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Economic Scenario Generators

Lessons Learned from History

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on behalf of the
Extreme Events Working Party

November 2016

Abstract

"Some UK insurers have been using real-world economic scenarios for more than thirty years. Popular approaches have included random walks, time-series models, arbitrage-free models with added risk premiums or one-year distribution fits. Based on interviews with experienced practitioners, this workshop traces historical model evolution in the UK and abroad. We examine the possible catalysts for changes in modelling practice with a particular emphasis on regulatory and socio-cultural influences. We apply past lessons to provide a non-technical perspective on the direction in which firms may develop real world multi-period economic scenario generators in future."

- Extreme Event Working Party

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Thanks

A large thanks to the members of the Extreme Events Working Party, in particular Sandy Sharp and Andrew Smith

We also have a large debt of gratitude to a number of key players in the stochastic modelling space who have been generous with their time and thoughts as we seek to uncover some of the historic drivers of change.

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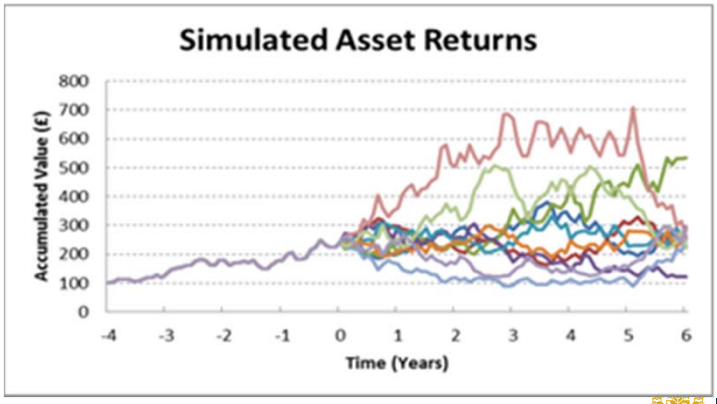
The Challenge

- ***A truly accurate model of the (asset) world would potentially be as large as the asset world itself!***



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Evolution of Economic Scenario Generators

1970s Random Walk	1980-90s Time Series	2000s Option Pricing	2010s 1-Year VaR	Multi-Year?

Evolution Factors

- Technical criteria (theory driven or data driven)
- Social criteria, often comprised of exogenous factors
- Exogenous / endogenous that drove the modelling jump across phases

EEWP Activities			
	Conduct interviews key ESG players over past few decades	We explore what lessons themes we can learn from developments?	Postulate what the next may look like?

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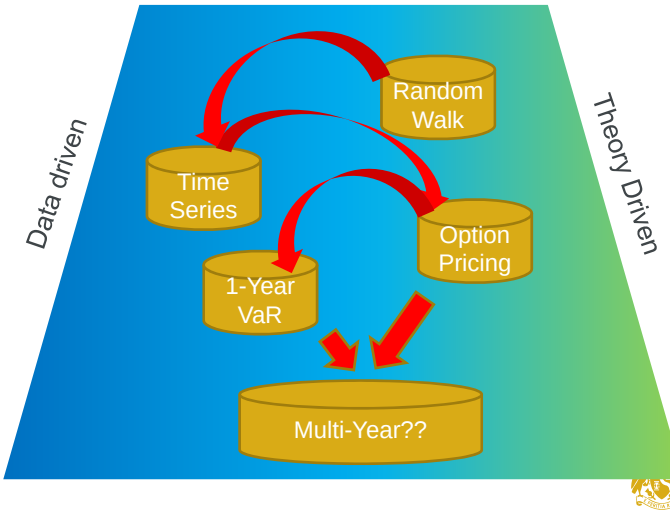
Bridging Data and Economic Theory



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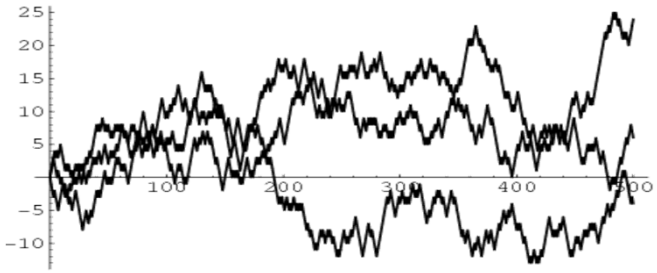
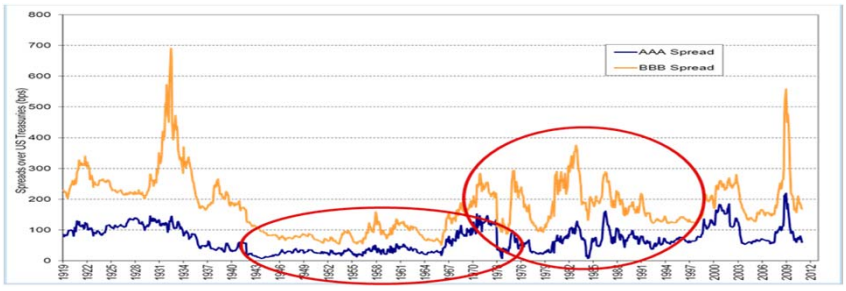
Phase A – Random Walks



- A significant step up from deterministic models
- Leveraged the rise of computing power since the 1950s, together with the Monte Carlo processes in physics
- Captures one general factoid, that asset returns in different periods are independent and identically distributed
- Small number of intuitive parameters

Phase B – Time Series Models



- Captured developments in statistics e.g. ***Box and Jenkins (1969) Time Series Analysis – Forecasting and Control***
- ***A. D. Wilkie (1984) – A stochastic Investment Model for Actuarial Use***; Presented to Faculty of Actuaries, published in a peer reviewed journal.
- Extensively used in Investment Modelling

Wilkie Model vs Random Walks

Wilkie Model

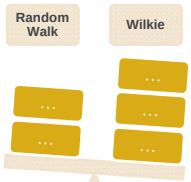
Published model in a peer reviewed journal, discussed by the Faculty of Actuaries, and reviewed in several other published papers.

Recommended parameters included, and easy to code in a spreadsheet

Use of static "strategic" asset allocation modestly improves expected return for an acceptable level of risk, by increasing equity allocation or making portfolios more efficient (according to the model).

Some Difficult Questions

- *Compared to a random walk, Wilkie's equity volatility term structure implies shares are a better long term match for long term inflation linked liabilities.*
- *Widespread use of Wilkie and similar models accompanied a general increase in pension scheme equity allocations in 1980-1995;*
- ***But was the increase because of the Wilkie model?***



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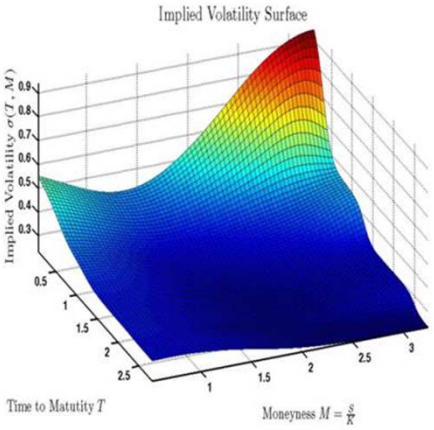
Phase C1 – Option Pricing Models

- Very much theory driven
- Pricing of options and other derivatives, under idealised (frictionless market conditions)
- ***Fisher Black, Myron Scholes (1973) The Pricing of Options and Corporate Liabilities***
- ***J. Hull, A White (1990). Model of future interest rates***
- Often different bottom-up models for different asset classes, challenging to consider from a holistic perspective



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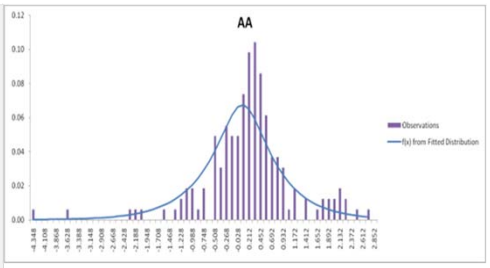
Phase C2 – One Year VaR

- Data driven
- Use of distributions imposed by regulations requiring 1 in 200 event. ICAS, Solvency II
- Focus on tails of distribution, kurtosis
- Self-assessment introduced by the FSA with effect from 31.12.2004 (GENPRU 2.1.6)
- Extreme Events Working Party created and published work on different asset classes.



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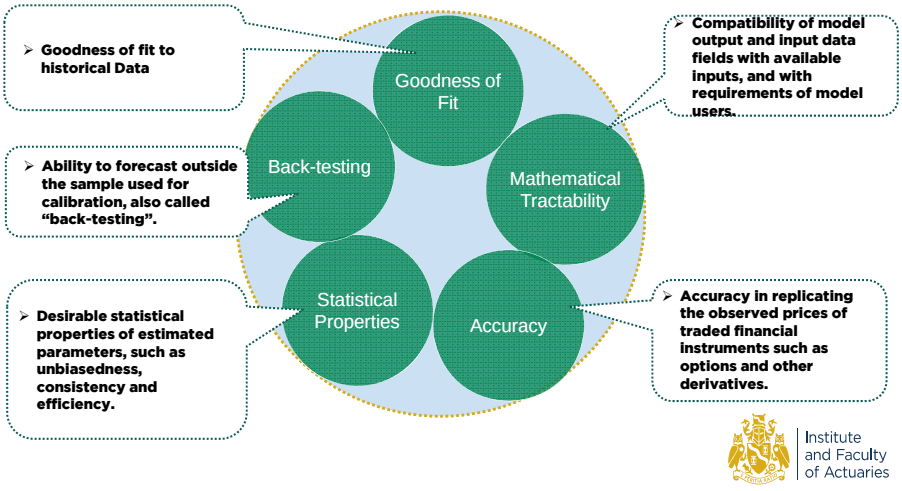
Technical and Social Model Criteria

Thought leadership
Progress
Community
Sessional Meetings
Education
Working parties
Volunteering
Research
Shaping the future
Networking
Professional support
Enterprise and risk
Learned society
Opportunity
International profile
Journals

Examples of Technical Criteria



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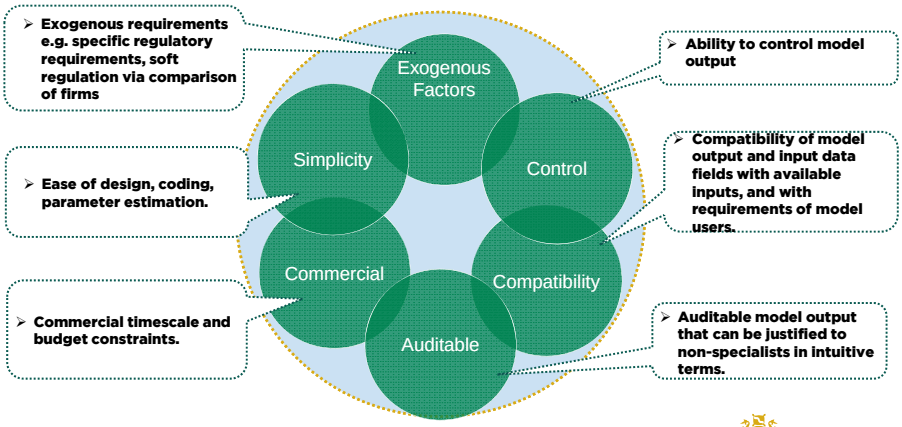
Examples of Social Criteria



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Surveys and Interviews (in progress)

The Interviews

- Put the same questions to Developers and Users (apart from one specific question to each)
  - Users were influential players at a time of change in model design
- Have 9 interviews – but already some key names

John Mulvey	David Hare
Craig Turnbull	John Hibbert
Adrian Eastwood	Stephen Carlin
Patrick Lee	David Dullaway
David Wilkie	

- Many other interviews in progress…

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Background Questions

- What do you feel are the most important / material components of an ESG?
- How much knowledge of scenario generators is important for making decisions?
- Do you think some model users place too much reliance on calibrations they don't understand?
- Do you feel that general awareness of ESGs has improved over time?
- How important do you think it is that models are published in (peer-reviewed) journals?

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Factors Influencing Change in the Past

- In your view, what are the key factors that affect change within the ESG industry historically? Would you classify them as user led, designer led, or led by exogenous factors?
- Designers - Were the evolutionary steps in ESG design you made driven by dissatisfaction with existing models or users / regulators dissatisfaction? With hindsight, how would you have designed your ESG differently?

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Past Changes: Continued

- Users – With hindsight were there any features that you wanted from an ESG that weren't available when you needed them?
- Why do you think time series models (such as Wilkie) supplanted random walk models in the 1980's?
- How do you think the market-consistent scenario generators of the early 2000's compared to the time-series (Wilkie-style) models that preceded them?

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Past Changes: Continued

- In 2003 the FSA introduced realistic reporting requirements (for UK with-profits funds), and about the same time, market-consistent economic scenario generators became available. Cause or effect?
- In the run-up to the ICAS regime and more recently the Solvency II regime, many insurance firms had access to multi-period, realistic (at least in spirit) scenario generators. Yet few of these insurers now use those models to calculate capital requirements. Instead, one-period models with explicit marginal distributions are prevalent. Why do you think this is?

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Factors Influencing Future Changes

- Can you think of examples where you were using a model that was disproved by emerging events? Was the issue with model calibration parameters or model properties (e.g. lognormal / normal for interest rates)?
- Do you consider, with hindsight, that the ESGs you used captured the material economic risks?
- What do you feel is the most pertinent component / feature you would like to add to ESGs?

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Future Changes: Continued

- Can you think of any decisions taken, relying on scenario generators, which with hindsight were unwise?
- In general, how do you think the use of Economic Scenario Generators has evolved in the past, and how do you feel it will evolve in the future?
- Where do you feel the pressure for the next big evolution in ESGs come from?

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What the Future Holds

Thought leadership
Progress
Community
Sessional Meetings
Education
Working parties
Volunteering
Research
Shaping the future
Networking
Professional support
Enterprise and risk
Learned society
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International profile
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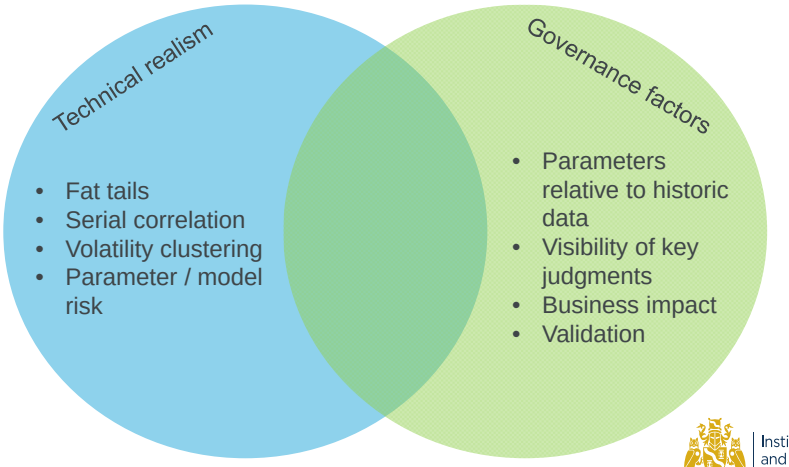
Can we Dust off the Time Series Model?



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What will determine Future Models?

- The history of scenario generators is not one of steadily increasing technical sophistication.
- Governance processes for multi-period models, as for 1-year VaR, now requiring term structures of return, volatility, skew, kurtosis.
- Importance of identifying “key” judgments.
- Permission is needed to discuss social constraints. Flexible software can help but does not make the judgements for you.
- Developments in big data?
- Exogenous shocks – New impending regulations?
- Fundamental changes in capital markets and / or future crises?

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Questions

Comments

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Appendix - UK Returns in the 20th Century

Return	Asset	Geometric	Arithmetic	Stdev
Nominal returns	Equities	10.1%	11.9%	21.8%
	Bonds	5.4%	6.1%	12.5%
	Bills	5.1%	5.1%	3.9%
	Inflation	4.1%	4.3%	6.9%
Real returns	Equities	5.8%	7.6%	20.0%
	Bonds	1.3%	2.3%	14.5%
	Bills	1.0%	1.2%	6.6%
Risk premiums	Equities vs bills	4.8%	6.5%	19.9%
	Equities vs bonds	4.4%	5.6%	16.7%
	Bonds vs bills	0.3%	0.9%	11.3%

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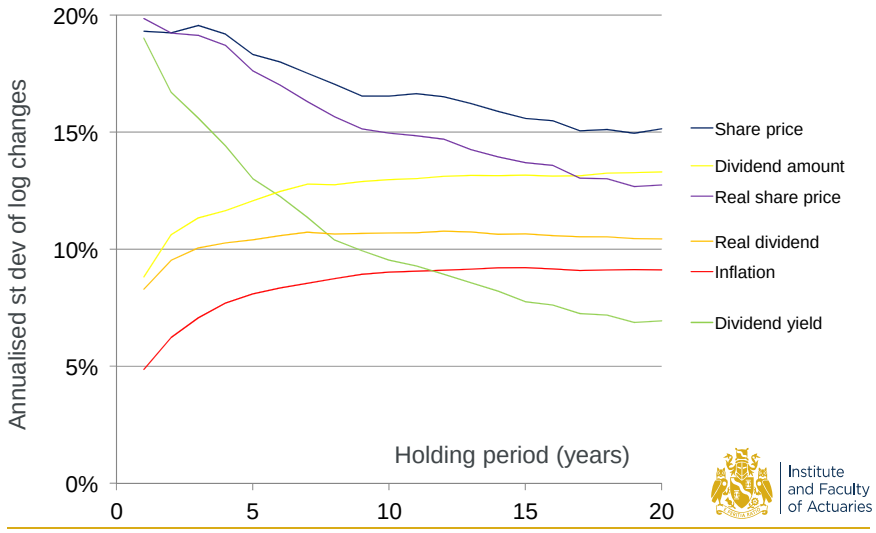
Appendix - Volatility Term Structure (Wilkie Model)



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Why did Option Models become Popular?

- Influence of solutions and idea from the banking sector – more advanced at individual asset class level (and traded on the markets)
- Post Equitable Life crisis, general realisation that there was embedded “Cost of Guarantees” was an important factor for insurance company balance sheets
- Regulations: In 2003 the FSA introduced realistic reporting requirements (for UK with-profits funds), and about the same time, market-consistent economic scenario generators became available. Cause?
- Market consistency was difficult to achieve from a Wilkie Model – additionally adding constant risk premiums to option pricing models gives stability to dynamic utility-maximising portfolios, (unlike for Wilkie-style models)
- Theoretically appealing concept of no-arbitrage?

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