Research Objective: Table P-23 contains Southwest Airlines' quarterly income before extraordinary items ($MM) for the years 1988–1999.

23 a. Plot the income data as a time series and describe any patterns that exist.

23 b. Is this series stationary or nonstationary? Explain.

23 c. Using Minitab or a similar program, compute the autocorrelations of the income series for the first 10 time lags. Is the behavior of the autocorrelations consistent with your choice in part b? Explain.

24 a. Use Minitab or Excel to compute the fourth differences of the income data in Table P-23. Fourth differences are computed by differencing observations four time periods apart. With quarterly data, this procedure is sometimes useful for creating a stationary series from a nonstationary series (see Chapter 9). Consequently, the fourth differenced data will be Y5 - Y1 = 19.64 - .17 = 19.47, Y6 - Y2 = 19.24 - 15.13 = 4.11, . . . , and so forth.

24 b. Plot the time series of fourth differences. Does this time series appear to be stationary or nonstationary? Explain.

25 a. Consider a naive forecasting method where the first-quarter income is used to forecast first-quarter income for the following year, second-quarter income is used to forecast second-quarter income, and so forth. For example, a forecast of first-quarter income for 1998 is provided by the first-quarter income for 1997, 50.87 (see Table P-23). Use this naive method to calculate forecasts of quarterly income for the years 1998–1999.

25. b. Using the forecasts in part a, calculate the MAD, RMSE, and MAPE.

25 c. Given the results in part b and the nature of the patterns in the income series, do you think this naive forecasting method is viable? Can you think of another naive method that might be better?

TABLE P-23 Quarterly Income for Southwest Airlines ($MM)

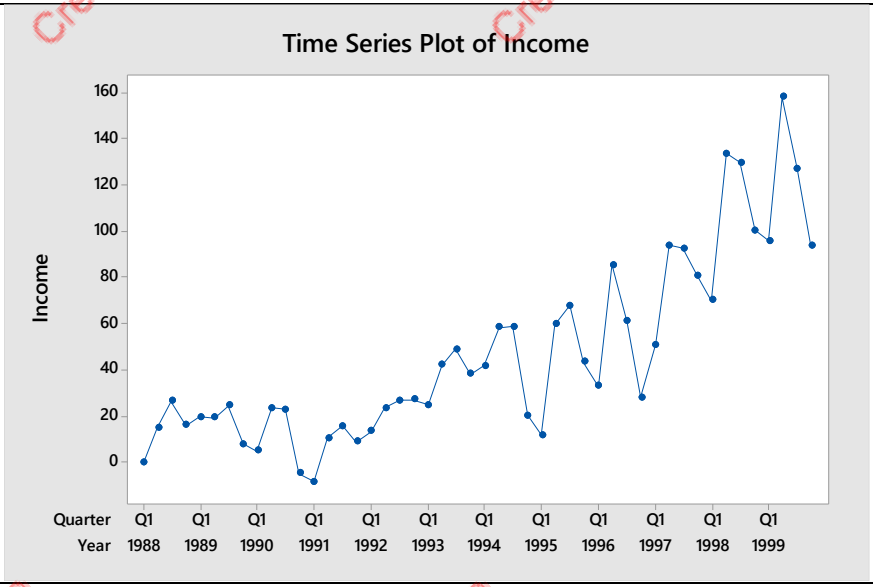
Year	*1st*	*2nd*	*3rd*	*4th*
1988	0.17	15.13	26.59	16.07
1989	19.64	19.24	24.57	8.11
1990	5.09	23.53	23.04	-4.58
1991	-8.21	10.57	15.72	8.84
1992	13.48	23.48	26.89	27.17
1993	24.93	42.15	48.83	38.37
1994	41.85	58.52	58.62	20.34
1995	11.83	59.72	67.72	43.36
1996	33.00	85.32	60.86	28.16
1997	50.87	93.83	92.51	80.55
1998	70.01	133.39	129.64	100.38
1999	95.85	157.76	126.98	93.80

Source: Based on *Compustat Industrial Quarterly Data Base.*

Ephrem Glushchenko

Problem 23 -

Graph Meaning - The data shows a trend and a little seasonality, due to the fluctuations in increasing and decreasing income amounts. Autocorrelation coefficient of quarterly income should be tested.



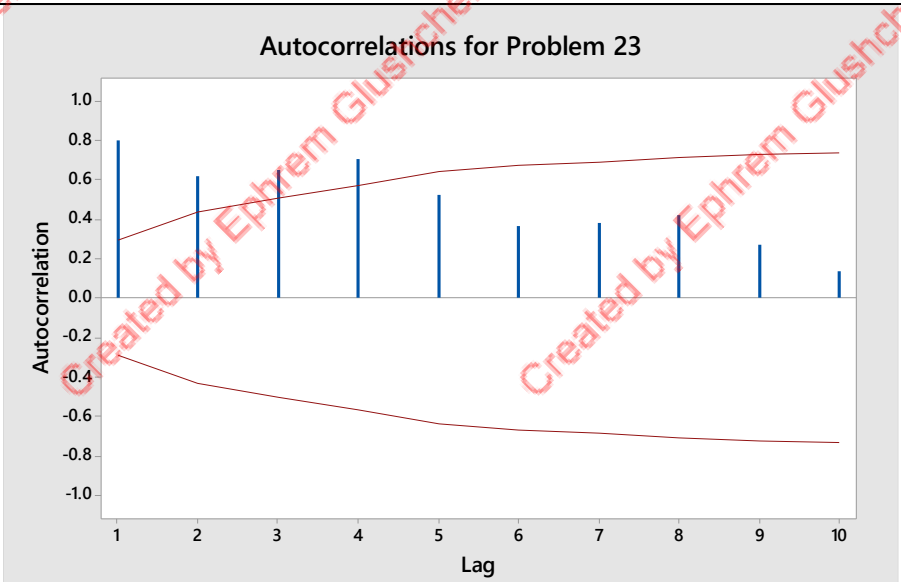
Problem Definition – Is there a significant difference from zero for the correlogram and significant at the time lags autocorrelation coefficients?

Hypothesis –
H_0: p = 0
H_1: p ≠ 0

Decision Rule – If t critical ratio less than -2.01174 or greater than 2.01174, reject null.
If the LBQ exceeds 18.3070, reject null.

Conclusion – t critical ratio is significant at the first four lags. The LBQ exceeds 18.3070, the data is non – stationary.

Interpretation – The autocorrelation is significant and shows a

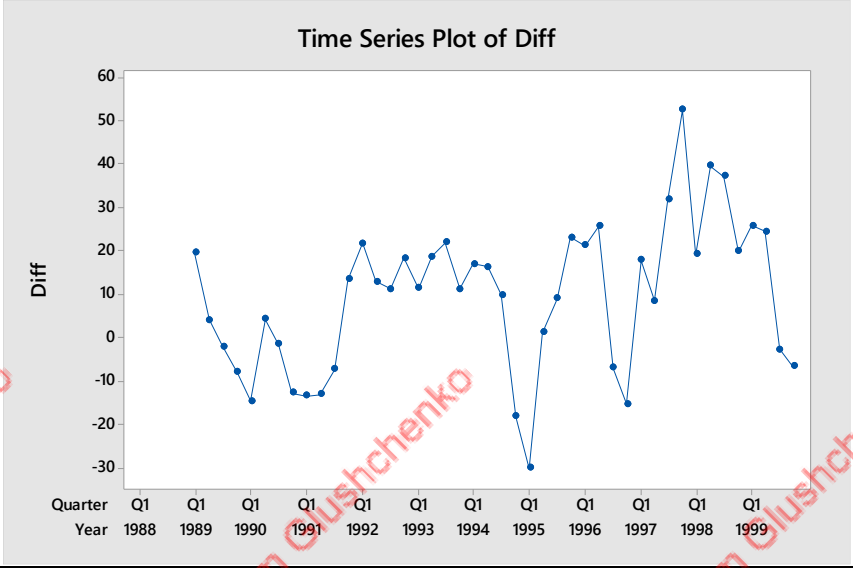


Autocorrelations

Lag	ACF	T	LBQ
1	0.799747	5.54	32.66
2	0.615777	2.83	52.44
3	0.649866	2.58	74.97
4	0.702622	2.47	101.90
5	0.521330	1.64	117.06
6	0.360830	1.07	124.50

trend. Use the difference to remove the trend and look at seasonality.	7	0.381694	1.11	133.03
	8	0.423295	1.20	143.78
	9	0.265449	0.73	148.12
	10	0.132383	0.36	149.23

Problem 24 -

After analyzing the graph we found it was stationary time series which means the mean rises and falls over time. After removing the trend, we can see that seasonality does not exist.	

Problem 25 –

Memo

To: Southwest Airlines Senior Management

Re: Forecast Errors for Naïve Forecasting Method

To Management Personal:

As per your request we have completed the requested naïve forecasting for periods (1998 – 1999) and wish to comment on the following errors terms regarding this technique. One method for evaluating a forecasting technique uses the sum of the absolute errors. Southwest Airlines data mean absolute difference (MAD) is $21.88 million which indicates the forecast accuracy by averaging the magnitudes of the forecast errors and provides an average size of the "miss" regardless of direction. While the square root mean squared error (rootMSE) another forecasting technique, accounts for large forecasting errors and penalizes large errors was $25.03 million. Using another more useful approach, the mean absolute percentage error or MAPE is useful when the error relative to the respective size of the time series value is important in evaluating the accuracy of the forecast, Southwest's MAPE was 19.61 % per quarterly income. While the mean percentage error (MPE) shows weather the forecasting approach is unbiased, the MPE will produce a number close to zero. The MPE results show that the forecasting approach is consistently underestimating by 17.33%. This type of inaccuracy would prevent Southwest Airlines from making proper or accurate business decisions during quarterly revenue.