QLib Documentation

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Contents

`Qlib` is an AI-oriented quantitative investment platform, which aims to realize the potential, empower the research, and create the value of AI technologies in quantitative investment.

CHAPTER 1

Document Structure

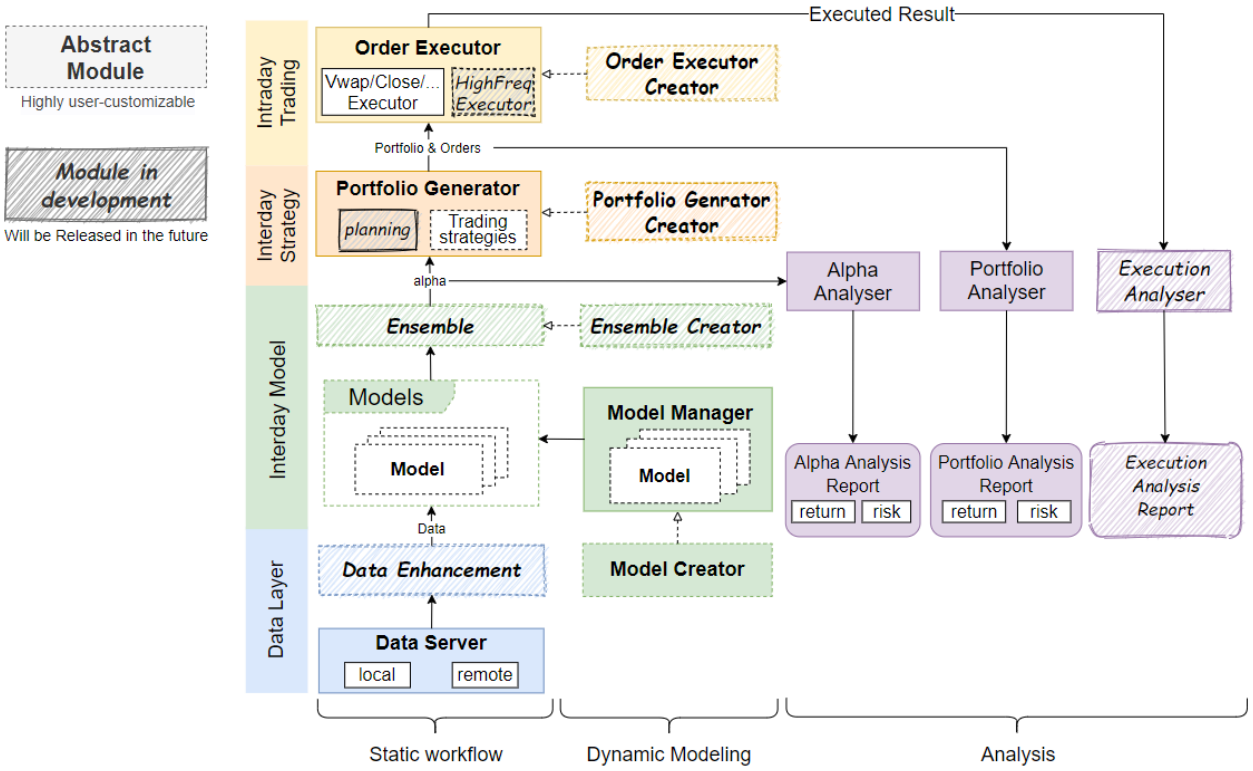
1.1 Qlib: Quantitative Platform

1.1.1 Introduction

Qlib is an AI-oriented quantitative investment platform, which aims to realize the potential, empower the research, and create the value of AI technologies in quantitative investment.

With Qlib, users can easily try their ideas to create better Quant investment strategies.

1.1.2 Framework



At the module level, Qlib is a platform that consists of above components. The components are designed as loose-coupled modules and each component could be used stand-alone.

Name	Description
Data layer	*DataServer* focuses on providing high-performance infrastructure for users to manage and retrieve raw data. *DataEnhancement* will preprocess the data and provide the best dataset to be fed into the models.
Interday Model	*Interday model* focuses on producing prediction scores (aka. *alpha*). Models are trained by *Model Creator* and managed by *Model Manager*. Users could choose one or multiple models for prediction. Multiple models could be combined with *Ensemble* module.
Interday Strategy	*Portfolio Generator* will take prediction scores as input and output the orders based on the current position to achieve the target portfolio.
Intraday Trading	*Order Executor* is responsible for executing orders output by *Interday Strategy* and returning the executed results.
Analysis	Users could get a detailed analysis report of forecasting signals and portfolios in this part.

- The modules with hand-drawn style are under development and will be released in the future.
- The modules with dashed borders are highly user-customizable and extendible.

1.2 Quick Start

1.2.1 Introduction

This `Quick Start` guide tries to demonstrate

- It's very easy to build a complete Quant research workflow and try users' ideas with `Qlib`.
- Though with public data and simple models, machine learning technologies work very well in practical Quant investment.

1.2.2 Installation

Users can easily intsall `Qlib` according to the following steps:

- Before installing `Qlib` from source, users need to install some dependencies:

- Clone the repository and install `Qlib`

To kown more about *installation*, please refer to Qlib Installation.

1.2.3 Prepare Data

Load and prepare data by running the following code:

This dataset is created by public data collected by crawler scripts in `scripts/data_collector/`, which have been released in the same repository. Users could create the same dataset with it.

To kown more about *prepare data*, please refer to Data Preparation.

1.2.4 Auto Quant Research Workflow

`Qlib` provides a tool named `Estimator` to run the whole workflow automatically (including building dataset, training models, backtest and evaluation). Users can start an auto quant research workflow and have a graphical reports analysis according to the following steps:

- **Quant Research Workflow:**
  - **Run `Estimator` with *estimator_config.yaml* as following.**
  - **Estimator result** The result of `Estimator` is as follows, which is also the result of `Interday Trading`. Please refer to please refer to Interdat Trading. for more details about the result.

```
                                                 risk
excess_return_without_cost mean               0.000605
                           std                0.005481
                           annualized_return  0.152373
                           information_ratio  1.751319
                           max_drawdown      -0.059055
excess_return_with_cost    mean               0.000410
                           std                0.005478
                           annualized_return  0.103265
```

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```
information_ratio  1.187411
max_drawdown      -0.075024
```

To know more about *Estimator*, please refer to Estimator.

- **Graphical Reports Analysis:**
  - **Run `examples/estimator/analyze_from_estimator.ipynb` with jupyter notebook** Users can have portfolio analysis or prediction score (model prediction) analysis by run `examples/estimator/analyze_from_estimator.ipynb`.
  - **Graphical Reports** Users can get graphical reports about the analysis, please refer to Aanalysis: Evaluation & Results Analysis for more details.

1.2.5 Custom Model Integration

`Qlib` provides `lightGBM` and `Dnn` model as the baseline of `Interday Model`. In addition to the default model, users can integrate their own custom models into `Qlib`. If users are interested in the custom model, please refer to Custom Model Integration.

1.3 Installation

1.3.1 `Qlib` Installation

Note: *Qlib* supports both *Windows* and *Linux*. It's recommended to use *Qlib* in *Linux*. `Qlib` supports Python3, which is up to Python3.8.

Please follow the steps below to install `Qlib`:

- Enter the root directory of `Qlib`, in which the file `setup.py` exists.
- Then, please execute the following command to install the environment dependencies and install `Qlib`:

```
$ pip install numpy
$ pip install --upgrade cython
$ git clone https://github.com/microsoft/qlib.git && cd qlib
$ python setup.py install
```

Note: It's recommended to use anaconda/miniconda to setup the environment. `Qlib` needs lightgbm and pytorch packages, use pip to install them.

Note: Do not import qlib in the root directory of `Qlib`, otherwise, errors may occur.

Use the following code to make sure the installation successful:

```
>>> import qlib
>>> qlib.__version__
<LATEST VERSION>
```

1.4 Qlib Initialization

1.4.1 Initialization

Please follow the steps below to initialize `Qlib`.

- **Download and prepare the Data: execute the following command to download stock data.**

```
python scripts/get_data.py qlib_data_cn --target_dir ~/.qlib/qlib_data/cn_data
```

  Please refer to Raw Data for more information about `get_data.py`,

- Initialize Qlib before calling other APIs: run following code in python.

```
import qlib
# region in [REG_CN, REG_US]
from qlib.config import REG_CN
provider_uri = "~/.qlib/qlib_data/cn_data"  # target_dir
qlib.init(provider_uri=provider_uri, region=REG_CN)
```

Parameters

Besides *provider_uri* and *region*, *qlib.init* has other parameters. The following are several important parameters of *qlib.init*:

- ***provider_uri*** Type: str. The URI of the Qlib data. For example, it could be the location where the data loaded by `get_data.py` are stored.
- ***region***

  Type: str, optional parameter(default: *qlib.config.REG_CN*). Currently: `qlib.config.REG_US` ('us') and `qlib.config.REG_CN` ('cn') is supported. Different value of *region* will result in different stock market mode. - `qlib.config.REG_US`: US stock market. - `qlib.config.REG_CN`: China stock market.

  Different modse will result in different trading limitations and costs.

- ***redis_host***

  Type: str, optional parameter(default: "127.0.0.1"), host of *redis* The lock and cache mechanism relies on redis.

- ***redis_port*** Type: int, optional parameter(default: 6379), port of *redis*

Note: The value of *region* should be aligned with the data stored in *provider_uri*. Currently, `scripts/get_data.py` only provides China stock market data. If users want to use the US stock market data, they should prepare their own US-stock data in *provider_uri* and switch to US-stock mode.

Note: If Qlib fails to connect redis via *redis_host* and *redis_port*, cache mechanism will not be used! Please refer to Cache for details.

1.5 Data Retrieval

1.5.1 Introduction

Users can get stock data with `Qlib`. The following examples demonstrate the basic user interface.

1.5.2 Examples

`QLib` Initialization:

Note: In order to get the data, users need to initialize `Qlib` with *qlib.init* first. Please refer to initialization.

If users followed steps in initialization and downloaded the data, they should use the following code to initialize qlib

```
>> import qlib
>> qlib.init(provider_uri='~/.qlib/qlib_data/cn_data')
```

Load trading calendar with given time range and frequency:

```
>> from qlib.data import D
>> D.calendar(start_time='2010-01-01', end_time='2017-12-31', freq='day')[:2]
[Timestamp('2010-01-04 00:00:00'), Timestamp('2010-01-05 00:00:00')]
```

Parse a given market name into a stock pool config:

```
>> from qlib.data import D
>> D.instruments(market='all')
{'market': 'all', 'filter_pipe': []}
```

Load instruments of certain stock pool in the given time range:

```
>> from qlib.data import D
>> instruments = D.instruments(market='csi300')
>> D.list_instruments(instruments=instruments, start_time='2010-01-01', end_time=
↪'2017-12-31', as_list=True)[:6]
['SH600036', 'SH600110', 'SH600087', 'SH600900', 'SH600089', 'SZ000912']
```

Load dynamic instruments from a base market according to a name filter

```
>> from qlib.data import D
>> from qlib.data.filter import NameDFilter
>> nameDFilter = NameDFilter(name_rule_re='SH[0-9]{4}55')
>> instruments = D.instruments(market='csi300', filter_pipe=[nameDFilter])
>> D.list_instruments(instruments=instruments, start_time='2015-01-01', end_time=
↪'2016-02-15', as_list=True)
['SH600655', 'SH601555']
```

Load dynamic instruments from a base market according to an expression filter

```
>> from qlib.data import D
>> from qlib.data.filter import ExpressionDFilter
>> expressionDFilter = ExpressionDFilter(rule_expression='$close>2000')
>> instruments = D.instruments(market='csi300', filter_pipe=[expressionDFilter])
```

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```
>> D.list_instruments(instruments=instruments, start_time='2015-01-01', end_time=
↪'2016-02-15', as_list=True)
['SZ000651', 'SZ000002', 'SH600655', 'SH600570']
```

For more details about filter, please refer Filter API.

Load features of certain instruments in a given time range:

```
>> from qlib.data import D
>> instruments = ['SH600000']
>> fields = ['$close', '$volume', 'Ref($close, 1)', 'Mean($close, 3)', '$high-$low']
>> D.features(instruments, fields, start_time='2010-01-01', end_time='2017-12-31',␣
↪freq='day').head()

                          $close     $volume  Ref($close, 1)  Mean($close, 3)  $high-
↪$low
  instrument  datetime
  SH600000    2010-01-04  86.778313  16162960.0       88.825928        88.061483   ␣
↪2.907631
              2010-01-05  87.433578  28117442.0       86.778313        87.679273   ␣
↪3.235252
              2010-01-06  85.713585  23632884.0       87.433578        86.641825   ␣
↪1.720009
              2010-01-07  83.788803  20813402.0       85.713585        85.645322   ␣
↪3.030487
              2010-01-08  84.730675  16044853.0       83.788803        84.744354   ␣
↪2.047623
```

Load features of certain stock pool in a given time range:

Note: With cache enabled, the qlib data server will cache data all the time for the requested stock pool and fields, it may take longer to process the request for the first time than that without cache. But after the first time, requests with the same stock pool and fields will hit the cache and be processed faster even the requested time period changes.

```
>> from qlib.data import D
>> from qlib.data.filter import NameDFilter, ExpressionDFilter
>> nameDFilter = NameDFilter(name_rule_re='SH[0-9]{4}55')
>> expressionDFilter = ExpressionDFilter(rule_expression='$close>Ref($close,1)')
>> instruments = D.instruments(market='csi300', filter_pipe=[nameDFilter,␣
↪expressionDFilter])
>> fields = ['$close', '$volume', 'Ref($close, 1)', 'Mean($close, 3)', '$high-$low']
>> D.features(instruments, fields, start_time='2010-01-01', end_time='2017-12-31',␣
↪freq='day').head()

                             $close        $volume  Ref($close, 1)  Mean($close, 3)
↪$high-$low
  instrument  datetime
  SH600655    2010-01-04  2699.567383  158193.328125     2619.070312      2626.
↪097738  124.580566
              2010-01-08  2612.359619   77501.406250     2584.567627      2623.
↪220133   83.373047
              2010-01-11  2712.982422  160852.390625     2612.359619      2636.
↪636556  146.621582
              2010-01-12  2788.688232  164587.937500     2712.982422      2704.
↪676758  128.413818
```

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```
              2010-01-13  2790.604004  145460.453125     2788.688232      2764.
↪091553  128.413818
```

For more details about features, please refer Feature API.

Note: When calling *D.features()* at the client, use parameter *disk_cache=0* to skip dataset cache, use *disk_cache=1* to generate and use dataset cache. In addition, when calling at the server, users can use *disk_cache=2* to update the dataset cache.

1.5.3 API

To know more about how to use the Data, go to API Reference: Data API

1.6 Custom Model Integration

1.6.1 Introduction

`Qlib` provides `lightGBM` and `Dnn` model as the baseline of `Interday Model`. In addition to the default model, users can integrate their own custom models into `Qlib`.

Users can integrate their own custom models according to the following steps.

- Define a custom model class, which should be a subclass of the qlib.contrib.model.base.Model.
- Write a configuration file that describes the path and parameters of the custom model.
- Test the custom model.

1.6.2 Custom Model Class

The Custom models need to inherit qlib.contrib.model.base.Model and override the methods in it.

- **Override the *__init__* method**
  - `Qlib` passes the initialized parameters to the __init__ method.
  - The parameter must be consistent with the hyperparameters in the configuration file.
  - Code Example: In the following example, the hyperparameter filed of the configuration file should contain parameters such as *loss:mse*.

```
def __init__(self, loss='mse', **kwargs):
    if loss not in {'mse', 'binary'}:
        raise NotImplementedError
    self._scorer = mean_squared_error if loss == 'mse' else roc_auc_score
    self._params.update(objective=loss, **kwargs)
    self._model = None
```

- **Override the *fit* method**
  - `Qlib` calls the fit method to train the model

  - The parameters must include training feature *x_train*, training label *y_train*, test feature *x_valid*, test label *y_valid* at least.
  - The parameters could include some optional parameters with default values, such as train weight *w_train*, test weight *w_valid* and *num_boost_round = 1000*.
  - Code Example: In the following example, *num_boost_round = 1000* is an optional parameter.

```
def fit(self, x_train:pd.DataFrame, y_train:pd.DataFrame, x_valid:pd.
↪DataFrame, y_valid:pd.DataFrame,
    w_train:pd.DataFrame = None, w_valid:pd.DataFrame = None, num_boost_round␣
↪= 1000, **kwargs):

    # Lightgbm need 1D array as its label
    if y_train.values.ndim == 2 and y_train.values.shape[1] == 1:
        y_train_1d, y_valid_1d = np.squeeze(y_train.values), np.squeeze(y_
↪valid.values)
    else:
        raise ValueError('LightGBM doesn\'t support multi-label training')

    w_train_weight = None if w_train is None else w_train.values
    w_valid_weight = None if w_valid is None else w_valid.values

    dtrain = lgb.Dataset(x_train.values, label=y_train_1d, weight=w_train_
↪weight)
    dvalid = lgb.Dataset(x_valid.values, label=y_valid_1d, weight=w_valid_
↪weight)
    self._model = lgb.train(
        self._params,
        dtrain,
        num_boost_round=num_boost_round,
        valid_sets=[dtrain, dvalid],
        valid_names=['train', 'valid'],
        **kwargs
    )
```

- **Override the *predict* method**
  - The parameters include the test features.
  - Return the *prediction score*.
  - Please refer to qlib.contrib.model.base.Model for the parameter types of the fit method.
  - Code Example: In the following example, users need to use dnn to predict the label(such as *preds*) of test data *x_test* and return it.

```
def predict(self, x_test:pd.DataFrame, **kwargs)-> numpy.ndarray:
    if self._model is None:
        raise ValueError('model is not fitted yet!')
    return self._model.predict(x_test.values)
```

- **Override the *score* method**
  - The parameters include the test features and test labels.
  - Return the evaluation score of the model. It's recommended to adopt the loss between labels and *prediction score*.
  - Code Example: In the following example, users need to calculate the weighted loss with test data *x_test*, test label *y_test* and the weight *w_test*.

```
def score(self, x_test:pd.Dataframe, y_test:pd.Dataframe, w_test:pd.DataFrame␣
↪= None) -> float:
    # Remove rows from x, y and w, which contain Nan in any columns in y_test.
    x_test, y_test, w_test = drop_nan_by_y_index(x_test, y_test, w_test)
    preds = self.predict(x_test)
    w_test_weight = None if w_test is None else w_test.values
    scorer = mean_squared_error if self.loss_type == 'mse' else roc_auc_score
    return scorer(y_test.values, preds, sample_weight=w_test_weight)
```

- **Override the *save* method & *load* method**
  - The *save* method parameter includes the a *filename* that represents an absolute path, user need to save model into the path.
  - The *load* method parameter includes the a *buffer* read from the *filename* passed in the *save* method, users need to load model from the *buffer*.
  - Code Example:

```
def save(self, filename):
    if self._model is None:
        raise ValueError('model is not fitted yet!')
    self._model.save_model(filename)

def load(self, buffer):
    self._model = lgb.Booster(params={'model_str': buffer.decode('utf-8')})
```

1.6.3 Configuration File

The configuration file is described in detail in the estimator document. In order to integrate the custom model into `Qlib`, users need to modify the "model" field in the configuration file.

- Example: The following example describes the *model* field of configuration file about the custom lightgbm model mentioned above, where *module_path* is the module path, *class* is the class name, and *args* is the hyper-parameter passed into the __init__ method. All parameters in the field is passed to *self._params* by ***kwargs* in *__init__* except *loss* = *mse*.

```
model:
    class: LGBModel
    module_path: qlib.contrib.model.gbdt
    args:
        loss: mse
        colsample_bytree: 0.8879
        learning_rate: 0.0421
        subsample: 0.8789
        lambda_l1: 205.6999
        lambda_l2: 580.9768
        max_depth: 8
        num_leaves: 210
        num_threads: 20
```

Users could find configuration file of the baseline of the `Model` in `qlib/examples/estimator/estimator_config.yaml` and `qlib/examples/estimator/estimator_config_dnn.yaml`

1.6.4 Model Testing

Assuming that the configuration file is `examples/estimator/estimator_config.yaml`, users can run the following command to test the custom model:

```
cd examples  # Avoid running program under the directory contains `qlib`
estimator -c estimator/estimator_config.yaml
```

Note: `estimator` is a built-in command of `Qlib`.

Also, `Model` can also be tested as a single module. An example has been given in `examples/train_backtest_analyze.ipynb`.

1.6.5 Reference

To know more about `Model`, please refer to Interday Model: Model Training & Prediction and Model API.

1.7 Estimator: Workflow Management

1.7.1 Introduction

The components in Qlib Framework are designed in a loosely-coupled way. Users could build their own Quant research workflow with these components like Example

Besides, `Qlib` provides more user-friendly interfaces named `Estimator` to automatically run the whole workflow defined by configuration. A concrete execution of the whole workflow is called an *experiment*. With `Estimator`, user can easily run an *experiment*, which includes the following steps:

- **Data**
  - Loading
  - Processing
  - Slicing
- **Model**
  - Training and inference(static or rolling)
  - Saving & loading
- Evaluation(Back-testing)

For each *experiment*, `Qlib` will capture the model training details, performance evaluation results and basic information (e.g. names, ids). The captured data will be stored in backend-storage (disk or database).

1.7.2 Complete Example

Before getting into details, here is a complete example of `Estimator`, which defines the workflow in typical Quant research. Below is a typical config file of `Estimator`.

```yaml
experiment:
  name: estimator_example
  observer_type: file_storage
  mode: train
model:
  class: LGBModel
  module_path: qlib.contrib.model.gbdt
  args:
    loss: mse
    colsample_bytree: 0.8879
    learning_rate: 0.0421
    subsample: 0.8789
    lambda_l1: 205.6999
    lambda_l2: 580.9768
    max_depth: 8
    num_leaves: 210
    num_threads: 20
data:
  class: QLibDataHandlerClose
  args:
    dropna_label: True
  filter:
    market: csi500
trainer:
  class: StaticTrainer
  args:
    rolling_period: 360
    train_start_date: 2007-01-01
    train_end_date: 2014-12-31
    validate_start_date: 2015-01-01
    validate_end_date: 2016-12-31
    test_start_date: 2017-01-01
    test_end_date: 2020-08-01
strategy:
  class: TopkDropoutStrategy
  args:
    topk: 50
    n_drop: 5
backtest:
  normal_backtest_args:
    verbose: False
    limit_threshold: 0.095
    account: 100000000
    benchmark: SH000905
    deal_price: close
    open_cost: 0.0005
    close_cost: 0.0015
    min_cost: 5
qlib_data:
  # when testing, please modify the following parameters according to the specific␣
↪environment
  provider_uri: "~/.qlib/qlib_data/cn_data"
  region: "cn"
```

After saving the config into *configuration.yaml*, users could start the workflow and test their ideas with a single command below.

```
estimator -c configuration.yaml
```

Note: *estimator* will be placed in your $PATH directory when installing `Qlib`.

1.7.3 Configuration File

Let's get into details of `Estimator` in this section.

Before using `estimator`, users need to prepare a configuration file. The following content shows how to prepare each part of the configuration file.

Experiment Section

At first, the configuration file needs to contain a section named *experiment* about the basic information. This section describes how *estimator* tracks and persists current *experiment*. `Qlib` used *sacred*, a lightweight open-source tool, to configure, organize, generate logs, and manage experiment results. Partial behaviors of *sacred* will base on the *experiment* section.

Following files will be saved by *sacred* after *estimator* finish an *experiment*:

- *model.bin*, model binary file
- *pred.pkl*, model prediction result file
- *analysis.pkl*, backtest performance analysis file
- *positions.pkl*, backtest position records file
- *run*, the experiment information object, usually contains some meta information such as the experiment name, experiment date, etc.

Here is the typical configuration of *experiment section*

```
experiment:
   name: test_experiment
   observer_type: mongo
   mongo_url: mongodb://MONGO_URL
   db_name: public
   finetune: false
   exp_info_path: /home/test_user/exp_info.json
   mode: test
   loader:
       id: 677
```

The meaning of each field is as follows:

- ***name*** The experiment name, str type, *sacred <https://github.com/IDSIA/sacred>_* will use this experiment name as an identifier for some important internal processes. Users can find this field in *run* object of *sacred*. The default value is *test_experiment*.
- ***observer_type*** Observer type, str type, there are two choices which include *file_storage* and *mongo* respectively. If *file_storage* is selected, all the above-mentioned managed contents will be stored in the *dir* directory, separated by the number of times of experiments as a subfolder. If it is *mongo*, the content will be stored in the database. The default is *file_storage*.
  - **For *file_storage* observer.**

    * ***dir*** Directory URL, str type, directory for *file_storage* observer type, files captured and managed by sacred with *file_storage* observer will be saved to this directory, which is the same directory as *config.json* by default.

  – **For *mongo* observer.**

    * ***mongo_url*** Database URL, str type, required if the observer type is *mongo*.

    * ***db_name*** Database name, str type, required if the observer type is *mongo*.

- ***finetune*** `Estimator`'s behaviors to train models will base on this flag. If you just want to train models from scratch each time instead of based on existing models, please leave *finetune=false*. Otherwise please read the details below.

  The following table is the processing logic for different situations.

.	Static		Rolling	
.	finetune:true	finetune:false	finetune:true	finetune:false
Train	– Need to provide model (Static or Rolling) – The args in model section will be used for finetuning – Update based on the provided model and parameters	– No need to provide model – The args in model section will be used for training – Train model from scratch	– Need to provide model (Static or Rolling) – The args in model section will be used for finetuning – Update based on the provided model and parameters – **Each rolling time slice is based on a model updated from the previous time**	– Need to provide model (Static or Rolling) – The args in model section will be used for finetuning – Based on the provided model update – Train model from scratch – **Train each rolling time slice separately**
Test	– Model must exist, otherwise an exception will be raised. – For *StaticTrainer*, users need to train a model and record 'exp_info' for 'Test'. – For *RollingTrainer*, users need to train a set of models until the latest time, and record 'exp_info' for 'Test'.			

Note:

1. finetune parameters: share model.args parameters.
2. provide model: from *loader.model_index*, load the index of the model(starting from 0).
3. **If *loader.model_index* is None:**

   – In 'Static Finetune=True', if provide 'Rolling', use the last model to update.

   – For *RollingTrainer* with Finetune=True.

* If *StaticTrainer* is used in loader, the model will be used for initialization for finetuning.
* If *RollingTrainer* is used in loader, the existing models will be used without any modification and the new models will be initialized with the model in the last period and finetune one by one.

- ***exp_info_path*** save path of experiment info, str type, save the experiment info and model *prediction score* after the experiment is finished. Optional parameter, the default value is *<config_file_dir>/ex_name/exp_info.json*.
- ***mode***

  ***train* or *test*, str type.**

  - *test mode* is designed for inference. Under *test mode*, it will load the model according to the parameters of *loader* and skip model training.
  - *train model* is the default value. It will train new models by default and

  Please note that when it fails to load model, it will fall back to *fit* model.

  Note: if users choose ' test mode', they need to make sure: - The loader of *test_start_date* must be less than or equal to the current *test_start_date*. - If other parameters of the *loader* model args are different, a warning will appear.

- ***loader*** If you just want to train models from scratch each time instead of based on existing models, please ignore *loader* section. Otherwise please read the details below.

  The *loader* section only works when the *mode* is *test* or *finetune* is *true*.

  - ***model_index*** Model index, int type. The index of the loaded model in loader_models (starting at 0) for the first *finetune*. The default value is None.
  - ***exp_info_path*** Loader model experiment info path, str type. If the field exists, the following parameters will be parsed from *exp_info_path*, and the following parameters will not work. One of this field and *id* must exist at least .
  - ***id*** The experiment id of the model that needs to be loaded, int type. If the *mode* is *test*, this value is required. This field and *exp_info_path* must exist one.
  - ***name*** The experiment name of the model that needs to be loaded, str type. The default value is the current experiment *name*.
  - ***observer_type*** The experiment observer type of the model that needs to be loaded, str type. The default value is the current experiment *observer_type*.

    Note: The observer type is a concept of the *sacred* module, which determines how files, standard input, and output which are managed by sacred are stored.

    ---

    * ***file_storage*** If *observer_type* is *file_storage*, the config may be as follows.

      ```
      experiment:
          name: test_experiment
          dir: <path to a directory> # default is dir of `config.yml`
          observer_type: file_storage
      ```

    * ***mongo*** If *observer_type* is *mongo*, the config may be as follows.

```
experiment:
    name: test_experiment
    observer_type: mongo
    mongo_url: mongodb://MONGO_URL
    db_name: public
```

Users need to indicate *mongo_url* and *db_name* for a mongo observer.

Note:

If users choose the mongo observer, they need to make sure:

- Have an environment with the mongodb installed and a mongo database dedicated to storing the results of the experiments.
- The python environment (the version of python and package) to run the experiments and the one to fetch the results are consistent.

Model Section

Users can use a specified model by configuration with hyper-parameters.

Custom Models

Qlib supports custom models, but it must be a subclass of the *qlib.contrib.model.Model*, the config for a custom model may be as following.

```
model:
    class: SomeModel
    module_path: /tmp/my_experment/custom_model.py
    args:
        loss: binary
```

The class *SomeModel* should be in the module *custom_model*, and `Qlib` could parse the *module_path* to load the class.

To know more about `Model`, please refer to Model.

Data Section

`Data Handler` can be used to load raw data, prepare features and label columns, preprocess data (standardization, remove NaN, etc.), split training, validation, and test sets. It is a subclass of *qlib.contrib.estimator.handler.BaseDataHandler*.

Users can use the specified data handler by config as follows.

```
data:
    class: QLibDataHandlerClose
    args:
        start_date: 2005-01-01
        end_date: 2018-04-30
        dropna_label: True
    filter:
```

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```
        market: csi500
        filter_pipeline:
          -
            class: NameDFilter
            module_path: qlib.filter
            args:
              name_rule_re: S(?!Z3)
              fstart_time: 2018-01-01
              fend_time: 2018-12-11
          -
            class: ExpressionDFilter
            module_path: qlib.filter
            args:
              rule_expression: $open/$factor<=45
              fstart_time: 2018-01-01
              fend_time: 2018-12-11
```

- ***class*** Data handler class, str type, which should be a subclass of *qlib.contrib.estimator.handler.BaseDataHandler*, and implements 5 important interfaces for loading features, loading raw data, preprocessing raw data, slicing train, validation, and test data. The default value is *ALPHA360*. If users want to write a data handler to retrieve the data in `Qlib`, *QlibDataHandler* is suggested.
- ***module_path*** The module path, str type, absolute url is also supported, indicates the path of the *class* implementation of the data processor class. The default value is *qlib.contrib.estimator.handler*.
- ***args*** Parameters used for `Data Handler` initialization.
  - ***train_start_date*** Training start time, str type, the default value is *2005-01-01*.
  - ***start_date*** Data start date, str type.
  - ***end_date*** Data end date, str type. the data from start_date to end_date decides which part of data will be loaded in *datahandler*, users can only use these data in the following parts.
  - ***dropna_feature*** **(Optional in args)** Drop Nan feature, bool type, the default value is False.
  - ***dropna_label*** **(Optional in args)** Drop Nan label, bool type, the default value is True. Some multi-label tasks will use this.
  - ***normalize_method*** **(Optional in args)** Normalize data by a given method. str type. `Qlib` gives two normalizing methods, *MinMax* and *Std*. If users want to build their own method, please override *_process_normalize_feature*.
- ***filter*** Dynamically filtering the stocks based on the filter pipeline.
  - ***market*** index name, str type, the default value is *csi500*.
  - ***filter_pipeline*** Filter rule list, list type, the default value is []. Can be customized according to users' needs.
    - ***class*** Filter class name, str type.
    - ***module_path*** The module path, str type.
    - ***args*** The filter class parameters, these parameters are set according to the *class*, and all the parameters as kwargs to *class*.

Custom Data Handler

Qlib support custom data handler, but it must be a subclass of the `qlib.contrib.estimator.handler.BaseDataHandler`, the config for custom data handler may be as follows.

```
data:
    class: SomeDataHandler
    module_path: /tmp/my_experment/custom_data_handler.py
    args:
        start_date: 2005-01-01
        end_date: 2018-04-30
```

The class *SomeDataHandler* should be in the module *custom_data_handler*, and `Qlib` could parse the *module_path* to load the class.

If users want to load features and labels by config, they can inherit `qlib.contrib.estimator.handler.ConfigDataHandler`, `Qlib` also has provided some preprocess methods in this subclass. If users want to use qlib data, *QLibDataHandler* is recommended, from which users can inherit the custom class. *QLibDataHandler* is also a subclass of *ConfigDataHandler*.

To know more about `Data Handler`, please refer to Data Framework&Usage.

Trainer Section

Users can specify the trainer `Trainer` by the config file, which is a subclass of `qlib.contrib.estimator.trainer.BaseTrainer` and implement three important interfaces for training the model, restoring the model, and getting model predictions as follows.

- ***train*** Implement this interface to train the model.
- ***load*** Implement this interface to recover the model from disk.
- ***get_pred*** Implement this interface to get model prediction results.

Qlib have provided two implemented trainer,

- ***StaticTrainer*** The static trainer will be trained using the training, validation, and test data of the data processor static slicing.
- ***RollingTrainer*** The rolling trainer will use the rolling iterator of the data processor to split data for rolling training.

Users can specify *trainer* with the configuration file:

```
trainer:
    class: StaticTrainer # or RollingTrainer
    args:
        rolling_period: 360
        train_start_date: 2005-01-01
        train_end_date: 2014-12-31
        validate_start_date: 2015-01-01
        validate_end_date: 2016-06-30
        test_start_date: 2016-07-01
        test_end_date: 2017-07-31
```

- ***class*** Trainer class, which should be a subclass of *qlib.contrib.estimator.trainer.BaseTrainer*, and needs to implement three important interfaces, the default value is *StaticTrainer*.
- ***module_path*** The module path, str type, absolute url is also supported, indicates the path of the trainer class implementation.

- ***args*** Parameters used for `Trainer` initialization.
  - ***rolling_period*** The rolling period, integer type, indicates how many time steps need rolling when rolling the data. The default value is *60*. Only used in *RollingTrainer*.
  - ***train_start_date*** Training start time, str type.
  - ***train_end_date*** Training end time, str type.
  - ***validate_start_date*** Validation start time, str type.
  - ***validate_end_date*** Validation end time, str type.
  - ***test_start_date*** Test start time, str type.
  - ***test_end_date*** Test end time, str type. If *test_end_date* is *-1* or greater than the last date of the data, the last date of the data will be used as *test_end_date*.

Custom Trainer

Qlib supports custom trainer, but it must be a subclass of the *qlib.contrib.estimator.trainer.BaseTrainer*, the config for a custom trainer may be as following:

```
trainer:
    class: SomeTrainer
    module_path: /tmp/my_experment/custom_trainer.py
    args:
        train_start_date: 2005-01-01
        train_end_date: 2014-12-31
        validate_start_date: 2015-01-01
        validate_end_date: 2016-06-30
        test_start_date: 2016-07-01
        test_end_date: 2017-07-31
```

The class *SomeTrainer* should be in the module *custom_trainer*, and `Qlib` could parse the *module_path* to load the class.

Strategy Section

Users can specify strategy through a config file, for example:

```
strategy :
    class: TopkDropoutStrategy
    args:
        topk: 50
        n_drop: 5
```

- ***class*** The strategy class, str type, should be a subclass of *qlib.contrib.strategy.strategy.BaseStrategy*. The default value is *TopkDropoutStrategy*.
- ***module_path*** The module location, str type, absolute url is also supported, and absolute path is also supported, indicates the location of the policy class implementation.
- ***args*** Parameters used for `Trainer` initialization.
  - ***topk*** The number of stocks in the portfolio
  - ***n_drop*** Number of stocks to be replaced in each trading date

Qlib supports custom strategy, but it must be a subclass of the `qlib.contrib.strategy.strategy.BaseStrategy`, the config for custom strategy may be as following:

```
strategy :
    class: SomeStrategy
    module_path: /tmp/my_experment/custom_strategy.py
```

The class *SomeStrategy* should be in the module *custom_strategy*, and `Qlib` could parse the *module_path* to load the class.

To know more about `Strategy`, please refer to Strategy.

Backtest Section

Users can specify *backtest* through a config file, for example:

```
backtest :
    normal_backtest_args:
        topk: 50
        benchmark: SH000905
        account: 500000
        deal_price: close
        min_cost: 5
        subscribe_fields:
          - $close
          - $change
          - $factor
```

- ***normal_backtest_args*** Normal backtest parameters. All the parameters in this section will be passed to the `qlib.contrib.evaluate.backtest` function in the form of ***kwargs*.
  - ***benchmark*** Stock index symbol, str, or list type, the default value is *None*.

    Note:

    * If *benchmark* is None, it will use the average change of the day of all stocks in 'pred' as the 'bench'.
    * If *benchmark* is list, it will use the daily average change of the stock pool in the list as the 'bench'.
    * If *benchmark* is str, it will use the daily change as the 'bench'.

  - ***account*** Backtest initial cash, integer type. The *account* in *strategy* section is deprecated. It only works when *account* is not set in *backtest* section. It will be overridden by *account* in the *backtest* section. The default value is 1e9.
  - ***deal_price*** Order transaction price field, str type, the default value is vwap.
  - ***min_cost*** Min transaction cost, float type, the default value is 5.
  - ***subscribe_fields*** Subscribe quote fields, array type, the default value is [*deal_price*, $close, $change, $factor].

Qlib Data Section

The *qlib_data* field describes the parameters of qlib initialization.

```
qlib_data:
  # when testing, please modify the following parameters according to the specific␣
↪environment
  provider_uri: "~/.qlib/qlib_data/cn_data"
  region: "cn"
```

- ***provider_uri*** The local directory where the data loaded by 'get_data.py' is stored.
- ***region***
  - If region == `qlib.config.REG_CN`, 'qlib' will be initialized in US-stock mode.
  - If region == `qlib.config.REG_US`, 'qlib' will be initialized in china-stock mode.

Please refer to Initialization.

1.7.4 Experiment Result

Form of Experimental Result

The result of the experiment is also the result of the `Interdat Trading(Backtest)`, please refer to Interday Trading.

Get Experiment Result

Base Class & Interface

Users can check the experiment results from file storage directly, or check the experiment results from the database, or get the experiment results through two interfaces of a base class *Fetcher* provided by `Qlib`.

The *Fetcher* provides the following interface

- ***get_experiments(self, exp_name=None):*** The interface takes one parameters. The *exp_name* is the experiment name, the default is all experiments. Users can get the returned dictionary with a list of ids and test end date as follows.

```
{
    "ex_a": [
        {
            "id": 1,
            "test_end_date": "2017-01-01"
        }
    ],
    "ex_b": [
        ...
    ]
}
```

- ***get_experiment(exp_name, exp_id, fields=None)*** The interface takes three parameters. The first parameter is the experiment name, the second parameter is the experiment id, and the third parameter is list of fields. The default value of *fields* is None, which means all fields.

  Note:

  Currently supported fields: ['model', 'analysis', 'positions', 'report_normal', 'pred', 'task_config', 'label']

Users can get the returned dictionary as follows.

```
{
    'analysis': analysis_df,
    'pred': pred_df,
    'positions': positions_dic,
    'report_normal': report_normal_df,
}
```

Implemented *Fetcher* s & Examples

`Qlib` provides two implemented *Fetcher* s as follows.

FileFetcher

The *FileFetcher* is a subclass of *Fetcher*, which could fetch files from *file_storage* observer. The following is an example: .. code-block:: python

```
>>> from qlib.contrib.estimator.fetcher import FileFetcher
>>> f = FileFetcher(experiments_dir=r'./')
>>> print(f.get_experiments())
{
    'test_experiment': [
        {
            'id': '1',
            'config': ...
        },
        {
            'id': '2',
            'config': ...
        },
        {
            'id': '3',
            'config': ...
        }
    ]
}
>>> print(f.get_experiment('test_experiment', '1'))
                                                    risk
excess_return_without_cost mean               0.000605
                           std                0.005481
                           annualized_return  0.152373
                           information_ratio  1.751319
                           max_drawdown      -0.059055
excess_return_with_cost    mean               0.000410
                           std                0.005478
                           annualized_return  0.103265
                           information_ratio  1.187411
                           max_drawdown      -0.075024
```

MongoFetcher

The *FileFetcher* is a subclass of *Fetcher*, which could fetch files from *mongo* observer. Users should initialize the fetcher with *mongo_url*. The following is an example:

```
>>> from qlib.contrib.estimator.fetcher import MongoFetcher
>>> f = MongoFetcher(mongo_url=..., db_name=...)
```

1.8 Data Layer: Data Framework&Usage

1.8.1 Introduction

`Data Layer` provides user-friendly APIs to manage and retrieve data. It provides high-performance data infrastructure.

It is designed for quantitative investment. For example, users could build formulaic alphas with `Data Layer` easily. Please refer to Building Formulaic Alphas for more details.

The introduction of `Data Layer` includes the following parts.

- Data Preparation
- Data API
- Data Handler
- Cache
- Data and Cache File Structure

1.8.2 Data Preparation

Qlib Format Data

We've specially designed a data structure to manage financial data, please refer to the File storage design section in Qlib paper for detailed information. Such data will be stored with filename suffix *.bin* (We'll call them *.bin* file, *.bin* format or qlib format). *.bin* file is designed for scientific computing on finance data

Qlib Format Dataset

`Qlib` has provided an off-the-shelf dataset in *.bin* format, users could use the script `scripts/get_data.py` to download the dataset as follows.

```
python scripts/get_data.py qlib_data_cn --target_dir ~/.qlib/qlib_data/cn_data
```

After running the above command, users can find china-stock data in Qlib format in the `~/.qlib/csv_data/cn_data` directory.

`Qlib` also provides the scripts in `scripts/data_collector` to help users crawl the latest data on the Internet and convert it to qlib format.

When `Qlib` is initialized with this dataset, users could build and evaluate their own models with it. Please refer to Initialization for more details.

Converting CSV Format into Qlib Format

`Qlib` has provided the script `scripts/dump_bin.py` to convert data in CSV format into *.bin* files(Qlib format).

Users can download the china-stock data in CSV format as follows for reference to the CSV format.

```
python scripts/get_data.py csv_data_cn --target_dir ~/.qlib/csv_data/cn_data
```

Supposed that users prepare their CSV format data in the directory `~/.qlib/csv_data/my_data`, they can run the following command to start the conversion.

```
python scripts/dump_bin.py dump --csv_path  ~/.qlib/csv_data/my_data --qlib_dir ~/.
↪qlib/qlib_data/my_data --include_fields open,close,high,low,volume,factor
```

After conversion, users can find their Qlib format data in the directory *~/.qlib/qlib_data/my_data*.

Note: The arguments of *–include_fields* should correspond with the columns names of CSV files. The columns names of dataset provided by `Qlib` includes open,close,high,low,volume,factor.

- ***open*** The opening price
- ***close*** The closing price
- ***high*** The highest price
- ***low*** The lowest price
- ***volume*** The trading volume
- ***factor*** The Restoration factor

China-Stock Mode & US-Stock Mode

- **If users use `Qlib` in china-stock mode, china-stock data is required. Users can use `Qlib` in china-stock mode according t**
  - Download china-stock in qlib format, please refer to section *Qlib Format Dataset*.
  - **Initialize `Qlib` in china-stock mode** Supposed that users download their Qlib format data in the directory `~/.qlib/csv_data/cn_data`. Users only need to initialize `Qlib` as follows.

    ```
    from qlib.config import REG_CN
    qlib.init(provider_uri='~/.qlib/qlib_data/cn_data', region=REG_CN)
    ```

- **If users use `Qlib` in US-stock mode, US-stock data is required. `Qlib` does not provide a script to download US-stock data**
  - Prepare data in CSV format
  - Convert data from CSV format to Qlib format, please refer to section *Converting CSV Format into Qlib Format*.
  - **Initialize `Qlib` in US-stock mode** Supposed that users prepare their Qlib format data in the directory `~/.qlib/csv_data/us_data`. Users only need to initialize `Qlib` as follows.

    ```
    from qlib.config import REG_US
    qlib.init(provider_uri='~/.qlib/qlib_data/us_data', region=REG_US)
    ```

1.8.3 Data API

Data Retrieval

Users can use APIs in `qlib.data` to retrieve data, please refer to Data Retrieval.

Feature

`Qlib` provides *Feature* and *ExpressionOps* to fetch the features according to users' needs.

- ***Feature*** Load data from the data provider. User can get the features like *$high*, *$low*, *$open*, *$close*, .etc, which should correspond with the arguments of *–include_fields*, please refer to section *Converting CSV Format into Qlib Format*.
- ***ExpressionOps*** *ExpressionOps* will use operator for feature construction. To know more about `Operator`, please refer to Operator API.

To know more about `Feature`, please refer to Feature API.

Filter

`Qlib` provides *NameDFilter* and *ExpressionDFilter* to filter the instruments according to users' needs.

- ***NameDFilter*** Name dynamic instrument filter. Filter the instruments based on a regulated name format. A name rule regular expression is required.
- ***ExpressionDFilter*** Expression dynamic instrument filter. Filter the instruments based on a certain expression. An expression rule indicating a certain feature field is required.
  - *basic features filter*: rule_expression = '$close/$open>5'
  - *cross-sectional features filter* : rule_expression = '$rank($close)<10'
  - *time-sequence features filter*: rule_expression = '$Ref($close, 3)>100'

To know more about `Filter`, please refer to Filter API.

API

To know more about `Data API`, please refer to Data API.

1.8.4 Data Handler

Users can use `Data Handler` in an automatic workflow by `Estimator`, refer to Estimator for more details.

Also, `Data Handler` can be used as an independent module, by which users can easily preprocess data(standardization, remove NaN, etc.) and build datasets. It is a subclass of `qlib.contrib.estimator.handler.BaseDataHandler`, which provides some interfaces as follows.

Base Class & Interface

Qlib provides a base class qlib.contrib.estimator.BaseDataHandler, which provides the following interfaces:

- ***setup_feature*** Implement the interface to load the data features.
- ***setup_label*** Implement the interface to load the data labels and calculate the users' labels.

- ***setup_processed_data*** Implement the interface for data preprocessing, such as preparing feature columns, discarding blank lines, and so on.

Qlib also provides two functions to help users init the data handler, users can override them for users' needs.

- ***_init_kwargs*** Users can init the kwargs of the data handler in this function, some kwargs may be used when init the raw df. Kwargs are the other attributes in data.args, like dropna_label, dropna_feature
- ***_init_raw_df*** Users can init the raw df, feature names, and label names of data handler in this function. If the index of feature df and label df are not same, users need to override this method to merge them (e.g. inner, left, right merge).

If users want to load features and labels by config, users can inherit `qlib.contrib.estimator.handler.ConfigDataHandler`, `Qlib` also have provided some preprocess method in this subclass. If users want to use qlib data, *QLibDataHandler* is recommended. Users can inherit their custom class from *QLibDataHandler*, which is also a subclass of *ConfigDataHandler*.

Usage

`Data Handler` can be used as a single module, which provides the following mehtods:

- ***get_split_data***
  - According to the start and end dates, return features and labels of the pandas DataFrame type used for the 'Model'
- ***get_rolling_data***
  - According to the start and end dates, and *rolling_period*, an iterator is returned, which can be used to traverse the features and labels used for rolling.

Example

`Data Handler` can be run with `estimator` by modifying the configuration file, and can also be used as a single module.

Know more about how to run `Data Handler` with `estimator`, please refer to Estimator.

Qlib provides implemented data handler *QLibDataHandlerClose*. The following example shows how to run *QLibDataHandlerV1* as a single module.

Note: Users need to initialize `Qlib` with *qlib.init* first, please refer to initialization.

```
from qlib.contrib.estimator.handler import QLibDataHandlerClose
from qlib.contrib.model.gbdt import LGBModel

DATA_HANDLER_CONFIG = {
    "dropna_label": True,
    "start_date": "2007-01-01",
    "end_date": "2020-08-01",
    "market": "csi300",
}

TRAINER_CONFIG = {
    "train_start_date": "2007-01-01",
    "train_end_date": "2014-12-31",
    "validate_start_date": "2015-01-01",
```

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```
    "validate_end_date": "2016-12-31",
    "test_start_date": "2017-01-01",
    "test_end_date": "2020-08-01",
}

exampleDataHandler = QLibDataHandlerClose(**DATA_HANDLER_CONFIG)

# example of 'get_split_data'
x_train, y_train, x_validate, y_validate, x_test, y_test = exampleDataHandler.get_
↪split_data(**TRAINER_CONFIG)

# example of 'get_rolling_data'

for (x_train, y_train, x_validate, y_validate, x_test, y_test) in exampleDataHandler.
↪get_rolling_data(**TRAINER_CONFIG):
    print(x_train, y_train, x_validate, y_validate, x_test, y_test)
```

Note: (x_train, y_train, x_validate, y_validate, x_test, y_test) can be used as arguments for the `fit`, `predict`, and `score` methods of the 'Model' , please refer to Model.

Also, the above example has been given in `examples.estimator.train_backtest_analyze.ipynb`.

API

To know more about `Data Handler`, please refer to Data Handler API.

1.8.5 Cache

`Cache` is an optional module that helps accelerate providing data by saving some frequently-used data as cache file. `Qlib` provides a *Memcache* class to cache the most-frequently-used data in memory, an inheritable *ExpressionCache* class and an inheritable *DatasetCache* class.

Global Memory Cache

Memcache is a global memory cache mechanism that composes of three *MemCacheUnit* instances to cache **Calendar**, **Instruments**, and **Features**. The *MemCache* is defined globally in *cache.py* as *H*. Users can use *H['c'], H['i'], H['f']* to get/set *memcache*.

class qlib.data.cache.**MemCacheUnit**(**args*, ***kwargs*)
Memory Cache Unit.

class qlib.data.cache.**MemCache**(*mem_cache_size_limit=None*, *limit_type='length'*)
Memory cache.

ExpressionCache

ExpressionCache is a cache mechanism that saves expressions such as **Mean($close, 5)**. Users can inherit this base class to define their own cache mechanism that saves expressions according to the following steps.

- Override *self._uri* method to define how the cache file path is generated
- Override *self._expression* method to define what data will be cached and how to cache it.

The following shows the details about the interfaces:

class qlib.data.cache.**ExpressionCache**(*provider*)
Expression cache mechanism base class.

This class is used to wrap expression provider with self-defined expression cache mechanism.

Note: Override the *_uri* and *_expression* method to create your own expression cache mechanism.

expression(*instrument*, *field*, *start_time*, *end_time*, *freq*)
Get expression data.

Note: Same interface as *expression* method in expression provider

update(*cache_uri*)
Update expression cache to latest calendar.

Overide this method to define how to update expression cache corresponding to users' own cache mechanism.

Parameters **cache_uri** (*str*) – the complete uri of expression cache file (include dir path)

Returns 0(successful update)/ 1(no need to update)/ 2(update failure)

Return type int

Qlib has currently provided implemented disk cache *DiskExpressionCache* which inherits from *ExpressionCache* . The expressions data will be stored in the disk.

DatasetCache

DatasetCache is a cache mechanism that saves datasets. A certain dataset is regulated by a stock pool configuration (or a series of instruments, though not recommended), a list of expressions or static feature fields, the start time, and end time for the collected features and the frequency. Users can inherit this base class to define their own cache mechanism that saves datasets according to the following steps.

- Override *self._uri* method to define how their cache file path is generated
- Override *self._expression* method to define what data will be cached and how to cache it.

The following shows the details about the interfaces:

class qlib.data.cache.**DatasetCache**(*provider*)
Dataset cache mechanism base class.

This class is used to wrap dataset provider with self-defined dataset cache mechanism.

Note: Override the *_uri* and *_dataset* method to create your own dataset cache mechanism.

dataset(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*, *disk_cache=1*)
Get feature dataset.

Note: Same interface as *dataset* method in dataset provider

Note: The server use redis_lock to make sure read-write conflicts will not be triggered

but client readers are not considered.

update(*cache_uri*)
Update dataset cache to latest calendar.

Overide this method to define how to update dataset cache corresponding to users' own cache mechanism.

Parameters **cache_uri** (*str*) – the complete uri of dataset cache file (include dir path)

Returns 0(successful update)/ 1(no need to update)/ 2(update failure)

Return type int

static cache_to_origin_data(*data*, *fields*)
cache data to origin data

Parameters

- **data** – pd.DataFrame, cache data
- **fields** – feature fields

Returns pd.DataFrame

static normalize_uri_args(*instruments*, *fields*, *freq*)
normalize uri args

`Qlib` has currently provided implemented disk cache *DiskDatasetCache* which inherits from *DatasetCache* . The datasets data will be stored in the disk.

1.8.6 Data and Cache File Structure

We've specially designed a file structure to manage data and cache, please refer to the File storage design section in Qlib paper for detailed information.The file structure of data and cache is listed as follows.

```
- data/
    [raw data] updated by data providers
    - calendars/
        - day.txt
    - instruments/
        - all.txt
        - csi500.txt
        - ...
    - features/
        - sh600000/
            - open.day.bin
            - close.day.bin
            - ...
        - ...
    [cached data] updated when raw data is updated
    - calculated features/
        - sh600000/
            - [hash(instrtument, field_expression, freq)]
                - all-time expression -cache data file
                - .meta : an assorted meta file recording the instrument name, field␣
↪name, freq, and visit times
        - ...
```

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```
    - cache/
        - [hash(stockpool_config, field_expression_list, freq)]
            - all-time Dataset-cache data file
            - .meta : an assorted meta file recording the stockpool config, field␣
↪names and visit times
            - .index : an assorted index file recording the line index of all␣
↪calendars
        - ...
```

1.9 Interday Model: Model Training & Prediction

1.9.1 Introduction

`Interday Model` is designed to make the *prediction score* about stocks. Users can use the `Interday Model` in an automatic workflow by `Estimator`, please refer to Estimator.

Because the components in `Qlib` are designed in a loosely-coupled way, `Interday Model` can be used as an independent module also.

1.9.2 Base Class & Interface

`Qlib` provides a base class qlib.contrib.model.base.Model from which all models should inherit.

The base class provides the following interfaces:

- ***__init__(**kwargs)***
  - Initialization.
  - If users use `Estimator` to start an *experiment*, the parameter of *__init__* method shoule be consistent with the hyperparameters in the configuration file.
- ***fit(self, x_train, y_train, x_valid, y_valid, w_train=None, w_valid=None, **kwargs)***
  - Train model.
  - **Parameter:**
    - ***x_train*, pd.DataFrame type, train feature** The following example explains the value of *x_train*:

```
                        KMID      KLEN      KMID2     KUP       ␣
↪  KUP2
instrument  datetime
SH600004    2012-01-04  0.000000  0.017685  0.000000  0.
↪012862  0.727275
            2012-01-05 -0.006473  0.025890 -0.250001  0.
↪012945  0.499998
            2012-01-06  0.008117  0.019481  0.416666  0.
↪008117  0.416666
            2012-01-09  0.016051  0.025682  0.624998  0.
↪006421  0.250001
            2012-01-10  0.017323  0.026772  0.647057  0.
↪003150  0.117648
...                          ...       ...       ...       ...␣
↪      ...
```

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```
SZ300273    2014-12-25 -0.005295  0.038697 -0.136843  0.
↪016293  0.421052
            2014-12-26 -0.022486  0.041701 -0.539215  0.
↪002453  0.058824
            2014-12-29 -0.031526  0.039092 -0.806451  0.
↪000000  0.000000
            2014-12-30 -0.010000  0.032174 -0.310811  0.
↪013913  0.432433
            2014-12-31  0.010917  0.020087  0.543479  0.
↪001310  0.065216
```

x_train is a pandas DataFrame, whose index is MultiIndex <instrument(str), datetime(pd.Timestamp)>. Each column of *x_train* corresponds to a feature, and the column name is the feature name.

Note: The number and names of the columns are determined by the data handler, please refer to Data Handler and Estimator Data.

---

* ***y_train*, pd.DataFrame type, train label** The following example explains the value of *y_train*:

```
                        LABEL
instrument  datetime
SH600004    2012-01-04 -0.798456
            2012-01-05 -1.366716
            2012-01-06 -0.491026
            2012-01-09  0.296900
            2012-01-10  0.501426
...                          ...
SZ300273    2014-12-25 -0.465540
            2014-12-26  0.233864
            2014-12-29  0.471368
            2014-12-30  0.411914
            2014-12-31  1.342723
```

y_train is a pandas DataFrame, whose index is MultiIndex <instrument(str), datetime(pd.Timestamp)>. The *LABEL* column represents the value of train label.

Note: The number and names of the columns are determined by the `Data Handler`, please refer to Data Handler.

---

* ***x_valid*, pd.DataFrame type, validation feature** The format of *x_valid* is same as *x_train*
* ***y_valid*, pd.DataFrame type, validation label** The format of *y_valid* is same as *y_train*
* **'w_train'(Optional args, default is None), pd.DataFrame type, train weight**
  w_train is a pandas DataFrame, whose shape and index is same as *x_train*. The float value in *w_train* represents the weight of the feature at the same position in *x_train*.
* **'w_train'(Optional args, default is None), pd.DataFrame type, validation weight**
  w_train is a pandas DataFrame, whose shape and index is the same as *x_valid*. The float value in *w_train* represents the weight of the feature at the same position in *x_train*.

- ***predict(self, x_test, **kwargs)***
  - Predict test data 'x_test'
  - **Parameter:**
    - ***x_test*, pd.DataFrame type, test features** The form of *x_test* is same as *x_train* in 'fit' method.
  - **Return:**
    - ***label*, np.ndarray type, test label** The label of *x_test* that predicted by model.
- ***score(self, x_test, y_test, w_test=None, **kwargs)***
  - Evaluate model with test feature/label
  - **Parameter:**
    - ***x_test*, pd.DataFrame type, test feature** The format of *x_test* is same as *x_train* in *fit* method.
    - ***x_test*, pd.DataFrame type, test label** The format of *y_test* is same as *y_train* in *fit* method.
    - ***w_test*, pd.DataFrame type, test weight** The format of *w_test* is same as *w_train* in *fit* method.
  - Return: float type, evaluation score

For other interfaces such as *save*, *load*, *finetune*, please refer to Model API.

1.9.3 Example

`Qlib` provides `LightGBM` and `DNN` models as the baseline, the following steps show how to run'' LightGBM'' as an independent module.

- Initialize `Qlib` with *qlib.init* first, please refer to initialization.
- **Run the following code to get the *prediction score pred_score***

```
from qlib.contrib.estimator.handler import QLibDataHandlerClose
from qlib.contrib.model.gbdt import LGBModel

DATA_HANDLER_CONFIG = {
    "dropna_label": True,
    "start_date": "2007-01-01",
    "end_date": "2020-08-01",
    "market": MARKET,
}

TRAINER_CONFIG = {
    "train_start_date": "2007-01-01",
    "train_end_date": "2014-12-31",
    "validate_start_date": "2015-01-01",
    "validate_end_date": "2016-12-31",
    "test_start_date": "2017-01-01",
    "test_end_date": "2020-08-01",
}

x_train, y_train, x_validate, y_validate, x_test, y_test =␣
↪QLibDataHandlerClose(
```

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```
    **DATA_HANDLER_CONFIG
).get_split_data(**TRAINER_CONFIG)


MODEL_CONFIG = {
    "loss": "mse",
    "colsample_bytree": 0.8879,
    "learning_rate": 0.0421,
    "subsample": 0.8789,
    "lambda_l1": 205.6999,
    "lambda_l2": 580.9768,
    "max_depth": 8,
    "num_leaves": 210,
    "num_threads": 20,
}
# use default model
# custom Model, refer to: TODO: Model API url
model = LGBModel(**MODEL_CONFIG)
model.fit(x_train, y_train, x_validate, y_validate)
_pred = model.predict(x_test)
pred_score = pd.DataFrame(index=_pred.index)
pred_score["score"] = _pred.iloc(axis=1)[0]
```

Note: *QLibDataHandlerClose* is the data handler provided by `Qlib`, please refer to Data Handler.

Also, the above example has been given in `examples/train_backtest_analyze.ipynb`.

1.9.4 Custom Model

Qlib supports custom models. If users are interested in customizing their own models and integrating the models into `Qlib`, please refer to Custom Model Integration.

1.9.5 API

Please refer to Model API.

1.10 Interday Strategy: Portfolio Management

1.10.1 Introduction

`Interday Strategy` is designed to adopt different trading strategies, which means that users can adopt different algorithms to generate investment portfolios based on the prediction scores of the `Interday Model`. Users can use the `Interday Strategy` in an automatic workflow by `Estimator`, please refer to Estimator.

Because the components in `Qlib` are designed in a loosely-coupled way, `Interday Strategy` can be used as an independent module also.

`Qlib` provides several implemented trading strategies. Also, `Qlib` supports custom strategy, users can customize strategies according to their own needs.

1.10.2 Base Class & Interface

BaseStrategy

Qlib provides a base class `qlib.contrib.strategy.BaseStrategy`. All strategy classes need to inherit the base class and implement its interface.

- ***get_risk_degree*** Return the proportion of your total value you will use in investment. Dynamically risk_degree will result in Market timing.
- ***generate_order_list*** Rerturn the order list.

Users can inherit *BaseStrategy* to customize their strategy class.

WeightStrategyBase

Qlib alse provides a class `qlib.contrib.strategy.WeightStrategyBase` that is a subclass of *BaseStrategy*.

WeightStrategyBase only focuses on the target positions, and automatically generates an order list based on positions. It provides the *generate_target_weight_position* interface.

- ***generate_target_weight_position***
  - According to the current position and trading date to generate the target position. The cash is not considered.
  - Return the target position.

> **Note:** Here the *target position* means the target percentage of total assets.

WeightStrategyBase implements the interface *generate_order_list*, whose processions is as follows.

- Call *generate_target_weight_position* method to generate the target position.
- Generate the target amount of stocks from the target position.
- Generate the order list from the target amount

Users can inherit *WeightStrategyBase* and implement the interface *generate_target_weight_position* to customize their strategy class, which only focuses on the target positions.

1.10.3 Implemented Strategy

Qlib provides a implemented strategy classes named *TopkDropoutStrategy*.

TopkDropoutStrategy

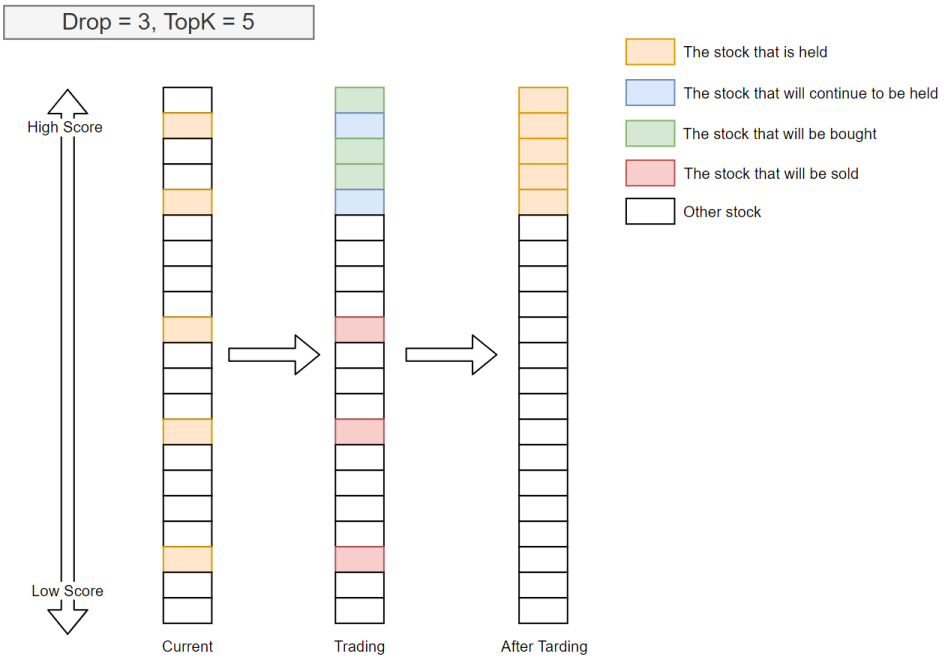
TopkDropoutStrategy is a subclass of *BaseStrategy* and implement the interface *generate_order_list* whose process is as follows.

- Adopt the `Topk-Drop` algorithm to calculate the target amount of each stock

> **Note:** `Topk-Drop` algorithm
>
> - *Topk*: The number of stocks held

- *Drop*: The number of stocks sold on each trading day

Currently, the number of held stocks is *Topk*. On each trading day, the *Drop* number of held stocks with the worst *prediction score* will be sold, and the same number of unheld stocks with the best *prediction score* will be bought.



`TopkDrop` algorithm sells *Drop* stocks every trading day, which guarantees a fixed turnover rate.

- Generate the order list from the target amount

1.10.4 Usage & Example

`Interday Strategy` can be specified in the `Intraday Trading(Backtest)`, the example is as follows.

```
from qlib.contrib.strategy.strategy import TopkDropoutStrategy
from qlib.contrib.evaluate import backtest
STRATEGY_CONFIG = {
    "topk": 50,
    "n_drop": 5,
}
BACKTEST_CONFIG = {
    "verbose": False,
    "limit_threshold": 0.095,
    "account": 100000000,
    "benchmark": BENCHMARK,
    "deal_price": "vwap",
}

# use default strategy
# custom Strategy, refer to: TODO: Strategy API url
strategy = TopkDropoutStrategy(**STRATEGY_CONFIG)
```

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```
# pred_score is the `prediction score` output by Model
report_normal, positions_normal = backtest(
    pred_score, strategy=strategy, **BACKTEST_CONFIG
)
```

Also, the above example has been given in `examples\train_backtest_analyze.ipynb`.

To know more about the *prediction score pred_score* output by `Interday Model`, please refer to Interday Model: Model Training & Prediction.

To know more about `Intraday Trading`, please refer to Intraday Trading: Model&Strategy Testing.

1.10.5 Reference

To know more about `Interday Strategy`, please refer to Strategy API.

1.11 Intraday Trading: Model&Strategy Testing

1.11.1 Introduction

`Intraday Trading` is designed to test models and strategies, which help users to check the performance of a custom model/strategy.

Note: `Intraday Trading` uses `Order Executor` to trade and execute orders output by `Interday Strategy`. `Order Executor` is a component in Qlib Framework, which can execute orders. `Vwap Executor` and `Close Executor` is supported by `Qlib` now. In the future, `Qlib` will support `HighFreq Executor` also.

1.11.2 Example

Users need to generate a *prediction score'(a pandas DataFrame) with MultiIndex<instrument, datetime> and a 'score* column. And users need to assign a strategy used in backtest, if strategy is not assigned, a *TopkDropoutStrategy* strategy with *(topk=50, n_drop=5, risk_degree=0.95, limit_threshold=0.0095)* will be used. If `Strategy` module is not users' interested part, *TopkDropoutStrategy* is enough.

The simple example of the default strategy is as follows.

```
from qlib.contrib.evaluate import backtest
# pred_score is the prediction score
report, positions = backtest(pred_score, topk=50, n_drop=0.5, verbose=False, limit_
↪threshold=0.0095)
```

To know more about backtesting with a specific strategy, please refer to Strategy.

To know more about the prediction score *pred_score* output by `Model`, please refer to Interday Model: Model Training & Prediction.

Prediction Score

The *prediction score* is a pandas DataFrame. Its index is <instrument(str), datetime(pd.Timestamp)> and it must contains a *score* column.

A prediction sample is shown as follows.

```
instrument datetime   score
SH600000   2019-01-04 -0.505488
SZ002531   2019-01-04 -0.320391
SZ000999   2019-01-04  0.583808
SZ300569   2019-01-04  0.819628
SZ001696   2019-01-04 -0.137140
...                         ...
SZ000996   2019-04-30 -1.027618
SH603127   2019-04-30  0.225677
SH603126   2019-04-30  0.462443
SH603133   2019-04-30 -0.302460
SZ300760   2019-04-30 -0.126383
```

`Model` module can make predictions, please refer to Model.

Backtest Result

The backtest results are in the following form:

```
                                                    risk
excess_return_without_cost mean               0.000605
                           std                0.005481
                           annualized_return  0.152373
                           information_ratio  1.751319
                           max_drawdown      -0.059055
excess_return_with_cost    mean               0.000410
                           std                0.005478
                           annualized_return  0.103265
                           information_ratio  1.187411
                           max_drawdown      -0.075024
```

- ***excess_return_without_cost***
  - ***mean*** Mean value of the *CAR* (cumulative abnormal return) without cost
  - ***std*** The *Standard Deviation* of *CAR* (cumulative abnormal return) without cost.
  - ***annualized_return*** The *Annualized Rate* of *CAR* (cumulative abnormal return) without cost.
  - ***information_ratio*** The *Information Ratio* without cost. please refer to Information Ratio – IR.
  - ***max_drawdown*** The *Maximum Drawdown* of *CAR* (cumulative abnormal return) without cost, please refer to Maximum Drawdown (MDD).
- ***excess_return_with_cost***
  - ***mean*** Mean value of the *CAR* (cumulative abnormal return) series with cost
  - ***std*** The *Standard Deviation* of *CAR* (cumulative abnormal return) series with cost.
  - ***annualized_return*** The *Annualized Rate* of *CAR* (cumulative abnormal return) with cost.
  - ***information_ratio*** The *Information Ratio* with cost. please refer to Information Ratio – IR.

  - ***max_drawdown*** The *Maximum Drawdown* of *CAR* (cumulative abnormal return) with cost, please refer to Maximum Drawdown (MDD).

1.11.3 Reference

To know more about `Intraday Trading`, please refer to Backtest API.

1.12 Aanalysis: Evaluation & Results Analysis

1.12.1 Introduction

`Aanalysis` is designed to show the graphical reports of `Intraday Trading` , which helps users to evaluate and analyse investment portfolios visually. The following are some graphics to view:

- **analysis_position**
  - report_graph
  - score_ic_graph
  - cumulative_return_graph
  - risk_analysis_graph
  - rank_label_graph
- **analysis_model**
  - model_performance_graph

1.12.2 Graphical Reports

Users can run the following code to get all supported reports.

```
>> import qlib.contrib.report as qcr
>> print(qcr.GRAPH_NAME_LIST)
['analysis_position.report_graph', 'analysis_position.score_ic_graph', 'analysis_
↪position.cumulative_return_graph', 'analysis_position.risk_analysis_graph',
↪'analysis_position.rank_label_graph', 'analysis_model.model_performance_graph']
```

Note: For more details, please refer to the function document: similar to `help(qcr.analysis_position.report_graph)`

1.12.3 Usage & Example

Usage of *analysis_position.report*

API

qlib.contrib.report.analysis_position.report.**report_graph**(*report_df: pandas.core.frame.DataFrame*, *show_notebook: bool = True*) → [<class 'list'>, <class 'tuple'>]

display backtest report

Example:

```
from qlib.contrib.evaluate import backtest
from qlib.contrib.strategy import TopkDropoutStrategy

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 230
strategy = TopkDropoutStrategy(**sparas)

report_normal_df, _ = backtest(pred_df, strategy, **bparas)

qcr.report_graph(report_normal_df)
```

Parameters

- **report_df** – **df.index.name** must be **date**, **df.columns** must contain **return**, **turnover**, **cost**, **bench**

```
            return      cost      bench  turnover
date
2017-01-04  0.003421  0.000864  0.011693  0.576325
2017-01-05  0.000508  0.000447  0.000721  0.227882
2017-01-06 -0.003321  0.000212 -0.004322  0.102765
2017-01-09  0.006753  0.000212  0.006874  0.105864
2017-01-10 -0.000416  0.000440 -0.003350  0.208396
```

- **show_notebook** – whether to display graphics in notebook, the default is **True**

Returns if show_notebook is True, display in notebook; else return **plotly.graph_objs.Figure** list

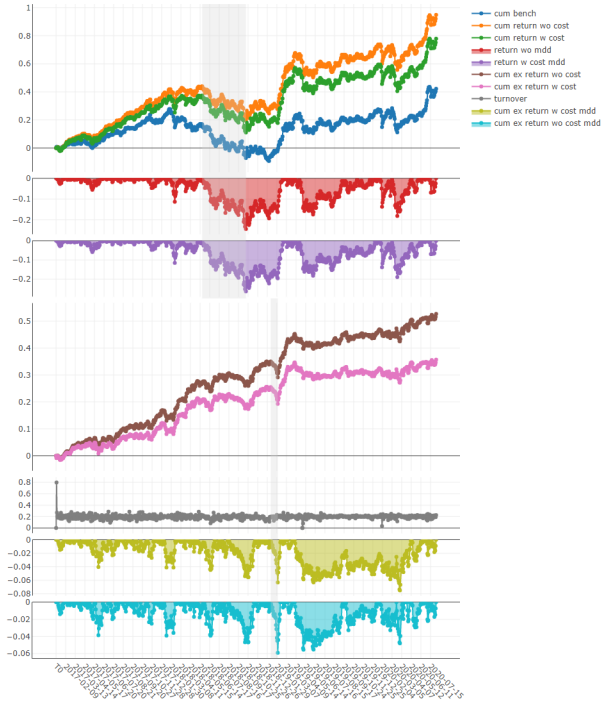
Graphical Result

Note:

- Axis X: Trading day
- **Axis Y:**

- ***cum bench*** Cumulative returns series of benchmark
- ***cum return wo cost*** Cumulative returns series of portfolio without cost
- ***cum return w cost*** Cumulative returns series of portfolio with cost
- ***return wo mdd*** Maximum drawdown series of cumulative return without cost
- ***return w cost mdd*:** Maximum drawdown series of cumulative return with cost
- ***cum ex return wo cost*** The *CAR* (cumulative abnormal return) series of the portfolio compared to the benchmark without cost.
- ***cum ex return w cost*** The *CAR* (cumulative abnormal return) series of the portfolio compared to the benchmark with cost.
- ***turnover*** Turnover rate series
- ***cum ex return wo cost mdd*** Drawdown series of *CAR* (cumulative abnormal return) without cost
- ***cum ex return w cost mdd*** Drawdown series of *CAR* (cumulative abnormal return) with cost

- The shaded part above: Maximum drawdown corresponding to *cum return wo cost*
- The shaded part below: Maximum drawdown corresponding to *cum ex return wo cost*



Usage of *analysis_position.score_ic*

API

qlib.contrib.report.analysis_position.score_ic.**score_ic_graph**(*pred_label: pandas.core.frame.DataFrame*, *show_notebook: bool = True*) → [<class 'list'>, <class 'tuple'>]

score IC

Example:

```
from qlib.data import D
from qlib.contrib.report import analysis_position
pred_df_dates = pred_df.index.get_level_values(level='datetime
↪')
features_df = D.features(D.instruments('csi500'), ['Ref($close,
↪ -2)/Ref($close, -1)-1'], pred_df_dates.min(), pred_df_dates.
↪max())
features_df.columns = ['label']
pred_label = pd.concat([features_df, pred], axis=1, sort=True).
↪reindex(features_df.index)
analysis_position.score_ic_graph(pred_label)
```

Parameters

- **pred_label** – index is **pd.MultiIndex**, index name is **[instrument, datetime]**; columns names is **[score, label]**

```
instrument      datetime        score       label
SH600004        2017-12-11      -0.013502       -0.013502
                2017-12-12  -0.072367       -0.072367
                2017-12-13  -0.068605       -0.068605
                2017-12-14  0.012440        0.012440
                2017-12-15  -0.102778       -0.102778
```

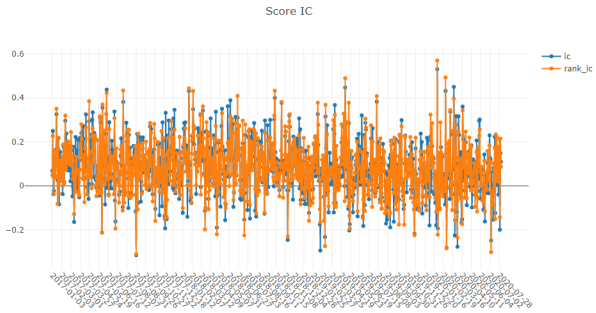
- **show_notebook** – whether to display graphics in notebook, the default is **True**

Returns if show_notebook is True, display in notebook; else return **plotly.graph_objs.Figure** list

Graphical Result

Note:

- Axis X: Trading day
- **Axis Y:**
  - ***ic*** The *Pearson correlation coefficient* series between *label* and *prediction score*. In the above example, the *label* is formulated as *Ref($close, -1)/$close - 1*. Please refer to Data API Featrue for more details.
  - ***rank_ic*** The *Spearman's rank correlation coefficient* series between *label* and *prediction score*.



Usage of *analysis_position.cumulative_return*

API

qlib.contrib.report.analysis_position.cumulative_return.**cumulative_return_graph**(*position: dict*, *report_normal: pandas.core.frame.* *label_data: pandas.core.frame.* *show_notebook* *start_date=Non* *end_date=None* → Iterable[plotly.grap

Backtest buy, sell, and holding cumulative return graph

Example:

```
from qlib.data import D
from qlib.contrib.evaluate import risk_analysis, backtest,␣
↪long_short_backtest
from qlib.contrib.strategy import TopkDropoutStrategy

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 5
strategy = TopkDropoutStrategy(**sparas)

report_normal_df, positions = backtest(pred_df, strategy,␣
↪**bparas)

pred_df_dates = pred_df.index.get_level_values(level='datetime
↪')
```

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```
features_df = D.features(D.instruments('csi500'), ['Ref($close,
↪ -1)/$close - 1'], pred_df_dates.min(), pred_df_dates.max())
features_df.columns = ['label']

qcr.cumulative_return_graph(positions, report_normal_df,␣
↪features_df)
```

Graph desc:

- Axis X: Trading day
- Axis Y:
- Above axis Y: *(((Ref($close, -1)/$close - 1) * weight).sum() / weight.sum()).cumsum()*
- Below axis Y: Daily weight sum
- In the **sell** graph, $y < 0$ stands for profit; in other cases, $y > 0$ stands for profit.
- In the **buy_minus_sell** graph, the **y** value of the **weight** graph at the bottom is *buy_weight + sell_weight*.
- In each graph, the **red line** in the histogram on the right represents the average.

Parameters

- **position** – position data
- **report_normal** –

```
                 return      cost            bench             ␣
↪turnover
date
2017-01-04       0.003421        0.000864        0.011693      ␣
↪0.576325
2017-01-05       0.000508        0.000447        0.000721      ␣
↪0.227882
2017-01-06       -0.003321       0.000212        -0.004322     ␣
↪0.102765
2017-01-09       0.006753        0.000212        0.006874      ␣
↪0.105864
2017-01-10       -0.000416       0.000440        -0.003350     ␣
↪0.208396
```

- **label_data** – *D.features* result; index is *pd.MultiIndex*, index name is [*instrument*, *datetime*]; columns names is [*label*].

The label T is the change from T to T+1, it is recommended to use `close`, example: *D.features(D.instruments('csi500'), ['Ref($close, -1)/$close-1'])*

```
                                label
instrument      datetime
SH600004        2017-12-11      -0.013502
                2017-12-12      -0.072367
                2017-12-13      -0.068605
                2017-12-14      0.012440
                2017-12-15      -0.102778
```

Parameters

- **show_notebook** – True or False. If True, show graph in notebook, else return figures

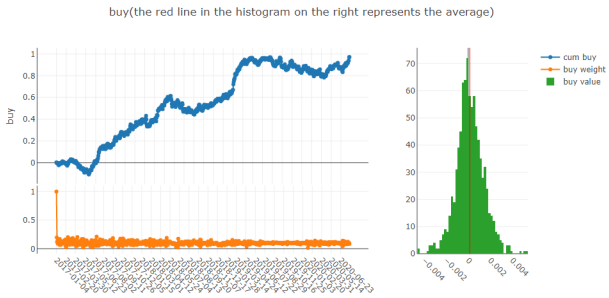
- **start_date** – start date
- **end_date** – end date

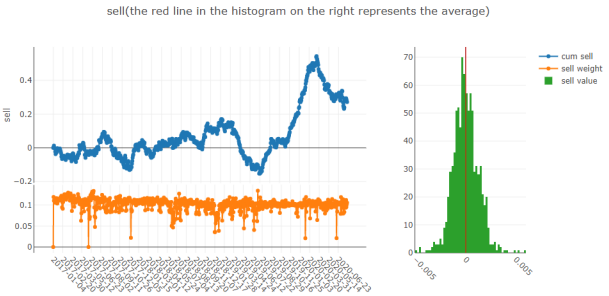
Returns

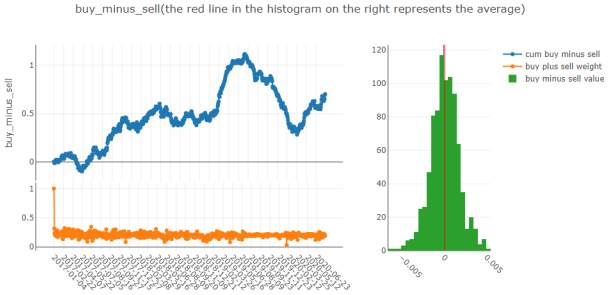
Graphical Result

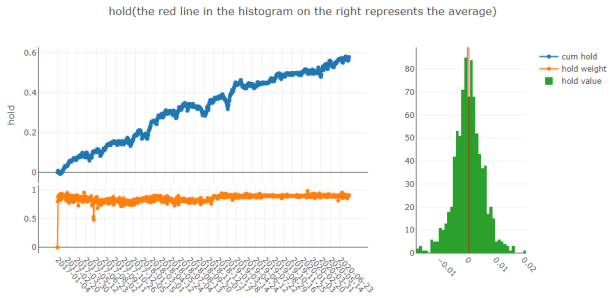
Note:

- Axis X: Trading day
- **Axis Y:**
  - Above axis Y: *(((Ref($close, -1)/$close - 1) * weight).sum() / weight.sum()).cumsum()*
  - Below axis Y: Daily weight sum
- In the **sell** graph, *y < 0* stands for profit; in other cases, *y > 0* stands for profit.
- In the **buy_minus_sell** graph, the **y** value of the **weight** graph at the bottom is *buy_weight + sell_weight*.
- In each graph, the **red line** in the histogram on the right represents the average.









Usage of *analysis_position.risk_analysis*

API

qlib.contrib.report.analysis_position.risk_analysis.**risk_analysis_graph**(*analysis_df: pandas.core.frame.DataFrame = None*, *report_normal_df: pandas.core.frame.DataFrame = None*, *report_long_short_df: pandas.core.frame.DataFrame = None*, *show_notebook: bool = True*) → Iterable[plotly.graph_objs._figu

Generate analysis graph and monthly analysis

Example:

```
from qlib.contrib.evaluate import risk_analysis, backtest,␣
↪long_short_backtest
from qlib.contrib.strategy import TopkDropoutStrategy
from qlib.contrib.report import analysis_position

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
```

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```
sparas['topk'] = 50
sparas['n_drop'] = 230
strategy = TopkDropoutStrategy(**sparas)

report_normal_df, positions = backtest(pred_df, strategy,␣
↪**bparas)
# long_short_map = long_short_backtest(pred_df)
# report_long_short_df = pd.DataFrame(long_short_map)

analysis = dict()
# analysis['pred_long'] = risk_analysis(report_long_short_df[
↪'long'])
# analysis['pred_short'] = risk_analysis(report_long_short_df[
↪'short'])
# analysis['pred_long_short'] = risk_analysis(report_long_
↪short_df['long_short'])
analysis['excess_return_without_cost'] = risk_analysis(report_
↪normal_df['return'] - report_normal_df['bench'])
analysis['excess_return_with_cost'] = risk_analysis(report_
↪normal_df['return'] - report_normal_df['bench'] - report_
↪normal_df['cost'])
analysis_df = pd.concat(analysis)

analysis_position.risk_analysis_graph(analysis_df, report_
↪normal_df)
```

Parameters

- **`analysis_df`** – analysis data, index is **pd.MultiIndex**; columns names is **[risk]**.

```
                                                    risk
excess_return_without_cost mean               0.000692
                           std                0.005374
                           annualized_return  0.174495
                           information_ratio  2.045576
                           max_drawdown      -0.079103
excess_return_with_cost    mean               0.000499
                           std                0.005372
                           annualized_return  0.125625
                           information_ratio  1.473152
                           max_drawdown      -0.088263
```

- **`report_normal_df`** – **df.index.name** must be **date**, df.columns must contain **return**, **turnover**, **cost**, **bench**

```
            return      cost      bench      ␣
↪turnover
date
2017-01-04  0.003421  0.000864  0.011693      ␣
↪0.576325
2017-01-05  0.000508  0.000447  0.000721      ␣
↪0.227882
2017-01-06 -0.003321  0.000212 -0.004322      ␣
↪0.102765
2017-01-09  0.006753  0.000212  0.006874      ␣
↪0.105864
2017-01-10 -0.000416  0.000440 -0.003350      ␣
↪0.208396
```

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- **report_long_short_df** – **df.index.name** must be **date**, df.columns contain **long**, **short**, **long_short**

date	long	short	long_short
2017-01-04	-0.001360	0.001394	0.000034
2017-01-05	0.002456	0.000058	0.002514
2017-01-06	0.000120	0.002739	0.002859
2017-01-09	0.001436	0.001838	0.003273
2017-01-10	0.000824	-0.001944	-0.001120

- **show_notebook** – Whether to display graphics in a notebook, default **True** If True, show graph in notebook If False, return graph figure

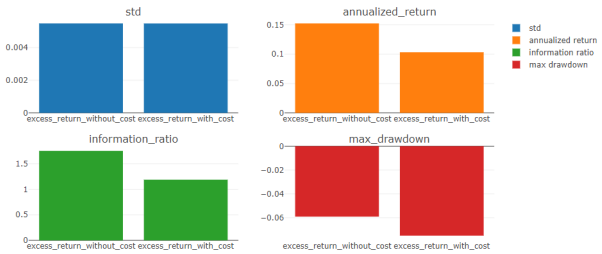
Returns

Graphical Result

Note:

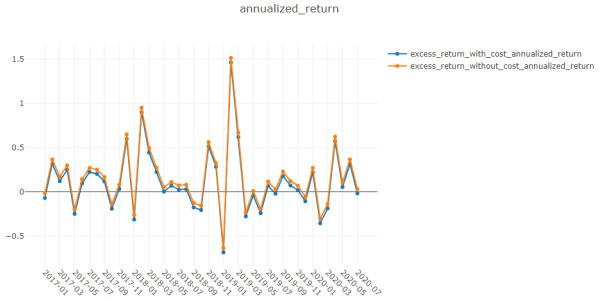
- **general graphics**
  - ***std***
    - ***excess_return_without_cost*** The *Standard Deviation* of *CAR* (cumulative abnormal return) without cost.
    - ***excess_return_with_cost*** The *Standard Deviation* of *CAR* (cumulative abnormal return) with cost.
  - ***annualized_return***
    - ***excess_return_without_cost*** The *Annualized Rate* of *CAR* (cumulative abnormal return) without cost.
    - ***excess_return_with_cost*** The *Annualized Rate* of *CAR* (cumulative abnormal return) with cost.
  - ***information_ratio***
    - ***excess_return_without_cost*** The *Information Ratio* without cost.
    - ***excess_return_with_cost*** The *Information Ratio* with cost.

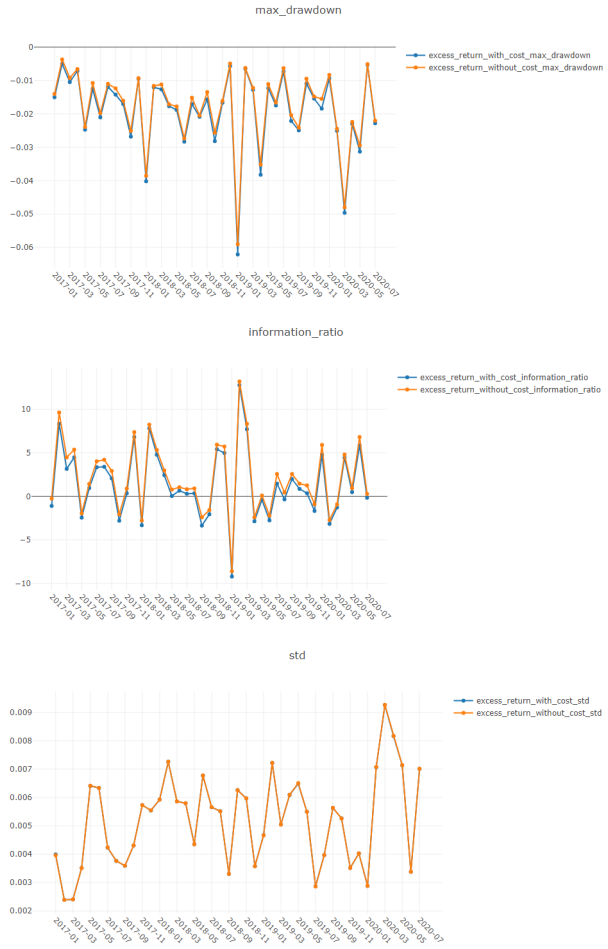
    To know more about *Information Ratio*, please refer to Information Ratio – IR.
  - ***max_drawdown***
    - ***excess_return_without_cost*** The *Maximum Drawdown* of *CAR* (cumulative abnormal return) without cost.
    - ***excess_return_with_cost*** The *Maximum Drawdown* of *CAR* (cumulative abnormal return) with cost.



Note:

- **annualized_return/max_drawdown/information_ratio/std graphics**
  - Axis X: Trading days grouped by month
  - **Axis Y:**
    - **annualized_return graphics**
      - ***excess_return_without_cost_annualized_return*** The *Annualized Rate* series of monthly *CAR* (cumulative abnormal return) without cost.
      - ***excess_return_with_cost_annualized_return*** The *Annualized Rate* series of monthly *CAR* (cumulative abnormal return) with cost.
    - **max_drawdown graphics**
      - ***excess_return_without_cost_max_drawdown*** The *Maximum Drawdown* series of monthly *CAR* (cumulative abnormal return) without cost.
      - ***excess_return_with_cost_max_drawdown*** The *Maximum Drawdown* series of monthly *CAR* (cumulative abnormal return) with cost.
    - **information_ratio graphics**
      - ***excess_return_without_cost_information_ratio*** The *Information Ratio* series of monthly *CAR* (cumulative abnormal return) without cost.
      - ***excess_return_with_cost_information_ratio*** The *Information Ratio* series of monthly *CAR* (cumulative abnormal return) with cost.
    - **std graphics**
      - ***excess_return_without_cost_max_drawdown*** The *Standard Deviation* series of monthly *CAR* (cumulative abnormal return) without cost.
      - ***excess_return_with_cost_max_drawdown*** The *Standard Deviation* series of monthly *CAR* (cumulative abnormal return) with cost.





Usage of *analysis_position.rank_label*

API

qlib.contrib.report.analysis_position.rank_label.**rank_label_graph**(*position: dict*, *label_data: pandas.core.frame.DataFrame*, *start_date=None*, *end_date=None*, *show_notebook=True*) → Iterable[plotly.graph_objs._figure.Figure

Ranking percentage of stocks buy, sell, and holding on the trading day. Average rank-ratio(similar to **sell_df['label'].rank(ascending=False) / len(sell_df)**) of daily trading

Example:

```
from qlib.data import D
from qlib.contrib.evaluate import backtest
from qlib.contrib.strategy import TopkDropoutStrategy
```

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```
# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 230
strategy = TopkDropoutStrategy(**sparas)

_, positions = backtest(pred_df, strategy, **bparas)

pred_df_dates = pred_df.index.get_level_values(level='datetime
↪')
features_df = D.features(D.instruments('csi500'), ['Ref($close,
↪ -1)/$close-1'], pred_df_dates.min(), pred_df_dates.max())
features_df.columns = ['label']

qcr.rank_label_graph(positions, features_df, pred_df_dates.
↪min(), pred_df_dates.max())
```

Parameters

- **position** – position data; **qlib.contrib.backtest.backtest.backtest** result
- **label_data** – **D.features** result; index is **pd.MultiIndex**, index name is **[instrument, datetime]**; columns names is **[label]**.

The label T is the change from T to T+1, it is recommended to use `close`, example: *D.features(D.instruments('csi500'), ['Ref($close, -1)/$close-1'])*

```
                                label
instrument      datetime
SH600004        2017-12-11      -0.013502
                2017-12-12      -0.072367
                2017-12-13      -0.068605
                2017-12-14      0.012440
                2017-12-15      -0.102778
```

Parameters

- **start_date** – start date
- **end_date** – end_date
- **show_notebook** – **True** or **False**. If True, show graph in notebook, else return figures

Returns

Graphical Result

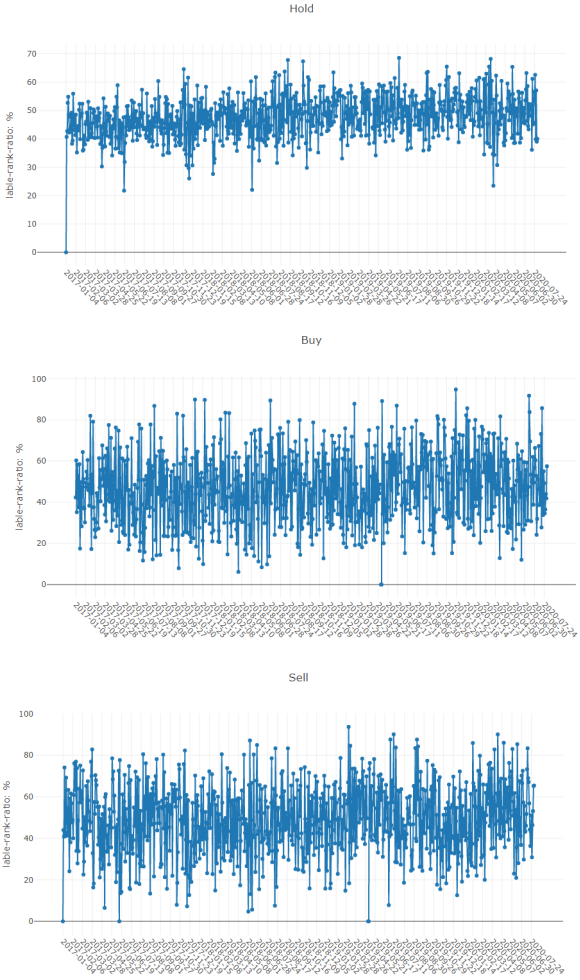
Note:

- **hold/sell/buy graphics:**
  - Axis X: Trading day

– **Axis Y:** Average *ranking ratio*‘*of* ‘*label* for stocks that is held/sold/bought on the trading day.

In the above example, the *label* is formulated as *Ref($close, -1)/$close - 1*. The *ranking ratio* can be formulated as follows. .. math:

```
ranking\ ratio = \frac{Ascending\ Ranking\ of\ label}{Number\ of\ Stocks\ in\ the\ Portfolio}
```



Usage of *analysis_model.analysis_model_performance*

API

qlib.contrib.report.analysis_model.analysis_model_performance.**ic_figure**(*ic_df: pandas.core.frame.DataFrame*, *show_nature_day=True*, ***kwargs*) → plotly.graph_objs._figure.Fi

IC figure

Parameters

- **ic_df** – ic DataFrame
- **show_nature_day** – whether to display the abscissa of non-trading day

Returns plotly.graph_objs.Figure

qlib.contrib.report.analysis_model.analysis_model_performance.**model_performance_graph**(*pred_l pandas.co lag: int = 1, N: int = 5, reverse= rank= graph_ list = ['grou 'pred_ 'pred_ show_ bool = True, show_* → [<class 'list'>, <class 'tuple'>]

Model performance

Parameters

- **pred_label** – index is **pd.MultiIndex**, index name is **[instrument, datetime]**; columns names is **[score, label]**

```
instrument      datetime        score       label
SH600004        2017-12-11      -0.013502       -0.013502
            2017-12-12  -0.072367       -0.072367
            2017-12-13  -0.068605       -0.068605
            2017-12-14  0.012440        0.012440
            2017-12-15  -0.102778       -0.102778
```

- **lag** – *pred.groupby(level='instrument')['score'].shift(lag).* It will be only used in the auto-correlation computing.
- **N** – group number, default 5
- **reverse** – if *True*, *pred['score'] *= -1*
- **rank** – if **True**, calculate rank ic

- **graph_names** – graph names; default ['cumulative_return', 'pred_ic', 'pred_autocorr', 'pred_turnover']
- **show_notebook** – whether to display graphics in notebook, the default is *True*
- **show_nature_day** – whether to display the abscissa of non-trading day

Returns if show_notebook is True, display in notebook; else return *plotly.graph_objs.Figure* list

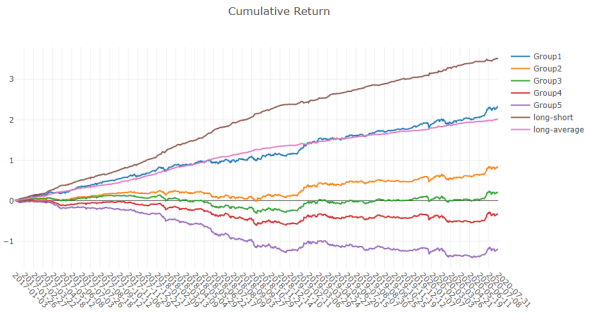
Graphical Results

Note:

- **cumulative return graphics**
  - ***Group1*:** The *Cumulative Return* series of stocks group with (*ranking ratio* of label <= 20%)
  - ***Group2*:** The *Cumulative Return* series of stocks group with (20% < *ranking ratio* of label <= 40%)
  - ***Group3*:** The *Cumulative Return* series of stocks group with (40% < *ranking ratio* of label <= 60%)
  - ***Group4*:** The *Cumulative Return* series of stocks group with (60% < *ranking ratio* of label <= 80%)
  - ***Group5*:** The *Cumulative Return* series of stocks group with (80% < *ranking ratio* of label)
  - ***long-short*:** The Difference series between *Cumulative Return* of *Group1* and of *Group5*
  - ***long-average*** The Difference series between *Cumulative Return* of *Group1* and average *Cumulative Return* for all stocks.

The *ranking ratio* can be formulated as follows.

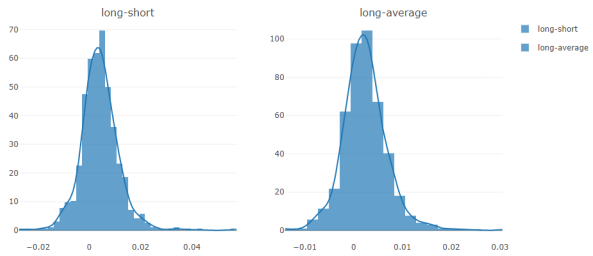
$$ranking\ ratio = \frac{Ascending\ Ranking\ of\ label}{Number\ of\ Stocks\ in\ the\ Portfolio}$$



Note:

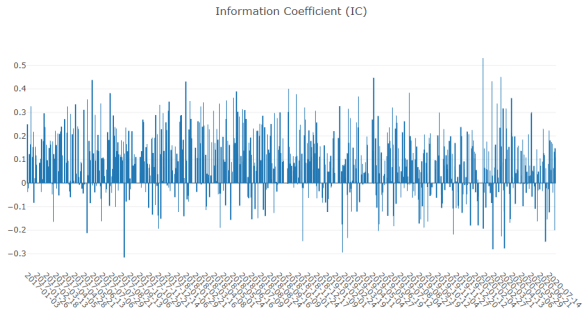
- **long-short/long-average** The distribution of long-short/long-average returns on each trading day

---



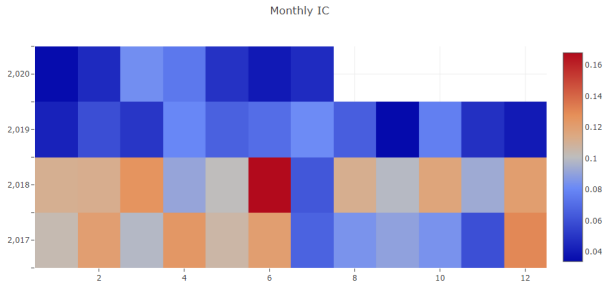
Note:

- **Information Coefficient**
  - The *Pearson correlation coefficient* series between *labels* and *prediction scores* of stocks in portfolio.
  - The graphics reports can be used to evaluate the *prediction scores*.



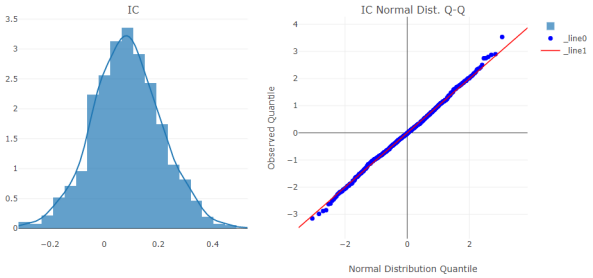
Note:

- **Monthly IC** Monthly average of the *Information Coefficient*



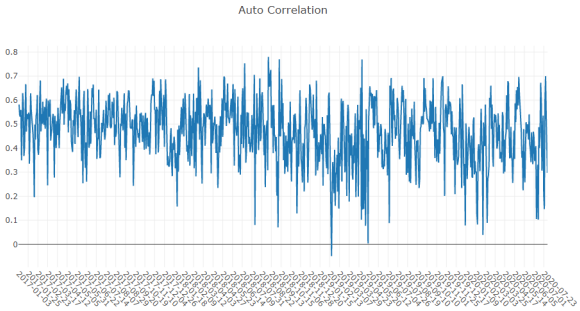
Note:

- **IC** The distribution of the *Information Coefficient* on each trading day.
- **IC Normal Dist. Q-Q** The *Quantile-Quantile Plot* is used for the normal distribution of *Information Coefficient* on each trading day.



Note:

- **Auto Correlation**
  - The *Pearson correlation coefficient* series between the latest *prediction scores* and the *prediction scores lag* days ago of stocks in portfolio on each trading day.
  - The graphics reports can be used to estimate the turnover rate.



1.13 Building Formulaic Alphas

1.13.1 Introduction

In quantitative trading practice, designing novel factors that can explain and predict future asset returns are of vital importance to the profitability of a strategy. Such factors are usually called alpha factors, or alphas in short.

A formulaic alpha, as the name suggests, is a kind of alpha that can be presented as a formula or a mathematical expression.

1.13.2 Building Formulaic Alphas in `Qlib`

In `Qlib`, users can easily build formulaic alphas.

Example

MACD, short for moving average convergence/divergence, is a formulaic alpha used in technical analysis of stock prices. It is designed to reveal changes in the strength, direction, momentum, and duration of a trend in a stock's price.

MACD can be presented as the following formula:

$$MACD = 2 \times (DIF - DEA)$$

Note: *DIF* means Differential value, which is 12-period EMA minus 26-period EMA.

$$DIF = \frac{EMA(CLOSE, 12) - EMA(CLOSE, 26)}{CLOSE}$$

'DEA'means a 9-period EMA of the DIF.

$$DEA = \frac{EMA(DIF, 9)}{CLOSE}$$

Users can use `Data Handler` to build formulaic alphas *MACD* in qlib:

Note: Users need to initialize `Qlib` with *qlib.init* first. Please refer to initialization.

```
>>> from qlib.contrib.estimator.handler import QLibDataHandler
>>> fields = ['(EMA($close, 12) - EMA($close, 26))/$close - EMA((EMA($close, 12) -␣
↪EMA($close, 26))/$close, 9)/$close'] # MACD
>>> names = ['MACD']
>>> labels = ['Ref($vwap, -2)/Ref($vwap, -1) - 1'] # label
>>> label_names = ['LABEL']
>>> data_handler = QLibDataHandler(start_date='2010-01-01', end_date='2017-12-31',␣
↪fields=fields, names=names, labels=labels, label_names=label_names)
>>> TRAINER_CONFIG = {
...     "train_start_date": "2007-01-01",
...     "train_end_date": "2014-12-31",
...     "validate_start_date": "2015-01-01",
...     "validate_end_date": "2016-12-31",
...  "test_start_date": "2017-01-01",
...  "test_end_date": "2020-08-01",
... }
>>> feature_train, label_train, feature_validate, label_validate, feature_test, label_
↪test = data_handler.get_split_data(**TRAINER_CONFIG)
>>> print(feature_train, label_train)
                          MACD
instrument  datetime
SH600004    2012-01-04 -0.030853
            2012-01-05 -0.030452
            2012-01-06 -0.028252
            2012-01-09 -0.024507
            2012-01-10 -0.019744
...                          ...
SZ300273    2014-12-25  0.031339
            2014-12-26  0.029695
            2014-12-29  0.025577
            2014-12-30  0.020493
            2014-12-31  0.017089

[605882 rows x 1 columns]
                           label
instrument  datetime
SH600004    2012-01-04  0.003021
            2012-01-05  0.017434
            2012-01-06  0.015490
            2012-01-09  0.002324
            2012-01-10 -0.002542
```

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```
...                           ...
SZ300273    2014-12-25 -0.032454
            2014-12-26 -0.016638
            2014-12-29  0.008263
            2014-12-30 -0.011985
            2014-12-31  0.047797

[605882 rows x 1 columns]
```

1.13.3 Reference

To kown more about `Data Handler`, please refer to Data Handler

To kown more about `Data Api`, please refer to Data Api

1.14 `Online` & `Offline` mode

1.14.1 Introduction

`Qlib` supports `Online` mode and `Offline` mode. Only the `Offline` mode is introduced in this document.

The `Online` mode is designed to solve the following problems:

- Manage the data in a centralized way. Users don't have to manage data of different versions.
- Reduce the amount of cache to be generated.
- Make the data can be accessed in a remote way.

1.14.2 Qlib-Server

`Qlib-Server` is the assorted server system for `Qlib`, which utilizes `Qlib` for basic calculations and provides extensive server system and cache mechanism. With QLibServer, the data provided for `Qlib` can be managed in a centralized manner. With `Qlib-Server`, users can use `Qlib` in `Online` mode.

1.14.3 Reference

If users are interested in `Qlib-Server` and `Online` mode, please refer to Qlib-Server Project and Qlib-Server Document.

1.15 API Reference

Here you can find all `Qlib` interfaces.

1.15.1 Data

Provider

class qlib.data.data.**CalendarProvider**

Calendar provider base class

Provide calendar data.

calendar(*start_time=None*, *end_time=None*, *freq='day'*, *future=False*)

Get calendar of certain market in given time range.

Parameters

- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day
- **future** (*bool*) – whether including future trading day

Returns calendar list

Return type list

locate_index(*start_time*, *end_time*, *freq*, *future*)

Locate the start time index and end time index in a calendar under certain frequency.

Parameters

- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day
- **future** (*bool*) – whether including future trading day

Returns

- *pd.Timestamp* – the real start time
- *pd.Timestamp* – the real end time
- *int* – the index of start time
- *int* – the index of end time

class qlib.data.data.**InstrumentProvider**

Instrument provider base class

Provide instrument data.

static instruments(*market='all'*, *filter_pipe=None*)

Get the general config dictionary for a base market adding several dynamic filters.

Parameters

- **market** (*str*) – market/industry/index shortname, e.g. all/sse/szse/sse50/csi300/csi500
- **filter_pipe** (*list*) – the list of dynamic filters

Returns

dict of stockpool config {'market'=>base market name, 'filter_pipe'=>list of filters}

example : {'market': 'csi500',

'filter_pipe': [{'filter_type': 'ExpressionDFilter',

'rule_expression': '$open<40', 'filter_start_time': None, 'filter_end_time': None, 'keep': False},

{'filter_type': 'NameDFilter', 'name_rule_re': 'SH[0-9]{4}55', 'filter_start_time': None, 'filter_end_time': None}]}

Return type dict

list_instruments(*instruments*, *start_time=None*, *end_time=None*, *freq='day'*, *as_list=False*)

List the instruments based on a certain stockpool config.

Parameters

- **instruments** (*dict*) – stockpool config
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **as_list** (*bool*) – return instruments as list or dict

Returns instruments list or dictionary with time spans

Return type dict or list

class qlib.data.data.**FeatureProvider**

Feature provider class

Provide feature data.

feature(*instrument*, *field*, *start_time*, *end_time*, *freq*)

Get feature data.

Parameters

- **instrument** (*str*) – a certain instrument
- **field** (*str*) – a certain field of feature
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day

Returns data of a certain feature

Return type pd.Series

class qlib.data.data.**ExpressionProvider**

Expression provider class

Provide Expression data.

expression(*instrument*, *field*, *start_time=None*, *end_time=None*, *freq='day'*)

Get Expression data.

Parameters

- **instrument** (*str*) – a certain instrument
- **field** (*str*) – a certain field of feature
- **start_time** (*str*) – start of the time range

- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day

Returns data of a certain expression

Return type pd.Series

class qlib.data.data.**DatasetProvider**

Dataset provider class

Provide Dataset data.

dataset(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*)

Get dataset data.

Parameters

- **instruments** (*list or dict*) – list/dict of instruments or dict of stockpool config
- **fields** (*list*) – list of feature instances
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency

Returns a pandas dataframe with <instrument, datetime> index

Return type pd.DataFrame

static get_instruments_d(*instruments*, *freq*)

Parse different types of input instruments to output instruments_d Wrong format of input instruments will lead to exception.

static get_column_names(*fields*)

Get column names from input fields

static dataset_processor(*instruments_d*, *column_names*, *start_time*, *end_time*, *freq*)

Load and process the data, return the data set. - default using multi-kernel method.

static expression_calculator(*inst*, *start_time*, *end_time*, *freq*, *column_names*, *spans=None*, *C=None*)

Calculate the expressions for one instrument, return a df result. If the expression has been calculated before, load from cache.

return value: A data frame with index 'datetime' and other data columns.

class qlib.data.data.**LocalCalendarProvider**(***kwargs*)

Local calendar data provider class

Provide calendar data from local data source.

calendar(*start_time=None*, *end_time=None*, *freq='day'*, *future=False*)

Get calendar of certain market in given time range.

Parameters

- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day
- **future** (*bool*) – whether including future trading day

Returns calendar list

Return type list

class qlib.data.data.**LocalInstrumentProvider**
Local instrument data provider class

Provide instrument data from local data source.

list_instruments(*instruments*, *start_time=None*, *end_time=None*, *freq='day'*, *as_list=False*)
List the instruments based on a certain stockpool config.

Parameters

- **instruments** (*dict*) – stockpool config
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **as_list** (*bool*) – return instruments as list or dict

Returns instruments list or dictionary with time spans

Return type dict or list

class qlib.data.data.**LocalFeatureProvider**(***kwargs*)
Local feature data provider class

Provide feature data from local data source.

feature(*instrument*, *field*, *start_index*, *end_index*, *freq*)
Get feature data.

Parameters

- **instrument** (*str*) – a certain instrument
- **field** (*str*) – a certain field of feature
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day

Returns data of a certain feature

Return type pd.Series

class qlib.data.data.**LocalExpressionProvider**
Local expression data provider class

Provide expression data from local data source.

expression(*instrument*, *field*, *start_time=None*, *end_time=None*, *freq='day'*)
Get Expression data.

Parameters

- **instrument** (*str*) – a certain instrument
- **field** (*str*) – a certain field of feature
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day

Returns data of a certain expression

Return type pd.Series

class qlib.data.data.**LocalDatasetProvider**

Local dataset data provider class

Provide dataset data from local data source.

dataset(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*)

Get dataset data.

Parameters

- **instruments** (*list or dict*) – list/dict of instruments or dict of stockpool config
- **fields** (*list*) – list of feature instances
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency

Returns a pandas dataframe with <instrument, datetime> index

Return type pd.DataFrame

static multi_cache_walker(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*)

This method is used to prepare the expression cache for the client. Then the client will load the data from expression cache by itself.

static cache_walker(*inst*, *start_time*, *end_time*, *freq*, *column_names*)

If the expressions of one instrument haven't been calculated before, calculate it and write it into expression cache.

class qlib.data.data.**ClientCalendarProvider**

Client calendar data provider class

Provide calendar data by requesting data from server as a client.

calendar(*start_time=None*, *end_time=None*, *freq='day'*, *future=False*)

Get calendar of certain market in given time range.

Parameters

- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency, available: year/quarter/month/week/day
- **future** (*bool*) – whether including future trading day

Returns calendar list

Return type list

class qlib.data.data.**ClientInstrumentProvider**

Client instrument data provider class

Provide instrument data by requesting data from server as a client.

list_instruments(*instruments*, *start_time=None*, *end_time=None*, *freq='day'*, *as_list=False*)

List the instruments based on a certain stockpool config.

Parameters

- **instruments** (*dict*) – stockpool config
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **as_list** (*bool*) – return instruments as list or dict

Returns instruments list or dictionary with time spans

Return type dict or list

class qlib.data.data.**ClientDatasetProvider**

Client dataset data provider class

Provide dataset data by requesting data from server as a client.

dataset(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*, *disk_cache=0*, *return_uri=False*)

Get dataset data.

Parameters

- **instruments** (*list or dict*) – list/dict of instruments or dict of stockpool config
- **fields** (*list*) – list of feature instances
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range
- **freq** (*str*) – time frequency

Returns a pandas dataframe with <instrument, datetime> index

Return type pd.DataFrame

class qlib.data.data.**BaseProvider**

Local provider class

To keep compatible with old qlib provider.

features(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*, *disk_cache=None*)

disk_cache [int] whether to skip(0)/use(1)/replace(2) disk_cache

This function will try to use cache method which has a keyword *disk_cache*, and will use provider method if a type error is raised because the DatasetD instance is a provider class.

class qlib.data.data.**LocalProvider**

features_uri(*instruments*, *fields*, *start_time*, *end_time*, *freq*, *disk_cache=1*)

Return the uri of the generated cache of features/dataset

Parameters

- **disk_cache** –
- **instruments** –
- **fields** –
- **start_time** –
- **end_time** –

- **freq** –

class qlib.data.data.**ClientProvider**

Client Provider

Requesting data from server as a client. Can propose requests:

- Calendar : Directly respond a list of calendars
- Instruments (without filter): Directly respond a list/dict of instruments
- Instruments (with filters): Respond a list/dict of instruments
- Features : Respond a cache uri

The general workflow is described as follows: When the user use client provider to propose a request, the client provider will connect the server and send the request. The client will start to wait for the response. The response will be made instantly indicating whether the cache is available. The waiting procedure will terminate only when the client get the reponse saying *feature_available* is true. *BUG* : Everytime we make request for certain data we need to connect to the server, wait for the response and disconnect from it. We can't make a sequence of requests within one connection. You can refer to https://python-socketio.readthedocs.io/en/latest/client.html for documentation of python-socketIO client.

class qlib.data.data.**Wrapper**

Data Provider Wrapper

qlib.data.data.**register_wrapper**(*wrapper*, *cls_or_obj*)

Parameters

- **wrapper** – A wrapper of all kinds of providers
- **cls_or_obj** – A class or class name or object instance in data/data.py

qlib.data.data.**register_all_wrappers**()

Filter

class qlib.data.filter.**BaseDFilter**

Dynamic Instruments Filter Abstract class

Users can override this class to construct their own filter

Override __init__ to input filter regulations

Override filter_main to use the regulations to filter instruments

static from_config(*config*)

Construct an instance from config dict.

Parameters **config** (*dict*) – dict of config parameters

to_config()

Construct an instance from config dict.

Returns return the dict of config parameters

Return type dict

class qlib.data.filter.**SeriesDFilter**(*fstart_time=None*, *fend_time=None*)

Dynamic Instruments Filter Abstract class to filter a series of certain features

Filters should provide parameters:

- filter start time
- filter end time
- filter rule

Override __init__ to assign a certain rule to filter the series.

Override _getFilterSeries to use the rule to filter the series and get a dict of {inst => series}, or override filter_main for more advanced series filter rule

filter_main(*instruments*, *start_time=None*, *end_time=None*)
Implement this method to filter the instruments.

Parameters

- **instruments** (*dict*) – input instruments to be filtered
- **start_time** (*str*) – start of the time range
- **end_time** (*str*) – end of the time range

Returns filtered instruments, same structure as input instruments

Return type dict

class qlib.data.filter.**NameDFilter**(*name_rule_re*, *fstart_time=None*, *fend_time=None*)
Name dynamic instrument filter

Filter the instruments based on a regulated name format.

A name rule regular expression is required.

static from_config(*config*)
Construct an instance from config dict.

Parameters **config** (*dict*) – dict of config parameters

to_config()
Construct an instance from config dict.

Returns return the dict of config parameters

Return type dict

class qlib.data.filter.**ExpressionDFilter**(*rule_expression*, *fstart_time=None*, *fend_time=None*, *keep=False*)
Expression dynamic instrument filter

Filter the instruments based on a certain expression.

An expression rule indicating a certain feature field is required.

Examples

- *basic features filter* : rule_expression = '$close/$open>5'
- *cross-sectional features filter* : rule_expression = '$rank($close)<10'
- *time-sequence features filter* : rule_expression = '$Ref($close, 3)>100'

from_config()
Construct an instance from config dict.

Parameters **config** (*dict*) – dict of config parameters

to_config()
Construct an instance from config dict.

Returns return the dict of config parameters

Return type dict

Feature

Class

class qlib.data.base.**Expression**
Expression base class

load(*instrument*, *start_index*, *end_index*, *freq*)
load feature

Parameters

- **instrument** (*str*) – instrument code
- **start_index** (*str*) – feature start index [in calendar]
- **end_index** (*str*) – feature end index [in calendar]
- **freq** (*str*) – feature frequency

Returns feature series: The index of the series is the calendar index

Return type pd.Series

get_longest_back_rolling()
Get the longest length of historical data the feature has accessed

This is designed for getting the needed range of the data to calculate the features in specific range at first. However, situations like Ref(Ref($close, -1), 1) can not be handled rightly.

So this will only used for detecting the length of historical data needed.

get_extended_window_size()
get_extend_window_size

For to calculate this Operator in range[start_index, end_index] We have to get the *leaf feature* in range[start_index - lft_etd, end_index + rght_etd].

Returns lft_etd, rght_etd

Return type (int, int)

class qlib.data.base.**Feature**(*name=None*)
Static Expression

This kind of feature will load data from provider

get_longest_back_rolling()
Get the longest length of historical data the feature has accessed

This is designed for getting the needed range of the data to calculate the features in specific range at first. However, situations like Ref(Ref($close, -1), 1) can not be handled rightly.

So this will only used for detecting the length of historical data needed.

get_extended_window_size()
get_extend_window_size

For to calculate this Operator in range[start_index, end_index] We have to get the *leaf feature* in range[start_index - lft_etd, end_index + rght_etd].

Returns lft_etd, rght_etd

Return type (int, int)

class qlib.data.base.**ExpressionOps**
Operator Expression

This kind of feature will use operator for feature construction on the fly.

Operator

class qlib.data.ops.**Abs**(*feature*)
Feature Absolute Value
Parameters **feature** (Expression) – feature instance
Returns a feature instance with absolute output
Return type *Expression*

class qlib.data.ops.**Sign**(*feature*)
Feature Sign
Parameters **feature** (Expression) – feature instance
Returns a feature instance with sign
Return type *Expression*

class qlib.data.ops.**Log**(*feature*)
Feature Log
Parameters **feature** (Expression) – feature instance
Returns a feature instance with log
Return type *Expression*

class qlib.data.ops.**Power**(*feature*, *exponent*)
Feature Power
Parameters **feature** (Expression) – feature instance
Returns a feature instance with power
Return type *Expression*

class qlib.data.ops.**Mask**(*feature*, *instrument*)
Feature Mask
Parameters
- **feature** (Expression) – feature instance
- **instrument** (*str*) – instrument mask

Returns a feature instance with masked instrument
Return type *Expression*

class qlib.data.ops.**Not**(*feature*)
Not Operator
Parameters
- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns feature elementwise not output
Return type *Feature*

class qlib.data.ops.**Add**(*feature_left*, *feature_right*)
Add Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns two features' sum

Return type *Feature*

class qlib.data.ops.**Sub**(*feature_left*, *feature_right*)
Subtract Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns two features' subtraction

Return type *Feature*

class qlib.data.ops.**Mul**(*feature_left*, *feature_right*)
Multiply Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns two features' product

Return type *Feature*

class qlib.data.ops.**Div**(*feature_left*, *feature_right*)
Division Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns two features' division

Return type *Feature*

class qlib.data.ops.**Greater**(*feature_left*, *feature_right*)
Greater Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns greater elements taken from the input two features

Return type *Feature*

class qlib.data.ops.**Less**(*feature_left*, *feature_right*)
Less Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns smaller elements taken from the input two features

Return type *Feature*

class qlib.data.ops.**Gt**(*feature_left*, *feature_right*)
Greater Than Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns bool series indicate *left* > *right*

Return type *Feature*

class qlib.data.ops.**Ge**(*feature_left*, *feature_right*)
Greater Equal Than Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns bool series indicate *left* >= *right*

Return type *Feature*

class qlib.data.ops.**Lt**(*feature_left*, *feature_right*)
Less Than Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns bool series indicate *left* < *right*

Return type *Feature*

class qlib.data.ops.**Le**(*feature_left*, *feature_right*)
Less Equal Than Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns bool series indicate *left* <= *right*

Return type *Feature*

class qlib.data.ops.**Eq**(*feature_left*, *feature_right*)
Equal Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns bool series indicate *left* == *right*

Return type *Feature*

class qlib.data.ops.**Ne**(*feature_left*, *feature_right*)
Not Equal Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns bool series indicate *left != right*

Return type *Feature*

class qlib.data.ops.**And**(*feature_left*, *feature_right*)
And Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns two features' row by row & output

Return type *Feature*

class qlib.data.ops.**Or**(*feature_left*, *feature_right*)
Or Operator

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

Returns two features' row by row | outputs

Return type *Feature*

class qlib.data.ops.**If**(*condition*, *feature_left*, *feature_right*)
If Operator

Parameters

- **condition** (Expression) – feature instance with bool values as condition
- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance

get_longest_back_rolling()
Get the longest length of historical data the feature has accessed

This is designed for getting the needed range of the data to calculate the features in specific range at first. However, situations like Ref(Ref($close, -1), 1) can not be handled rightly.

So this will only used for detecting the length of historical data needed.

get_extended_window_size()
get_extend_window_size

For to calculate this Operator in range[start_index, end_index] We have to get the *leaf feature* in range[start_index - lft_etd, end_index + rght_etd].

Returns lft_etd, rght_etd

Return type (int, int)

class qlib.data.ops.**Ref**(*feature*, *N*)
Feature Reference

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – N = 0, retrieve the first data; N > 0, retrieve data of N periods ago; N < 0, future data

Returns a feature instance with target reference

Return type *Expression*

get_longest_back_rolling()
Get the longest length of historical data the feature has accessed

This is designed for getting the needed range of the data to calculate the features in specific range at first. However, situations like Ref(Ref($close, -1), 1) can not be handled rightly.

So this will only used for detecting the length of historical data needed.

get_extended_window_size()
get_extend_window_size

For to calculate this Operator in range[start_index, end_index] We have to get the *leaf feature* in range[start_index - lft_etd, end_index + rght_etd].

Returns lft_etd, rght_etd

Return type (int, int)

class qlib.data.ops.**Mean**(*feature*, *N*)
Rolling Mean (MA)

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling average

Return type *Expression*

class qlib.data.ops.**Sum**(*feature*, *N*)
Rolling Sum

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling sum

Return type *Expression*

class qlib.data.ops.**Std**(*feature*, *N*)
Rolling Std

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling std

Return type *Expression*

class qlib.data.ops.**Var**(*feature*, *N*)
Rolling Variance

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling variance

Return type *Expression*

class qlib.data.ops.**Skew**(*feature*, *N*)
Rolling Skewness
Parameters
- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling skewness

Return type *Expression*

class qlib.data.ops.**Kurt**(*feature*, *N*)
Rolling Kurtosis
Parameters
- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling kurtosis

Return type *Expression*

class qlib.data.ops.**Max**(*feature*, *N*)
Rolling Max
Parameters
- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling max

Return type *Expression*

class qlib.data.ops.**IdxMax**(*feature*, *N*)
Rolling Max Index
Parameters
- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling max index

Return type *Expression*

class qlib.data.ops.**Min**(*feature*, *N*)
Rolling Min
Parameters
- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling min

Return type *Expression*

class qlib.data.ops.**IdxMin**(*feature*, *N*)
Rolling Min Index
Parameters
- **feature** (Expression) – feature instance

- **N** (*int*) – rolling window size

Returns a feature instance with rolling min index

Return type *Expression*

class qlib.data.ops.**Quantile**(*feature*, *N*, *qscore*)
Rolling Quantile

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling quantile

Return type *Expression*

class qlib.data.ops.**Med**(*feature*, *N*)
Rolling Median

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling median

Return type *Expression*

class qlib.data.ops.**Mad**(*feature*, *N*)
Rolling Mean Absolute Deviation

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling mean absolute deviation

Return type *Expression*

class qlib.data.ops.**Rank**(*feature*, *N*)
Rolling Rank (Percentile)

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling rank

Return type *Expression*

class qlib.data.ops.**Count**(*feature*, *N*)
Rolling Count

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling count of number of non-NaN elements

Return type *Expression*

class qlib.data.ops.**Delta**(*feature*, *N*)
Rolling Delta

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with end minus start in rolling window

Return type *Expression*

class qlib.data.ops.**Slope**(*feature*, *N*)

Rolling Slope

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with regression slope of given window

Return type *Expression*

class qlib.data.ops.**Rsquare**(*feature*, *N*)

Rolling R-value Square

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with regression r-value square of given window

Return type *Expression*

class qlib.data.ops.**Resi**(*feature*, *N*)

Rolling Regression Residuals

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with regression residuals of given window

Return type *Expression*

class qlib.data.ops.**WMA**(*feature*, *N*)

Rolling WMA

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with weighted moving average output

Return type *Expression*

class qlib.data.ops.**EMA**(*feature*, *N*)

Rolling Exponential Mean (EMA)

Parameters

- **feature** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with regression r-value square of given window

Return type *Expression*

class qlib.data.ops.**Corr**(*feature_left*, *feature_right*, *N*)
Rolling Correlation

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling correlation of two input features

Return type *Expression*

class qlib.data.ops.**Cov**(*feature_left*, *feature_right*, *N*)
Rolling Covariance

Parameters

- **feature_left** (Expression) – feature instance
- **feature_right** (Expression) – feature instance
- **N** (*int*) – rolling window size

Returns a feature instance with rolling max of two input features

Return type *Expression*

Cache

class qlib.data.cache.**MemCacheUnit**(**args*, ***kwargs*)
Memory Cache Unit.

class qlib.data.cache.**MemCache**(*mem_cache_size_limit=None*, *limit_type='length'*)
Memory cache.

class qlib.data.cache.**ExpressionCache**(*provider*)
Expression cache mechanism base class.

This class is used to wrap expression provider with self-defined expression cache mechanism.

Note: Override the *_uri* and *_expression* method to create your own expression cache mechanism.

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expression(*instrument*, *field*, *start_time*, *end_time*, *freq*)
Get expression data.

Note: Same interface as *expression* method in expression provider

---

update(*cache_uri*)
Update expression cache to latest calendar.

Overide this method to define how to update expression cache corresponding to users' own cache mechanism.

Parameters **cache_uri** (*str*) – the complete uri of expression cache file (include dir path)

Returns 0(successful update)/ 1(no need to update)/ 2(update failure)

Return type int

class qlib.data.cache.**DatasetCache**(*provider*)

Dataset cache mechanism base class.

This class is used to wrap dataset provider with self-defined dataset cache mechanism.

Note: Override the *_uri* and *_dataset* method to create your own dataset cache mechanism.

dataset(*instruments*, *fields*, *start_time=None*, *end_time=None*, *freq='day'*, *disk_cache=1*)

Get feature dataset.

Note: Same interface as *dataset* method in dataset provider

Note: The server use redis_lock to make sure read-write conflicts will not be triggered

but client readers are not considered.

update(*cache_uri*)

Update dataset cache to latest calendar.

Overide this method to define how to update dataset cache corresponding to users' own cache mechanism.

Parameters **cache_uri** (*str*) – the complete uri of dataset cache file (include dir path)

Returns 0(successful update)/ 1(no need to update)/ 2(update failure)

Return type int

static cache_to_origin_data(*data*, *fields*)

cache data to origin data

Parameters

- **data** – pd.DataFrame, cache data
- **fields** – feature fields

Returns pd.DataFrame

static normalize_uri_args(*instruments*, *fields*, *freq*)

normalize uri args

class qlib.data.cache.**DiskExpressionCache**(*provider*, ***kwargs*)

Prepared cache mechanism for server.

gen_expression_cache(*expression_data*, *cache_path*, *instrument*, *field*, *freq*, *last_update*)

use bin file to save like feature-data.

update(*sid*, *cache_uri*)

Update expression cache to latest calendar.

Overide this method to define how to update expression cache corresponding to users' own cache mechanism.

Parameters **cache_uri** (*str*) – the complete uri of expression cache file (include dir path)

Returns 0(successful update)/ 1(no need to update)/ 2(update failure)

Return type int

class qlib.data.cache.**DiskDatasetCache**(*provider*, ***kwargs*)

Prepared cache mechanism for server.

classmethod read_data_from_cache(*cache_path*, *start_time*, *end_time*, *fields*)

read_cache_from

This function can read data from the disk cache dataset

Parameters

- **cache_path** –
- **start_time** –
- **end_time** –
- **fields** – The fields order of the dataset cache is sorted. So rearrange the columns to make it consistent

Returns

class IndexManager(*cache_path*)

The lock is not considered in the class. Please consider the lock outside the code. This class is the proxy of the disk data.

gen_dataset_cache(*cache_path*, *instruments*, *fields*, *freq*)

Note: This function does not consider the cache read write lock. Please

---

Aquire the lock outside this function

The format the cache contains 3 parts(followed by typical filename).

- **index** [cache/d41366901e25de3ec47297f12e2ba11d.index]
  - The content of the file may be in following format(pandas.Series)

```
                    start end
1999-11-10 00:00:00     0   1
1999-11-11 00:00:00     1   2
1999-11-12 00:00:00     2   3
...
```

Note: The start is closed. The end is open!!!!!

  - Each line contains two element <timestamp, end_index>
  - It indicates the *end_index* of the data for *timestamp*
- meta data: cache/d41366901e25de3ec47297f12e2ba11d.meta
- **data** [cache/d41366901e25de3ec47297f12e2ba11d]
  - This is a hdf file sorted by datetime

Parameters

- **cache_path** – The path to store the cache
- **instruments** – The instruments to store the cache
- **fields** – The fields to store the cache
- **freq** – The freq to store the cache

:return type pd.DataFrame; The fields of the returned DataFrame are consistent with the parameters of the function

update(*cache_uri*)
Update dataset cache to latest calendar.

Overide this method to define how to update dataset cache corresponding to users' own cache mechanism.

Parameters **cache_uri** (*str*) – the complete uri of dataset cache file (include dir path)

Returns 0(successful update)/ 1(no need to update)/ 2(update failure)

Return type int

1.15.2 Contrib

Data Handler

class qlib.contrib.estimator.handler.**BaseDataHandler**(*processors=[]*, ***kwargs*)

split_rolling_periods(*train_start_date*, *train_end_date*, *validate_start_date*, *validate_end_date*, *test_start_date*, *test_end_date*, *rolling_period*, *calendar_freq='day'*)
Calculating the Rolling split periods, the period rolling on market calendar. :param train_start_date: :param train_end_date: :param validate_start_date: :param validate_end_date: :param test_start_date: :param test_end_date: :param rolling_period: The market period of rolling :param calendar_freq: The frequence of the market calendar :yield: Rolling split periods

get_split_data(*train_start_date*, *train_end_date*, *validate_start_date*, *validate_end_date*, *test_start_date*, *test_end_date*)
all return types are DataFrame

setup_process_data(*df_train*, *df_valid*, *df_test*)
process the train, valid and test data :return: the processed train, valid and test data.

get_origin_test_label_with_date(*test_start_date*, *test_end_date*, *freq='day'*)
Get origin test label

Parameters

- **test_start_date** – test start date
- **test_end_date** – test end date
- **freq** – freq

Returns pd.DataFrame

setup_feature()

Implement this method to load raw feature. the format of the feature is below

return: df_features

setup_label()

Implement this method to load and calculate label. the format of the label is below

return: df_label

class qlib.contrib.estimator.handler.**QLibDataHandler**(*start_date*, *end_date*, **args*, ***kwargs*)

setup_feature()
Load the raw data. return: df_features

setup_label()
Build up labels in df through users' method :return: df_labels

qlib.contrib.estimator.handler.**parse_config_to_fields**(*config*)
create factors from config
config = { 'kbar': {}, # whether to use some hard-code kbar features 'price': { # whether to use raw price features

'windows': [0, 1, 2, 3, 4], # use price at n days ago 'feature': ['OPEN', 'HIGH', 'LOW'] # which price field to use

}, 'volume': { # whether to use raw volume features

'windows': [0, 1, 2, 3, 4], # use volume at n days ago

}, 'rolling': { # whether to use rolling operator based features

'windows': [5, 10, 20, 30, 60], # rolling windows size 'include': ['ROC', 'MA', 'STD'], # rolling operator to use #if include is None we will use default operators 'exclude': ['RANK'], # rolling operator not to use

}
}

class qlib.contrib.estimator.handler.**ConfigQLibDataHandler**(*start_date*, *end_date*, *processors=None*, ***kwargs*)

class qlib.contrib.estimator.handler.**ALPHA360**(*start_date*, *end_date*, *processors=None*, ***kwargs*)

class qlib.contrib.estimator.handler.**QLibDataHandlerV1**(*start_date*, *end_date*, *processors=None*, ***kwargs*)

setup_label()
load the labels df :return: df_labels

class qlib.contrib.estimator.handler.**QLibDataHandlerClose**(*start_date*, *end_date*, *processors=None*, ***kwargs*)

Model

class qlib.contrib.model.base.**Model**
Model base class

fit(*x_train*, *y_train*, *x_valid*, *y_valid*, *w_train=None*, *w_valid=None*, ***kwargs*)
fix train with cross-validation Fit model when ex_config.finetune is False

Parameters

- **x_train** (*pd.dataframe*) – train data

- **y_train** (*pd.dataframe*) – train label
- **x_valid** (*pd.dataframe*) – valid data
- **y_valid** (*pd.dataframe*) – valid label
- **w_train** (*pd.dataframe*) – train weight
- **w_valid** (*pd.dataframe*) – valid weight

Returns trained model

Return type *Model*

score(*x_test*, *y_test*, *w_test=None*, ***kwargs*)
evaluate model with test data/label

Parameters

- **x_test** (*pd.dataframe*) – test data
- **y_test** (*pd.dataframe*) – test label
- **w_test** (*pd.dataframe*) – test weight

Returns evaluation score

Return type float

predict(*x_test*, ***kwargs*)
predict given test data

Parameters **x_test** (*pd.dataframe*) – test data

Returns test predict label

Return type np.ndarray

save(*fname*, ***kwargs*)
save model

Parameters **fname** (*str*) – model filename

load(*buffer*, ***kwargs*)
load model

Parameters **buffer** (*bytes*) – binary data of model parameters

Returns loaded model

Return type *Model*

get_data_with_date(*date*, ***kwargs*)
Will be called in online module need to return the data that used to predict the label (score) of stocks at date.

:param

date: pd.Timestamp predict date

Returns data: the input data that used to predict the label (score) of stocks at predict date.

finetune(*x_train*, *y_train*, *x_valid*, *y_valid*, *w_train=None*, *w_valid=None*, ***kwargs*)
Finetune model In *RollingTrainer*:

if loader.model_index is None: If provide 'Static Model', based on the provided 'Static' model update. If provide 'Rolling Model', skip the model of load, based on the last 'provided model' update.

if loader.model_index is not None: Based on the provided model(loader.model_index) update.

In *StaticTrainer*:

If the load is 'static model': Based on the 'static model' update

If the load is 'rolling model': Based on the provided model(*loader.model_index*) update. If *loader.model_index* is None, use the last model.

Parameters

- **x_train** (*pd.dataframe*) – train data
- **y_train** (*pd.dataframe*) – train label
- **x_valid** (*pd.dataframe*) – valid data
- **y_valid** (*pd.dataframe*) – valid label
- **w_train** (*pd.dataframe*) – train weight
- **w_valid** (*pd.dataframe*) – valid weight

Returns finetune model

Return type *Model*

Strategy

class qlib.contrib.strategy.strategy.**StrategyWrapper**(*inner_strategy*)
StrategyWrapper is a wrapper of another strategy. By overriding some methods to make some changes on the basic strategy Cost control and risk control will base on this class.

class qlib.contrib.strategy.strategy.**AdjustTimer**
Responsible for timing of position adjusting

This is designed as multiple inheritance mechanism due to - the is_adjust may need access to the internel state of a strategyw - it can be reguard as a enhancement to the existing strategy

is_adjust(*trade_date*)
Return if the strategy can adjust positions on *trade_date* Will normally be used in strategy do trading with trade frequency

class qlib.contrib.strategy.strategy.**ListAdjustTimer**(*adjust_dates=None*)

is_adjust(*trade_date*)
Return if the strategy can adjust positions on *trade_date* Will normally be used in strategy do trading with trade frequency

class qlib.contrib.strategy.strategy.**WeightStrategyBase**(*order_generator_cls_or_obj=<class 'qlib.contrib.strategy.order_generator.OrderGenWI*
**args*, ***kwargs*)

generate_target_weight_position(*score*, *current*, *trade_date*)

Parameter: score : pred score for this trade date, pd.Series, index is stock_id, contain 'score' column current : current position, use Position() class trade_exchange : Exchange() trade_date : trade date generate target position from score for this date and the current position The cash is not considered in the position

generate_order_list(*score_series*, *current*, *trade_exchange*, *pred_date*, *trade_date*)

Parameter score_series : pd.Seires

stock_id , score

current [Position()] current of account

trade_exchange [Exchange()] exchange

trade_date [pd.Timestamp] date

class qlib.contrib.strategy.strategy.**TopkDropoutStrategy**(*topk*, *n_drop*, *method='bottom'*, *risk_degree=0.95*, *thresh=1*, *hold_thresh=1*, ***kwargs*)

get_risk_degree(*date*)

Return the proportion of your total value you will used in investment. Dynamically risk_degree will result in Market timing

generate_order_list(*score_series*, *current*, *trade_exchange*, *pred_date*, *trade_date*)

Gnererate order list according to score_series at trade_date. will not change current.

Parameter

score_series [pd.Seires] stock_id , score

current [Position()] current of account

trade_exchange [Exchange()] exchange

pred_date [pd.Timestamp] predict date

trade_date [pd.Timestamp] trade date

Evaluate

qlib.contrib.evaluate.**risk_analysis**(*r*, *N=252*)

Risk Analysis

Parameters

- **r** (*pandas.Series*) – daily return series
- **N** (*int*) – scaler for annualizing information_ratio (day: 250, week: 50, month: 12)

qlib.contrib.evaluate.**get_strategy**(*strategy=None*, *topk=50*, *margin=0.5*, *n_drop=5*, *risk_degree=0.95*, *str_type='amount'*, *adjust_dates=None*)

Parameters

- **strategy** (*Strategy()*) – strategy used in backtest
- **topk** (*int (Default value: 50)*) – top-N stocks to buy.
- **margin** (*int or float(Default value: 0.5)*) –

if isinstance(margin, int): sell_limit = margin

else: sell_limit = pred_in_a_day.count() * margin

buffer margin, in single score_mode, continue holding stock if it is in nlargest(sell_limit) sell_limit should be no less than topk

- **n_drop** (*int*) – number of stocks to be replaced in each trading date
- **risk_degree** (*float*) – 0-1, 0.95 for example, use 95% money to trade
- **str_type** (*'amount', 'weight' or 'dropout'*) – strategy type: TopkAmountStrategy ,TopkWeightStrategy or TopkDropoutStrategy

Returns

- *class: Strategy*
- *an initialized strategy object*

qlib.contrib.evaluate.**get_exchange**(*pred*, *exchange=None*, *subscribe_fields=[]*, *open_cost=0.0015*, *close_cost=0.0025*, *min_cost=5.0*, *trade_unit=None*, *limit_threshold=None*, *deal_price=None*, *extract_codes=False*, *shift=1*)

Parameters

- **exchange related arguments** (*#*) –
- **exchange** (*Exchange()*) –
- **subscribe_fields** (*list*) – subscribe fields
- **open_cost** (*float*) – open transaction cost
- **close_cost** (*float*) – close transaction cost
- **min_cost** (*float*) – min transaction cost
- **trade_unit** (*int*) – 100 for China A
- **deal_price** (*str*) – dealing price type: 'close', 'open', 'vwap'
- **limit_threshold** (*float*) – limit move 0.1 (10%) for example, long and short with same limit
- **extract_codes** (*bool*) – will we pass the codes extracted from the pred to the exchange. NOTE: This will be faster with offline qlib.

Returns

- *class: Exchange*
- *an initialized Exchange object*

qlib.contrib.evaluate.**backtest**(*pred*, *account=1000000000.0*, *shift=1*, *benchmark='SH000905'*, *verbose=True*, ***kwargs*)

This function will help you set a reasonable Exchange and provide default value for strategy :param # backtest workflow related or commmon arguments: :param pred: predict should has <instrument, datetime> index and one *score* column :type pred: pandas.DataFrame :param account: init account value :type account: float :param shift: whether to shift prediction by one day :type shift: int :param benchmark: benchmark code, default is SH000905 CSI 500 :type benchmark: str :param verbose: whether to print log :type verbose: bool :param # strategy related arguments: :param strategy: strategy used in backtest :type strategy: Strategy() :param topk: top-N stocks to buy. :type topk: int (Default value: 50) :param margin:

if isinstance(margin, int): sell_limit = margin

else: sell_limit = pred_in_a_day.count() * margin

buffer margin, in single score_mode, continue holding stock if it is in nlargest(sell_limit) sell_limit should be no less than topk

Parameters

- **n_drop** (*int*) – number of stocks to be replaced in each trading date
- **risk_degree** (*float*) – 0-1, 0.95 for example, use 95% money to trade
- **str_type** (*'amount', 'weight' or 'dropout'*) – strategy type: TopkAmountStrategy ,TopkWeightStrategy or TopkDropoutStrategy
- **exchange related arguments** (*#*) –
- **exchange** (*Exchange()*) – pass the exchange for speeding up.
- **subscribe_fields** (*list*) – subscribe fields
- **open_cost** (*float*) – open transaction cost. The default value is 0.002(0.2%).
- **close_cost** (*float*) – close transaction cost. The default value is 0.002(0.2%).
- **min_cost** (*float*) – min transaction cost
- **trade_unit** (*int*) – 100 for China A
- **deal_price** (*str*) – dealing price type: 'close', 'open', 'vwap'
- **limit_threshold** (*float*) – limit move 0.1 (10%) for example, long and short with same limit
- **extract_codes** (*bool*) – will we pass the codes extracted from the pred to the exchange.

Note: This will be faster with offline qlib.

---

qlib.contrib.evaluate.**long_short_backtest**(*pred*, *topk=50*, *deal_price=None*, *shift=1*, *open_cost=0*, *close_cost=0*, *trade_unit=None*, *limit_threshold=None*, *min_cost=5*, *subscribe_fields=[]*, *extract_codes=False*)

A backtest for long-short strategy

Parameters

- **pred** – The trading signal produced on day *T*
- **topk** – The short topk securities and long topk securities
- **deal_price** – The price to deal the trading
- **shift** – Whether to shift prediction by one day. The trading day will be T+1 if shift==1.
- **open_cost** – open transaction cost
- **close_cost** – close transaction cost
- **trade_unit** – 100 for China A
- **limit_threshold** – limit move 0.1 (10%) for example, long and short with same limit
- **min_cost** – min transaction cost
- **subscribe_fields** – subscribe fields

- **extract_codes** – bool will we pass the codes extracted from the pred to the exchange. NOTE: This will be faster with offline qlib.

Returns

The result of backtest, it is represented by a dict. { "long": long_returns(excess),

"short": short_returns(excess), "long_short": long_short_returns}

Report

qlib.contrib.report.analysis_position.report.**report_graph**(*report_df: pandas.core.frame.DataFrame*, *show_notebook: bool = True*) → [<class 'list'>, <class 'tuple'>]

display backtest report

Example:

```
from qlib.contrib.evaluate import backtest
from qlib.contrib.strategy import TopkDropoutStrategy

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 230
strategy = TopkDropoutStrategy(**sparas)

report_normal_df, _ = backtest(pred_df, strategy, **bparas)

qcr.report_graph(report_normal_df)
```

Parameters

- **report_df** – **df.index.name** must be **date**, **df.columns** must contain **return**, **turnover**, **cost**, **bench**

```
            return      cost      bench      turnover
date
2017-01-04  0.003421  0.000864  0.011693  0.576325
2017-01-05  0.000508  0.000447  0.000721  0.227882
2017-01-06 -0.003321  0.000212 -0.004322  0.102765
2017-01-09  0.006753  0.000212  0.006874  0.105864
2017-01-10 -0.000416  0.000440 -0.003350  0.208396
```

- **show_notebook** – whether to display graphics in notebook, the default is **True**

Returns if show_notebook is True, display in notebook; else return **plotly.graph_objs.Figure** list

qlib.contrib.report.analysis_position.score_ic.**score_ic_graph**(*pred_label: pandas.core.frame.DataFrame*, *show_notebook: bool = True*) → [<class 'list'>, <class 'tuple'>]

score IC

Example:

```
from qlib.data import D
from qlib.contrib.report import analysis_position
pred_df_dates = pred_df.index.get_level_values(level='datetime
↪')
features_df = D.features(D.instruments('csi500'), ['Ref($close,
↪ -2)/Ref($close, -1)-1'], pred_df_dates.min(), pred_df_dates.
↪max())
features_df.columns = ['label']
pred_label = pd.concat([features_df, pred], axis=1, sort=True).
↪reindex(features_df.index)
analysis_position.score_ic_graph(pred_label)
```

Parameters

- **pred_label** – index is **pd.MultiIndex**, index name is **[instrument, datetime]**; columns names is **[score, label]**

```
instrument      datetime        score       label
SH600004        2017-12-11      -0.013502       -0.013502
                2017-12-12  -0.072367       -0.072367
                2017-12-13  -0.068605       -0.068605
                2017-12-14  0.012440        0.012440
                2017-12-15  -0.102778       -0.102778
```

- **show_notebook** – whether to display graphics in notebook, the default is **True**

Returns if show_notebook is True, display in notebook; else return **plotly.graph_objs.Figure** list

qlib.contrib.report.analysis_position.cumulative_return.**cumulative_return_graph**(*position: dict*, *report_normal: pandas.core.frame.*, *label_data: pandas.core.frame.*, *show_notebook*, *start_date=Non*, *end_date=None* → Iterable[plotly.grap

Backtest buy, sell, and holding cumulative return graph

Example:

```
from qlib.data import D
from qlib.contrib.evaluate import risk_analysis, backtest, long_short_backtest
from qlib.contrib.strategy import TopkDropoutStrategy

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 5
strategy = TopkDropoutStrategy(**sparas)

report_normal_df, positions = backtest(pred_df, strategy, **bparas)

pred_df_dates = pred_df.index.get_level_values(level='datetime')
features_df = D.features(D.instruments('csi500'), ['Ref($close, -1)/$close - 1'], pred_df_dates.min(), pred_df_dates.max())
features_df.columns = ['label']

qcr.cumulative_return_graph(positions, report_normal_df, features_df)
```

Graph desc:

- Axis X: Trading day
- Axis Y:
- Above axis Y: *(((Ref($close, -1)/$close - 1) * weight).sum() / weight.sum()).cumsum()*
- Below axis Y: Daily weight sum
- In the **sell** graph, $y < 0$ stands for profit; in other cases, $y > 0$ stands for profit.
- In the **buy_minus_sell** graph, the **y** value of the **weight** graph at the bottom is *buy_weight + sell_weight*.
- In each graph, the **red line** in the histogram on the right represents the average.

Parameters

- **position** – position data
- **report_normal** –

	return	cost	bench	turnover
date				
2017-01-04	0.003421	0.000864	0.011693	0.576325
2017-01-05	0.000508	0.000447	0.000721	0.227882
2017-01-06	-0.003321	0.000212	-0.004322	0.102765
2017-01-09	0.006753	0.000212	0.006874	0.105864

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```
2017-01-10      -0.000416       0.000440        -0.003350
↪0.208396
```

- **label_data** – *D.features* result; index is *pd.MultiIndex*, index name is [*instrument*, *datetime*]; columns names is [*label*].

The label T is the change from T to T+1, it is recommended to use `close`, example: *D.features(D.instruments('csi500'), ['Ref($close, -1)/$close-1'])*

```
                                label
instrument      datetime
SH600004        2017-12-11      -0.013502
                2017-12-12      -0.072367
                2017-12-13      -0.068605
                2017-12-14      0.012440
                2017-12-15      -0.102778
```

Parameters

- **show_notebook** – True or False. If True, show graph in notebook, else return figures
- **start_date** – start date
- **end_date** – end date

Returns

qlib.contrib.report.analysis_position.risk_analysis.**risk_analysis_graph**(*analysis_df: pandas.core.frame.DataFrame = None*, *report_normal_df: pandas.core.frame.DataFrame = None*, *report_long_short_df: pandas.core.frame.DataFrame = None*, *show_notebook: bool = True*) → Iterable[plotly.graph_objs._figu

Generate analysis graph and monthly analysis

Example:

```
from qlib.contrib.evaluate import risk_analysis, backtest,␣
↪long_short_backtest
from qlib.contrib.strategy import TopkDropoutStrategy
from qlib.contrib.report import analysis_position

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 230
strategy = TopkDropoutStrategy(**sparas)

report_normal_df, positions = backtest(pred_df, strategy,␣
↪**bparas)
# long_short_map = long_short_backtest(pred_df)
# report_long_short_df = pd.DataFrame(long_short_map)

analysis = dict()
# analysis['pred_long'] = risk_analysis(report_long_short_df[
↪'long'])
# analysis['pred_short'] = risk_analysis(report_long_short_df[
↪'short'])
# analysis['pred_long_short'] = risk_analysis(report_long_
↪short_df['long_short'])
analysis['excess_return_without_cost'] = risk_analysis(report_
↪normal_df['return'] - report_normal_df['bench'])
analysis['excess_return_with_cost'] = risk_analysis(report_
↪normal_df['return'] - report_normal_df['bench'] - report_
↪normal_df['cost'])
analysis_df = pd.concat(analysis)

analysis_position.risk_analysis_graph(analysis_df, report_
↪normal_df)
```

Parameters

- **analysis_df** – analysis data, index is **pd.MultiIndex**; columns names is **[risk]**.

```
                                                    risk
excess_return_without_cost mean               0.000692
                           std                0.005374
                           annualized_return  0.174495
                           information_ratio  2.045576
                           max_drawdown      -0.079103
excess_return_with_cost    mean               0.000499
                           std                0.005372
                           annualized_return  0.125625
                           information_ratio  1.473152
                           max_drawdown      -0.088263
```

- **report_normal_df** – **df.index.name** must be **date**, df.columns must contain **return**, **turnover**, **cost**, **bench**

```
            return          cost            bench                ␣
↪turnover
```

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```
date
2017-01-04      0.003421        0.000864        0.011693
↪0.576325
2017-01-05      0.000508        0.000447        0.000721
↪0.227882
2017-01-06      -0.003321       0.000212        -0.004322
↪0.102765
2017-01-09      0.006753        0.000212        0.006874
↪0.105864
2017-01-10      -0.000416       0.000440        -0.003350
↪0.208396
```

- **report_long_short_df** – **df.index.name** must be **date**, df.columns contain **long**, **short**, **long_short**

```
            long            short           long_short
date
2017-01-04      -0.001360       0.001394        0.000034
2017-01-05      0.002456        0.000058        0.002514
2017-01-06      0.000120        0.002739        0.002859
2017-01-09      0.001436        0.001838        0.003273
2017-01-10      0.000824        -0.001944       -0.001120
```

- **show_notebook** – Whether to display graphics in a notebook, default **True** If True, show graph in notebook If False, return graph figure

Returns

qlib.contrib.report.analysis_position.rank_label.**rank_label_graph**(*position: dict*, *label_data: pandas.core.frame.DataFrame*, *start_date=None*, *end_date=None*, *show_notebook=True*) → Iterable[plotly.graph_objs._figure.Figure

Ranking percentage of stocks buy, sell, and holding on the trading day. Average rank-ratio(similar to **sell_df['label'].rank(ascending=False) / len(sell_df)**) of daily trading

Example:

```
from qlib.data import D
from qlib.contrib.evaluate import backtest
from qlib.contrib.strategy import TopkDropoutStrategy

# backtest parameters
bparas = {}
bparas['limit_threshold'] = 0.095
bparas['account'] = 1000000000

sparas = {}
sparas['topk'] = 50
sparas['n_drop'] = 230
strategy = TopkDropoutStrategy(**sparas)
```

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```
_, positions = backtest(pred_df, strategy, **bparas)

pred_df_dates = pred_df.index.get_level_values(level='datetime
↪')
features_df = D.features(D.instruments('csi500'), ['Ref($close,
↪ -1)/$close-1'], pred_df_dates.min(), pred_df_dates.max())
features_df.columns = ['label']

qcr.rank_label_graph(positions, features_df, pred_df_dates.
↪min(), pred_df_dates.max())
```

Parameters

- **position** – position data; **qlib.contrib.backtest.backtest.backtest** result
- **label_data** – **D.features** result; index is **pd.MultiIndex**, index name is **[instrument, datetime]**; columns names is **[label]**.

The label T is the change from T to T+1, it is recommended to use `close`, example: *D.features(D.instruments('csi500'), ['Ref($close, -1)/$close-1'])*

```
                            label
instrument      datetime
SH600004        2017-12-11      -0.013502
                2017-12-12      -0.072367
                2017-12-13      -0.068605
                2017-12-14      0.012440
                2017-12-15      -0.102778
```

Parameters

- **start_date** – start date
- **end_date** – end_date
- **show_notebook** – **True** or **False**. If True, show graph in notebook, else return figures

Returns

qlib.contrib.report.analysis_model.analysis_model_performance.**ic_figure**(*ic_df: pandas.core.frame.DataFrame*, *show_nature_day=True*, ***kwargs*) → plotly.graph_objs._figure.Fi

IC figure

Parameters

- **ic_df** – ic DataFrame
- **show_nature_day** – whether to display the abscissa of non-trading day

Returns plotly.graph_objs.Figure

qlib.contrib.report.analysis_model.analysis_model_performance.**model_performance_graph**(*pred_l* *pan-das.co* *lag: int* = *1,* *N: int* = *5,* *re-verse=* *rank=* *graph_list* = *['grou* *'pred_* *'pred_* *show_* *bool* = *True,* *show_* → [<class 'list'>, <class 'tu-ple'>]

Model performance

Parameters

- **pred_label** – index is **pd.MultiIndex**, index name is **[instrument, datetime]**; columns names is **[score, label]**

```
instrument      datetime        score       label
SH600004        2017-12-11      -0.013502       -0.013502
            2017-12-12  -0.072367       -0.072367
            2017-12-13  -0.068605       -0.068605
            2017-12-14  0.012440        0.012440
            2017-12-15  -0.102778       -0.102778
```

- **lag** – *pred.groupby(level='instrument')['score'].shift(lag).* It will be only used in the auto-correlation computing.
- **N** – group number, default 5
- **reverse** – if *True*, *pred['score'] *= -1*
- **rank** – if **True**, calculate rank ic
- **graph_names** – graph names; default ['cumulative_return', 'pred_ic', 'pred_autocorr', 'pred_turnover']
- **show_notebook** – whether to display graphics in notebook, the default is *True*

- **show_nature_day** – whether to display the abscissa of non-trading day

Returns if show_notebook is True, display in notebook; else return *plotly.graph_objs.Figure* list

1.16 Changelog

Here you can see the full list of changes between each QLib release.

1.16.1 Version 0.1.0

This is the initial release of QLib library.

1.16.2 Version 0.1.1

Performance optimize. Add more features and operators.

1.16.3 Version 0.1.2

- Support operator syntax. Now `High() - Low()` is equivalent to `Sub(High(), Low())`.
- Add more technical indicators.

1.16.4 Version 0.1.3

Bug fix and add instruments filtering mechanism.

1.16.5 Version 0.2.0

- Redesign `LocalProvider` database format for performance improvement.
- Support load features as string fields.
- Add scripts for database construction.
- More operators and technical indicators.

1.16.6 Version 0.2.1

- Support registering user-defined `Provider`.
- Support use operators in string format, e.g. `['Ref($close, 1)']` is valid field format.
- Support dynamic fields in `$some_field` format. And exising fields like `Close()` may be deprecated in the future.

1.16.7 Version 0.2.2

- Add `disk_cache` for reusing features (enabled by default).
- Add `qlib.contrib` for experimental model construction and evaluation.

1.16.8 Version 0.2.3

- Add `backtest` module
- Decoupling the Strategy, Account, Position, Exchange from the backtest module

1.16.9 Version 0.2.4

- Add `profit attribution` module
- Add `rick_control` and `cost_control` strategies

1.16.10 Version 0.3.0

- Add `estimator` module

1.16.11 Version 0.3.1

- Add `filter` module

1.16.12 Version 0.3.2

- Add real price trading, if the `factor` field in the data set is incomplete, use `adj_price` trading
- Refactor `handler` `launcher` `trainer` code
- Support `backtest` configuration parameters in the configuration file
- Fix bug in position `amount` is 0
- Fix bug of `filter` module

1.16.13 Version 0.3.3

- Fix bug of `filter` module

1.16.14 Version 0.3.4

- Support for `finetune model`
- Refactor `fetcher` code

1.16.15 Version 0.3.5

- Support multi-label training, you can provide multiple label in `handler`. (But LightGBM doesn't support due to the algorithm itself)
- Refactor `handler` code, dataset.py is no longer used, and you can deploy your own labels and features in `feature_label_config`
- Handler only offer DataFrame. Also, `trainer` and model.py only receive DataFrame
- Change `split_rolling_data`, we roll the data on market calender now, not on normal date

- Move some date config from `handler` to `trainer`

1.16.16 Version 0.4.0

- Add *data* package that holds all data-related codes
- Reform the data provider structure
- Create a server for data centralized management **'qlib-server<https://amc-msra.visualstudio.com/trading-algo/_git/qlib-server>'_**
- Add a *ClientProvider* to work with server
- Add a pluggable cache mechanism
- Add a recursive backtracking algorithm to inspect the furthest reference date for an expression

---

Note: The `D.instruments` function does not support `start_time`, `end_time`, and `as_list` parameters, if you want to get the results of previous versions of `D.instruments`, you can do this:

```
>>> from qlib.data import D
>>> instruments = D.instruments(market='csi500')
>>> D.list_instruments(instruments=instruments, start_time='2015-01-01', end_time=
↪'2016-02-15', as_list=True)
```

1.16.17 Version 0.4.1

- Add support Windows
- Fix `instruments` type bug
- Fix `features` is empty bug(It will cause failure in updating)
- Fix `cache` lock and update bug
- Fix use the same cache for the same field (the original space will add a new cache)
- Change "logger handler" from config
- Change model load support 0.4.0 later
- The default value of the `method` parameter of `risk_analysis` function is changed from **ci** to **si**

1.16.18 Version 0.4.2

- Refactor DataHandler
- Add `ALPHA360` DataHandler

1.16.19 Version 0.4.3

- Implementing Online Inference and Trading Framework
- Refactoring The interfaces of backtest and strategy module.

1.16.20 Version 0.4.4

- Optimize cache generation performance
- Add report module
- Fix bug when using `ServerDatasetCache` offline.
- In the previous version of `long_short_backtest`, there is a case of `np.nan` in long_short. The current version `0.4.4` has been fixed, so `long_short_backtest` will be different from the previous version.
- In the `0.4.2` version of `risk_analysis` function, `N` is `250`, and `N` is `252` from `0.4.3`, so `0.4.2` is `0.002122` smaller than the `0.4.3` the backtest result is slightly different between `0.4.2` and `0.4.3`.
- **refactor the argument of backtest function.**
  - **NOTE**: - The default arguments of topk margin strategy is changed. Please pass the arguments explicitly if you want to get the same backtest result as previous version. - The TopkWeightStrategy is changed slightly. It will try to sell the stocks more than `topk`. (The backtest result of TopkAmountStrategy remains the same)
- The margin ratio mechanism is supported in the Topk Margin strategies.

1.16.21 Version 0.4.5

- **Add multi-kernel implementation for both client and server.**
  - Support a new way to load data from client which skips dataset cache.
  - Change the default dataset method from single kernel implementation to multi kernel implementation.
- Accelerate the high frequency data reading by optimizing the relative modules.
- Support a new method to write config file by using dict.

1.16.22 Version 0.4.6

- **Some bugs are fixed**
  - The default config in *Version 0.4.5* is not friendly to daily frequency data.
  - Backtest error in TopkWeightStrategy when *WithInteract=True*.

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