# ARIMAX Modeling - US Economy

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This exercise is taken from **Time Series Analysis and Its Applications: With R Examples** by Shumway and Stoffer. We will be using the `econ5` data set from the `astsa` library. `econ5` is a five quarterly economic series containing the following numeric variables: quarterly U.S. unemployment, GNP, consumption, government investment, and private investment. There are 161 observtions spanning from 1948-III to 1988-II.

Consider the data set `econ5`. The seasonal component has been removed from the data. Concentrating on unemployment (U_t), GNP (G_t), and consumption (C_t), fit a vector ARMA model to the data after first logging each series, and then removing the linear trend. That is, fit a vector ARMA model to $x_t = (x_{1t}, x_{2t}, x_{3t})^t$ where, for example, $x_{1t} = log(U_t) - \hat{\beta}_0 - \hat{\beta}_1 t$, where $\hat{\beta}_0$ and $\hat{\beta}_1$ are the least squares estimates for the regression of $log(U_t)$ on time t. Run a complete set of diagnostics on the residuals.

Curious Plotting
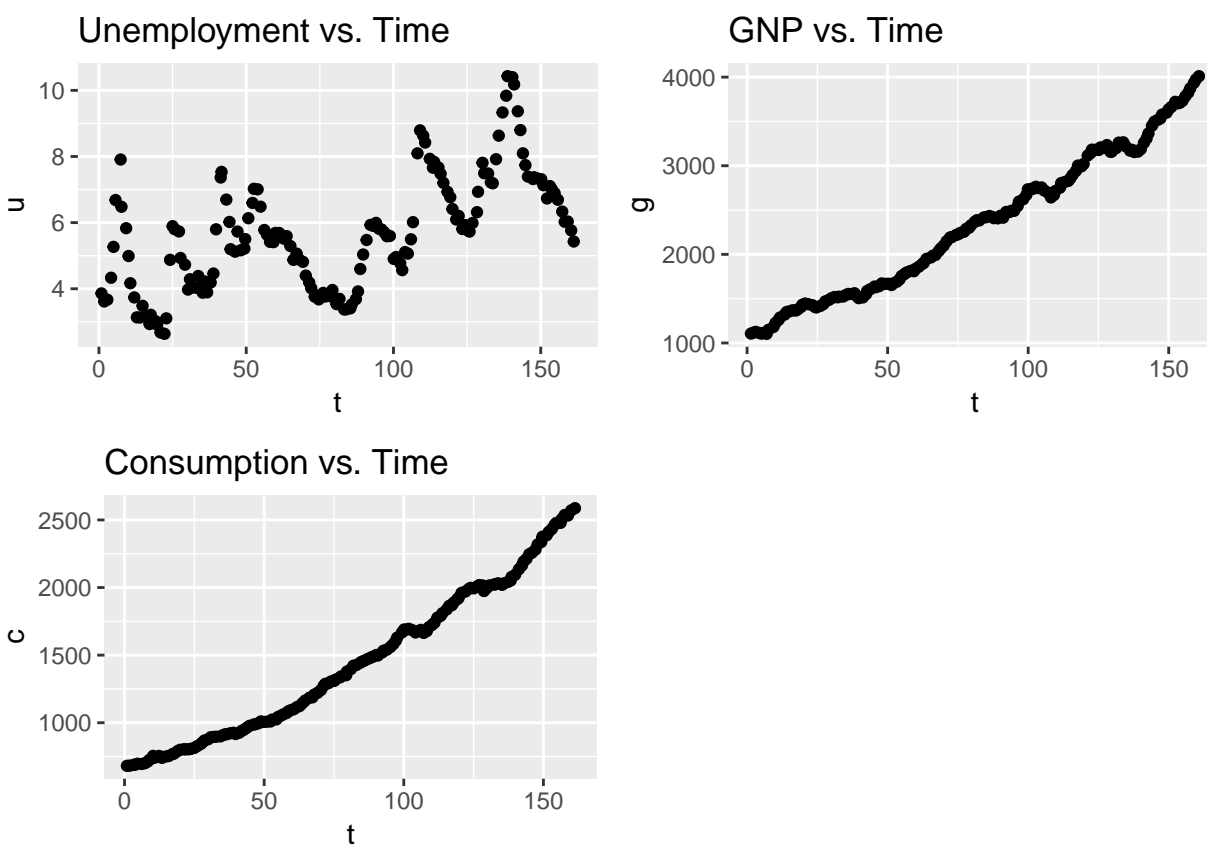
Model Fitting

```
# log transform
log.u=log(u)
log.g=log(g)
log.c=log(c)
log.df=cbind(t,log.u,log.g,log.c)
```

```
# fit vector ARMA model
library(forecast)
```

```
##
## Attaching package: 'forecast'
```

```
## The following object is masked from 'package:astsa':
##
##      gas
```

```
varma=auto.arima(log.u,xreg=log.g+log.c)
summary(varma)
```

```
## Series: log.u
## Regression with ARIMA(2,0,2) errors
##
## Coefficients:
##          ar1      ar2     ma1     ma2  intercept    xreg
##       1.3402  -0.4594  0.0105  0.1673    -0.5774  0.1519
## s.e.  0.1629   0.1505  0.1615  0.1218     1.2475  0.0838
##
## sigma^2 estimated as 0.006463:  log likelihood=179.12
## AIC=-344.24   AICc=-343.51   BIC=-322.67
##
## Training set error measures:
##                        ME       RMSE        MAE        MPE      MAPE
## Training set 0.0002232862 0.07887831 0.05894522 -0.2729806 3.777929
##                   MASE        ACF1
## Training set 0.8940719 0.01596416
```
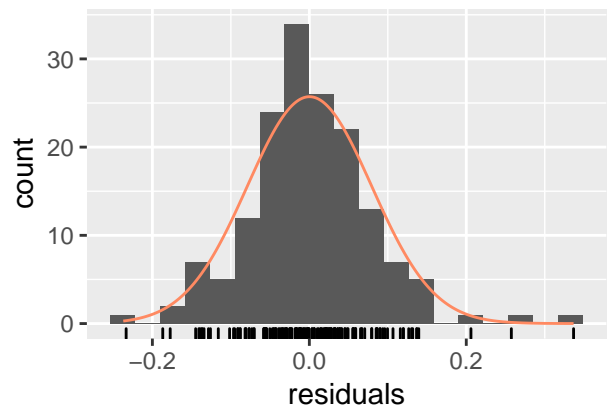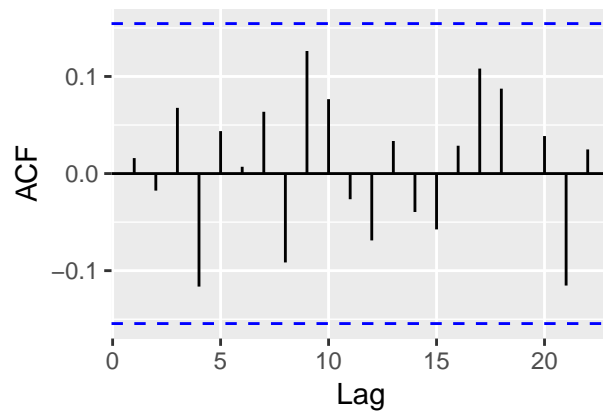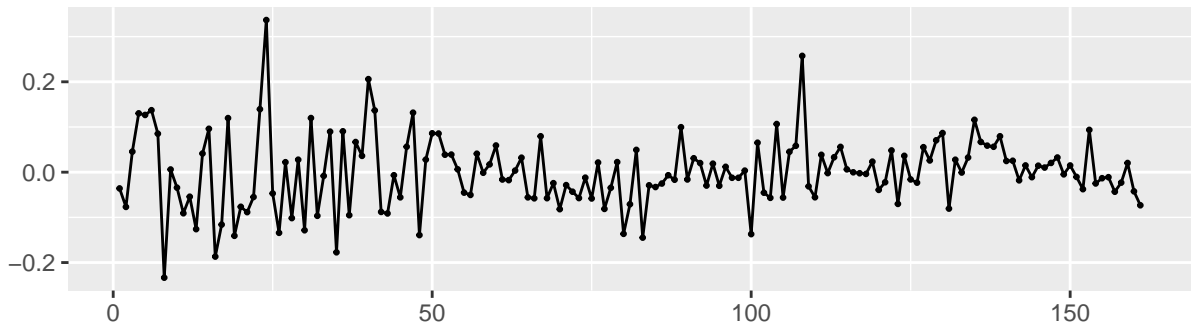
Diagnostics

Residuals from Regression with ARIMA(2,0,2) errors


```
## 
##  Ljung-Box test
## 
## data:  Residuals from Regression with ARIMA(2,0,2) errors
## Q* = 9.3476, df = 4, p-value = 0.05297
## 
## Model df: 6.   Total lags used: 10
```