Assignment 1 Calibration of a single underlier model

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Written by Peili Guo (peili.guo.7645@student.uu.se) and Francisco José Peralta Alguacil (franciscojose.peraltaalguacil.0481@student.uu.se) This report is for Computational Finance: Calibration and Estimation Assignment 1.

In this project, the Black-Scholes model will be used to calibrate the implied volatility with an European call option. In the first part, we compute the volatility from one observation. Meanwhile, in the second part, we will obtain the volatility from several observations with different strike prices.

Part 1

In this part, we compute the volatility from a single observed call option with strike price K=100 and maturity T = 1. We have the input values listed in the function below, where fzero is called to compute σ.

```
format long
dbtype('function1.m');

%The result is
sigma = fzero(@function1,0)
```

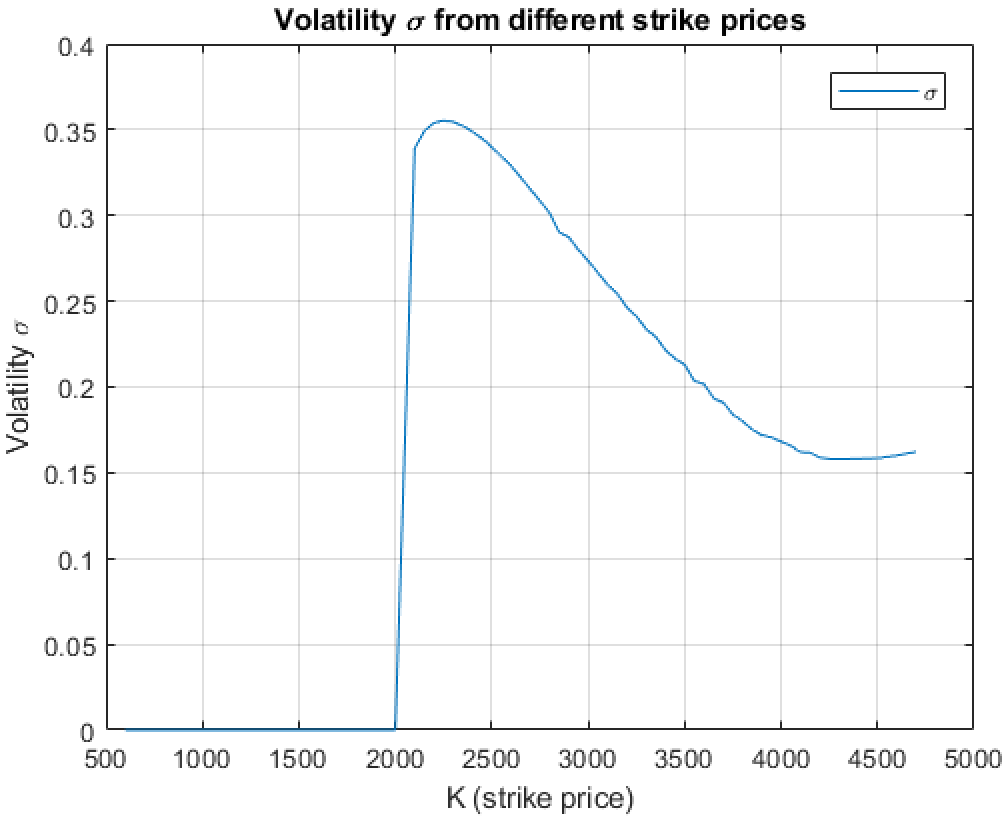
```
function y_out = function1(sigma)

C = 23.50604; %option price
K = 100; %strike price
T = 1; %maturity time
S0 = 110; %current asset price
r = 0.1; %interest rate
q = 0.01; %divident with continuous rate

d1 = 1/(sigma*sqrt(T))*(log(S0/K)+(r-q+0.5*sigma*sigma)*T);
d2 = 1/(sigma*sqrt(T))*(log(S0/K)+(r-q-0.5*sigma*sigma)*T);


y_out = normcdf(d1)*S0*exp(-q*T)-normcdf(d2)*K*exp(-r*T)-C;
end
```

```
sigma =

   0.307197841638419
```

Part 2

In this program, we compute the volatility from real market data

```
format long
load('SX5E.mat'); %load market data

r = -0.0644; %interest rate

%change time to appropiate units
t = datenum(SX5E.t);
T = datenum(SX5E.T);

myfun = @(sigma,C,K,S0) normcdf(1/(sigma*sqrt((T-t)/365))*(log(S0/
K)+(r-0+0.5*sigma*sigma)*(T-t)/365))*S0*exp(-0*(T-t)/365)-normcdf(1/
(sigma*sqrt((T-t)/365))*(log(S0/K)+(r-0-0.5*sigma*sigma)*(T-
t)/365))*K*exp(-r*(T-t)/365)-C;

for i=1:70
    C = SX5E.C(i);
    K = SX5E.K(i);
    C0(i) = SX5E.C(i);
    K0(i) = SX5E.K(i);
    S0 = SX5E.S0;

    fun = @(sigma) myfun(sigma,C,K,S0);

    sigma(i) = fzero(fun,0);
end

%plot of result
plot(K0,sigma);
grid on
xlabel('K (strike price)');
ylabel('Volatility \sigma');
title ('Volatility \sigma from different strike prices');
legend('\sigma');
```



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