Financial Statistics, fall 2010
Examination – Project

The project assignments are handed out December 8, 2010. The results are to be documented in a written report and be presented and discussed at a seminar.

There will be 2 seminars: 17 December, 2010, 14 January in MH:227. We need your written report the day (at least 24h) before the seminar.

The project can be solved alone or (preferably) working in groups of two (but not more than two). Maximum of four groups per occasion.

Groups are expected to do more as their work capacity is far greater than that of a student working alone. Also, groups should work independently of other groups, i.e. questions should be posed directly to Magnus Wiktorsson. Sharing of solutions between groups is strictly prohibited.

Do not hesitate to ask if you have question on the formulation of the assignments! Office hours for questions are every Monday, Tuesday or Thursday between 10-12.

The written report shall include a description of what you have done, discussing choices made, models used etc. as well as figures presenting the result and Matlab code showing how you have implemented your solutions. Data can be downloaded from the home page http://www.maths.lth.se/matstat/kurser/fms161mas229/ht10/Project/

Remember to keep an open mind when solving the problems!

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Good luck!
Assignment 1 – Modeling of stock returns

Find a suitable, discrete time model for daily log returns on the Boliden stock. Boliden is a Swedish metal producing mining company. Boliden has about 4400 employees and a yearly turnover of approximately 3 billion Euros. The data, which stretches 20011205–20101206, can be downloaded from the home page (Boliden.mat). The first column is the date and the second is the stock price (not the log returns). Remember to include a discussion on which models that do work and which that do not work. Also, include appropriate model validation results supporting your results.

Try to keep an open mind when modeling as no model is correct, although several different models can give a good fit to data.

Assignment 2 – Stochastic Differential Equations

Estimation of parameters in stochastic differential equations has been given much attention in the lectures.

\[
dX_t = \left( -aX_t^3 + \frac{b}{X_t} \right) dt + c\sqrt{X_t}dW_t.
\]  

(1)

In the dataset (SDEdata.mat) the parameters are \( a = 0.2, b = 0.1 \) and \( c = 0.3 \) and the process has been sampled at \( \Delta t = 0.01 \) (datasetA) and \( \Delta t = 0.2 \) (datasetB). Note that data set A and data set B are from different simulations. The data is presented below.

Estimate the parameters and use the results to evaluate some methods of your choice (at least three) and report the estimates and their corresponding confidence intervals. An accurate method is of course preferable to less accurate or biased methods, but of course simplicity of implementation and computer time are also relevant. So which of your tested methods would you recommend? Does the result depend on the sample rate?
Assignment 3 – Calibration

In this assignment you will study a calibration problem using using real market data. The file OMXS30opt20081112.mat contains ask and bid quotes (ten minute data) on European Put and Call Options Call or put (C) (1 for call 0 for put), corresponding dividend adjusted Stock prices (S), Strikes (K), Time to maturity (T) and interest rates (r) (in practice yields for STIBOR contracts). Calibrate a model to the option quotes.

The variable opt contain all prices, optest contains 90 % of the prices and can be used as an estimation set, optval contains the remaining 10 % of data and can be used to check the calibration.

You can compute option prices model by using the routine opt_price.p To calculate Heston prices for a European call option with parameters $V_0 = 0.4$, $\kappa = 2$, $\theta = 0.5$, $\sigma = 0.3$, $\rho = -0.7$, strike $K=10, S_0=8, r=0.05, \text{Tau}=2$ use:

```matlab
>> prices=opt_price('Heston',[0.4 2 0.5 0.3 -0.7],1,1,10,8,0.05,2)
```

To calculate NIGCIR prices for all the options at the first time index in the structvector opt use:

```matlab
>> prices=opt_price('NIGCIR',par,opt(1).C,ones(size(opt(1).C)),opt(1).K,opt(1).S,opt(1).r,opt(1).T)
```

See appendix for a more detailed account of usage.

Compute the parameter estimate for each time, in order to capture time variation in the model parameters. The easiest approach is to use a ordinary least squares calibration (see lecture notes). To get more stable estimates you can use a penalized least squares method. The Matlab routine lsqnonlin from Matlab’s Optimization Toolbox can be used here for both approaches. Run OLS on the first time index to get a starting value for the parameters before looping over all time indices. Report which model that fitted best and why you think it fitted best?

Assignment 4 – Review an article

Review one of the articles found on the home page, and write (approximately one–two pages) a summary of it. Furthermore, write a review of the article you summarized discussing the models used and suggest possible improvements. The review can be of similar length as the summary.

The paper you should review depends on which seminar you attend.

14/1    **NOTE!** Read only section 1–6.
        Durham, Garland B. and Gallant A. Ronald (2002),
        Numerical Techniques for Maximum Likelihood Estimation of Continuous-Time Diffusion Processes,

A The opt_price routine

function P=opt_price(model,par,call,power,K,S,r,Tau)
calculates the option price using inverse fourier transform
by the Gauss-Laguerre quadrature method,
using the optimal straight integration path
going through the saddle point of the integrand

------------------------- input---------------------------------

model : Modelname for the model used to price options
use the syntax:
[P]=opt_price('Heston',par,C,p,k,s0,r,Tau)
to use the Heston model and so on
Available models are:
BS,Heston,Merton,Bates,NIG,NIGCIR,VG,CGMY

NOTE TO GET INFO of a model and its parameters just use
opt_price('modelname') e.g. opt_price('BS') for info
about Black Scholes

par : model parameters corresponding to the
the chosen logchararteristic function
see the help text for the corresponding file

call : row vector containing 1 if call 0 if put option

power : vector containing the p for power options
payoff=max(S_T-K,0)^p for call i.e. p=1 for an
ordinary call option, p=0 for a binary option

K : row vector containing strike prices

S : intial/current stock price

r : row vector of interest rate yields

Tau : row vector containing time to maturity

Note that C,p,K,S,Tau and r should be vectors with
matching dimensions

------------------------output----------------------------

P : calculated price

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