

risk_dash

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Overview

risk_dash is a framework to help simplify the data flow for a portfolio of assets and handle market risk metrics at the asset and portfolio level. If you clone the source repository, included is a Dash application to be an example of some of the uses for the package. To run the Dash app, documentation is [here](#)

Installation

Since the package is in heavy development, to install the package fork or clone the repository and run `pip install -e risk_dash/` from the directory above your local repository.

To see if installation was successful run `python -c 'import risk_dash; print(*dir(risk_dash), sep="\n")'` in the command line, currently the output should match the following:

```
$ python -c 'import risk_dash; print(*dir(risk_dash), sep="\n")'
__builtins__
__cached__
__doc__
__file__
__loader__
__name__
__package__
__path__
__spec__
market_data
name
securities
simgen
```

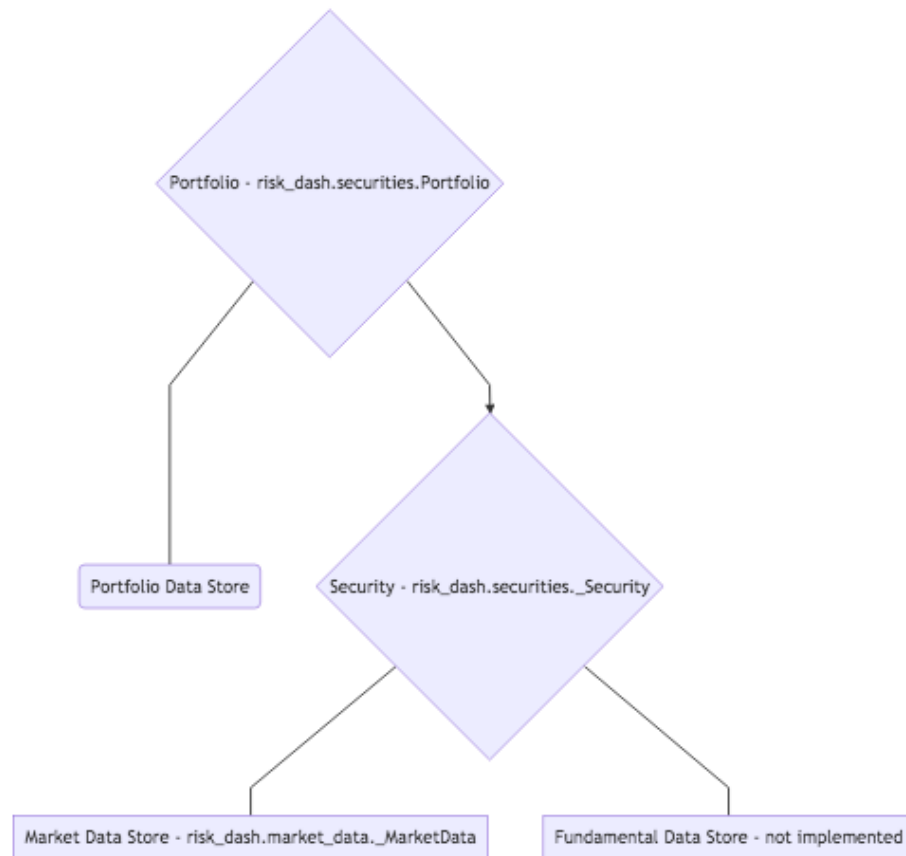
Getting Started

Now that we have the package installed, let's go through the object workflow to construct a simple long/short equity portfolio.

High level, we need to specify:

1. Portfolio Data
 - We need to know what's in the portfolio
 - Portfolio weights
 - Types of Assets/Securities
2. Security data
 - We need to know what is important to financially model the security
 - Identification data: Ticker, CUSIP, Exchange
 - Security specific data: expiry, valuation functions
 - Market data: Closing prices, YTM
3. Portfolio/security constructors to handle the above data

To visualize these constructors, the below chart shows how to



To do so, we'll need subclasses for the `_Security` and `_MarketData` classes to model specific types of securities. Currently supported is the `Equity` subclass. Once we have the portfolio constructed, we will specify and calculate parameters to simulate or look at historic distributions. We'll then create a subclass of

`_Simulation` and `_RandomGen`

Security data, `_Security` objects, and creating Security Subclasses

The core of the package is in the `_Security` and `Portfolio` objects. `Portfolio` objects are naturally a collection of `Securities`, however we want to specify the type of securities that are in the portfolio. Since we're focusing on a long/short equity portfolio we want to create an `Equity` subclass.

Subclasses of `_Security` classes must have the following methods:

- `valuation(current_price)`
- `mark_to_market(current_price)`
- `get_marketdata()`

In addition, we want to pass them the associated `_MarketData` object to represent the security's historic pricing data. To build the `Equity` subclass, we first want to inherit any methods from the `_Security` class:

```
class Equity(_Security):

    def __init__(
        self,
        ticker,
        market_data : md.QuandlStockData,
        ordered_price,
        quantity,
        date_ordered
    ):
        self.name = ticker
        self.market_data = market_data
        self.ordered_price = ordered_price
        self.quantity = quantity
        self.initial_value = ordered_price * quantity
        self.date_ordered = date_ordered
        self.type = 'Equity'
```

To break down the inputs, we want to keep in mind that the goal of this subclass of the `_Security` object is to provide an interface to model the `Equity` data.

- `ticker` is going to be the ticker code for the equity, such as 'AAPL'
- `market_data` is going to be a subclass of the `_MarketData` object
- `ordered_price` is going to be the price which the trade occurred
- `quantity` for `Equity` will be the number of shares
- `date_ordered` should be the date the order was placed

Note: Currently the implemented `_MarketData` subclass is `QuandlStockData`, which is a wrapper for this Quandl dataset api. This

data is no longer being updated, for current market prices you must create a `__MarketData` subclass for your particular market data. Information to construct the subclass is below.

Required Inputs at the `__Security` level are intentionally limited, for example if we wanted to create a class for Fixed Income securities, we would want more information than this Equity subclass. An example Bond class might look like this:

```
class Bond(__Security):
    def __init__(
        self,
        CUSIP,
        market_data,
        expiry,
        coupon,
        frequency,
        settlement_date,
        face_value
    ):
        self.name = CUSIP
        self.market_data = market_data
        self.expiry = expiry
        self.coupon = coupon
        self.frequency = frequency
        self.settlement_date = settlement_date
        self.face_value = face_value
        self.type = 'Bond'
```

Similarly to the Equity subclass, we want identification information, market data, and arguments that will either help in calculating valuation, current returns, or risk measures.

Returning to the Equity subclass, we now need to write the valuation and mark to market methods:

```
class Equity(__Security):
    # ...
    def valuation(self, price):
        value = (price - self.ordered_price) * self.quantity
        return(value)

    def mark_to_market(self, current_price):
        self.market_value = self.quantity * current_price
        self.marked_change = self.valuation(current_price)
        return(self.marked_change)
```

For linear instruments such as equities, valuation of a position is just the price observed minus the price ordered at the size of the position. `valuation` is then

used to pass a hypothetical price into the valuation function, in this case (Price - Ordered) * Quantity, where as `mark_to_market` is used to pass the current EOD price and mark the value of the position. This is an important distinction, if we had a nonlinear instrument such as a call option on a company's equity price, the valuation function would then be:

$$Value = \min\{0, S_T - K\}$$

Where S_T is the spot price for the equity at expiry and K is the agreed strike price. Valuation also is dependent on time for option data, however if you were to use a binomial tree to evaluate the option, you would want to use this same value function and discount the value at each node back to time=0.

Our mark to market then would need to make the distinction between this valuation and the current market price for the call option. The mark would then keep track of what the current market value for the option to keep track of actualized returns.

The final piece to creating the Equity subclass is then to add a `get_marketdata()` method. Since we just want a copy of the reference of the `market_data`, we can just inherit the `get_marketdata()` from the `_Security` class.

The Equity subclass is already implemented in the package, we can create an instance from `risk_dash.securities`. Let's make an instance that represents an order of 50 shares at close on March 9th, 2018:

```
>>> from risk_dash.market_data import QuandlStockData
>>> from risk_dash.securities import Equity
>>> from datetime import datetime
>>> apikey = 'valid-quandl-apikey'
>>> aapl_market_data = QuandlStockData(
    apikey = apikey,
    ticker = 'AAPL'
)
>>> aapl_stock = Equity(
    ticker = 'AAPL',
    market_data = aapl_market_data,
    ordered_price = 179.98,
    quantity = 50,
    date_ordered = datetime(2018,3,9)
)
>>> aapl_stock.valuation(180.98) # $1 increase in value
50.0
>>> aapl_stock.mark_to_market(180.98) # Same $1 increase
50.0
>>> aapl_stock.market_value
9049.0
```

```
>>> aapl_stock.marked_change
50.0
>>> vars(aapl_stock)
{'name': 'AAPL',
 'market_data': <risk_dash.market_data.QuandlStockData at 0x1147c2668>,
 'ordered_price': 179.98,
 'quantity': 50,
 'initial_value': 8999.0,
 'date_ordered': datetime.datetime(2018, 3, 9, 0, 0),
 'type': 'Equity',
 'market_value': 9049.0,
 'marked_change': 50.0}
```

As we can see `aapl_stock` now is a container that we can use to access it's attributes at the Portfolio level.

Note: Another important observation is that the Equity subclass will only keep a reference to the underlying `QuandlStockData`, which will minimize duplication of data. However, at scale, you'd want minimize price calls to your data source, you could then do one call at the Portfolio level then pass a reference to that `market_data` at the individual level. Then your Equity or other `_Security` subclasses can share the same `_MarketData`, you would then just write methods to interact with that data.

Now that we have a feeling for the `_Security` class, we now want to build a Portfolio that contains the `_Security` instances.

Portfolio Data and creating a Portfolio Object

To iterate on what we said before, an equity position in your portfolio is represented by the quantity you ordered, the price ordered at, and when you ordered or settled the position. In this example, we'll use the following theoretical portfolio found in `portfolio_example.csv`:

Type	Ticker	Ordered Price	Ordered Date	Quantity
Equity	AAPL	179.98	3/9/18	50
Equity	AMD	11.7	3/9/18	100
Equity	INTC	52.19	3/9/18	-50
Equity	GOOG	1160.04	3/9/18	5

With this example, the portfolio is static, or just one snap shot of the weights at a given time. In practice, it might be useful to have multiple snapshots of your portfolio, one's portfolio would be changing as positions enter and leave thus having a time dimensionality. The Portfolio class could be easily adapted

to handle that information to accurately plot historic performance by remarking through time. This seems more of an accounting exercise, risk metrics looking forward would probably still only want to account for the current positions in the portfolio. Due to this insight, the current Portfolio class only looks at one snap shot in time.

With a portfolio so small, it is very easily stored in a csv and each security can store the reference to the underlying market data independently. As such, there is an included portfolio constructor method in the portfolio class from csv, `construct_portfolio_csv`:

```
>>> from risk_dash.securities import Portfolio
>>> current_portfolio = Portfolio()
>>> port_dict = current_portfolio.construct_portfolio_csv(
    data_input='portfolio_example.csv',
    apikey=apikey
)
>>> vars(current_portfolio)
{'port': {'AAPL Equity': <risk_dash.securities.Equity at 0x11648b5c0>,
  'AMD Equity': <risk_dash.securities.Equity at 0x116442c50>,
  'INTC Equity': <risk_dash.securities.Equity at 0x1177b75c0>,
  'GOOG Equity': <risk_dash.securities.Equity at 0x1177bc390>}}
>>> vars(current_portfolio.port['AMD Equity'])
{'name': 'AMD',
 'market_data': <risk_dash.market_data.QuandlStockData at 0x11648b2e8>,
 'ordered_price': 11.699999999999999,
 'quantity': 100,
 'initial_value': 1170.0,
 'date_ordered': '3/9/18',
 'type': 'Equity'}
```

At this moment, the `current_portfolio` instance is only a wrapper for it's port attribute, a dictionary containing the securities in the Portfolio object. Soon we'll use this object to mark the portfolio, create a simulation to estimate value at risk, look at the covariance variance matrix to calculate a parameterized volatility measure, and much more.

The `Portfolio` class handles interactions with the portfolio data and the associated securities in the portfolio. If you have a list of securities you can also just pass the list into the Portfolio instance. The following code creates a portfolio of just the AAPL equity that we created earlier:

```
>>> aapl_portfolio = sec.Portfolio([aapl_stock])
>>> vars(aapl_portfolio)
{'port': {'AAPL Equity': <risk_dash.securities.Equity at 0x1164b2e80>}}
```

If we want to add a security to this portfolio, we can call the `add_security` method, to remove a security we call the `remove_security` method:

```

>>> amd_market_data = sec.QuandlStockData(
    ticker='AMD',
    apikey=apikey
)
>>> amd_stock = sec.Equity(
    ticker = 'AAPL',
    market_data = amd_market_data,
    ordered_price = 11.70,
    quantity = 100,
    date_ordered = datetime(2018,3,9)
)
>>> aapl_portfolio.add_security(amd_stock)
>>> aapl_portfolio.port
{'AAPL Equity': <risk_dash.securities.Equity at 0x1164b2e80>,
 'AMD Equity': <risk_dash.securities.Equity at 0x11791cc88>}
>>> aapl_portfolio.remove_security(amd_stock)
>>> aapl_portfolio.port
{'AAPL Equity': <risk_dash.securities.Equity at 0x1164b2e80>}
>>> aapl_portfolio.remove_security(aapl_stock)
>>> aapl_portfolio.port
{}

```

Calculating Risk Metrics and Using the Portfolio class

risk_dash Dash application documentation

Overview

The included Dash application is purely to demonstrate a use case for the risk_dash package. There is minimal css provided through using Bootstrap

Getting Started

**** __Security(*name*, *market_data*, kwargs)**

Generic class for Security objects, shouldn't externally be used

Parameters

name : string identifier for security, i.e. 'AAPL'

market_data : MarketData object reference for the Market Data associated with the Security

****kwargs** : Generic arguments

Attributes

Attribute	Description
-----------	-------------

Portfolio(*securities=None, input=None, apikey=None*)

Main handler for portfolio data. A Portfolio is a collection of Security objects in the `port` dictionary.

Parameters

securities : array-like of Security objects - should contain all securities in portfolio

input : either `pandas.core.frame.DataFrame` or string for csv input path for the method `construct_portfolio_csv(input, apikey)`

apikey : String for quandl apikey for the method `construct_portfolio_csv(input, apikey)`

Attributes

Attribute	Description
<code>port</code>	dict of all securities in Portfolio

Methods

Method	Description
<code>value()</code>	calculate the current valuation of the portfolio
<code>mark()</code>	mark the portfolio at the current market price
<code>get_date()</code>	grab the max date available

Method	Description
set_portfolio_marketdata()	combines individual security market_data into one pandas DataFrame
set_port_variance()	variance of portfolio variance using weights and covariance matrix
set_weights()	set the portfolio weights by invested value
construct_portfolio_csv(input, apikey)	construct portfolio from a .csv matching format portfolio_example.csv
get_portfolio_marketdata()	return market_data object
get_weights()	return portfolio weights
get_port_return_csv()	return value weighted portfolio

value()

mark()

get_date()

set_portfolio_marketdata()*