Binomial Model

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Project Goals

Excel/VBA application to compare different Binomial Models

- **Cox-Ross-Ruberstein Model**
- **The Tian Model**
- **The Leisen Reimer Model**

Description

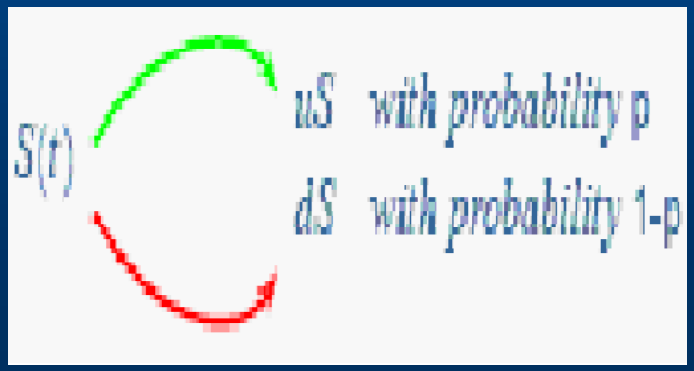
S(t) = 1/R(p x uS+ q x dS)

- **R=exp{r x dt}**

For risk-neutral probabilities

- **P + q =1**
- **P x u + q x d = R**

So p=(R-d)/(u-d), q=1-p



Lognormal Distribution

$S(T)=[S(T)/S(T-\Delta)][S(T-\Delta)/S(T-2\Delta)]\ldots[S(2\Delta)/S(\Delta)][S(\Delta)/S(0)]S(0)$

$S(T)=S(0)\exp\{z1+z2+\ldots+zT\}$

- $Z(T)=z1+z2+\ldots.+zT$
- $Z(T)=\ln[S(T)/S(0)]$

Lognormal Distribution -2

$Ln[S(t)/S(t-\Delta)]=$

- $\mu\Delta+ \sigma\ sqr(\Delta)$
- $\mu\Delta- \sigma\ sqr(\Delta)$

$S(t)=S(t- \Delta)U$ or $S(t)=S(t- \Delta)D$

$U=exp\{\mu\Delta+ \sigma\ sqr(\Delta)\}$

$D=exp\{\mu\Delta- \sigma\ sqr(\Delta)\}$

Assumption

- The returns {z(t)} are independently distributed
- The returns {z(t)} are identically distributed
- $E[zt]=\mu\Delta$
- $Var[zt]=\sigma^2\Delta$

Multi-period Binomial Price

Stock prices at T with n intervals

– S(0)u^n	p^n
– S(0)(u^n-1)d	n(p^n-1)q
– S(0)(u^n-2)(d^2)	n(n-1)/2(p^n-2)(q^2)
– ……	
– S(0)d^n	q^n

Compare with Diff. Models

- Tian model used 2nd order moments for normal distribution, so has better accuracy
- L-R model has quadratic convergence, accuracy is much better
- Binomial approaches often use complex numerical analyses involving large amounts of computer time. It is used more frequently in the real world
- Black-Scholes model works well on only a narrow set of problems

Example – Wal-Mart (WMT)

Volatility from Robert's Web Page

1 month : 15.30%

2 months: 15.02%

3 months: 17.66%

6 months: 17.82%

9 months: 16.75%

1 year: 16.89%

Wal-Mart 2

Stock price: 48.31

Strike price: $45, $50, $55

Example 2 – Alcoa (AA)

Stock price: $26.99

Volatility (1 month): 25.16%

Nov 27.50 call @0.60

Nov 27.50 put @1.10

Complicated Real World

Model Choose

Continuous Trading

Continuously Changing Prices