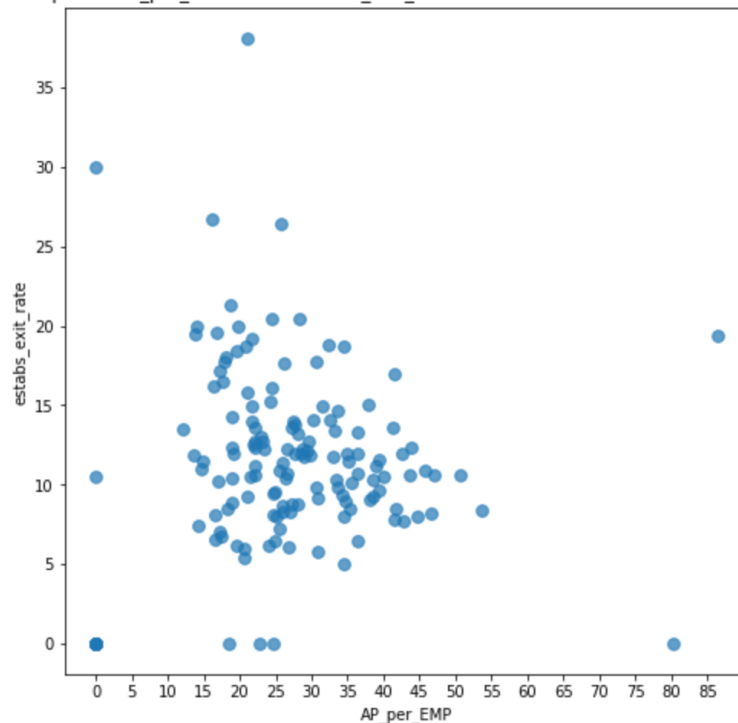
Scatterplot of AP_per_EMP versus estabs_exit_rate after Hurricane for construction sector
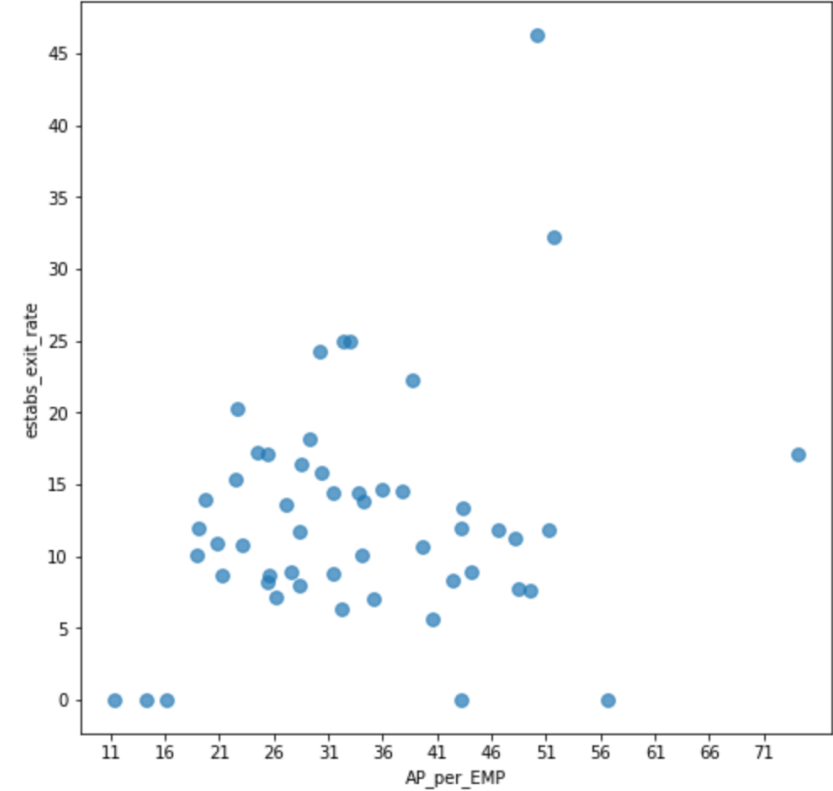
Task 6

Summary:

This study examines the effects of 2006 Hurricane Katrina on business establishments in the coastal counties of Louisiana. The study uses two primary measures, Establishment Exist Rates (EER) and Annual Payroll per Employee ratio (AP/EMP). The results of the regression analysis indicate a significant increase in EMP and AP/EMP growth in coastal counties following the hurricane, while the effects were not statistically significant in non-coastal counties. The study also finds that the impact of Hurricane Katrina on EER in the coastal counties varies by sector, with the Agriculture, Forestry, Fishing and Hunting industry being the most affected. Additionally, the study finds that the correlation coefficient between two parameters in the Construction sector increased from 0.12 to 0.22 after the hurricane.

Possible issues and improvements in task (3):

An identified issue in this analysis is the use of growth in AP/EMP as the response variable. Firstly, it is necessary to include data on growth in AP/EMP both before and after the 2016 hurricane. However, the available data only extends up to 2016, precluding some "post-event" data on this parameter. Secondly, using AP/EMP growth instead of AP/EMP itself raises concerns. Even if the regression coefficient of the event variable is negative, the hurricane could still bring a significant increase in AP/EMP. Therefore, it is recommended to conduct new regression analyses using AP/EMP and extending the data at least until 2017.

Another identified issue relates to the distinction between coastal and non-coastal counties. The simple approach of defining coastal counties as those that touch the sea may fail to capture counties that are situated near the coastline but still substantially impacted by the hurricane, such as Saint Charles county. A more viable approach is to define counties with the shortest distance to the coastline below a certain threshold as coastal counties.