Applied (Financial) Econometrics
Time Series

Empirical Exercises using Stata

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Setting

- The data file USMacro_Quarterly.dta contains quarterly data on several macroeconomic variables.
- Data are from the first quarter of 1957 to the fourth quarter of 2013 (1957:Q1-2013:Q4).
- All data series are from the Federal Reserve Economic Data (FRED) database maintained by the Federal Reserve Bank of St. Louis.
- We will construct **forecasting models for the rate of inflation.**
- In the exercise we only consider the time period **1963:Q1-2012:Q4**, but we use data from before 1963 to create lagged values.

Variable description

Variable Name	Description
GDPC96	Real Gross Domestic Product
JAPAN_IP	Production of Total Industry in Japan (FRED series name is JPNPROINDQISMEI)
PCECTPI	Personal Consumption Expenditures: Chain-type Price Index
GS10	10-Year Treasury Constant Maturity Rate (Quarterly Average of Monthly Values)
GS1	1-Year Treasury Constant Maturity Rate (Quarterly Average of Monthly Values)
TB3MS	3-Month Treasury Bill: Secondary Market Rate (Quarterly Average of Monthly Values)
UNRATE	Civilian Unemployment Rate (Quarterly Average of Monthly Values)
EXUSUK	U.S. / U.K. Foreign Exchange Rate (Quarterly Average of Daily Values)
CPIAUCSL	Consumer Price Index for All Urban Consumers: All Items (Quarterly Average of Monthly Values)

Questions

1) **Open the data USMacro_Quarterly.dta.**

2) We need to **tell Stata that it is a time series data** set and that the variable time indicates the time period. Browse the data to see how the dataset looks like.

3) Compute the inflation rate by typing:
gen infl=400*(ln(PCECTPI)-ln(L1.PCECTPI))

What are the units of infl? Is infl measured in dollars, percentage points, percentage per quarter, percentage per year, or something else? Explain.

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$$\mathbf{infl} = 400 \times \boldsymbol{ln}\left(\frac{\boldsymbol{PI_t}}{\boldsymbol{PI_{t-1}}}\right)$$

Quarterly percentage change in PI, measured in annual terms.

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- Inflation increased over the 20-year period 1960-1980, then declined for a decade and has been reasonably stable since then.

- **It appears to have a stochastic trend.**

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You can make the plot look nicer by adding a number of options:

twoway (line infl time if tin(1963q1, 2012q4), sort), **ytitle**(Inflation) **ytitle**(, size(large)) **xtitle**(, size(large)) **ylabel**(, angle(horizontal)) scheme(s2mono) **graphregion**(fcolor(white) lcolor(white) ifcolor(white) ilcolor(white)).

For more options type **help twoway_options**.

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The j^{th}autocorrelation$= \rho_j = \frac{Cov(infl_t, iflt-j)}{Var(ifl_t)}$ can be estimated by

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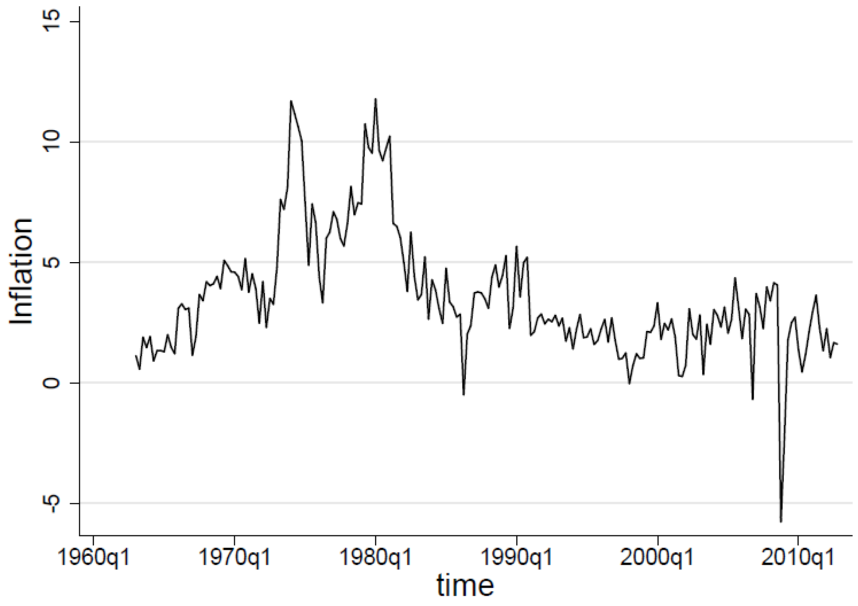
It means that values above the mean tend to be correlated by values above the mean.
If there is an increase in one year, then expect to see that increase to continue.



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6) Compute the first **four autocorrelations of Δinfl**.

7) Plot the value of Δinfl from 1963:Q1 through 2012:Q4. Explain **why the behavior you see** is consistent with the first autocorrelation that you computed in part 6.

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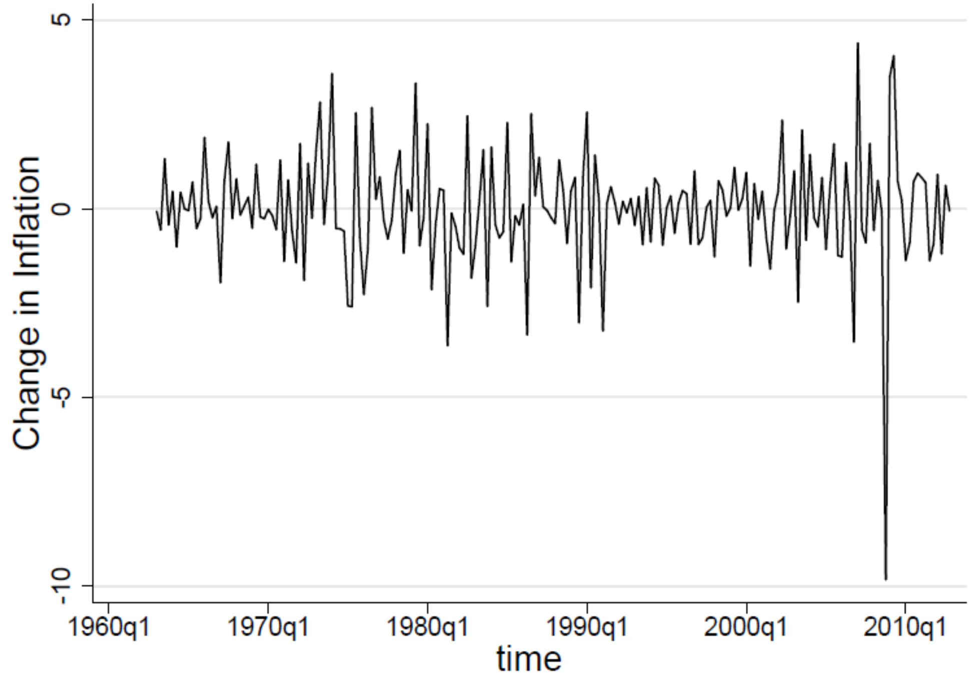
7) Plot the value of Δinfl from 1963:Q1 through 2012:Q4. Explain **why the behavior you see** is consistent with the first autocorrelation that you computed in part 6.

The change in inflation is slightly negatively serially correlated (the first autocorrelation is -0.25), so that **values above the mean tend to be followed by values below the mean**.



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Does knowing the change in inflation over the current quarter **help predict** the change in inflation over the next quarter? Explain.

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The coefficient on $\triangle \mathrm{ifl}_{t-1}$ is -0.25 statistically significant at a 1% level, so that the lagged change in inflation **helps predict the current change in inflation**.

Interpret the coefficient:

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Interpret the coefficient:

A 1 percentage point increase in inflation at t-1 is correlated with 0.25 percentage points decrease in inflation at t.

Questions

9) Compute the BIC and the AIC for the AR(1) model manually. Then summarize them.

- $BIC(p) = ln\left[\frac{SSR(p)}{T}\right] + (p+1)\,\frac{ln(T)}{T}$
- $AIC(p) = ln\left[\frac{SSR(p)}{T}\right] + (p+1)\,\frac{2}{T}$

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Work on the next two points on your own:
12) Estimate an AR(p) model for **p = 3, …, 6**. After each estimation of an AR(p) model compute the BIC and AIC for this AR(p) model.

13) Compare the AIC and BIC of the AR(p) models for p=1,2,…,6. **What lag length is chosen by the BIC? What lag length is chosen by the AIC?**

Questions

14) Use the ADF (augmented Dickey-Fuller test) test for the regression in Equation (15.32) with **two lags of ΔInfl** (so that p = 3 in Equation (15.32) in S&W) to test for a stochastic trend in Infl.

What do you conclude?

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The 5% critical value is -2.86

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The 10% critical value is -2.57
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→ The unit root null hypothesis can be rejected at the 10% but not the 5% significance level.
→ At 5% level **we cannot reject the presence of a stochastic trend!!**

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The Dickey-Fuller regression with a deterministic trend:

$$\Delta Y_t = \beta_0 + \alpha t + \delta Y_{t-1} + \gamma_1 \Delta Y_{t-1} + u_t$$

The inflation rate does not exhibit a linear trend in the plotted time series, so that the specification that includes only an intercept, but no time trend is appropriate.

Questions

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17) Based on the test you carried out in (14), does the **AR model for Infl contain a unit root**?

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Both the **AIC and the BIC choose two lags**, so the specification with 2 lags is appropriate.

17) Based on the test you carried out in (14), does the **AR model for Infl contain a unit root**?

- Inflation is highly persistent.
- The null hypothesis of a unit root cannot be rejected at the 5% significance level, and given the precision of the estimate, this suggests that inflation indeed has a unit root.
- However, we can never accept a null hypothesis! It is nonetheless **safer** to make forecasts using the first differences!