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Quantitative Analyst – Assignment

Quantitative Scenario Analytics Team

This test assesses your quantitative and programming skills. The test is designed to be fully completed within one week. Take the time to solve the two problems listed below and submit detailed and well documented answers (code, documentation, data, etc.). Bear in mind that all exercises and information disclosed at the interviews with UBS are confidential and must not be shared or disclosed with anyone nor in any websites.

1. Model development

The attached csv-file (HistoricalData.csv) contains historical time series of different variables with start date of January 1980 and end date of December 2018. The US variables are two equity indices (index level points), VIX index (index level points), CPI (index level points), Libor rate (in %), HPI (index level points) and 5Y CDS (in %). Please complete the following tasks and provide your code in line with coding standards (preferably in **Python**).

1. Read the data from the csv file into a data format of your choice.
2. Preprocess data. Do not use any outlier detection or missing data package. You are free with respect to the methodology you choose and criterion. However, ensure that the approach is economically and statistically plausible.
3. Select and build a simple quarterly model that explains the VIX index by one or more variables provided.
4. Provide and explain **all** the steps and details of your modelling approach as well as model performance.

Include a short justification for all of your choices.

2. Model implementation

The purpose of this exercise is to build an application, Economic Scenario Expansion Simulator (ESES), that simulates future paths of the volatility index under specific economic scenarios.

We provide, in Appendix A, the details of the following csv-files as inputs to ESES:

- *EconomicScenario.csv*
- *Metadata.csv*

We provide, in Appendix B, the details of the ESES application framework in Python using object oriented programming.

- *ESESFramework.py*

Complete the following tasks and provide your code in line with coding standards, as well as the output of the executed code.

1. Implement the VIX scenario expansion model that you developed in the previous exercise in *ESESFramework.py* (see Appendix B for further details)

2. Generate a 9 quarters forecast of the VIX using *EconomicScenario.csv* as an input (see output sample in Appendix C)

Appendix A: Scenario and meta data files

EconomicScenario.csv. Scenario file consists of three columns:

1. ***Variable***: ticker representing the explanatory variable, where the STARTDATE indicates the start date of scenario forecasts (i.e. the last historical data point available)
2. ***TimeStamp***: refers to the periods of the scenario forecasts (i.e. 1Q means first quarter, 2Q means second quarter)
3. ***Value***: the forecasted value of the variable as provided in the scenario

Metadata.csv. Meta Data file consists of five columns:

1. ***Variable***: ticker representing the explanatory variable
2. ***Specification***: description of the variable (i.e. country, tenor, aggregation type)
3. ***Description***: explanatory variable
4. ***Unit***: unit of the variable
5. ***ForecastType***: type of the variable (Hint on suggested transformations: log-differences for absolute and log-returns for relative)

Appendix B: ESES framework in Python

1. Use the Python script (*ESESFramework.py*) attached in order to complete this assignment
2. ESES application framework uses object oriented programming (OOP) class in Python, with a generic parent class and a child VIX class attached
3. Add and/or modify (if needed) **methods** in the framework in order to complete the implementation of, and successfully run, the scenario expansion model.

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Appendix C: Scenario output sample

1. Based on the quarterly model inputs run scenario forecast for the given time horizon
2. Below we provide an example of 9 quarter scenario forecast of the VIX:

TimeStamp	*VIX*
0	0.25
1Q	0.43
2Q	0.44
3Q	0.39
4Q	0.32
5Q	0.26
6Q	0.22
7Q	0.20
8Q	0.18
9Q	0.17

3. Note the following:
   - The final output of your model's scenario forecast should be in the format shown in the table above
   - The values provided in the table are only for illustration purposes and may not reflect the expected values of the forecast.