

## Touching the Void:

An Introduction to Share Options

Ian Gamon, Lane Clark & Peacock LLP

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## Touching the Void

### Outline for the session:

- Understanding share options
- A rôle for actuaries?
- Modelling options
- Real world applications

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## Understanding share options

### Focus on employee share options

- Option to buy shares in the company
- Fixed “exercise” price
- Benefit to employees
- Subject to:
  - Service conditions
  - Performance conditions

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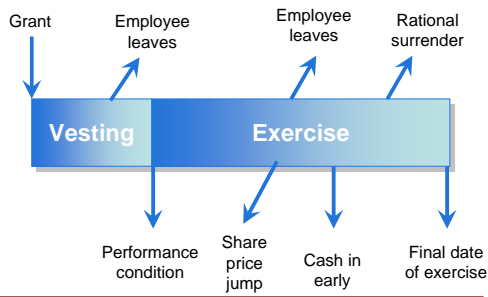
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## Executive share options



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## A rôle for actuaries?

### Key words:

- Uncertainty
- Probability
- Risk
- Discounted value

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## Accounting standards



FRS20  
IAS39

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## Executive remuneration

### Understand value of employee options

- Benchmarking compensation
- Design of performance conditions
- Impact on P&L
- Compensation on loss of office
- M&A due diligence

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## Modelling options

### the options are endless...

- Black and Schöles
- Binomial Tree / Lattice Model
- Stochastic / Monte Carlo Models  
plus
- derivatives of the above

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## Modelling options

### Actuarial Enterprises plc

- New venture
- Need to pay for services
- Grant options to buy new shares at £110
- Redeemable after a year of service

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## Modelling options

### Venture floated on stock market

- Share price at floatation £100
- Term to redemption 1 year
- Intrinsic value £0 at floatation
- Time value?

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## Modelling options

### Replication strategy

- Replication strategy involves:
  - Short cash by £39
  - Invest £53 in share
- Need to inject £14 into replication strategy
- Replication strategy changes continuously

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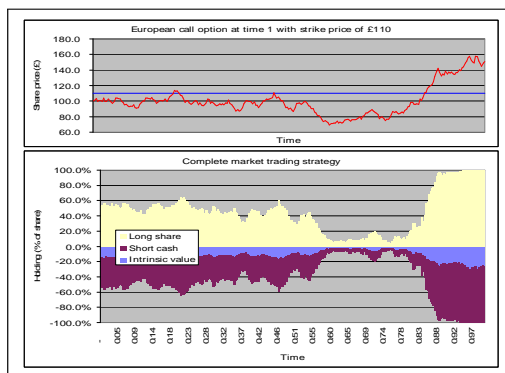
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## Black and Schöles

- Closed formula
- “Easy” to apply

$$f(S) = Se^{-qT} \Phi(d_1) - Ke^{-rT} \Phi(d_2)$$

Where:

$$d_1 = \frac{\log \frac{S}{K} + T(r - q + \frac{\sigma^2}{2})}{\sigma \sqrt{T}}$$

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

S = Price of the share at the date of calculation.  
 K = The option exercise price  
 r = The risk free discount rate  
 q = The dividend yield  
 T = Exercise date of the option  
 σ = Volatility of the share price

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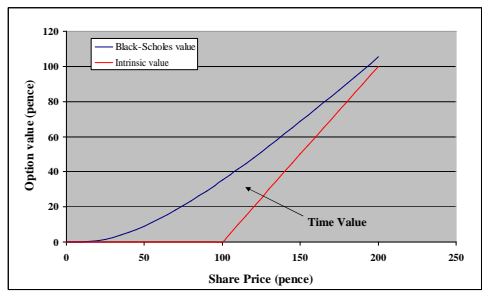
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## Black and Schöles values



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## Black and Schöles

### Limited applications

- Designed for “Vanilla” options
- Employee share options complicated by:
  - Vesting periods
  - Early exercise (forced or voluntary)
  - Performance conditions

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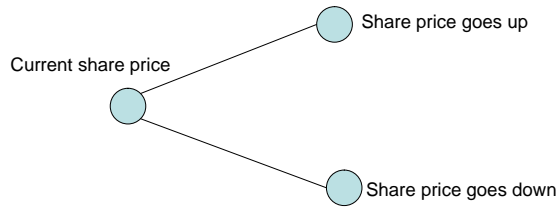
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### Textbook Binomial Model



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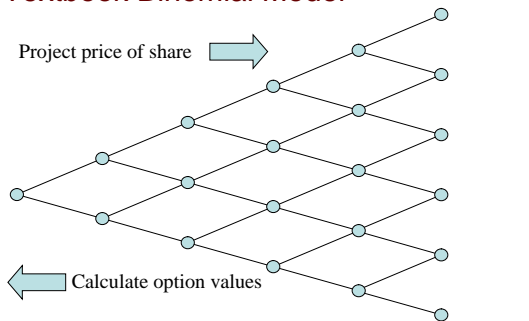
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### Textbook Binomial Model



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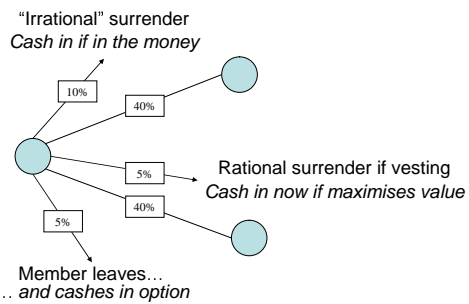
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### Modified Lattice Model



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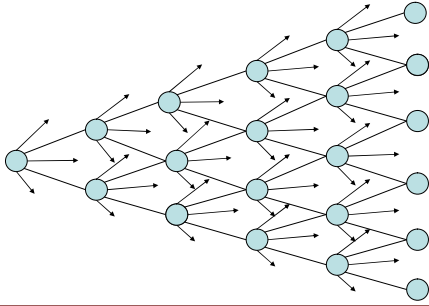
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### Modified Lattice Model



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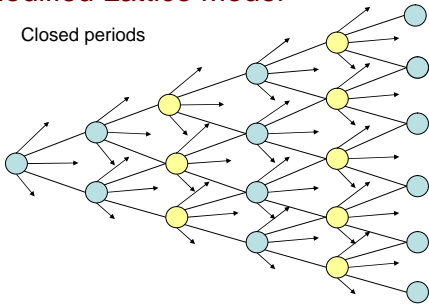
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### Modified Lattice Model

Closed periods



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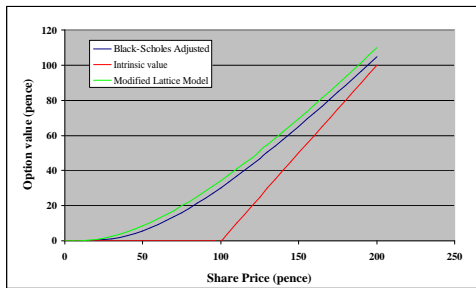
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### Modified Lattice Model values



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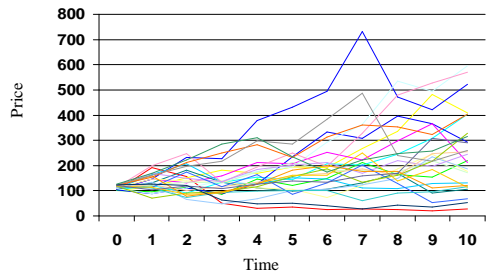
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## Monte Carlo Model



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## Real world applications

### Mining Company plc

- Executive share options
- Standard HMRC features
- 3 yr vesting / 10 yr expiry
- Vesting condition
- Relative TSR performance

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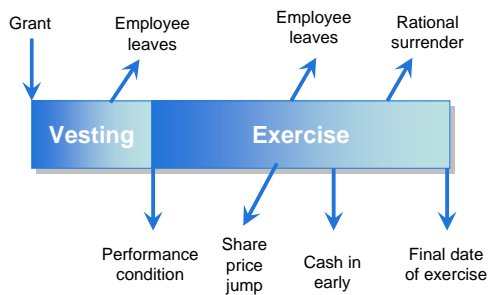
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## Executive share options



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## Real world applications (cont.)

### Choice of model

- Fair value for IFRS2
- Black-Schöles?
- Modified Binomial Model?
- Monte Carlo?

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## Real world applications (cont.)

### Black-Schöles – adjusted for:

- Expected term to exercise
- Relative TSR performance
- ...subjective adjustments

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## Real world applications (cont.)

### Modified Binomial Model:

- Service conditions = Yes
- Early exercise = Yes
- Relative TSR performance = Not readily...

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## Real world applications (cont.)

### Monte Carlo Model:

- Service conditions = Yes
- Early exercise = Yes
- Relative TSR performance = Yes
- ...but efficiency & convergence issues

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## Real world applications (cont.)

### A solution:

- Modified Lattice Model
- with Monte Carlo overlay
- Relative TSR performance
  
- many other solutions...

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## Real world applications (cont.)

### Choice of model influenced by:

- Materiality
- Efficiency
- Compliance (with IFRS2)
- End-user's knowledge

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