Time Series
Practical

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The following are data of new registrations of cars in the GB, in thousands, from 1955 to 1999, per quarters, obtained from the National Statistics web site `www.statistics.gov.uk`. You can find them under /public/reinert as *carseries* on nightingale. Carry out an analysis of the data.

1. Load the data as a time series, for example
   `attach(carseries)`
   `cars<-rts(cars, start=1955, frequency=4)`

2. Plot the data, using `ts.plot` in S-PLUS. What does the plot suggest? Are there any outliers? Would you like to break up the data into different blocks? If so, use the `window` command in S-PLUS. For example,
   `cars3<-window(cars, start=c(1990, 4))`
   Then for each block:

3. Use the function `stl` to obtain a decomposition into trend, seasonal part, and remainder. For example,
   `cars3.stl <-stl(cars3, "periodic")`. You might enjoy plotting the different components that `stl` gives.

4. Remove seasonality by using `.stl$rem`

5. Do the data look stationary? If not, try differencing, using `diff`.

6. Estimate the autocorrelation function using `acf`. Plot the acf using `acf.plot`.

7. Estimate the partial autocorrelation function, using
   `acf( , type="partial")`.

8. Suggest some AR, or MA, or perhaps ARIMA models to fit the data.

9. Fitting with confidence intervals and trend removal can be done using the function `gls`. It is advisable to shift the time axis. For example
   `tim<-time(newcars) -1990`
   `fit<-gls(newcars ~tim, correlation=corARMA(p=1,q=1), method="ML")`.
   `summary(fit)` would give you the summary of the fit.

10. You can also use `arima.mle` to fit ARIMA models to the data; this uses a conditional likelihood approach. The option `n.cond.` specifies on how many observations is being conditioned on. Using `arima.mle`, obtain diagnostic plots for the fit, using `arima.diag`. Compare the aic with the aic you obtained by the `gls` fit.

11. If you differenced in order to remove a trend, you could have used gls instead, as `gls` removes trend. Would that change your result?

12. Give an interpretation of your findings.

For interpreting your findings, it might be interesting to know that in January 1963 a suffix was introduced to indicate the year in which the vehicle was registered with the letter A corresponding to 1963, B for 1964, and so forth.

In order to shift the focus of the new car sales away from the start of the year, the month for the new registration letter was changed to August in 1967.

In 1973 a new style of number plates was introduced.

In 1974 the Driver and Vehicle Licensing Centre took over the registration of all new vehicles.

See also
Jeremy Penzer. Messy and mistaken seasonal time series. At
`http://www.lse.ac.uk/Depts/statistics/docs/jp1.pdf`

Another data set to analyze would be canadian lynx data, available as S-PLUS data set `lynx`.