

MOODY'S | Better decisions

# Moody's Analytics

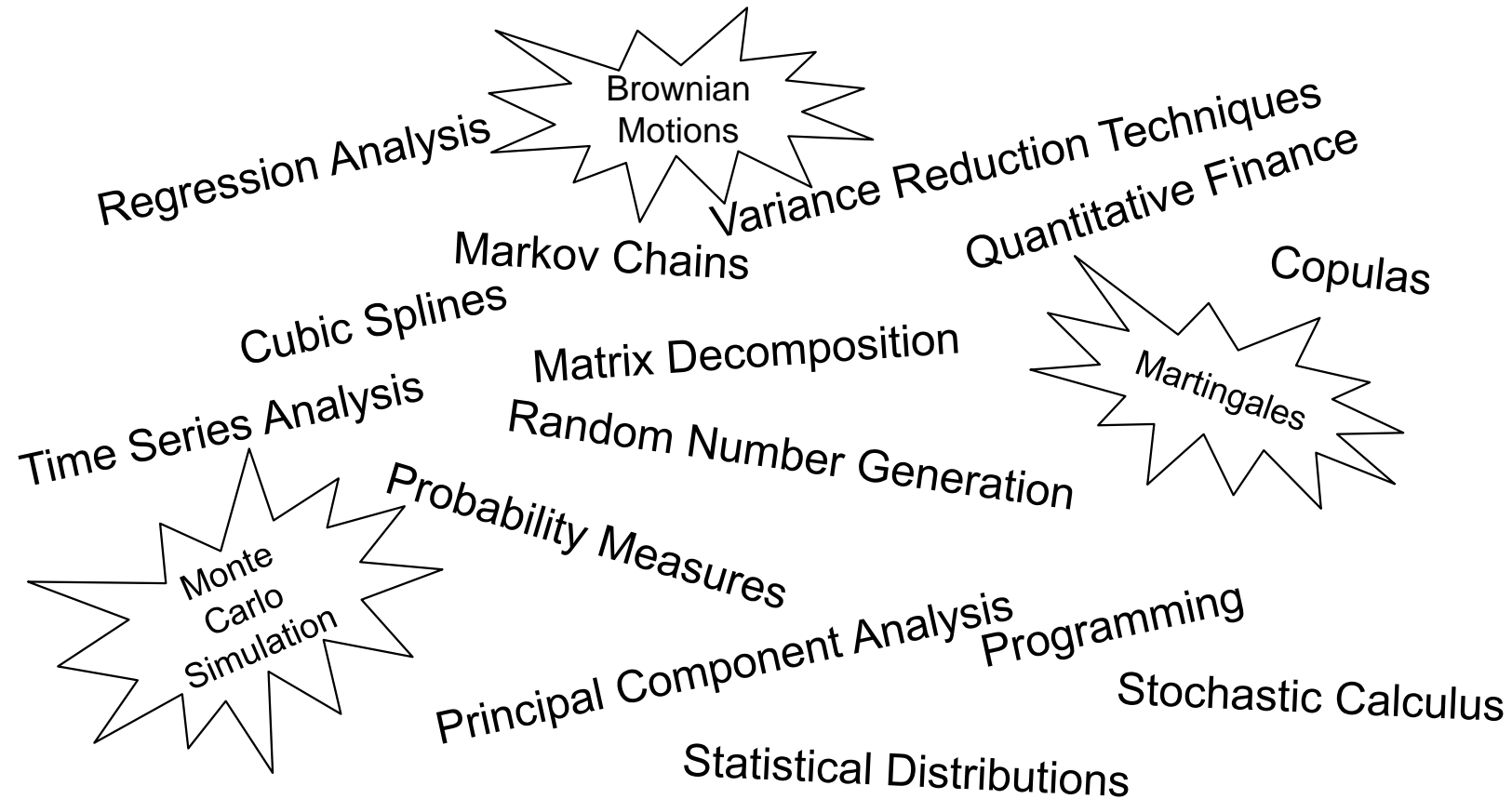
## The University of Edinburgh

Amalie Fabricius-Vieira & Jack Menton  
Modelling & Calibration Services

November 2021

# Do you want to apply your knowledge and skills to solve challenging problems in the real world?

Moody's day to day work requires the use of a wide range of expertise and knowledge directly related to technical learnings at Edinburgh University



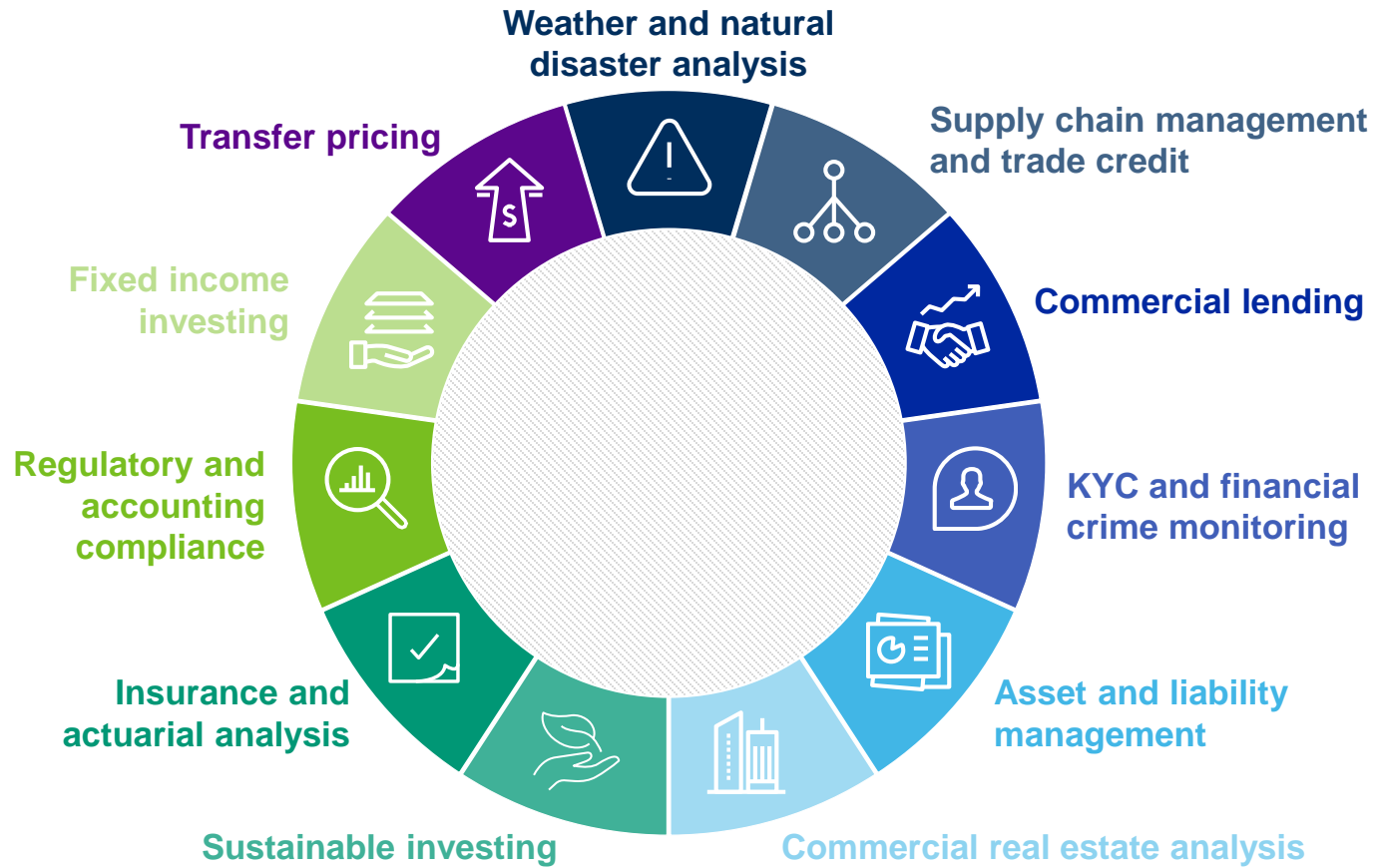
# Agenda

1. About Moody's
2. Insurance ERS
3. SG Models & Case Study
4. Working at Moody's Analytics
5. Moody's Analytics Graduate Programme
6. Q+A

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About Moody's

# Moody's as an Integrated Risk Assessment Business



\*Including RMS.

## \$40B+

Total Addressable Market\*



Helping customers make  
**BETTER DECISIONS**

## CURATED DATA



**ENTITIES**  
**~400 million**  
public & private entities



**SECURITIES**  
**\$70+ trillion**  
rated debt



**ECONOMIES**  
**500+ million**  
economic, financial and  
demographic time series



**PROPERTIES**  
**20+ million**  
commercial real  
estate properties



**PEOPLE**  
**13+ million**  
risk profiles





# Moody's Analytics companies



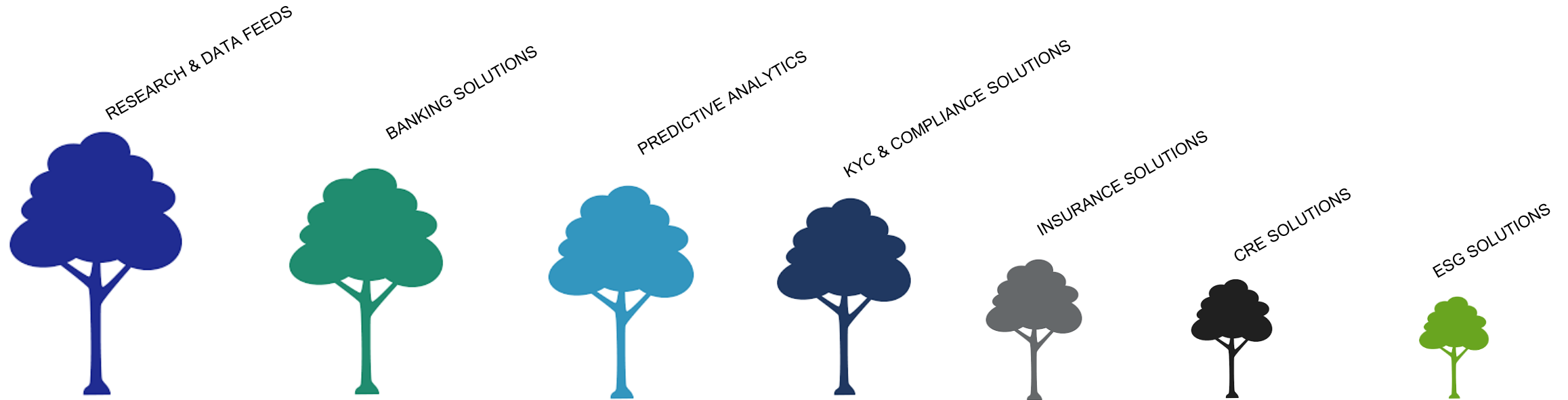
## Some of our later acquisitions



## MA brands



# Diverse Product Base Enables Growth Across Sectors



Moody's CreditView

CreditLens

orbis

grid

AXIS

Economic Data & Forecasts

# MA – By the Numbers

## 2021 FINANCIAL PROFILE

### FORECAST \*



### Moody's Analytics \*\*

- » Revenue: \$2,423m
- » Margin: ~29%
- » Recurring revenue: 93%
- » Retention rate: 94%



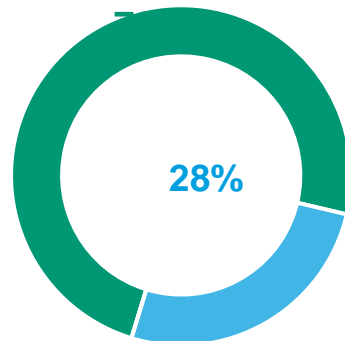
### Research, Data & Analytics

- » Revenue: \$1,748M



### Enterprise Risk Solutions

- » Revenue: \$675M



\* Including RMS

\*\* MIS revenue: \$3.3bn

## CUSTOMERS



1,500+

Asset Managers



2,900+

Commercial Banks



3,100+

Corporations



300+

Real Estate Entities



225+

Securities Dealers and Investment Banks



1,000+ \*

Insurance Companies



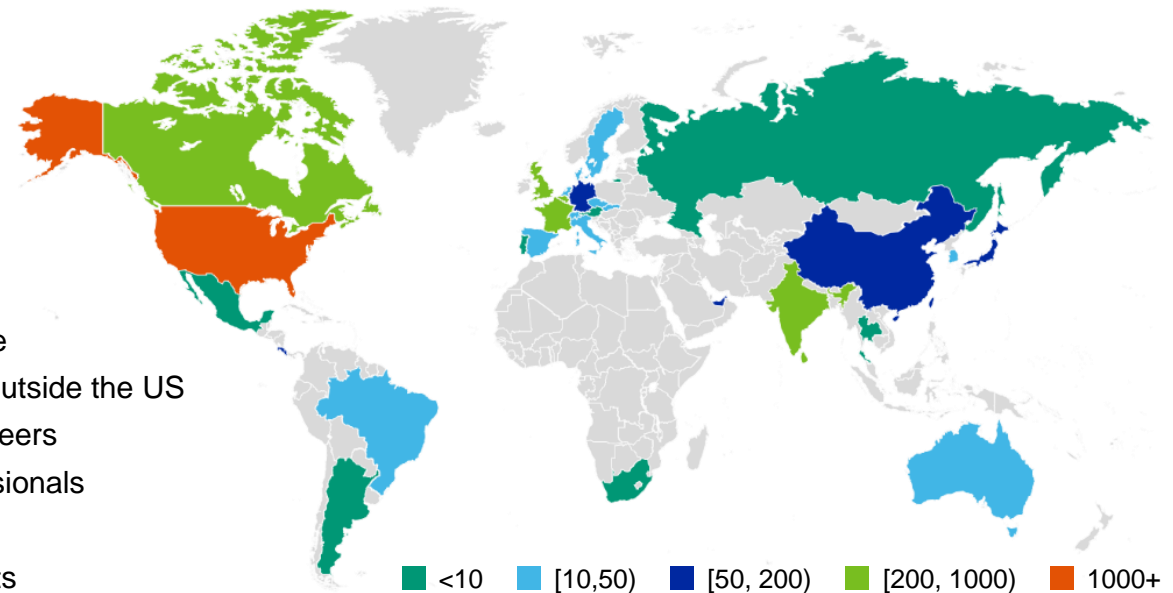
4,000+

Governments & Other Entities

## PEOPLE \*



- » 63 cities
- » 6,500 FTE worldwide
- » 60% of FTE based outside the US
- » ~700 software engineers
- » ~1,000 sales professionals
- » ~400 quants
- » ~570 data specialists







# Our Culture and Values

# We play an important role in this world

## MOODY'S | Better decisions



### Purpose

#### WHY WE EXIST

To bring clarity, knowledge and fairness to an interconnected world



### Mission

#### WHAT WE DO

To provide trusted insights and standards that help decision makers act with confidence



### Vision

#### OUR ASPIRATION

To promote progress through better decisions

# Business Resource Groups

Moody's BRGs drive networking and professional development opportunities for diverse populations at Moody's.

Diversity & Inclusion at Moody's has been largely defined and acknowledged through BRGs



MOODY'S  
ENABLE  
BRG



MOODY'S  
GENERATIONAL  
BRG



MOODY'S  
MINDS  
BRG



MOODY'S  
MULTICULTURAL  
BRG



MOODY'S  
PRIDE  
BRG



MOODY'S  
VETERANS  
BRG



MOODY'S  
WOMEN'S  
BRG



We've been recognized for how we value our team members, whether they're LGBTQA+, working parents, or veterans etc..

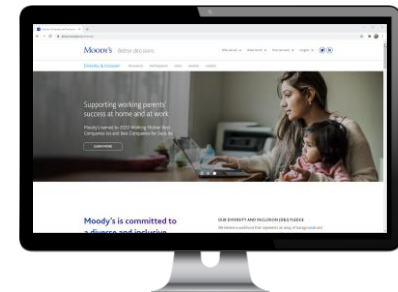


We provide Business Resource Groups (BRGs) to support team members who find their diversity in gender, sexual orientation, multiculturalism, generational divides, military duty, accessibility & disability and mental health.



We are consistently recognized as a Top Employer

Visit the Diversity, Equity & Inclusion Microsite at [www.moody.com/diversity](http://www.moody.com/diversity)



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ERS Insurance

# ERS Insurance

ERS Insurance teams are located in:

- » Edinburgh
- » London
- » Paris
- » Grenoble
- » New York
- » Hong Kong
- » Tokyo

There are around 150 people involved in the development, implementation and support of our products, including

- » Quantitative PhDs
- » Software & Quality Assurance Engineers
- » Economists, Actuaries, CFAs and FRMs
- » Product Managers, Project Managers and Business Analysts
- » Data & Operations Specialists



# What we do

## Insurance ERM

### Description

Award winning capital and regulatory reporting solutions.

Advanced internal model solutions using cutting-edge proxy modelling techniques.

### Products

- » Proxy Generator
- » RiskIntegrity™
- » Capital Aggregator

## Scenario Generation

### Description

Market leading scenario generation products using advanced stochastic modelling for market risks.

Used for liability valuation, real-world projection and risk aggregation.

### Products

- » Scenario Generator (SG)
- » Risk Scenario Generator (RSG)

## Wealth & Pensions

### Description

Asset Liability Modelling for pension funds.

Helping product providers understand their products and communicating risk profile to retail customers.

### Products

- » DBALM
- » Pensions Risk Analytics
- » Investment Governance
- » Wealth Scenario Generator (WSG)





# Moody's Analytics Scenario Generator (SG)

# Moody's Analytics Scenario Generator

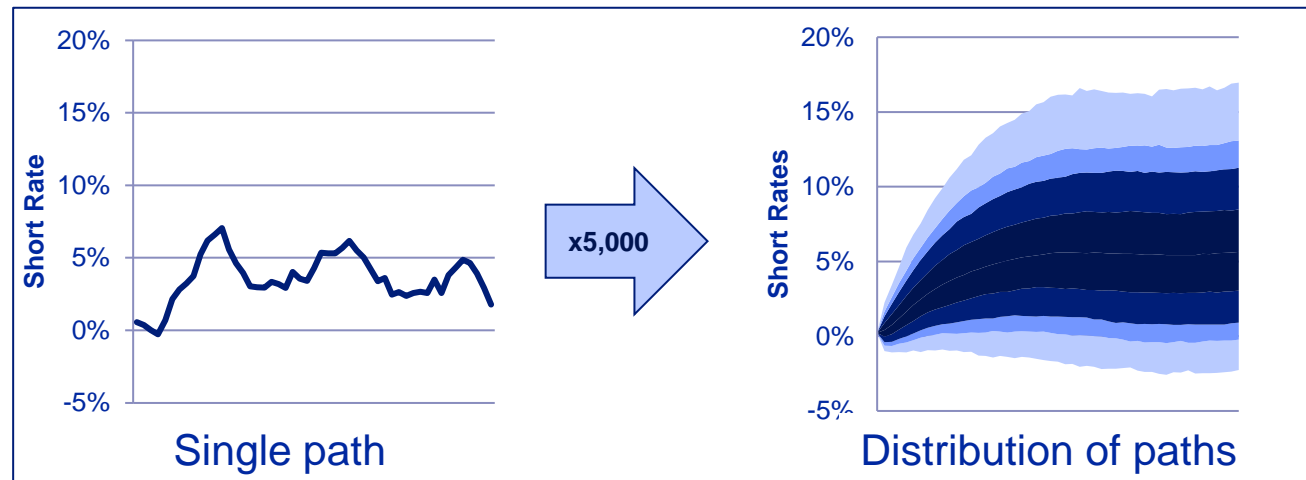


## ESG Trusted by Regulators

Over 90% of Approved Internal Model firms in Europe use our ESG

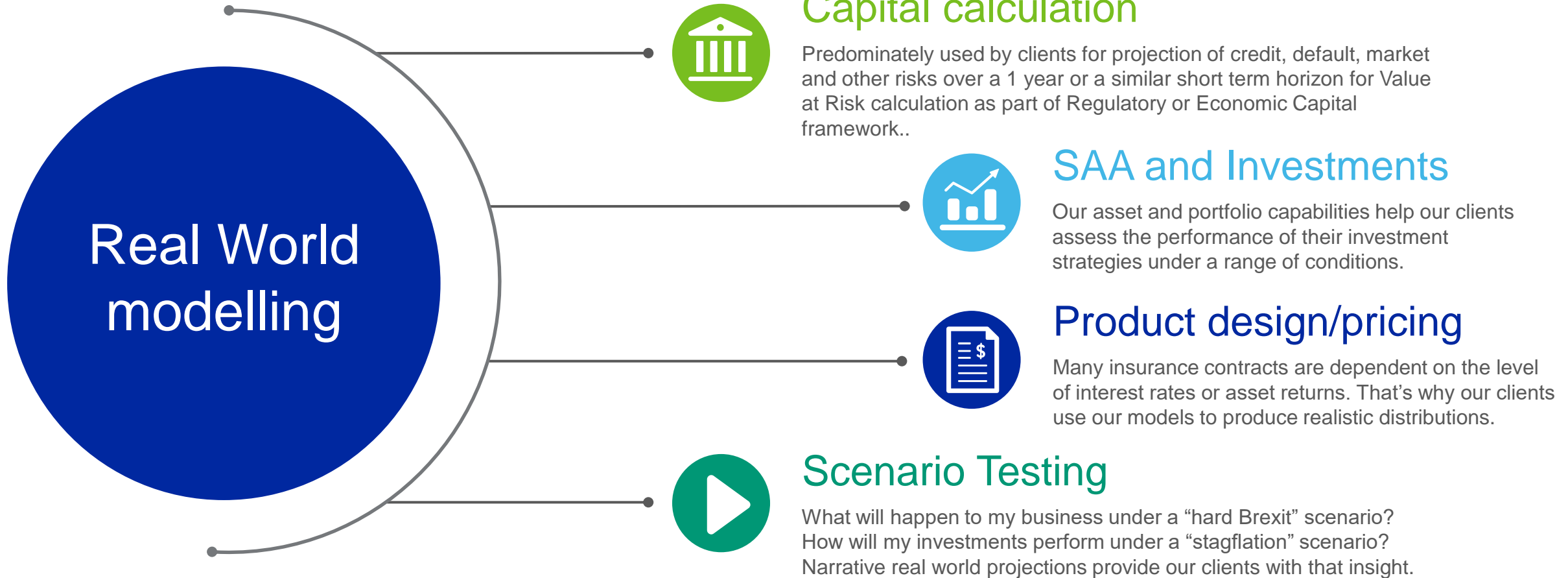
# What is an Economic Scenario Generator?

- » Generates scenarios for various economic variables and asset returns using Monte Carlo simulation
  - A simulation is a collection of many paths (trials)
  - Generate 1000s of different paths of an economy by stochastically modelling many different risk drivers
  - Interest rates, equity returns, corporate bond returns
- » Two main uses:
  - Real-world projections for risk management
  - Market-consistent valuation for pricing



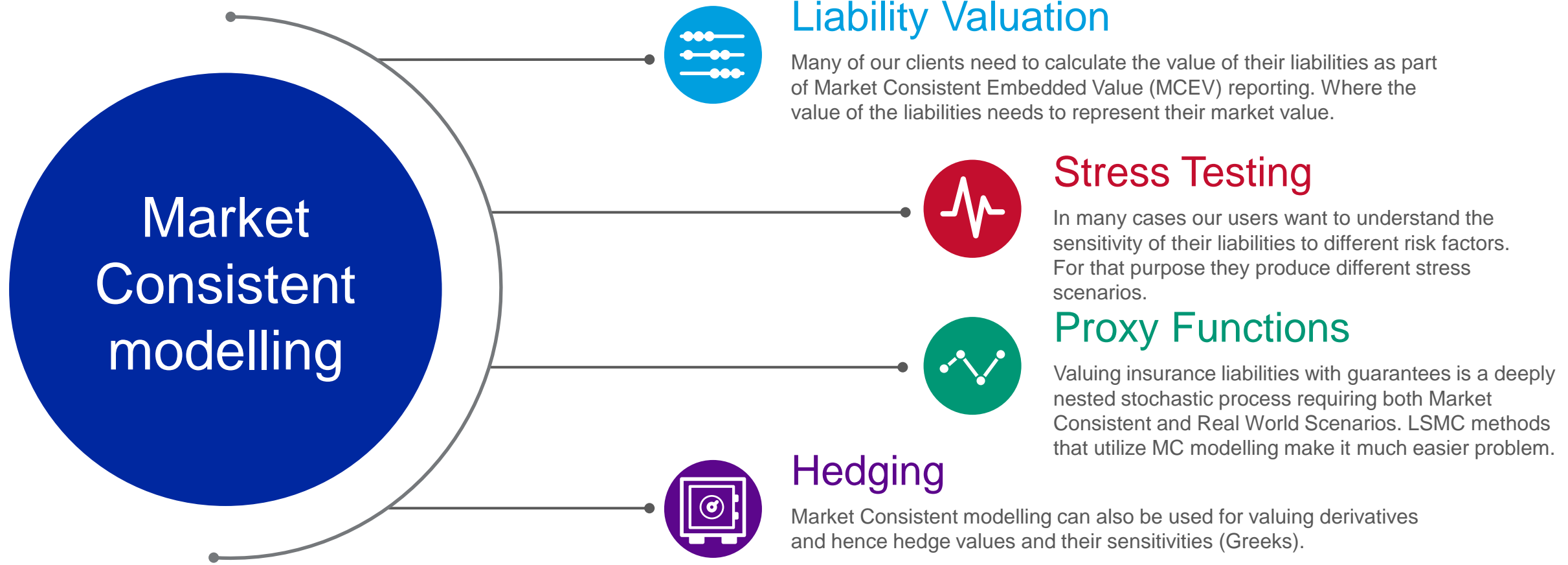
# Real World Modelling

What our clients use it for?

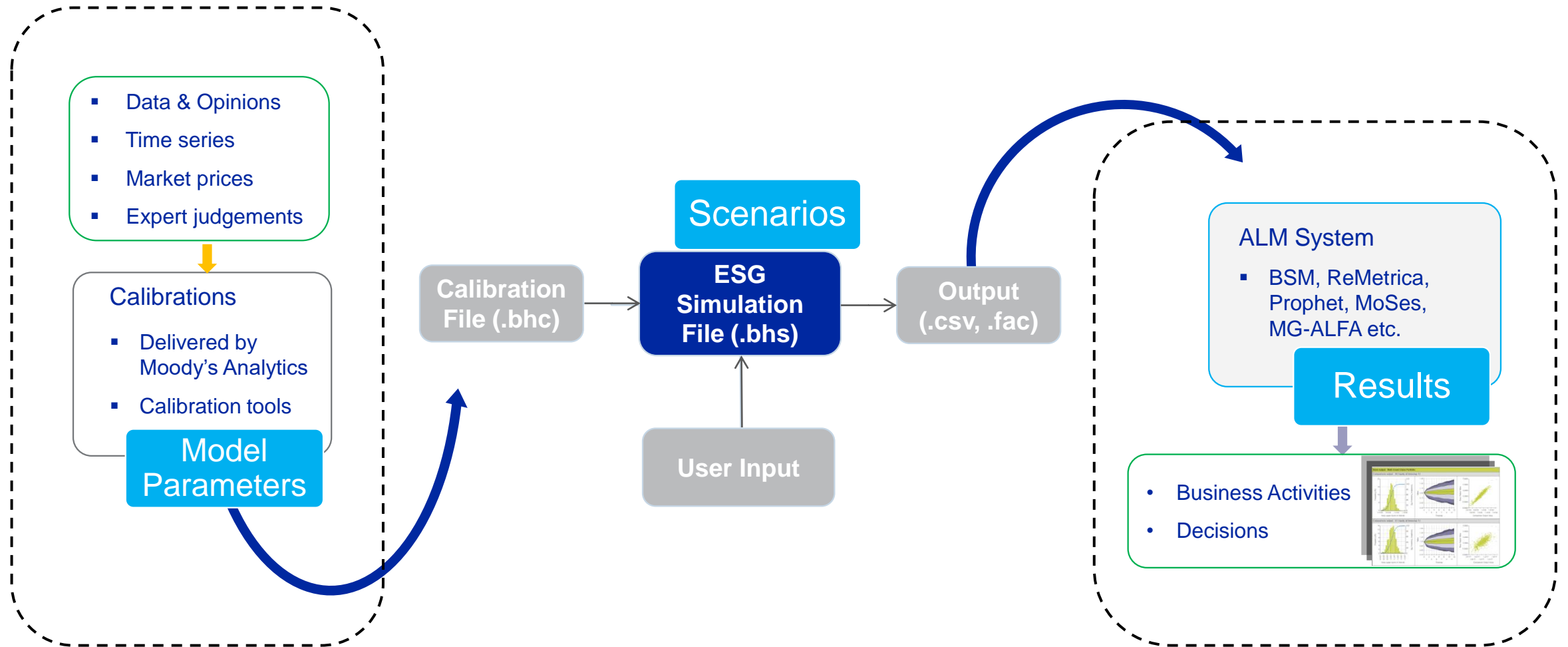


# Market Consistent Modelling

What our clients use it for?



# SG Production Process





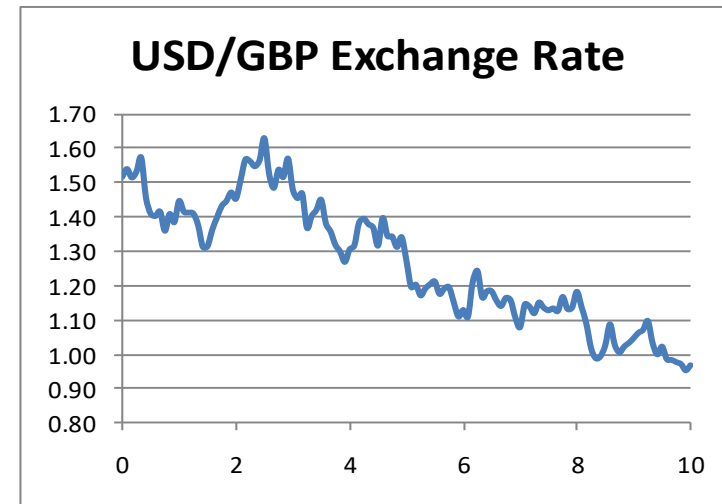
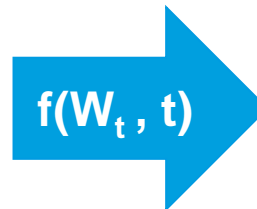
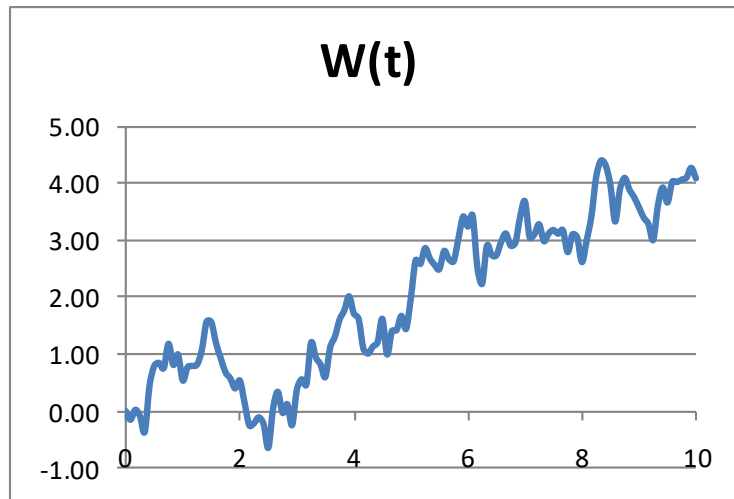
# 3

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## SG Models & Case Study

# Randomness in our Models

- » A Brownian motion  $W(t)$  is a process for describing the evolution of a normally distributed random variable.
- »  $dW(t)$  represents the normally distributed increments of a Brownian motion (aka “Shocks”)
- » Brownian motions in our stochastic equations result in the stochastic evolution of our economic variables, e.g. equity returns, interest rates and exchange rates.
- » We need to sample from a normal distribution to obtain our Brownian Motion shocks
  - We do this using pseudo random numbers





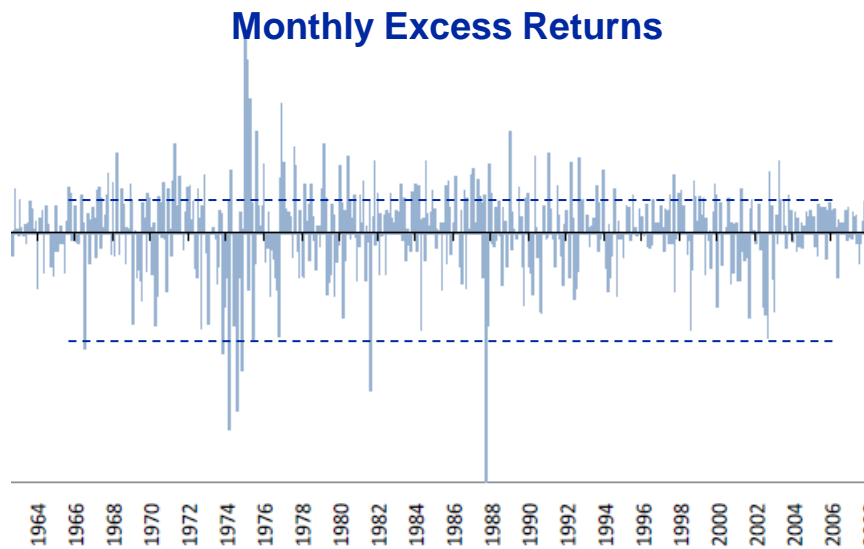
Example:

SVJD Equity Model

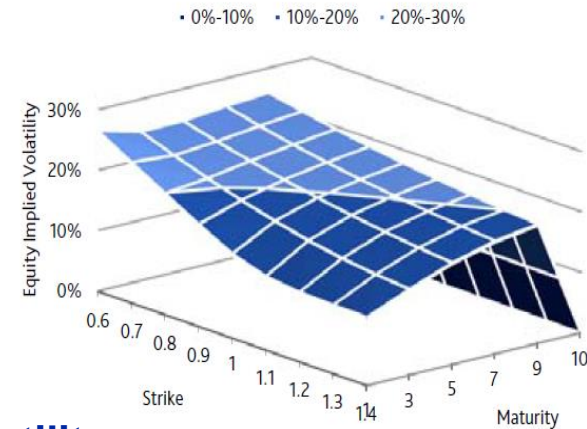
# SVJD Model Motivation

## Equity Returns

- » Large asset returns are more likely to be negative
- » Returns are correlated across economies – Tail Correlations
- » Negative skew in equity return distributions



## Market Implied Volatility Surface

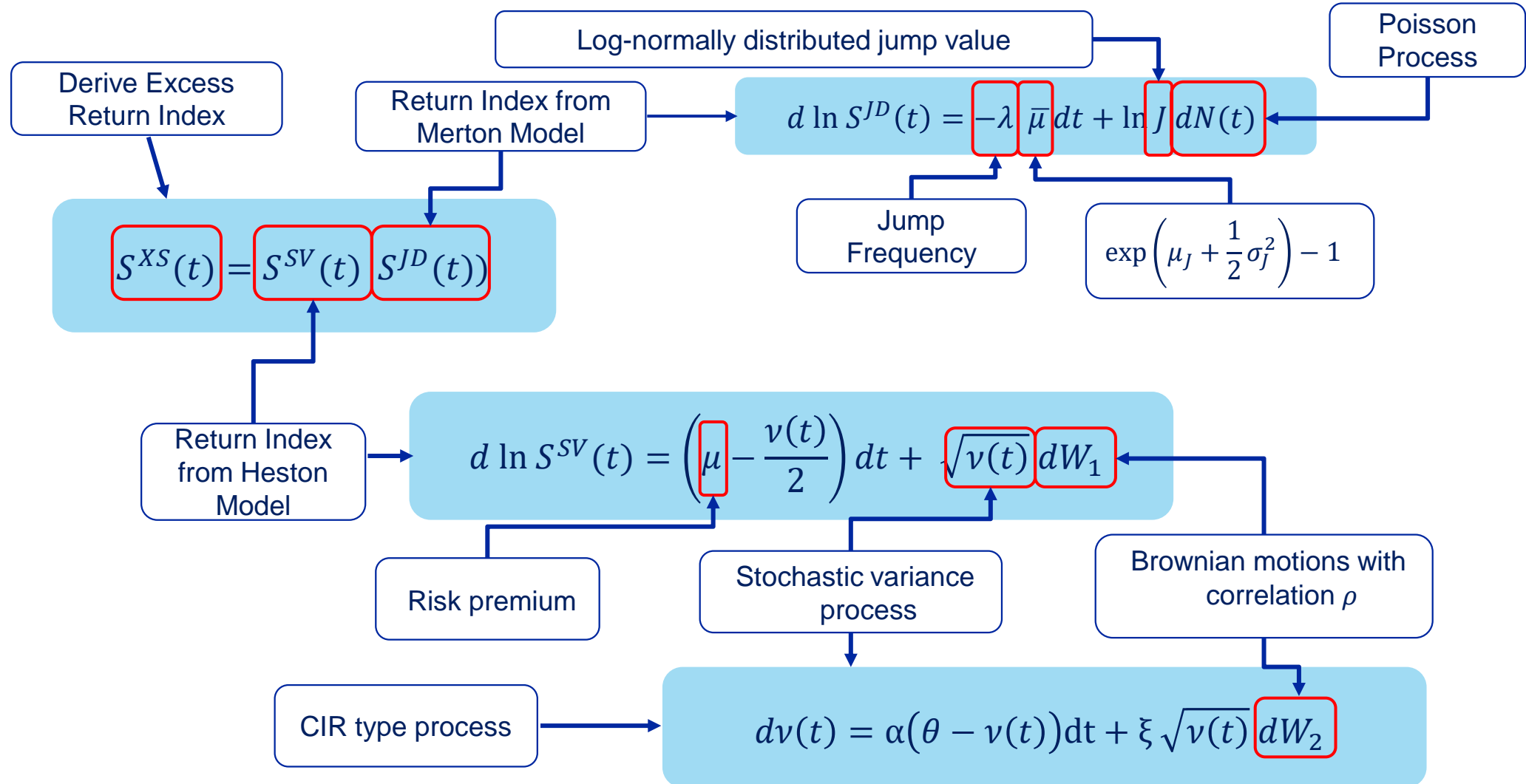


## Volatility

- » Asset returns do not display constant volatility
- » Large asset returns tend to be associated with large volatility
- » Volatility tends to be mean reverting
- » Asset returns exhibit volatility clustering
- » Implied volatilities can vary by option term and strike (Volatility smile)

# SVJD Model Structure

» A model of “excess” return, being the additional return over the risk free (i.e. cash) return



# SVJD Implementation

- » Stochastic volatility part is implemented using a biased Euler scheme:

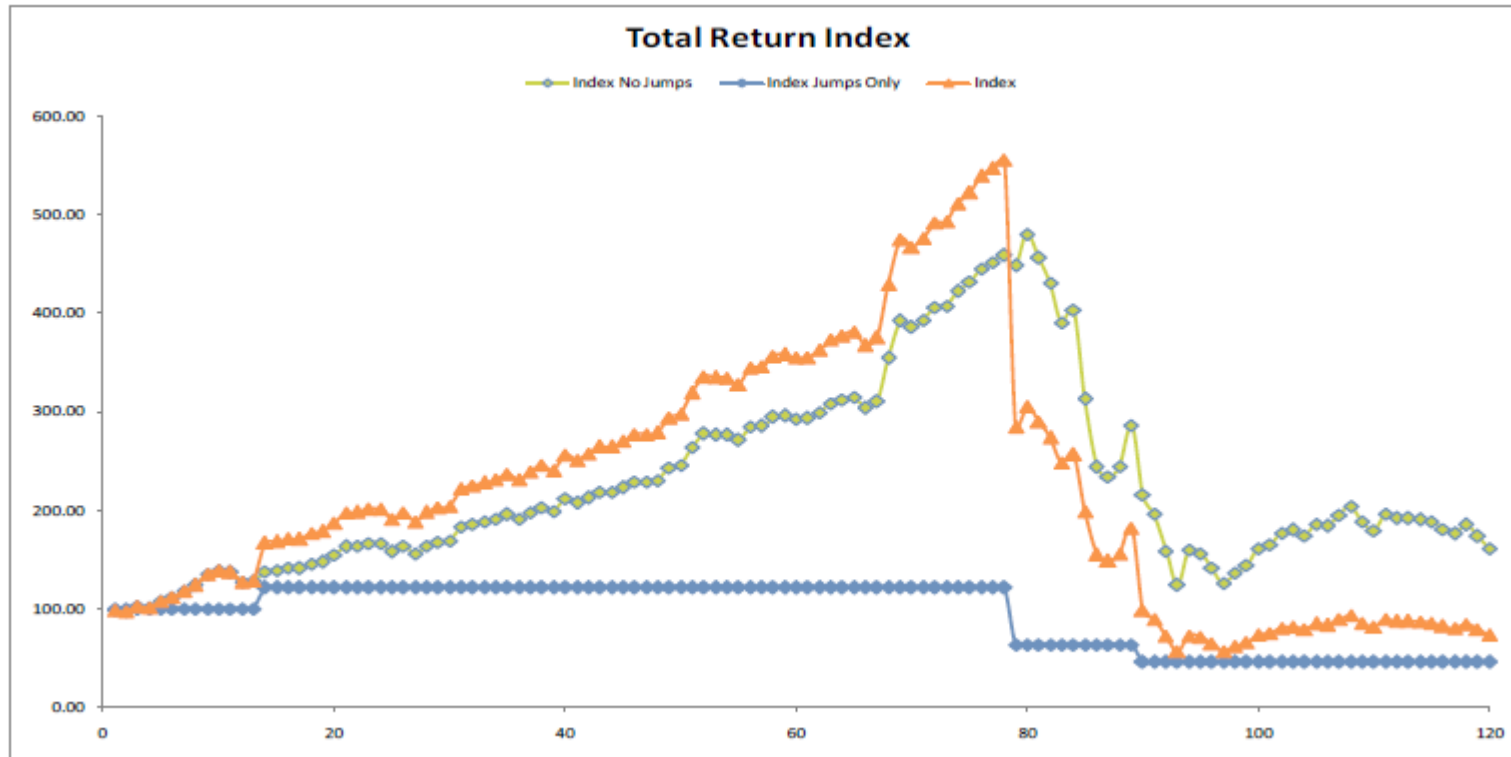
$$S_{t+\Delta t}^{SV} = S_t^{SV} \exp \left\{ \left( \mu - \frac{(v_t)_+}{2} \right) \Delta t + \sqrt{(v_t)_+} \sqrt{\Delta t} Z^{(1)} \right\}$$
$$v_{t+\Delta t} = v_t + \alpha(\theta - (v_t)_+) \Delta t + \varepsilon \sqrt{(v_t)_+} \sqrt{\Delta t} Z^{(2)}$$

- » The jump diffusion part is implemented as:

$$S_{t+\Delta t}^{JD} = S_t^{JD} \exp\{-\lambda \bar{\mu} \Delta t\} \prod_u^{N(\Delta t)} J_u$$
$$N(\Delta t) \sim \text{Poisson}(\lambda \Delta t)$$
$$J_u \sim \text{LogNormal}(\mu_J, \sigma_J^2)$$



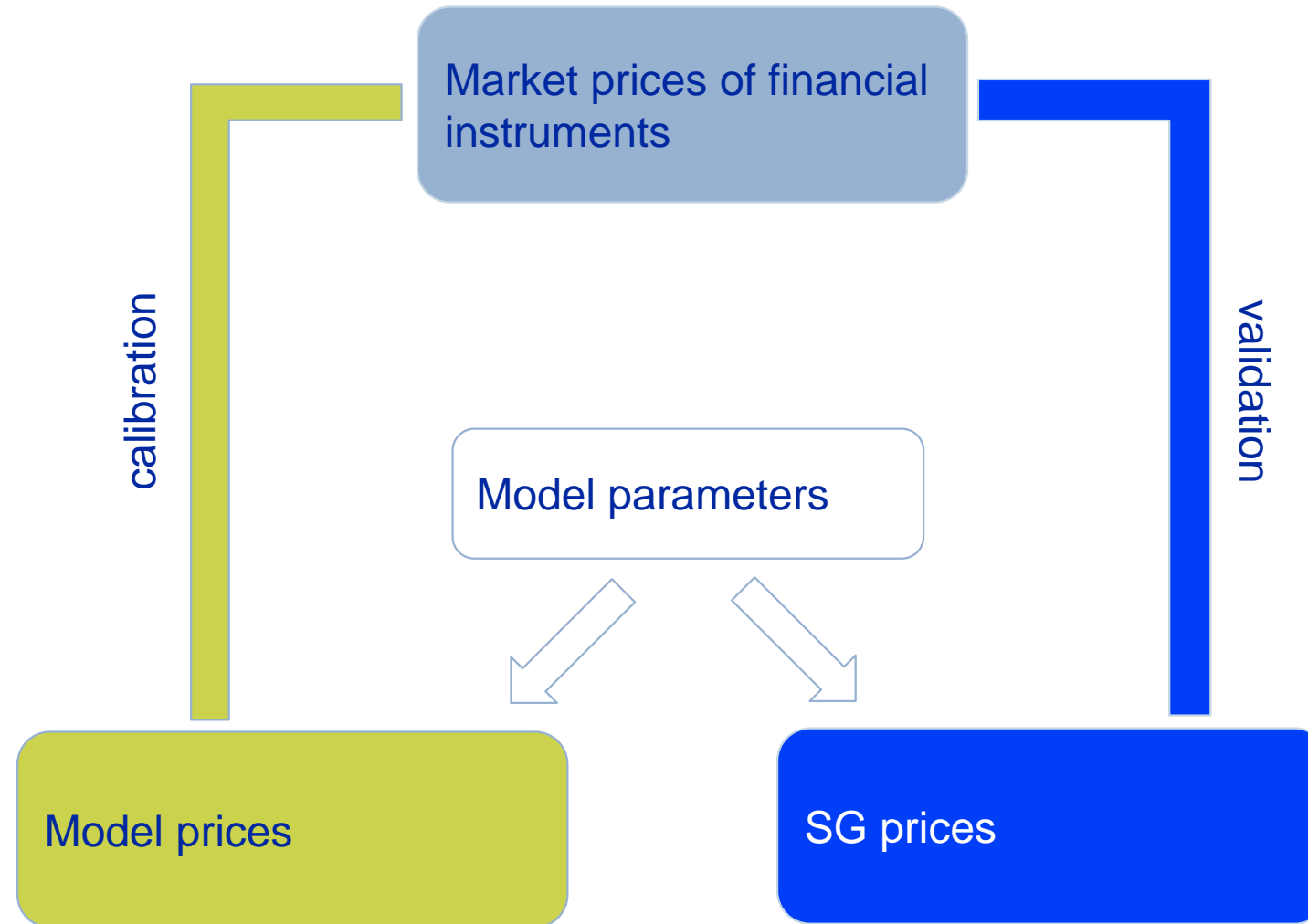
# SVJD Model - Results



Desired properties captured:

- » Large jumps are rare and most likely negative
- » Volatility in returns is stochastic
- » Volatility clustering

# Market Consistent (MC) Calibration & Validation

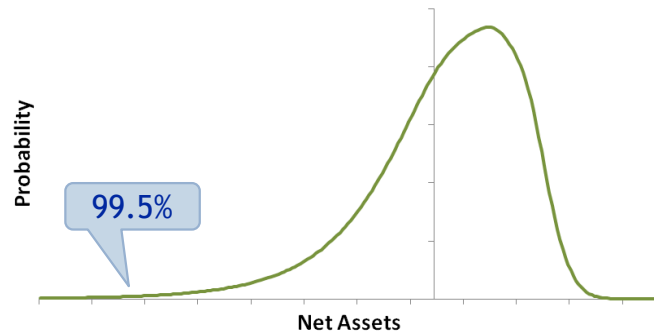




Example:  
Case Study

# Objective (Solvency Risk)

- » Insurers need to ensure that they have adequate capital resources.
  - “How much capital does the insurance company need to hold today for there to be an X% probability that this capital will be sufficient to fund all liability cashflows?”



- » When calculating solvency an insurer must project asset and liability portfolios
  - SG must produce realistic distributions
- » Value at Risk:
  - Insurer models behavior of the economy over 1 year and calculates value of assets and liabilities
  - Then evaluates whether the company has sufficient capital to survive a 1/200 year event in the next year e.g. asset values drop or many claims are made?

# Example Capital requirement



- » Calculate  $X$  such that there is a 99.5% probability of meeting your liability if
  - $X$  is invested in UK Equities
  - $X$  is invested in a 50:50 portfolio of cash and UK Equities
- » We can use the SG:
  - › Simulate  $E\_GBP$  to estimate probability distribution of  $X$  at 12 months
  - › Estimate the median
  - › Estimate 0.5th percentile point

# Implementation in SG (Real World Projection)

## .BHS setup

- » Build an initial simulation file with GBP economy and one equity asset
- » Select appropriate models
- » Select appropriate simulation setup options for Real World runs
- » Select appropriate outputs
- » Calibrate the sim file with our RW *calibration* file
- » Run your simulation file to simulate the probability distribution of the investment returns with the ESG
- » Choice of model, parameters, time-step, number of trials, etc. affect the distribution of returns

## Project the Capital Requirement

- » Analyse the ESG outputs based on
  - »  $X$  invested in Equities
  - »  $X$  invested in the Portfolio of Cash and Equities
- » *What is the minimum capital we need to invest today in order to meet our future liability of £1million in 1 year?*
  - » *With 99.5% probability*
  - » *With 50% probability*



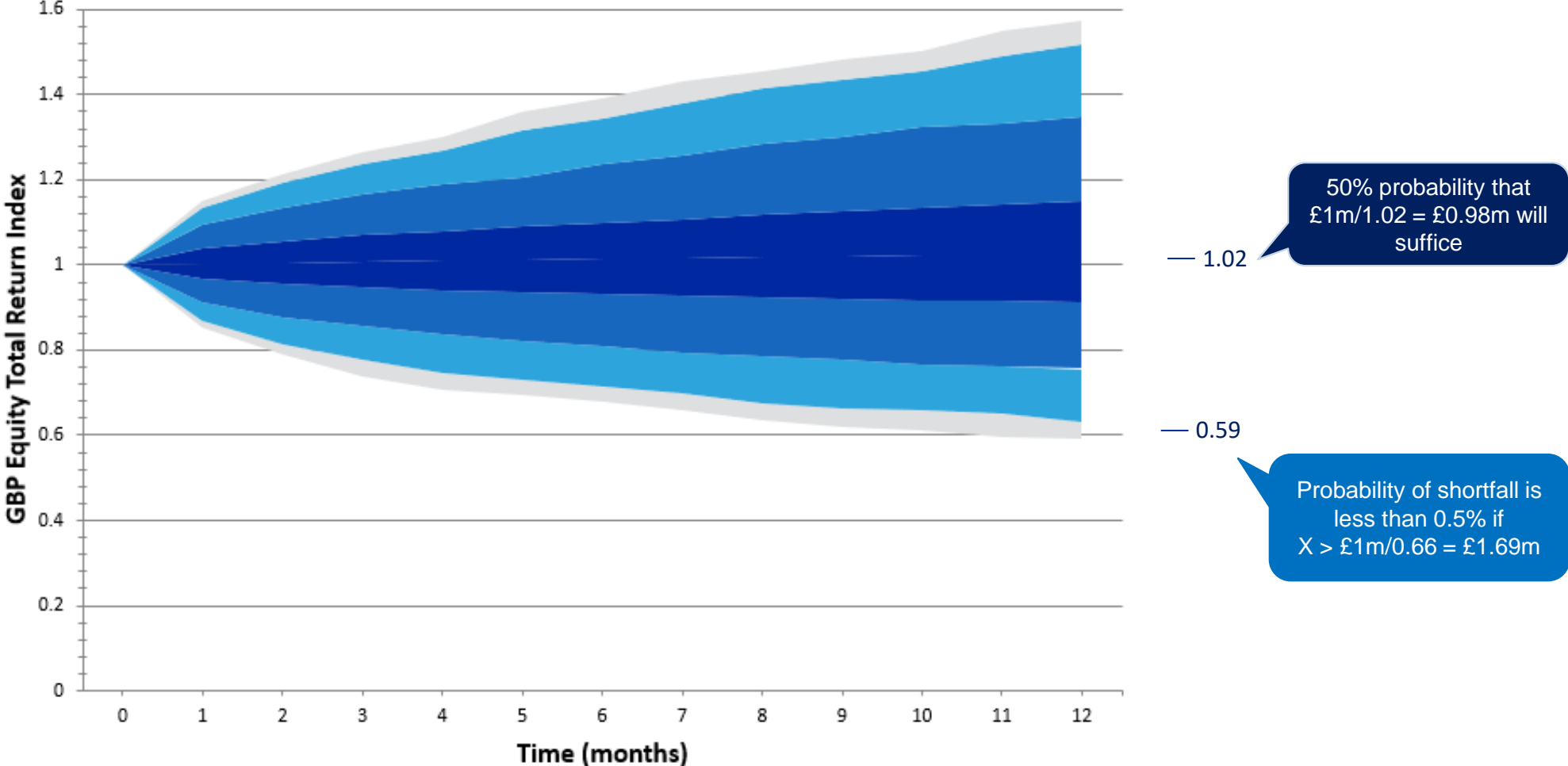
SG Demo



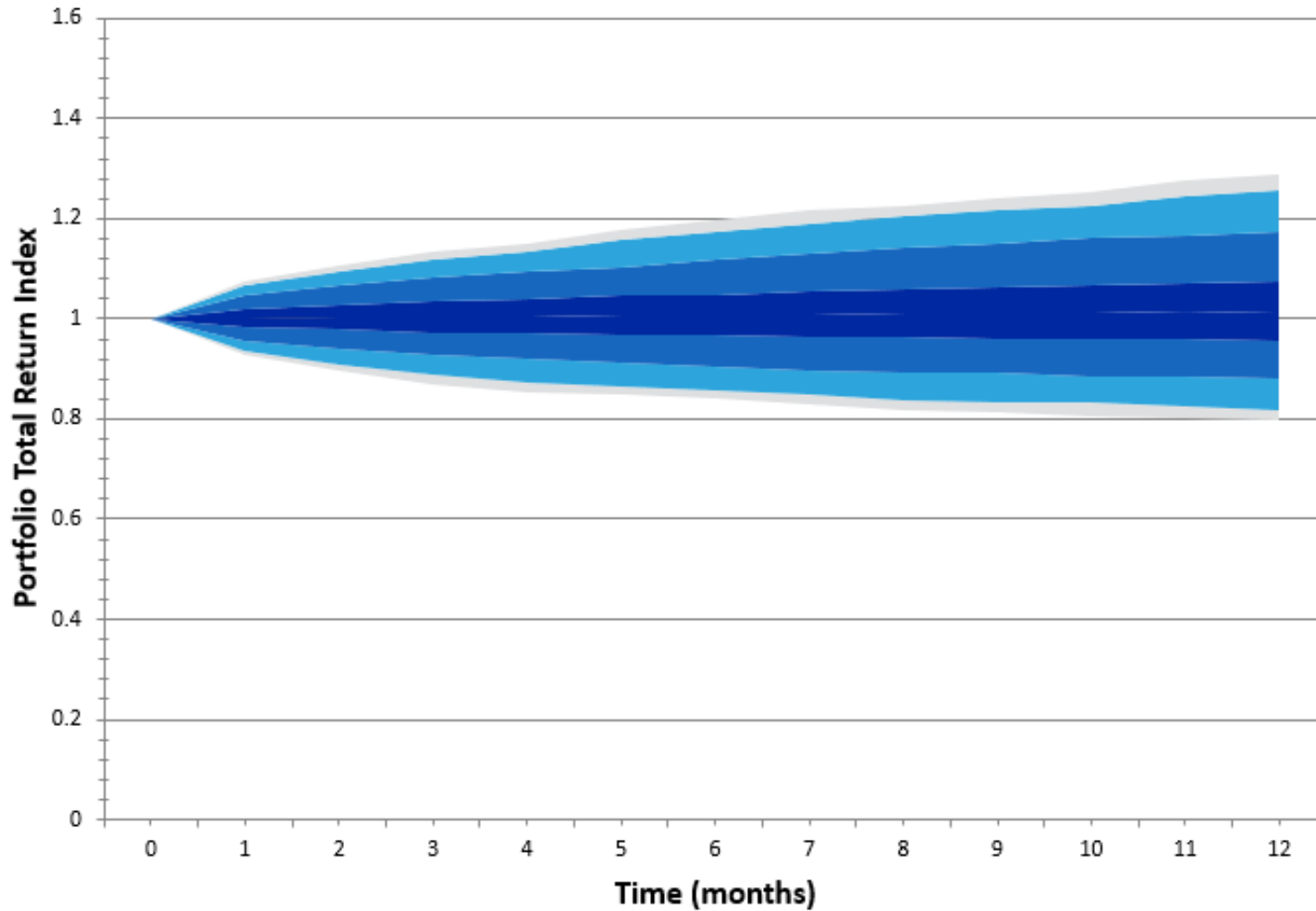
# Discussion



# Exercise 2: Equity TRI distribution



# Exercise 2: Portfolio TRI distribution



— 1.01 — 50% probability that £1m/1.01 = £0.99m will suffice

— 0.80 — Probability of shortfall is less than 0.5% if  $X > £1m/0.80 = £1.25m$

» Less risk implies lower expected return

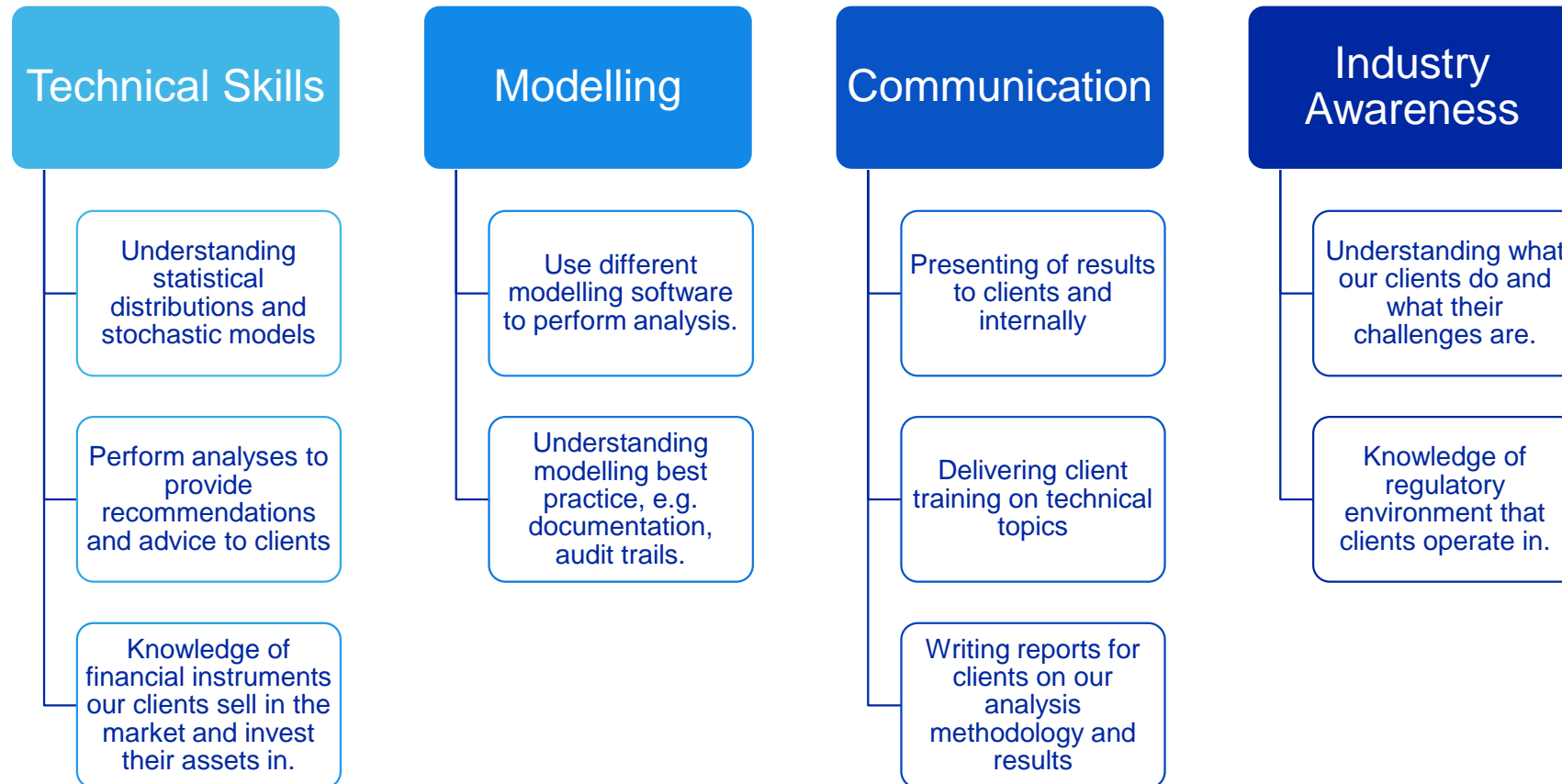
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Working at Moody's  
Analytics ERS

# Roles within MA Insurance



# How do mathematical skills help me do my job?



5

Moody's Analytics  
Graduate Programme

# Moody's Analytics Graduate Programme – wider opportunities

- » Current program is in its 10th year
- » Graduates have been recruited and developed in the insurance business over the last ten years
- » In this period we have recruited 20-25 graduates with all moving into permanent roles
- » These graduates have developed and moved into a variety of roles in the organization:
  - » Advisory Services Teams
  - » Modelling and Calibration Services
  - » Product Management
  - » Research Teams
- » Career progression is a focal points for us

## **Director – Advisory Service**

Leading Advisory Team in  
Edinburgh Office

## **Associate Director - Modelling Operation**

Leading client projects  
and engagements in US  
Office (WTC)

## **Assistant Director - Advisory Services**

Product manager  
responsible for delivery of  
our ESG software in  
Edinburgh Office

# Snapshot of Assignments

Partnered with a senior consultant on projects such as:

- » Product Implementation – configuring the ESG software to produce scenario sets used in liability valuation, capital analysis, portfolio optimization and general risk management
- » Product Customisation/Parameterisation
- » Model and Calibration Method Development
- » Business Analysis in Implementation projects related to the Solvency II
- » Calibrating economic models to new data or market conditions
- » Answering technical questions from customers to help them understand models or methods
- » Implementing new services (such as economic scenario or model calibration services) to a customer's specific requirements
- » Developing and implementing new methods, tools or infrastructure to enhance our propositions
- » Providing training to internal teams and clients on the use of our software and the underlying quantitative models and techniques

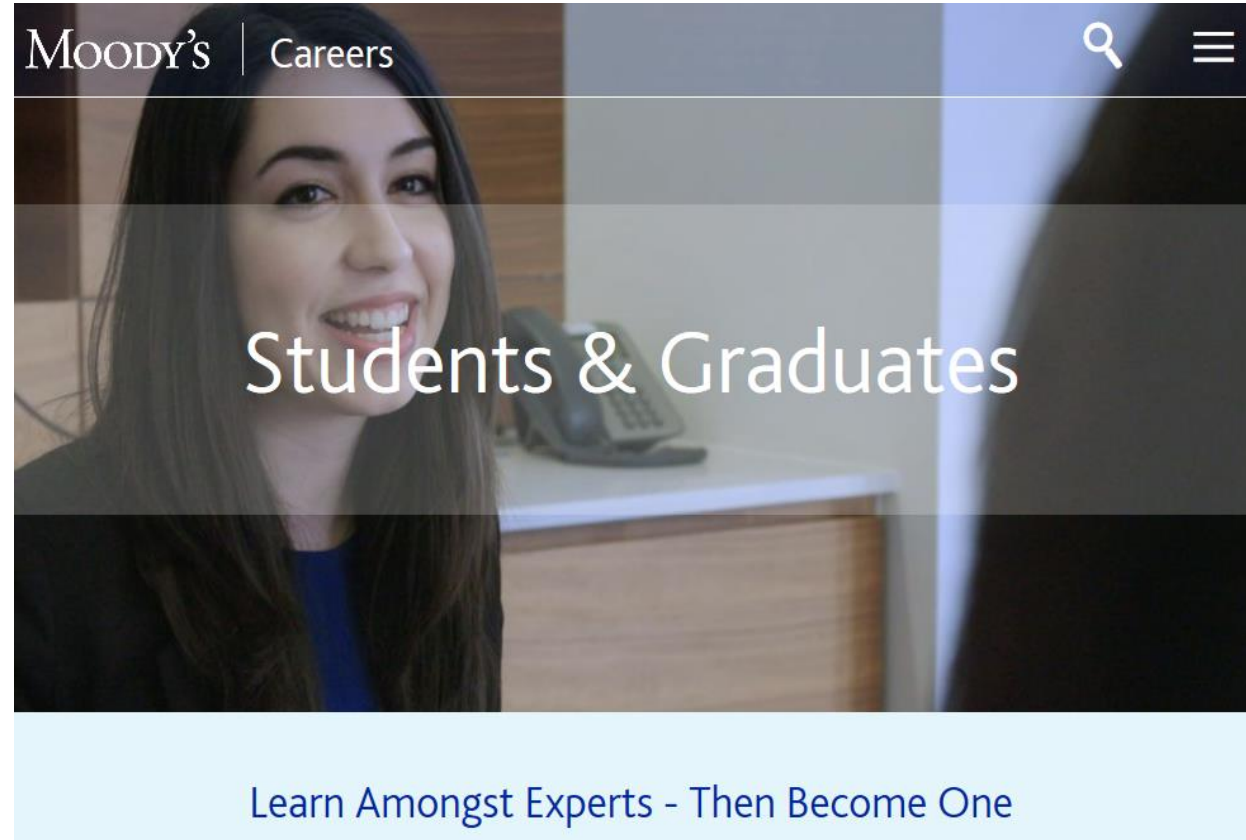


# What we are looking for

- » Higher education within Finance, Actuarial, Maths or Physical Sciences
- » Quantitative aptitude and proven analytical skills
- » Good communication skills – both verbal and written
- » Able to work to tight deadlines and manage own workflow/priorities
- » Strong attention to detail
- » Initiative and Result driven
- » Fluency in English is essential
- » Other European language is beneficial

# The General Application Process

- » Visit our career page: <https://careers.moody's.com/students-and-graduates/ma-graduate-program/>
- » Select our Students and Graduates page to learn about working as a graduate at Moody's
- » Or Select our search job function to look for roles globally
- » Upon receiving your application, our recruitment team will review your CV, assessing your suitability for the programme alongside other applicants
- » **Applications for the 2022 Graduate Programme will close 6<sup>th</sup> December**





# Q+A

Submit questions to

[Campus.Emea@moodys.com](mailto:Campus.Emea@moodys.com)

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