# Interest Rate Models

## Programming Assignment #1

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The purpose of this assignment is to build the LIBOR and OIS curves based on the actual closing market data as of December 13, 2011 (please see the enclosed Excel spreadsheet DataSheetCurve.xls), and use it for pricing swaps. I suggest that you:

(A) Use Excel as your front end (but by no means you have to do it if you prefer other formats). Excel comes with graphing capabilities, and a number of date functions that will allow you generate the relevant dates and day count fractions for both 30/360 and act/360 conventions (you should not try do it yourself!). You can easily find these functions in the category "Date & Time" of Excel functions.

(B) Ignore the holidays and end of the month issues (I chose the date so that that latter should not be an issue). This will lead to small inaccuracies but is going to be good enough.

(C) All your functions should preferably be programmed in C++ or C#. In order to establish an interface in Excel (if you use it) you may want to use the open source package XLW (http://xlw.sourceforge.net). You can also use VBA for Excel or Matlab but your code will run slower.

(D) Don't delete your files, you will need them later.

**Problems**

1. Develop a small library implementing B-splines. This library should be capable of calculating the derivatives and integrals of the basis functions. Make sure that you take a full advantage of the recursive properties of the basis functions. Pay attention to computational performance issues: (i) cashe data whenever appropriate, (ii) take advantage of the support properties of the basis functions.

2. Build a function that computes the discount factor between any two dates.

3. Build a function that computes the forward LIBOR rate for any settlement and underlying tenor.

4. Build a function that computes the (spot or forward) swap rate for any settlement and underlying tenor.

5. Use the enclosed market data sheet and the method described in class to build the instantaneous OIS and LIBOR curves. Make sure that three of the knot points of the B-spline lie to the left of $t_0$, choose $t_0 = 0$, choose $t_N$ to be close to 30 (say, $t_N = 31$), and make sure that there are four auxiliary knot points to the right of $t_N$. Experiment with the positions of the knot points using the following guidelines: (a) $N$ should be around 10 - 12, (b) they should be close to each other in the short end of the curve and get sparser as we move further out. In order to complete the task you will need an optimizer: you can write your own Newton-Raphson style search algorithm or (even better) use Excel's Solver, Matlab's optimizer, etc. Plot the resulting curves.

6. Build a function that calculates the PV of any spot or forward starting swap based on your curves.

**This assignment is due on March 26**