E-Finance: Lecture 1

Microsoft Calls

```
<< "Statistics`ContinuousDistributions`"
```

Black Scholes Formula

```
Nor[x_] = CDF[NormalDistribution[0, 1], x]
```

$$\frac{1}{2}\left(1+\text{Erf}\left[\frac{x}{\sqrt{2}}\right]\right)$$

$$d_1 = \frac{\text{Log}\left[\frac{s}{x}\right]+\left(r+\frac{1}{2}\sigma^2\right)t}{\sigma\sqrt{t}}$$

$$\frac{t\left(r+\frac{\sigma^2}{2}\right)+\text{Log}\left[\frac{s}{x}\right]}{\sqrt{t}\,\sigma}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

$$-\sqrt{t}\,\sigma+\frac{t\left(r+\frac{\sigma^2}{2}\right)+\text{Log}\left[\frac{s}{x}\right]}{\sqrt{t}\,\sigma}$$

```
c[t_, x_, s_, σ_, r_] = s Nor[d1] - x E^(-r t) Nor[d2]
```

$$\frac{1}{2}s\left(1+\text{Erf}\left[\frac{t\left(r+\frac{\sigma^2}{2}\right)+\text{Log}\left[\frac{s}{x}\right]}{\sqrt{2}\sqrt{t}\,\sigma}\right]\right)-\frac{1}{2}E^{-rt}x\left(1+\text{Erf}\left[\frac{-\sqrt{t}\,\sigma+\frac{t\left(r+\frac{\sigma^2}{2}\right)+\text{Log}\left[\frac{s}{x}\right]}{\sqrt{t}\,\sigma}}{\sqrt{2}}\right.\right.$$

Solve for the implied volatility

February Calls

```
σ = s /. FindRoot[c[36, 60, 53 + 4.5 / 8, s, 0.055 1/365] == 1 + 9.5 / 16, {s, .02
```

```
0.0289455
```

Solve the price of the Feb 55 Call

```
c[36, 50, 53 + 4.5 / 8, σ, 0.055 1/365]
```

```
5.81107
```

Oakland Fire

NPV if you build today

```
2000 (100 - 75)
```

```
50000
```

NPV if you wait

10% Interest Rate

$$\frac{.5\,2000\,(100-75)\;+\;.5\,5000\,(100-75)}{1.1^5}$$

```
54330.6
```

20% Interest Rate

$$\frac{.5\,2000\,(100-75)\;+\;.5\,5000\,(100-75)}{1.2^5}$$

```
35164.3
```