Counterparty Credit Risk Exercises Day 1

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1 Getting the Data

Exercise 1. *Create a Pandas data frame containing historical FX rates from Jan 1 2013 - Dec 31 2015 for each of the 7 major currencies (EUR/JPY/USD/GBP/CHF/AUD/CAD). We will use GBP as our base currency, so the values in each series should be the amount of that currency that is equal to 1 GBP.*

You can get historical data for these currencies from various places online. For example, the ECB has rates going back to 1999 on its website `https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/index.en.html`.

Exercise 2. *Calculate the log returns of the currencies from Exercise 1. Calculate the correlation matrix of these log returns.*

We'll focus on the GBP/EUR exchange rate for the rest of today. The next exercise is to generate a year's worth of values for this exchange rate.

Exercise 3. *Assuming the log returns follow a Gaussian random walk (ie, the change in the log return is normally distributed with mean zero), and using the historical data from the previous three years, generate a Pandas dataframe of 1000 simulations of the GBP/EUR FX rates for Jan 1 2016 - Dec 31 2016.*

We will only generate prices for working days (non-weekends). There were 261 working days in 2016, so your Dataframe should be 261×1000.

2 Pricing a Trade

Exercise 4. *Create an FXForward class, which contains the required information to price an FX Forward (at least: the currencies of the two legs, the amounts of each currency, and the dates on which the legs are to be paid).*

Exercise 5. *Add a function to your Trade class that will give the price of the trade give the exchange rates between the two currency legs on the exchange dates as an input.*

Exercise 6. *Add a function to your trade class which will take an input the Dataframe we created in exercise 3 and return a Dataframe of valuations for the trade.*

Once again, we want a valuation for every time we simulated the FX rate, so this Dataframe should be 261×1000.

3 Risk Metrics

Exercise 7. *Create a function which takes an $m \times n$ Dataframe, and returns an $m \times 1$ Dataframe (or a Series of length m) with the Expected Exposure of the valuations in the input.*

Exercise 8. *Create a function which takes as input an $m \times n$ Dataframe and a percentile p, $(0 < p < 100)$, and returns an $m \times 1$ Dataframe (or a Series of length m) with the p^{th} percentile of the valuations in the input.*

We now have a simple counterparty credit risk calculator - we can create a portfolio of trades using the class you created in Exercise 4 and simulate the risk on these trades over a year. In the next set of exercises, we will think about what we need to add to this to simulate trades on more than one currency pair.

Exercise 9. *Generate a portfolio of trades which expire throughout 2016, and use the solutions to the previous three exercises to generate PFE and EE curves for this portfolio. Plot the curves, and comment on their shapes.*

4 Multiple Currencies

In Exercise 2 we calculated a correlation matrix for the 7 major currencies. We now want to price trades denominated in each of these different currencies, and we want to make sure that our simulation preserves the correlations between the currency pairs.

We will do this using the Cholesky decomposition.