

```
% Black-Scholes Matlab Function
% Price and Greeks
% Antonio Rivela . Nov 2007
```

```
function[price,delta,gamma,vega,theta]=BlackScholesPrice(CallPutFlag,S,X,T,r,v)
```

```
n=size(S,1);
```

```
noutparams=nargout;
```

```
if size(S,1)>1,
```

```
    price=S*0;
```

```
    delta=S*0;
```

```
    gamma=S*0;
```

```
    vega=S*0;
```

```
    theta=S*0;
```

```
    for i=1:size(S,1),
```

```
        [price(i),delta(i),gamma(i),vega(i),theta(i)]=BlackScholesPriceTmp(CallPutFlag,S(i),X,T,r,v,noutparams);
```

```
    end
```

```
elseif size(X,1)>1,
```

```
    price=X*0;
```

```
    delta=X*0;
```

```
    gamma=X*0;
```

```
    vega=X*0;
```

```
    theta=X*0;
```

```
    if size(T,1)>1,
```

```
        for i=1:size(X,1),
```

```
            [price(i),delta(i),gamma(i),vega(i),theta(i)]=BlackScholesPriceTmp(CallPutFlag,S,X(i),T(i),r,v,noutparams);
```

```
        end
```

```
    else
```

```
        for i=1:size(X,1),
```

```
            [price(i),delta(i),gamma(i),vega(i),theta(i)]=BlackScholesPriceTmp(CallPutFlag,S,X(i),T,r,v,noutparams);
```

```
        end
```

```
    endif
```

```
elseif size(v,1)>1,
```

```
    price=v*0;
```

```
    delta=v*0;
```

```
    gamma=v*0;
```

```
    vega=v*0;
```

```

        theta=v*0;
        for i=1:size(v,1),

            [price(i),delta(i),gamma(i),vega(i),theta(i)]=BlackScholesPriceTmp(CallPutFlag,S,X,T,r,v(i),noutparams);
        end
elseif size(T,1)>1,
    price=T*0;
    delta=T*0;
    gamma=T*0;
    vega=T*0;
    theta=T*0;
    for i=1:size(T,1),

        [price(i),delta(i),gamma(i),vega(i),theta(i)]=BlackScholesPriceTmp(CallPutFlag,S,X,T(i),r,v,noutparams);
    end
else
    [price,delta,gamma,vega,theta]=BlackScholesPriceTmp(CallPutFlag,S,X,T,r,v,noutparams);
endif
endfunction

```

```

function [price,delta,gamma,vega,theta]=BlackScholesPriceTmp(CallPutFlag,S,X,T,r,v,noutparams)

```

```

    delta=0;
    gamma=0;
    vega=0;
    theta=0;

    b=r;
    d1 = (log(S / X) + (b + v ^ 2 / 2) * T) / (v * T^0.5);
    d2 = d1 - v * T^0.5;

    price=0;
    if CallPutFlag == "c" ,
        price = S * normal_cdf(d1) - X * exp(-r * T) * normal_cdf(d2);
        if noutparams>1,
            delta=exp((b-r)*T)*normal_cdf(d1);

```

```

theta_tmp1= -( S*exp((b-r)*T)*normal_pdf(d1)*v)/(2*T^0.5);
theta_tmp2= -(b-r)*S*exp((b-r)*T)*normal_cdf(d1);
theta_tmp3= -r*X*exp(-r*T)*normal_cdf(d2);
theta=theta_tmp1+theta_tmp2+theta_tmp3;
endif
else
price = X * exp(-r * T) * normal_cdf(-d2) - S * normal_cdf(-d1);
if noutparams>1,
delta=exp((b-r)*T)*(normal_cdf(d1)-1);
theta_tmp1= -( S*exp((b-r)*T)*normal_pdf(d1)*v)/(2*T^0.5);
theta_tmp2= (b-r)*S*exp((b-r)*T)*normal_cdf(-d1);
theta_tmp3= r*X*exp(-r*T)*normal_cdf(-d2);
theta=theta_tmp1+theta_tmp2+theta_tmp3;
endif
end
if noutparams>1,
gamma=(normal_pdf(d1)*exp((b-r)*T))/(S*v*T^0.5);
vega=S * exp((b-r)*T)*normal_pdf(d1)*T^0.5;
endif
endfunction

```