

# List 02. Intro to Time series with Python

Nikita V. Artamonov

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Python package: `pandas`, `numpy`, `yfinance`, `pandas-datareader`<sup>1</sup>

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## 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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<sup>1</sup>`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

$$\text{corr}(\log(gdp_t), \log(gdp_{t-1}))$$

and test its significance (formally!)

10. calculate

$$\text{corr}(\Delta \log(gdp_t), \Delta \log(gdp_{t-1}))$$

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

$$\text{corr}(\log(m2_t), \log(m2_{t-1}))$$

and test its significance (formally!)

10. calculate

$$\text{corr}(\Delta \log(m2_t), \Delta \log(m2_{t-1}))$$

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  $\Delta \log(\text{rates})$  in two ways
  4. visualize the series  $\Delta^2 \log(\text{rates})$  in two ways
  5. draw a histogram for *rates*,  $\Delta \text{rates}$ ,  $\Delta^2 \text{rates}$  in two ways
  6. draw a histogram for *rate1* vs *rate2*
  7. draw a scatter plot  $\Delta \text{rate1}$  vs  $\Delta \text{rate2}$
  8. calculate  $\text{corr}(\text{rate1}, \text{rate2})$  and test its significance (formally!)
  9. calculate  $\text{corr}(\Delta \text{rate1}, \Delta \text{rate2})$  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  $\{r_{part}(h)\}_{h=1}^4$
- 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  $y_t = \log(sp500_t)$

- 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  $r(3), r_{part}(3)$