NAME: Yu-Pei Sun

The Ozone Hole

Introduction

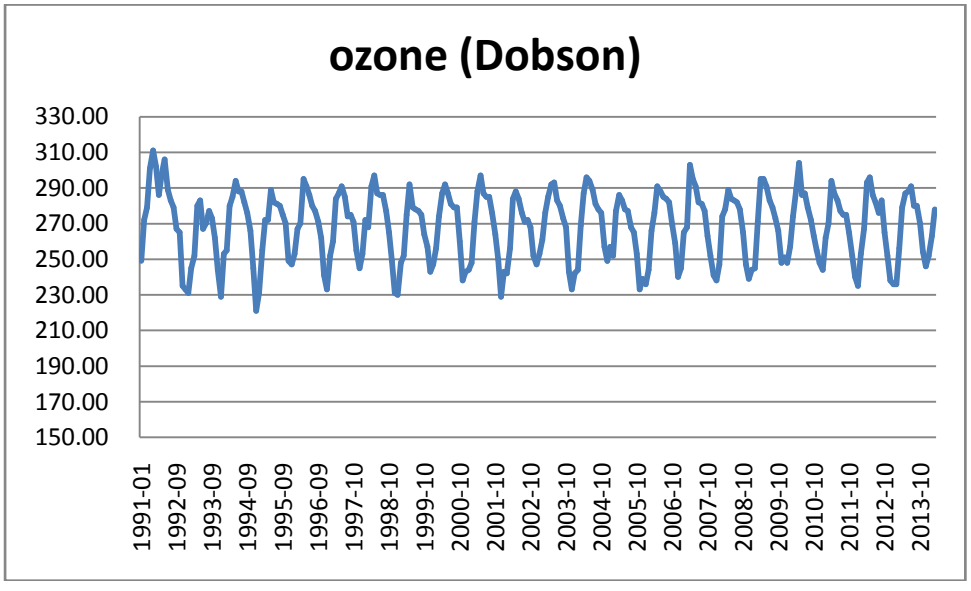
The ozone layer is important for human living in the earth, because it can absorbs most of the Sun's UV radiation and lower the temperature. Therefore, we live in a mild world. The weather in our earth would not be cooler than Mars and warmer than Mercury, so we have diversified creatures and beautiful scenery.

But, some scientists found out that our ozone layer did not completely cover our planet, especially on the air of Antarctic circle. It was called ozone hole. If the situation is getting worse, it may damage our beautiful world. So, I am interested in this measurement of ozone concentration in my country's sky.

Data collection

I obtained the ozone concentration from the website.
http://opendata.cwb.gov.tw/observe/dataset/A0006-002.htm
The unit of ozone concentration is Dobson Unit. The scientist, G. M. B. Dobson ,who developed a simple spectrophotometer (the Dobsonmeter) that could be used to measure stratospheric ozone from the ground. Between 1928 and 1958 Dobson established a worldwide network of ozone monitoring stations, which continue to operate to this day.

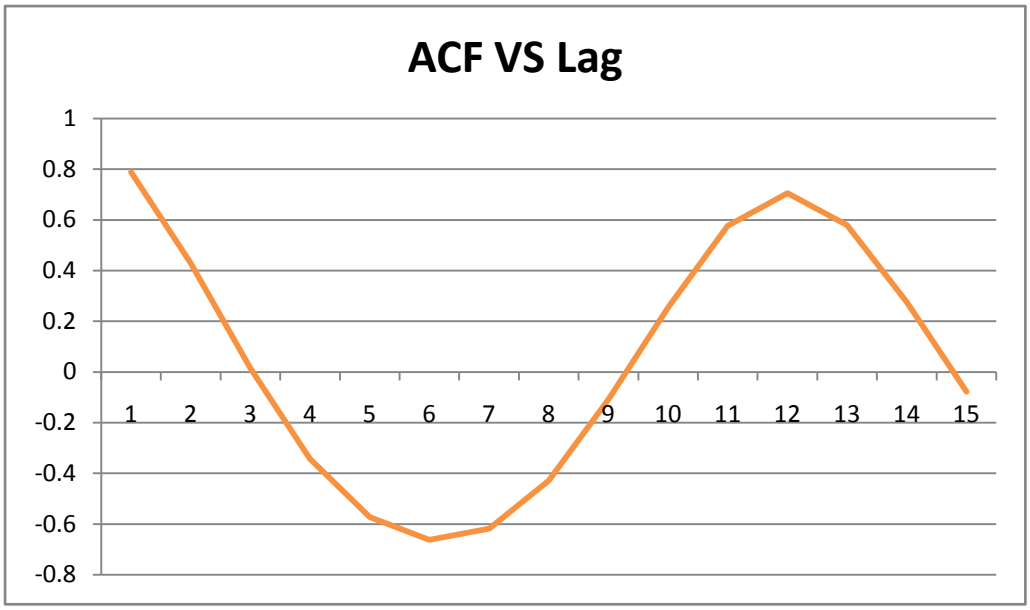
The following graph is the data I collect from the website in my hometown, Taipei. The data was collected once a month, and the unit is Dobson.



Analysis and Model

First, I compute the autocorrelation (ACF), and the following graph shows the ACF versus the lag.

NAME: Yu-Pei Sun



Secondly, I use the excel add-in function to compute the AR(1) ,AR(2), and AR(3).

AR(1)

Regression statistics	
R multiple	0.787280334
R square	0.619810325
adjusted R square	0.608628275
Standard Error	11.64665059
Observations	36

ANOVA

	df	SS	MS	F	Significance F
Regression	1	7518.643577	7518.643577	55.42904608	1.22959E-08
residual	34	4611.911979	135.64447		
total	35	12130.55556			

	Coefficient	Standard Error	t statistics	P-value	lower 95%	upper 95%
intercept	56.54320327	28.55040907	1.980469111	0.055788644	-1.478208471	114.564615
X variable 1	0.790151592	0.106130868	7.445068575	1.22959E-08	0.574467719	1.005835465

AR(2)

Regression statistics	
R multiple	0.884112736
R square	0.781655329
adjusted R square	0.768422319
Standard Error	8.95889969
Observations	36

ANOVA

	df	SS	MS	F	Significance F
Regression	2	9481.913395	4740.956697	59.06859497	1.24696E-11
residual	33	2648.642161	80.26188366		
total	35	12130.55556			

	Coefficient	Standard Error	t statistics	P-value	lower 95%	upper 95%
intercept	93.23766762	23.18108884	4.022143578	0.000315944	46.075388	140.39995
X variable 1	1.316095861	0.134065111	9.816840881	2.56678E-11	1.043338343	1.5888534
X variable 2	-0.66273411	0.133999755	-4.945786002	2.16397E-05	-0.935358659	-0.3901096

NAME: Yu-Pei Sun

AR(3)

Regression statistics	
R multiple	0.905703346
R square	0.820298552
adjusted R square	0.803451541
Standard Error	8.253556815
Observations	36

ANOVA

	df	SS	MS	F	Significance F
Regression	3	9950.677153	3316.892384	48.691044	4.97818E-12
residual	32	2179.878403	68.12120009		
total	35	12130.55556			

	Coefficient	Standard Error	t statistics	P-value	lower 95%	upper 95%
intercept	130.3098059	25.6086014	5.08851709	1.536E-05	78.14679204	182.4728197
X variable 1	1.047323483	0.160475886	6.526360474	2.386E-07	0.7204448	1.374202165
X variable 2	-0.121836211	0.240325802	-0.506962672	0.6156569	-0.611363847	0.367691426
X variable 3	-0.410580428	0.15651731	-2.623226968	0.0132317	-0.729395754	-0.091765102

Here I only observed the last three years data. And I try to use further data (six years ago) to find out whether the estimate is getting better or not. And I compute the AR(1), AR(2), AR(3) with the six year data.

AR(1)

Regression statistics	
R multiple	0.793411534
R square	0.629501863
adjusted R square	0.624209032
Standard Error	11.05986203
Observations	72

ANOVA

	df	SS	MS	F	Significance F
Regression	1	14548.173	14548.173	118.93482	9.60219E-17
residual	70	8562.4384	122.32055		
total	71	23110.611			

	Coefficient	tandard Erro	t statistics	P-value	lower 95%	upper 95%
intercept	55.44400177	19.65838	2.8203749	0.0062354	16.23660016	94.651403
X variable 1	0.794328616	0.0728359	10.905724	9.602E-17	0.649061929	0.9395953

NAME: Yu-Pei Sun

AR(2)

Regression statistics	
R multiple	0.877766744
R square	0.770474456
adjusted R square	0.763821542
Standard Error	8.767922086
Observations	72

ANOVA

	df	SS	MS	F	Significance F
Regression	2	17806.13553	8903.067765	115.8100676	8.88526E-23
residual	69	5304.475582	76.87645771		
total	71	23110.61111			

	Coefficient	Standard Error	t statistics	P-value	lower 95%	upper 95%
intercept	88.90707582	16.41040767	5.417724995	8.30718E-07	56.16920869	121.64494
X variable 1	1.269822564	0.093108464	13.63810028	2.89736E-21	1.084076264	1.4555689
X variable 2	-0.600246154	0.092204689	-6.509930889	1.01593E-08	-0.784189473	-0.4163028

AR(3)

Regression statistics	
R multiple	0.902668548
R square	0.814810507
adjusted R square	0.806640382
Standard Error	7.933401431
Observations	72

ANOVA

	df	SS	MS	F	Significance F
Regression	3	18830.769	6276.9229	99.73048588	7.56529E-25
residual	68	4279.8424	62.938858		
total	71	23110.611			

	Coefficient	tandard Erro	t statistics	P-value	lower 95%	upper 95%
intercept	127.8495526	17.70962	7.219215	5.70671E-10	92.51055688	163.1885484
X variable 1	1.001454151	0.107338	9.3299091	8.59509E-14	0.78726443	1.215643873
X variable 2	-0.048550801	0.1601761	-0.303109	0.762732212	-0.368177168	0.271075566
X variable 3	-0.428137426	0.1061105	-4.0348258	0.000140894	-0.639877653	-0.2163972

In my opinion, it did not have significant difference between the three year data and the six year data because their R square is similar.

Conclusion

The AR(3):

Y(t)=127.8495526+1.001454151*Y(t-1)-0.48550801*Y(t-2)-0.428137426*Y(t-3) is adopted because of the best R square. I put the compared graph below.

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