# List 03. ARIMA model with Python

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**#1**. Let $y_t$ be a natural logarithm of US GDP (**quarterly data**) from 1995 up to now

1. Fitting of models of given order

    (a) Fit the following models

    | Model | drift/trend | specification |
    |---|---|---|
    | ARIMA(1,0,1) | + | $y_t = \alpha_0 + \alpha_1 t + \phi y_{t-1} + u_t + \theta u_{t-1}$ |
    | ARIMA(1,1,0) | + | $\Delta y_t = \alpha_0 + \phi \Delta y_{t-1} + u_t + \theta u_{t-1}$ |
    | ARIMA(1,1,1) | - | $\Delta y_t = \phi \Delta y_{t-1} + u_t + \theta u_{t-1}$ |
    | ARIMA(1,2,0) | - | $\Delta^2 y_t = \phi \Delta^2 y_{t-1} + u_t$ |

    and evaluate forecasts for 10 periods forward. Is drift/trend significant?

    (b) Perform diagnostics of each model

    (c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

    (a) fit ARIMA of «optimal» order

    (b) perform its diagnostic

    (c) forecast for 10 periods forward.

**#2**. Let $y_t$ be a natural logarithm of US US M2 (**monthly data**) from 1995 up to now

1. Fitting of models of given order

   (a) Fit the following models

   | Model | drift/trend |
   |---|---|
   | ARIMA(2,0,2) | + |
   | ARIMA(2,1,0) | + |
   | ARIMA(2,1,1) | - |
   | ARIMA(1,2,0) | - |

   and evaluate forecasts for 10 periods forward. Is drift/trend significant?

   (b) Perform diagnostics of each model

   (c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

   (a) fit ARIMA of «optimal» order

   (b) perform its diagnostic

   (c) forecast for 10 periods forward.

**#3**. Let $y_t$ be a natural logarithm of US US M2 (**weekly data**) from 1995 up to now

1. Fitting of models of given order

   (a) Fit the following models

   | Model | drift/trend |
   |---|---|
   | ARIMA(3,0,2) | + |
   | ARIMA(2,1,0) | + |
   | ARIMA(2,1,1) | - |
   | ARIMA(2,2,0) | - |

   and evaluate forecasts for 10 periods forward. Is drift/trend significant?

   (b) Perform diagnostics of each model

   (c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

   (a) fit ARIMA of «optimal» order

   (b) perform its diagnostic

   (c) forecast for 10 periods forward.

#**4**. Let $y_t$ be a 10-years rate (treasury securities with constant maturity **monthly data**) from 2000 up to now

1. Fitting of models of given order

   (a) Fit the following models

   | Model | drift/const |
   |---|:---:|
   | ARIMA(2,0,2) | - |
   | ARIMA(2,0,2) | + |
   | ARIMA(2,1,0) | + |
   | ARIMA(2,1,1) | - |
   | ARIMA(2,2,0) | - |

   and evaluate forecasts for 10 periods forward. Is drift/const significant?

   (b) Perform diagnostics of each model

   (c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

   (a) fit ARIMA of «optimal» order

   (b) perform its diagnostic

   (c) forecast for 10 periods forward.

#**5**. Let $y_t$ be a 10-years rate (treasury securities with constant maturity **daily data**) from 2010 up to now

1. Fitting of models of given order

   (a) Fit the following models

| Model | drift/const |
|---|---|
| ARIMA(3,0,2) | - |
| ARIMA(3,0,2) | + |
| ARIMA(3,1,0) | + |
| ARIMA(3,1,1) | - |
| ARIMA(2,2,0) | - |

and evaluate forecasts for 10 periods forward. Is drift/const significant?

(b) Perform diagnostics of each model

(c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

(a) fit ARIMA of «optimal» order

(b) perform its diagnostic

(c) forecast for 10 periods forward.

**#6**. Let $y_t$ be a 3-month rate (treasury bill, **monthly data**) from 2000 up to now

1. Fitting of models of given order

(a) Fit the following models

| Model | drift/const |
|---|---|
| ARIMA(2,0,2) | - |
| ARIMA(2,0,2) | + |
| ARIMA(2,1,0) | + |
| ARIMA(2,1,1) | - |
| ARIMA(2,2,0) | - |

and evaluate forecasts for 10 periods forward. Is drift/const significant?

(b) Perform diagnostics of each model

(c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

    (a) fit ARIMA of «optimal» order

    (b) perform its diagnostic

    (c) forecast for 10 periods forward.

#**7**. Let $y_t$ be a 3-month rate (treasury bill, **daily data**) from 2010 up to now

1. Fitting of models of given order

    (a) Fit the following models

    | Model | drift/const |
    | --- | --- |
    | ARIMA(3,0,2) | - |
    | ARIMA(3,0,2) | + |
    | ARIMA(3,1,0) | + |
    | ARIMA(3,1,1) | - |
    | ARIMA(2,2,0) | - |

    and evaluate forecasts for 10 periods forward. Is drift/const significant?

    (b) Perform diagnostics of each model

    (c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

    (a) fit ARIMA of «optimal» order

    (b) perform its diagnostic

    (c) forecast for 10 periods forward.

#**8**. Let $y_t$ be a natural logarithm of S&P (**daily data**) from 2010 up to now

1. Fitting of models of given order

    (a) Fit the following models

| Model | drift/const |
|---|---|
| ARIMA(2,0,2) | - |
| ARIMA(2,0,2) | + |
| ARIMA(2,1,0) | + |
| ARIMA(2,1,1) | - |
| ARIMA(2,2,0) | - |

    and evaluate forecasts for 10 periods forward. Is drift/const significant?

(b) Perform diagnostics of each model

(c) Perform cross-validation of each model. Which one is preferable?

2. Perform unit-root test and find an optimal integration order for $y_t$.

3. Fitting of the «optimal» model

    (a) fit ARIMA of «optimal» order

    (b) perform its diagnostic

    (c) forecast for 10 periods forward.

#**9**. Write down specification the following model

1. ARIMA(0,1,1) with and without drift

2. ARIMA(0,1,2) with and without drift

3. ARIMA(1,1,0) with and without drift

4. ARIMA(2,1,0) with and without drift

5. ARIMA(0,2,0) with and without drift

6. ARIMA(1,2,0) with and without drift

7. ARIMA(0,2,1) with and without drift