Modelling Financial Time series using Grammatical Evolution

Kamal Adamu and Steve Phelps
CCFEA
(Centre for Computational Finance and Economic Agents)

AMLCF July 2009
Motivation

• Modelling Issues
  – Functional form of f(x)
  – Nature of parameters
  – Constraints satisfaction

\[ r^e_t = f(x) \]
\[ r_t = \ln\left( \frac{P_t}{P_{t-1}} \right) \]
\[ A \leq a, \quad B \geq b, \quad C \neq c \]
Framework

• Key problem
  – Infer model for $r^e_t$ from high frequency data
  – Inferred model should be profitable
  – Main Ingredients
    • Past returns
    • Arithmetic operators
    • Moving Average operators
    • Trigonometric functions

$$f = \frac{1}{T} \sum_{t=1}^{T} r_t \times I_{t-1} / \sigma$$

$$I_t \begin{cases} +1 & r^e_t > 0 \\ -1 & r^e_t < 0 \end{cases}$$
Framework

Generate solutions → Map solutions

Generate offspring → Evaluate solutions
Framework

N Initial Guesses → N Final Solutions
Data

• High frequency data
  – Three FTSE stocks
    • Invesco, GlaxoSmithKline, HSBC (1-30 March 2007)
  – Ljung-Box test of autocorrelation reveals none
Elitist

\[
\left( \frac{1}{T-1} \sum_{i=1}^{T=77} r_{t-i} \right) \times r_{t-35} - \tan(r_{t-88})
\]
GE Elitist Vs Buy & Hold, and AR Model
Conclusion & Future Work

• Conclusion
  – GE is able to produce solutions for some stocks that are better than a zero intelligence strategy (coin)
  – GE is able to produce solution that outperforms buy & hold, and an AR model picked using AIC

• Future work
  – Subject decision rule to evolution (coevolve model and decision rule eg. Coevolutionary Grammatical evolution presented at CMS2009)
  – Evolve models of volatility, and maybe higher moments (Possibly coevolve these models)
  – Include some elements of market friction