

Problem 1: Employee Data (in excel file) gives the number of employees (in thousands) for a metal fabricator and one of their primary vendors for each month over a 5-year period, so  $n = 60$ .

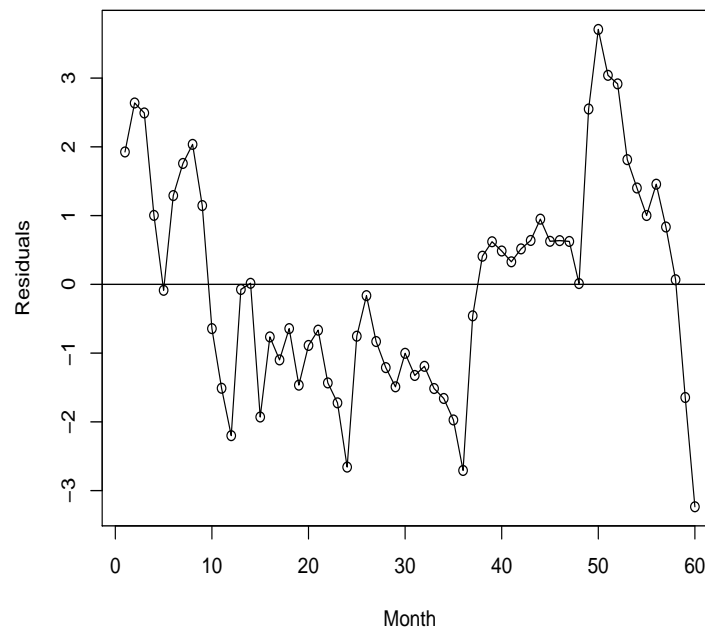
a. Fit a simple linear regression model to predict employees for a metal fabricator from employees of primary vendors using this data. Plot the residuals versus time. Is there any indication of autocorrelation?

Parameter Estimates		Estimate	Std. Error	t value	Pr(> t )
	(Intercept)	2.8479	3.3000	0.86	0.3917
	vendor	0.1224	0.0094	12.99	0.0000

ANOVA TABLE		Df	Sum Sq	Mean Sq	F value	Pr(>F)
	vendor	1	426.72	426.72	168.83	0.0000
	Residuals	58	146.59	2.53		

**Residual Plot over Time – Model-1**



From the graph, there is a clear indication of positive correlation.

b. Use the DurbinWatson test to determine if there is positive autocorrelation in the errors. What are your conclusions?

Correlation = 0.772038, Alternative hypothesis:  $H_0 : \rho \leq 0$  vs  $\rho > 0$

R - Output	lag	Autocorrelation	D-W Statistic	p-value
	1	0.772038	0.3592396	0

As p-value is close to 0, we reject the null hypothesis and conclude that data provide sufficient evidence to support the fact that there exists positive correlation.

c. Use one iteration of the CochraneOrcutt procedure to estimate the regression coefficients.

Parameter Estimate	R - Output				
		Estimate	Std. Error	t value	Pr(>  t )
	(Intercept)	39.623789	5.958102	6.650	1.214e-08
	vendor	0.021390	0.012691	1.685	0.09737

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6515 on 57 degrees of freedom

Multiple R-squared: 0.0475 , Adjusted R-squared: 0.0308

F-statistic: 2.8 on 1 and 57 DF, p-value: < 9.737e-02

Durbin-Watson statistic

(original): 0.35924 p-value: 2.309e-17

(transformed): 1.86449 p-value: 2.909e-01

d. Is there positive autocorrelation remaining after the first iteration? Would you conclude that the iterative parameter estimation technique has been successful?

After the first iteration the p-value for the test is 0.2909, hence there is not enough evidence for positive autocorrelation at 5% level.

**Problem - 2** The data in the excel file (Problem2) gives the percentage share of market of a particular brand of canned peaches for the past 15 months and the relative selling price.

a. Fit a simple linear regression model to predict share using price using this data. Plot the residuals versus time. Is there any indication of autocorrelation?

Parameter Estimates		Estimate	Std. Error	t value	Pr(> t )	
		(Intercept)	24.5941	1.2056	20.40	0.0000
		Price	-0.0892	0.0137	-6.52	0.0000

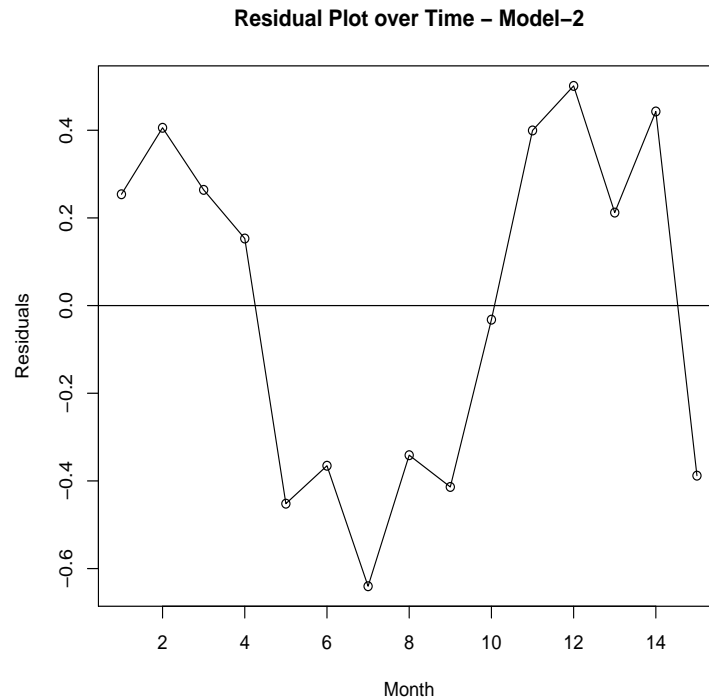
ANOVA TABLE		Df	Sum Sq	Mean Sq	F value	Pr(>F)
		Price	1	7.07	7.07	42.51
		Residuals	13	2.16	0.17	

From the graph, there is a clear indication of positive correlation.

b. Use the DurbinWatson test to determine if there is positive autocorrelation in the errors. What are your conclusions?

R - Output				
lag	Autocorrelation	D-W Statistic	p-value	
1	0.5410964	0.8182972	0.001	

As p-value=0.001, we reject the null hypothesis and conclude that data provide sufficient evidence to support the fact that there exists positive correlation.



c. Use one iteration of the CochraneOrcutt procedure to estimate the regression coefficients.

Here is the output from the CochraneOrcutt procedure.

	Estimate	Std. Error	t-value	p-value	Sig
(Intercept)	26.611277	1.113022	23.909	1.719e-11	***
Price	-0.115793	0.012955	-8.938	1.188e-06	***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2999 on 12 degrees of freedom Multiple R-squared: 0.8694 , Adjusted R-squared: 0.8585 F-statistic: 79.9 on 1 and 12 DF, p-value: < 1.188e-06

d. Is there positive autocorrelation remaining after the first iteration? Would you conclude that the iterative parameter estimation technique has been successful?

Durbin-Watson statistic

(original): 0.81830 , p-value: 1.563e-03

(transformed): 0.85205 , p-value: 1.243e-02

After the first iteration the p-value for the test is 0.01243, hence there is enough evidence for positive autocorrelation at 5% level.