Assignment 7
Structured Products

1. Case Study: Structured bond

On the 16 Sep 2011, the Bank XX issues a structured bond, whose hedging termsheet is described in the annex. Determine the upfront X% in the Structured bond issue, in a single-curve interest rate modeling setting, and neglecting the counterparty risk. Market parameters for Depo & Swap Rates, Cap Volatilities and payment dates can be found in the SpreadSheet CapData.xls.

2. Exercise: Pricing

Compute call prices C according to a NIG model with parameters $\sigma = 25\%; \kappa = 1; \eta = 5;$ t=1; for moneyness x between -20% and 20% (in a grid with 1% steps). F_0 , discount and ttm are the values in the Assignment 6. Compute prices according to the following methods:

a. FFT;

b. Quadrature;

c. MonteCarlo.

d. Facultative: Consider a VG model with same parameters (same values for a different model). Compute C with FFT. Comment the results: Do you observe significant differences with NIG results?

3. Case study: Volatility surface calibration

Calibrate NIG model parameters considering EUROSTOXX 50 volatility surface via a global calibration with constant weights. F_0 , discount and ttm are the values in the Assignment 6.
Plot implied volatility obtained with the model and compare it with market's one.

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Exercise 9.1, Annex:

Indicative Terms and Conditions as of 16 September 2011

Swap Termsheet

Principal Amount (N):	50 MIO EUR
Party A:	Bank XX
Party B:	I.B.
Trade date:	today
Start Date:	20 Sep 2011
Maturity Date (t):	6 years after the Start Date, subject to the Following Business Day Convention.

Party A pays:	Euribor 6m + 1.10%
Party A payment dates:	Semiannually, subject to Modified Business Convention
Daycount:	Act/360

Party B pays @ Start Date:	X% of the Principal Amount
Party B pays @ Maturity Date:	Coupon
Party B payment dates:	Semiannually, subject to Modified Business Convention
First Semester Coupon:	3%
Next Semester Coupons:	[Up to (and including) the third year] Euribor 6m+ 1.10% capped at 4.20% [After the third year] Euribor 6m+ 1.10% capped at 4.60%

Function signatures:

capletVolatilities = CapletFromCapVolatilities(capVolatilityData, discountCurve) with

capVolatilityData, struct containing:	maturities:	vector of cap maturities
	strikes:	vector of fixed strikes
	atm:	vector with the cap volatilities for the ATM strike
	surface:	matrix (length(strikes) x length(maturities)) with the cap volatilities
	payment_dates:	vector with the payment dates of the underlying caplets (except for first element which is the fixing date of the first caplet)
discountCurve, struct containing:	dates:	vector with dates associated to discount factors. The first date is the settlement date.
	discounts:	vector of discounts. The first one is 1.
capletVolatilities:		Matrix (length(strikes) x length(payment_dates) - 1) with caplet volatilitites

upfront = certificatePricing(certificate, discountCurve, capletVolatilityData) with

certificate, struct containing:	setDate:	settlement date (and certificate start date)
	maturity:	Maturity
	fixingEUR6M:	Fixing EURIBOR 6M at settlement date, i.e. 1.736%
	spol:	spread over Libor
	flagYearfrac:	flag for yearfrac conv. (floating leg): 2 for Act/360
discountCurve, struct containing:	dates:	vector with dates associated to discount factors. The first date is the settlement date.
	discounts:	vector of discounts. The first one is 1.
capletVolatilityData:	strikes:	vector of fixed strikes
	fixings:	vector of fixing dates associated to the caplets
	surface:	matrix (identical to capletVolatilities from previous exercise)

prices = CallPricesNIGFFT(forward, discount, moneyness, timeToMaturity, sigma, k, eta, numericalMethodParameters)
prices = CallPricesNIGQuadrature(forward, discount, moneyness, timeToMaturity, sigma, k, eta, numericalMethodParameters)

moneyness:		moneyness of interest as a vector
numericalMethodParameters:		parameters of the numerical method as a struct, e.g. x1, xN, dx, z1, zN, dz, M for fft x1, xN for quadrature

prices = CallPricesNIGMC(forward, discount, moneyness, timeToMaturity, sigma, k, eta, numberOfSamples) [sigma, k, eta] = CalibrateNIGToVolatilitySurface(volatilityData, discountCurve) with

volatilityData, struct provided as cSelect in 'eurostoxx_Poli.mat':		input data set
discountCurve, struct containing:	dates:	vector with dates associated to discount factors. The first date is the settlement date.
	discounts:	vector of discounts. The first one is 1.

Notes:
1. all dates are to be considered numeric.