MF 803: Advanced Programming for Mathematical Finance

Professor Chris Kelliher   Fall 2018

Problem set # 5

Due: Wednesday, October 30th, by 6:30pm.

1. **Yield Curve Construction:**

   Consider the following table of USD swap rates:

1Y	2.8438
2Y	3.060
3Y	3.126
4Y	3.144
5Y	3.150
7Y	3.169
10Y	3.210
30Y	3.237

   Note: You may assume that these swaps pay coupons semi-annually (every 6 months). For simplicity, you may use a year fraction of 0.5 in all swap coupon payments.

   (a) Extract the constant forward rate for the first year that enables you to match the 1Y market swap rate.

   (b) Holding this first year forward rate fixed, find the forward rate from one year to two years that enables you to match the two year swap (while also matching the one year).

   (c) Continue this process and extract piecewise constant forward rates for the entire curve. Comment on the forward rates vs. the swap rates.

   (d) Compute the fair market, breakeven swap rate of a 15Y swap. That is, find the swap rate that equates the present values of the fixed and floating legs.

   (e) Compute discount factors. Compute zero rates by finding the constant rate that leads to the calibrated discount factors. Comment on the differences in the zero rates and swap rates.

   (f) Shift all forward rates up 100 basis points and re-calculate the breakeven swap rates for each benchmark point. Generate a table of new swap rates. Are these rates equivalent to having shifted the swap rates directly?

   (g) Consider a bearish steepener to the swap rates, that is perform the following shifts on each swap rate:

1Y	+0 bps
2Y	+0 bps
3Y	+0 bps
4Y	+5 bps
5Y	+10 bps
7Y	+15 bps
10Y	+25 bps
30Y	+50 bps

Print the new swap rates.

(h) Re-run your bootstrapping procedure with this new curve. Comment on the changes to the forward rates.

(i) Consider a bull steepener to the swap rates, that is perform the following shifts on each swap rate:

1Y	-50 bps
2Y	-25 bps
3Y	-15 bps
4Y	-10 bps
5Y	-5 bps
7Y	+0 bps
10Y	+0 bps
30Y	+0 bps

Print the new swap rates.

(j) Re-run your bootstrapping procedure with this new curve. Comment on the changes to the forward rates.

NOTE: All code for completing these exercises should be completed either in Python or C++ and should be written generically. You may end up using this code on future assignments so I encourage you to code thoughtfully.