My Project

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Contents

Chapter 1

tsap

Time series analysis in python APC 524, Fall 2016, Final project Project members: Wenyan Gong, Zongxi Li, Cong Ma, Qingcan Wang, Zhuoran Yang, Hao Zhang

In this project, we will develop a python module that provides tools for time series analysis. We provide python class in src/ folder.

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

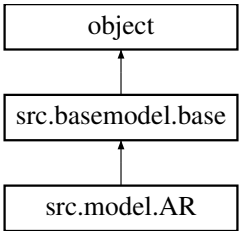
Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

Class Documentation

4.1 src.model.AR Class Reference

Inheritance diagram for src.model.AR:



Public Member Functions

- def __init__ (self, lag, phi, sigma, intercept)
- def loss (self, X, lag=None, phi=None, sigma=None, intercept=None)
- def predict (self, X, nstep, lag=None, phi=None, sigma=None, intercept=None)

Public Attributes

- **params**

4.1.1 Detailed Description

```
class AR implements the AR model which has __init__ , loss and predict as functions
```

4.1.2 Constructor & Destructor Documentation

4.1.2.1 __init__()

```
def src.model.AR.__init__ (
              self,
              lag,
              phi,
              sigma,
              intercept )
```

```
__init__: initialize the model with lag phi sigma and intercept
   Input:
 lag: the number of lag in AR model, dimension 1
 phi: the coefficients for each lag, dimension lag, column vector
 sigma: the standard deviation of the error term, dimension 1
 intercept: the constant component in the AR model, dimension 1
   Output:
 _lag: the number of lag in the AR model
 params: hash table of phi, sigma and intercept
```

4.1.3 Member Function Documentation

4.1.3.1 loss()

```
def src.model.AR.loss (
              self,
              X,
              lag = None,
              phi = None,
              sigma = None,
              intercept = None )
```

```
loss: return the loglikelihood and its gradient with respect to phi, sigma and intercept
   Input:
 X: the input time series, each row is about one stock. For one stock, X is a row vector. Note phi is a column
   Output:
  loglikelihood: the loglikelihood that calculated from the input time series
  grads: hash table that records the gradient of phi sigma and intercept
```

```
the number of samples, usually it's about how many stocks we have
```

4.1.3.2 predict()

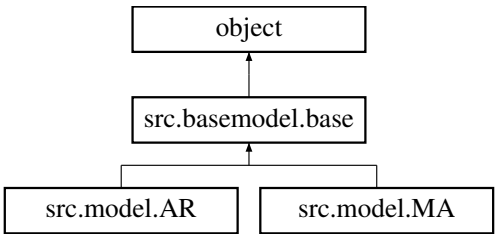
```
def src.model.AR.predict (
              self,
              X,
              nstep,
              lag = None,
              phi = None,
              sigma = None,
              intercept = None )


predict: return the predicted series based on the samples given
   Input:
 X: the input time series, each row is about one stock. For one stock, X is a row vector. Note phi is a column
 nstep: the number of steps to predict
   Output:
  pred_state: the predicted series based on AR model, which is a row vector


parameters
```

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/model.py

4.2 src.basemodel.base Class Reference

Inheritance diagram for src.basemodel.base:



Public Member Functions

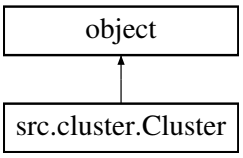
- def **__init__** (self)
- def **loss** (self, X)
- def **predict** (self, X, nstep)

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/basemodel.py

4.3 src.cluster.Cluster Class Reference

Inheritance diagram for src.cluster.Cluster:



Public Member Functions

- def __init__ (self, X)
- def assign_label (self, Centers)
- def kMeans (self, nClusters, maxIter=300)

4.3.1 Constructor & Destructor Documentation

4.3.1.1 __init__()

```
def src.cluster.Cluster.__init__ (
              self,
              X )
```

```
Return a new object to cluster data based on selected clutering
algorithm.
Example usage: clusterObj = Clustering(X)
X:     numpy array, shape (n_samples, n_features)
```

4.3.2 Member Function Documentation

4.3.2.1 assign_label()

```
def src.cluster.Cluster.assign_label (
              self,
              Centers )
```

```
Assign labels to the data points
    Input:
self
Centers:  numpy array, shape (n_clusters, n_features) the centers of each cluster
    Output:
clusters: the index of data points in each class
labels: the label of each class
```

4.3.2.2 kMeans()

```
def src.cluster.Cluster.kMeans (
              self,
              nClusters,
              maxIter = 300 )
```

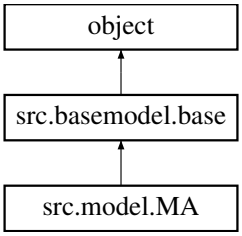
```
K-means clustering algorithm.

Function usage: kMeans(nClusters, maxIter, nInit)

Inputs:
nClusters : int
    The number of clusters to form as well as the number of
    centroids to generate.
maxIter : int, optional, default 300
    Maximum number of iterations of the k-means algorithm to run.

Returns:
centroid :  float ndarray with shape (k, n_features)
    Centroids found at the last iteration of k-means.
label : integer ndarray with shape (n_samples,)
    label[i] is the code or index of the centroid the ith
    observation is closest to.
inertia : float
    The final value of the inertia criterion (sum of squared
    distances to the closest centroid for all observations
    in the training set).
```

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/cluster.py

4.4 src.model.MA Class Reference

Inheritance diagram for src.model.MA:



Public Member Functions

- def __init__ (self, lag, phi, sigma, intercept)
- def **loss** (self, X, lag=None, phi=None, sigma=None, intercept=None)
- def get_loglikelihood (self, X, lag=None, phi=None, sigma=None, intercept=None)
- def predict (self, X, nstep)

Public Attributes

- **params**

4.4.1 Constructor & Destructor Documentation

4.4.1.1 __init__()

```
def src.model.MA.__init__ (
              self,
              lag,
              phi,
              sigma,
              intercept )
```

lag, phi, sigma, intercept is the parameter of AR

4.4.2 Member Function Documentation

4.4.2.1 get_loglikelihood()

```
def src.model.MA.get_loglikelihood (
              self,
              X,
              lag = None,
              phi = None,
              sigma = None,
              intercept = None )
```

X is dataset, right now X is a row vector

phi is a column vector, and we need to make it into matrix form

4.4.2.2 predict()

```
def src.model.MA.predict (
              self,
              X,
              nstep )
```

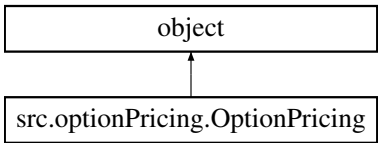
X is a row vector

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/model.py

4.5 src.optionPricing.OptionPricing Class Reference

Inheritance diagram for src.optionPricing.OptionPricing:



Public Member Functions

- def **__init__** (self, sigma=0.1, r=0.01, T=1, K=1, Smax=None, Vmax=None)
- def BlackScholesEqn (self, dS, dt)
- def optionPrice (self, V, S, t)

4.5.1 Detailed Description

```
Callable option pricing object.
Example usage:
optionPriceobj = optionPricing(sigma,r,T,K), declare a class object
V = optionPriceobj.BlackScholesEqn(dS,dt), compute V array in shape [nS,nt]
Vst = optionPriceobj.optionPrice(V,S,t), compute V(S,t) given V array
```

4.5.2 Member Function Documentation

4.5.2.1 BlackScholesEqn()

```
def src.optionPricing.OptionPricing.BlackScholesEqn (
              self,
              dS,
              dt )
```

```
V(S, t) satisfies Black-Scholes equation
dVdt + (1/2)*sigma^2*S^2*d2VdS2 + r*S*dVdS - r*V = 0

Inputs:
dS: float, size of grids in S dimension
dt: float, size of grids in t dimension

Returns:
V: array, shape [nS, nt]
```

4.5.2.2 optionPrice()

```
def src.optionPricing.OptionPricing.optionPrice (
              self,
              V,
              S,
              t )
```

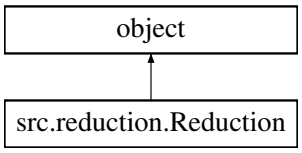
```
Given discrete V arrary in shape [nS, nt], compute V at V(S,t) by
simple interpolation
Inputs:
V: array in shape [nS, nt]
S: stock price
t: time
Returns:
VSt: option price V(S,t)
```

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/optionPricing.py

4.6 src.reduction.Reduction Class Reference

Inheritance diagram for src.reduction.Reduction:



Public Member Functions

- def **__init__** (self, X)
- def PCA (self, n_components=None)
- def ICA (self, n_components, gfunc='logcosh', tol=1e-4, max_iter=200)
- def DMD (self, n_components=None)

4.6.1 Detailed Description

```
Callable modal reduction object.
Example usage:
xreduction = Reduction(X), X shape [n_features, n_samples], make sure X is
zero-mean
xmean, ux, at, energy_content = xreduction.PCA(n_components=3)
```

4.6.2 Member Function Documentation

4.6.2.1 DMD()

```
def src.reduction.Reduction.DMD (
              self,
              n_components = None )
```

```
Dynamic mode decomposition(DMD) of time series data x(k), find square
matrix A such that x(k+1) = Ax(k). Find eigendecomposition of A, and
corresponding DMD modes, and DMD eigenvalues.
```

4.6.2.2 ICA()

```
def src.reduction.Reduction.ICA (
              self,
              n_components,
              gfunc = 'logcosh',
              tol = 1e-4,
              max_iter = 200 )
```

```
Independent component analysis(ICA) of data in matrix X
Inputs:
n_components: integer, number of independent components
gfunc: string, 'logcosh' or 'exp', default 'logcosh', Non-gaussian function
tol: float, tolerance of iteration, default 1e-4
max_iter: integer, maximum iteration steps, default 200
Returns:
Ex: array, mean of data
T: array [n_features, n_features], whitening matrix, st, xtilde = Tx
A: array [n_features, n_components], mixing matrix, st, xtilde = As
W: array [n_components, n_features], orthogonal rows, unmixing matrix, st, W = inv(A), s = W*xtilde
S: array, [n_components, n_samples], source data, st, S = W*Xtilde
```

4.6.2.3 PCA()

```
def src.reduction.Reduction.PCA (
              self,
              n_components = None )
```

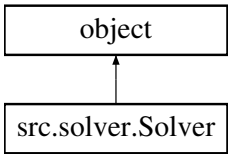
```
Principal component analysis (PCA) of data in matrix
Inputs:
n_components: integer, number of principal components
Returns:
ux: principal components
at: principal components coefficients
energy_content: energy content percentage in the principal components
```

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/reduction.py

4.7 src.solver.Solver Class Reference

Inheritance diagram for src.solver.Solver:



Public Member Functions

- def **__init__** (self, model, data, kwargs)
- def **train** (self)

Public Attributes

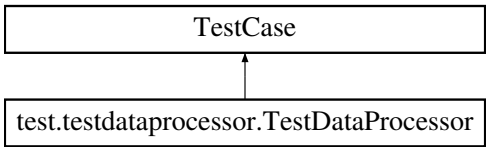
- **model**
- **X**
- **update_rule**
- **optim_config**
- **batch_size**
- **num_epochs**
- **print_every**
- **epoch**
- **loss_history**
- **optim_configs**

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/src/solver.py

4.8 test.testdataprocessor.TestDataProcessor Class Reference

Inheritance diagram for test.testdataprocessor.TestDataProcessor:



Public Member Functions

- def testGetReturn1 (self)
- def testGetReturn2 (self)
- def testGetReturn3 (self)
- def testGetReturn4 (self)
- def testGetPrice1 (self)
- def testGetPrice2 (self)
- def testGetPrice3 (self)
- def testMaxDrawdown1 (self)
- def testMaxDrawdown2 (self)
- def testMaxDrawdown3 (self)
- def testGetIndicator1 (self)
- def testGetIndicator2 (self)
- def testGetIndicator3 (self)
- def testGetIndicator4 (self)

4.8.1 Member Function Documentation

4.8.1.1 testGetIndicator1()

```
def test.testdataprocessor.TestDataProcessor.testGetIndicator1 (
              self )
```

test get_indicator with upper trend

4.8.1.2 testGetIndicator2()

```
def test.testdataprocessor.TestDataProcessor.testGetIndicator2 (
              self )
```

test get_indicator with lower trend

4.8.1.3 testGetIndicator3()

```
def test.testdataprocessor.TestDataProcessor.testGetIndicator3 (
              self )
```

test get_indicator without trend, trough before peak

4.8.1.4 testGetIndicator4()

```
def test.testdataprocessor.TestDataProcessor.testGetIndicator4 (
              self )
```

test get_indicator without trend, trough after peak

4.8.1.5 testGetPrice1()

```
def test.testdataprocessor.TestDataProcessor.testGetPrice1 (
              self )
```

test get_price with a row vector whose elements are all 1.0

4.8.1.6 testGetPrice2()

```
def test.testdataprocessor.TestDataProcessor.testGetPrice2 (
              self )
```

test get_price with a row vector whose elements are not the same

4.8.1.7 testGetPrice3()

```
def test.testdataprocessor.TestDataProcessor.testGetPrice3 (
              self )
```

test get_price with a row vector whose elements are not the same, can be negative

4.8.1.8 testGetReturn1()

```
def test.testdataprocessor.TestDataProcessor.testGetReturn1 (
              self )
```

test get_return with a row vector whose elements are all 1.0

4.8.1.9 testGetReturn2()

```
def test.testdataprocessor.TestDataProcessor.testGetReturn2 (
              self )
```

test get_return with a row vector whose elements are not the same

4.8.1.10 testGetReturn3()

```
def test.testdataprocessor.TestDataProcessor.testGetReturn3 (
              self )
```

test get_return with a matrix

4.8.1.11 testGetReturn4()

```
def test.testdataprocessor.TestDataProcessor.testGetReturn4 (
              self )
```

test get_return with a larger matrix

4.8.1.12 testMaxDrawdown1()

```
def test.testdataprocessor.TestDataProcessor.testMaxDrawdown1 (
              self )
```

test max_drawdown with upper trend

4.8.1.13 testMaxDrawdown2()

```
def test.testdataprocessor.TestDataProcessor.testMaxDrawdown2 (
              self )
```

test max_drawdown with lower trend

4.8.1.14 testMaxDrawdown3()

```
def test.testdataprocessor.TestDataProcessor.testMaxDrawdown3 (
              self )
```

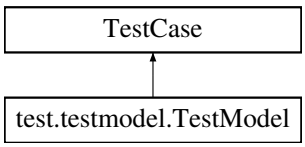
test max_drawdown with peak and trough

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/test/testdataprocessor.py

4.9 test.testmodel.TestModel Class Reference

Inheritance diagram for test.testmodel.TestModel:



Public Member Functions

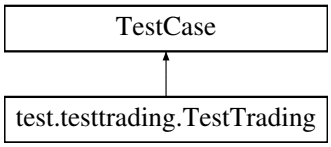
- def **testARloglklh1** (self)
- def **testARlklh2** (self)
- def **testARgrad1** (self)
- def **testARgrad2** (self)
- def **testMAloglklh1** (self)
- def **testMAloglklh2** (self)

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/test/testmodel.py

4.10 test.testtrading.TestTrading Class Reference

Inheritance diagram for test.testtrading.TestTrading:



Public Member Functions

- def testSignalGeneration1 (self)
- def testSignalGeneration2 (self)
- def testSignalGeneration3 (self)
- def testSignalGeneration4 (self)
- def testSignalGeneration5 (self)
- def testProfitLoss1 (self)
- def testProfitLoss2 (self)
- def testProfitLoss3 (self)
- def testProfitLoss4 (self)
- def testTrade1 (self)

4.10.1 Member Function Documentation

4.10.1.1 testProfitLoss1()

```
def test.testtrading.TestTrading.testProfitLoss1 (
              self )
```

test profit_loss with upper trend, this is immediate buy

4.10.1.2 testProfitLoss2()

```
def test.testtrading.TestTrading.testProfitLoss2 (
              self )
```

test profit_loss with upper trend, this is immediate buy

4.10.1.3 testProfitLoss3()

```
def test.testtrading.TestTrading.testProfitLoss3 (
              self )
```

test profit_loss with longer holding period

4.10.1.4 testProfitLoss4()

```
def test.testtrading.TestTrading.testProfitLoss4 (
              self )
```

test profit_loss with longer holding period, multiple trades and more money

4.10.1.5 testSignalGeneration1()

```
def test.testtrading.TestTrading.testSignalGeneration1 (
              self )
```

test signal_generation with upper trend

4.10.1.6 testSignalGeneration2()

```
def test.testtrading.TestTrading.testSignalGeneration2 (
              self )
```

test signal_generation with lower trend

4.10.1.7 testSignalGeneration3()

```
def test.testtrading.TestTrading.testSignalGeneration3 (
              self )
```

test signal_generation without trend

4.10.1.8 testSignalGeneration4()

```
def test.testtrading.TestTrading.testSignalGeneration4 (
              self )
```

test signal_generation with bigger window

4.10.1.9 testSignalGeneration5()

```
def test.testtrading.TestTrading.testSignalGeneration5 (
              self )
```

test signal_generation with bigger holding period

4.10.1.10 testTrade1()

```
def test.testtrading.TestTrading.testTrade1 (
              self )
```

test trade with a very simple model

The documentation for this class was generated from the following file:

- /u/qingcanw/Programs/tsap/test/testtrading.py