Black Scholes Formula

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```
# -*- coding: utf-8 -*-
"""
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"""
from pylab import *
from scipy import *
from scipy.stats import norm

def d1(x, c, s, r, tau, t):
    return (log(x/c) + (r + 0.5*s**2)*(tau-t))/(s*sqrt(tau-t))

def d2(x, c, s, r, tau, t):
    return (log(x/c) + (r - 0.5*s**2)*(tau-t))/(s*sqrt(tau-t))

def w(x, c, r, t, tau, d1, d2):
    return x*norm.cdf(d1) - c*exp(r*(t-tau))*norm.cdf(d2)

#DEFINITION OF PARAMETERS
c = 20
s = sqrt(0.2)
r = 1
tau = 1
t1 = 0.1
t2 = 0.5
t3 = 0.8
t4 = 0.99

rc('font', size=14)
xlabel(r' $X(t)$ [$ \$ $]')
ylabel(r'Option price $w(X,t)$ [$ \$ $]')
minorticks_on()
grid(which='major')
#yscale('log')
```

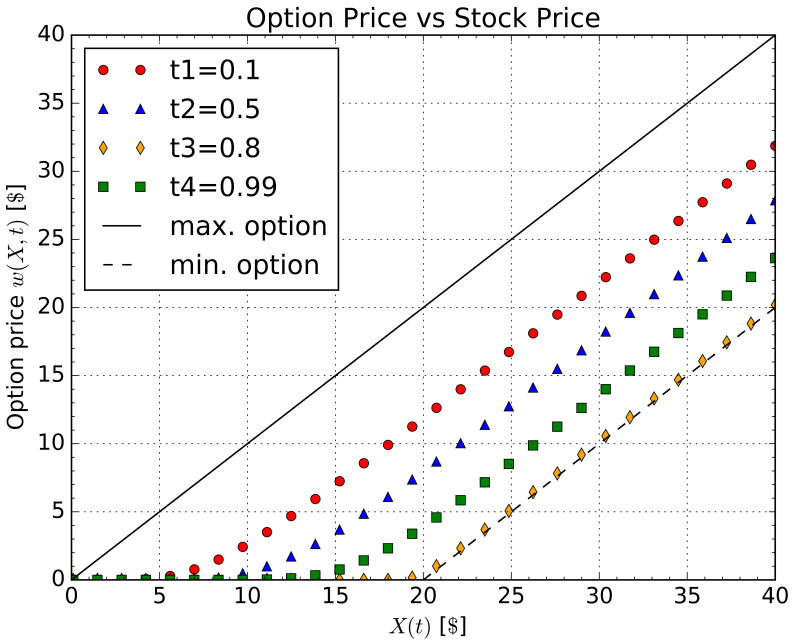

Figure 1. Option price as a function of stock price for different times. Maturity t^* set to 1.

```
#xscale('log')
title("Option Price vs Stock Price")
xdata = linspace(0.1, 40, 30)
xxdata = linspace(0.1, 40, 200)
xxxdata = linspace(20, 40, 100)
plot(xdata, w(xdata, c, r, t1, tau, d1(xdata, c, s, r, tau, t1), d2(xdat
plot(xdata, w(xdata, c, r, t2, tau, d1(xdata, c, s, r, tau, t2), d2(xdat
plot(xdata, w(xdata, c, r, t4, tau, d1(xdata, c, s, r, tau, t4), d2(xdat
plot(xdata, w(xdata, c, r, t3, tau, d1(xdata, c, s, r, tau, t3), d2(xdat
plot(xxdata, xxdata, linestyle='-',color="k", label='max. option')
plot(xxxdata, xxxdata-c, linestyle='--',color="k", label='min. option')
legend(loc='upper left')
savefig('black_scholes.png', dpi=600)
show()
```