Economics 513: Economic Forecast and Analysis
Department of Economics, Finance and Legal Studies
University of Alabama

Problem Set #1 – Answers (Linear Regression)

1. (a) Neither figure appears to have a constant mean or variance.

   (b) They appear to move together. In general, the one-year rate is greater than the three-month rate, as expected.

   (c) $\widehat{TB1yr}_t = \underset{(0.067)}{0.698} + \underset{(0.010)}{0.916} TB3mo_t$

   (d) The positive coefficient near one tells us that long-run and short-run rates move in the same direction. It also tells us that a one-unit increase in the short term rate is followed by a one-unit increase in the long term rate.

   (e) $t = \frac{0.916-1}{0.010} = -8.4 \Rightarrow$ we reject the null that $\beta = 1$

   (f) We not observe any particular pattern.

   (g) The F-statistic for the test with no cross-equation restrictions is 19.020 with a p-value equal to 0.000. Therefore we reject the null of homoskedasticity.

   (h) $\widehat{TB1yr}_t = \underset{(0.088)}{0.698} + \underset{(0.017)}{0.916} TB3mo_t$

   (i) We see that both standard errors increase and that the coefficients do not change (as is the case for any data set). Recall that only the standard errors change when using robust standard errors after OLS regression.

   (j) $\widehat{TB1yr}_t = \underset{(0.081)}{0.556} + \underset{(0.014)}{0.945} TB3mo_t - \underset{(0.152)}{0.444} D_t$

   (k) $t = \frac{-0.444-0}{0.152} = -2.931$ and the p-value is 0.004 $\Rightarrow$ we reject the null that the dummy variable is irrelevant

   (l) The fit here (in terms of R^2) is raised to 0.981 from 0.979. We also see decreases in AIC and SC.

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Problem Set #2 – Answers (ARMA models)

1. (a) The mean does not appear to be constant over time, but the variance appears to be constant.

   (b) There is geometric decay in the ACF and a single significant spike in the PACF.

   (c)

$$\begin{aligned}
\widehat{Y1}_t &= -0.559 + 0.754Y1_{t-1} \\
\widehat{Y1}_t &= -0.522 + 0.694Y1_{t-1} + 0.087Y1_{t-2} \\
\widehat{Y1}_t &= -0.549 + 0.805Y1_{t-1} - 0.116\varepsilon_{t-1} \\
\widehat{Y1}_t &= -0.520 + 0.919Y1_{t-1} - 0.245\varepsilon_{t-1} - 0.089\varepsilon_{t-2} - 0.084\varepsilon_{t-3} - 0.090\varepsilon_{t-4} \\
\widehat{Y1}_t &= -0.539 - 0.031Y1_{t-1} + 0.617Y1_{t-2} + 0.762\varepsilon_{t-1}
\end{aligned}$$

   (d)

$$\begin{aligned}
\widehat{Y1}_t &= 0.710Y1_{t-1} + 0.105Y1_{t-2} \\
\widehat{Y1}_t &= 0.846Y1_{t-1} - 0.147\varepsilon_{t-1}
\end{aligned}$$

   (e) Each goodness-of-fit measure points to the AR(1) model: $\overline{R}^2 = 0.557$, $AIC = 2.708$, and $SC = 2.761$.

   (f) No. The data is a simulated series from an AR(1) process. We should be surprised if the correctly specified model isn't preferred.

   (g) The residuals appear to be white noise.

2. (a) The series trends upwards over time and is definitely not stationary.

   (b) There is a very slow decay in the ACF and a single spike near 1.00 in the PACF.

   (c) There appears to be a change in the mean from 1975 to 1985.

   (d) The ACF now shows geometric decay.

   (e) Again, we find a large change in the mean from 1975 to 1985. However, this series appears to be less volatile.

   (f) There is geometric decay in the ACF and 3 or 5 seemingly significant spikes in the PACF at lags 1, 2 and 5.

   (g) Referring to $\log(CPINSA_t/CPINSA_{t-4})$ as y_t we have

$$\begin{aligned}
\widehat{y}_t &= 0.044 + 0.974y_{t-1} \\
\widehat{y}_t &= 0.042 + 1.448y_{t-1} - 0.484y_{t-2} \\
\widehat{y}_t &= 0.043 + 1.443y_{t-1} - 0.434y_{t-2} + 0.218y_{t-3} - 0.635y_{t-4} + 0.381y_{t-5}
\end{aligned}$$

(h) The AR(5) has the largest $\overline{R}^2 = 0.970$, and the smallest $AIC = -8.014$ and $SC = -7.909$.

(i) Referring to $\log(CPINSA_t)$ as y_t we have

$$\widehat{y_t} = 0.011 - 0.003D_{1t} - 0.001D_{2t} - 0.002D_{3t}$$

(j) We see some jumps in the residuals from 1975 to 1985. They do not appear to be mean zero over time.

(k) The ACF and PACF do not show that the residuals are white noise. We should go back and try to find a better model.

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Problem Set #3 – Answers (Forecasting)

1. (a) The series appears to be more or less stationary.

   (b) The ACF shows decay and the PACF has one prominent spike at lag 1 and perhaps several other significant, but smaller, spikes.

   (c) $\widehat{s}_t = 1.388 + 1.109 s_{t-1} - 0.245 s_{t-2}$

   (d) The ACF and PACF of the residuals have very small, but sometimes significant spikes.

   (e)

$$\begin{aligned}\widehat{s}_t &= 1.389 + 1.179 s_{t-1} - 0.471 s_{t-2} + 0.392 s_{t-3} - 0.345 s_{t-4} \\ &\quad + 0.324 s_{t-5} - 0.383 s_{t-6} + 0.152 s_{t-7}\end{aligned}$$

   (f) The ACF and PACF of the residuals have very small and insignificant spikes.

   (g) All signs point to the AR(7) model. It encompasses the AR(2) model. The AR(2) model is more parsimonious, but perhaps too parsimonious.

   (h) First, we try to estimate the value of s at time period 2005:Q4, 0.66

$$\begin{aligned}\widehat{e}_{t+1} &= y_{t+1} - \widehat{y}_{t+1|t} \\ &= 0.66 - (1.388 + 1.109 s_t - 0.245 s_{t-1}) \\ &= 0.66 - (1.388 + 1.109 \times 0.84 - 0.245 \times 1.29) \\ &= -1.344\end{aligned}$$

$$\begin{aligned}\widehat{e}_{t+1} &= y_{t+1} - \widehat{y}_{t+1|t} \\ &= 0.66 - \begin{pmatrix} 1.389 + 1.179 s_t - 0.471 s_{t-1} + 0.392 s_{t-2} - 0.345 s_{t-3} \\ +0.324 s_{t-4} - 0.383 s_{t-5} + 0.152 s_{t-6} \end{pmatrix} \\ &= 0.66 - \begin{pmatrix} 1.389 + 1.179 \times 0.84 - 0.471 \times 1.29 + 0.392 \times 1.77 - 0.345 \times 2.17 \\ +0.324 \times 2.81 - 0.383 \times 3.52 + 0.152 \times 3.52 \end{pmatrix} \\ &= -1.090\end{aligned}$$

   This result should be expected as we have previously argued that the AR(7) model is a better model than the AR(2) model for this particular data set.

   (i) These values are 1.729 and 1.610 for the AR(2) and AR(7) models, respectively. Again, as expected, the AR(7) model performs better.

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Problem Set #4 – Answers (Univariate Nonstationary Time Series)

1. (a) There is an upward sloping trend. The series is definitely nonstationary.
   (b) $\widehat{GDP}_t = 2262.277 + 38.173t - 0.1667t^2 + 0.001t^3$
   (c) There is a large spike near 1.00 (0.925) in the PACF and decay in the ACF.
   (d) Our test statistic is 2.669 and our p-value is equal to 1.000. Hence, we fail to reject the null of a unit root.
   (e) The series appears to be stationary.
   (f) $\widehat{dlrgdp}_t = 0.008 + 0.256dlrgdp_{t-1} + 0.150dlrgdp_{t-2}$
   (g) The ACF and PACF lags for the residuals are very small and the series appears to be white noise.
   (h) Our test statistic is -6.536 and our p-value is 0.000. Hence, we reject the null of a unit root.
   (i) Our F-statistic is 1.222 and our p-value is 0.303. Hence, we fail to reject the null of a break point in 1973:Q1.
   (j) $\widehat{dlrgdp}_t = 0.010 + 0.242dlrgdp_{t-1} + 0.138dlrgdp_{t-2} - 0.003D_t$
   (k) The ACF and PACF lags for the residuals are very small and the series appears to be white noise.

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Problem Set #5 – Answers (Multivariate Nonstationary Time Series)

1. (a) *indpro* and $M1NSA$ have an upward trend. Each appear to be nonstationary
   (b) Our test statistic is 0.175 and our p-value is 0.970. Hence, we fail to reject the null of a unit root.
   (c) Our test statistic is 1.138 and our p-value is 0.998. Hence, we fail to reject the null of a unit root.
   (d) $\widehat{indpro}_t = 28.537 + 0.056 M1NSA_t$
   (e) They have a single tall spike in the PACF and a relatively slow decay in the ACF. They may be nonstationary.
   (f) Our test statistic is -2.097 and our p-value is 0.246. Hence, we fail to reject the null of a unit root.
   (g) The two series move with one another, but do not necessarily cause one another. This likely is a spurious regression.

2. (a) Each series appears to be nonstationary.
   (b) $\log(ex\_ca)$ has a test statistic equal to -1.456 and a p-value equal to 0.553. Hence, we fail to reject the null of a unit root. $\log(p\_ca)$ has a test statistic equal to -5.208 and a p-value equal to 0.000. Hence, we reject the null of a unit root. $\log(p\_us)$ has a test statistic equal to -1.809 and a p-value equal to 0.3752. Hence, we fail to reject the null of a unit root (at the 5% level).
   (c) $\log\widehat{(ex\_ca_t)} = 4.713 + 1.339 \log(p\_ca_t) - 1.358 \log(p\_us_t)$
   (d) The coefficients are fairly equal in magnitude, and have different signs. Absolute PPP also requires that each coefficient is near 1.00. Relative PPP allows the coefficients to be equal in magnitude and opposite signs, but this requires us to regress on growth rates and not logs. In short, it appears that PPP does not hold.
   (e) Since the residuals from the equilibrium regression appear to contain a unit root, shocks to the real exchange rate never decay. Hence, long-run PPP fails.