List 02. Intro to Time series with Python

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Python package: `pandas`, `numpy`, `yfinance`, `pandas-datareader`[1]

Contents

1 Import, visualization, data processing

#1. From FRED database load quarterly data on US GDP from 1990 Q1 up to now (series *gdp*)

1. set a right time index
2. visualize the series *gdp*
3. visualize the series $\log(gdp)$
4. visualize the series $\Delta\log(gdp)$
5. visualize the series $\Delta^2\log(gdp)$
6. draw a histogram for $\log(gdp), \Delta\log(gdp)$
7. draw a scatter plot $\log(gdp_t)$ vs $\log(gdp_{t-1})$

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[1] `conda install -c conda-forge yfinance pandas-datareader`
`pip install yfinance pandas-datareader`

8. draw a scatter plot $\Delta\log(gdp_t)$ vs $\Delta\log(gdp_{t-1})$
9. calculate
$$\mathrm{corr}(\log(gdp_t), \log(gdp_{t-1}))$$
and test its significance (formally!)
10. calculate
$$\mathrm{corr}(\Delta\log(gdp_t), \Delta\log(gdp_{t-1}))$$
and test its significance (formally!)

#**2**. From FRED database load monthly data on US M2 from 1990-01 up to now (series $m2$)

1. set a right time index
2. visualize the series $m2$
3. visualize the series $\log(m2)$
4. visualize the series $\Delta\log(m2)$
5. visualize the series $\Delta^2\log(m2)$
6. draw a histogram for $\log(m2), \Delta\log(m2)$
7. draw a scatter plot $\log(m2_t)$ vs $\log(m2_{t-1})$
8. draw a scatter plot $\Delta\log(m2_t)$ vs $\Delta\log(m2_{t-1})$
9. calculate
$$\mathrm{corr}(\log(m2_t), \log(m2_{t-1}))$$
and test its significance (formally!)
10. calculate
$$\mathrm{corr}(\Delta\log(m2_t), \Delta\log(m2_{t-1}))$$
and test its significance (formally!)

#**3**. From FRED database load daily data on 3-month rate ($rate1$) and 10-year rate ($rate2$) for US stock from 1990-01-01 up to now

1. aggregate into monthly multivariate time series $rates$

2. visualize the series $rates$ in two ways
   - as subplots
   - on the same plot
3. visualize the series $\Delta \log(rates)$ in two ways
4. visualize the series $\Delta^2 \log(rates)$ in two ways
5. draw a histogram for $rates, \Delta rates, \Delta^2 rates$ in two ways
6. draw a histogram for $rate1$ vs $rate2$
7. draw a scatter plot $\Delta rate1$ vs $\Delta rate2$
8. calculate $\text{corr}(rate1, rate2)$ and test its significance (formally!)
9. calculate $\text{corr}(\Delta rate1, \Delta rate2)$ and test its significance (formally!)

#**4**. From `finance.yahoo.com` database load daily data on S&P500 (series y_t) from 2000-01-01 up to now

1. visualize the series y
2. visualize the series $\Delta \log(y)$
3. visualize the series $\Delta^2 \log(y)$
4. draw a histogram for $y, \Delta y, \Delta^2 y$

2 Sample ACF & PACF

The default significant level is 5%

#**1**. From FRED database load quarterly data on US GDP from 1990 Q1 up to now (series gdp_t) and let $y_t = \log(gdp_t)$

- Draw ACF and PACF for $y_t, \Delta y_t, \Delta^2 y_t$
- Report $\{r(h)\}_{h=1^3}$ and $\{r_{part}(h)\}_{h=1^3}$
- Test the significance of $r(3), r_{part}(3)$

#**2**. From FRED database load monthly data on US M2 from 1990-01 up to now (series $m2$) and let $y_t = \log(m2_t)$

- Draw ACF and PACF for $y_t, \Delta y_t, \Delta^2 y_t$
- Report $\{r(h)\}_{h=1^4}$ and $\{r_{part}(h)\}_{h=1^4}$
- Test the significance of $r(4), r_{part}(4)$

#**3**. From FRED database load weekly data on 3-month rate for US stock from 1990-01-01 up to now (series y_t)

- Draw ACF and PACF for $y_t, \Delta y_t, \Delta^2 y_t$
- Report $\{r(h)\}_{h=1^3}$ and $\{r_{part}(h)\}_{h=1^3}$
- Test the significance of $r(3), r_{part}(3)$

#**4**. From FRED database load weekly data on 10-year rate for US stock from 1990-01-01 up to now (series y_t)

- Draw ACF and PACF for $y_t, \Delta y_t, \Delta^2 y_t$
- Report $\{r(h)\}_{h=1^3}$ and $\{r_{part}(h)\}_{h=1^3}$
- Test the significance of $r(3), r_{part}(3)$

#**5**. From `finance.yahoo.com` database load daily data on S&P500 (series $sp500$) from 2000-01-01 up to now and let $y_t = \log(sp500)$

- Draw ACF and PACF for $y_t, \Delta y_t, \Delta^2 y_t$
- Report $\{r(h)\}_{h=1^3}$ and $\{r_{part}(h)\}_{h=1^3}$
- Test the significance of $r(3), r_{part}(3)$