

# CAREERS THROUGH MATHS: ACTUARY



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## JOB DESCRIPTION

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An actuary is a strategic business professional who uses mathematical and statistical techniques to measure, manage, and mitigate financial risk and uncertainty. Their work is fundamental to the financial health of insurance companies, pension funds, and other financial institutions. A typical day involves analysing large datasets, building sophisticated mathematical models in software like Excel or R, and running simulations to forecast future financial scenarios. For instance, an actuary at a firm like Aviva or Legal & General might spend their morning calibrating a mortality model to assess the life insurance portfolio's longevity risk, before meeting with underwriters to discuss the pricing of a new cyber insurance product for UK businesses.

The work environment is typically office-based, often in the City of London, Edinburgh (a major insurance hub), or other large financial centres. Actuaries work closely with other professionals, including data scientists, finance directors, and senior management, to communicate complex technical findings in an accessible manner. Their key duties include calculating premium rates and policy terms for insurance products, determining the contribution levels needed to ensure a company pension scheme remains solvent, performing statutory valuations to ensure regulatory compliance with the Prudential Regulation Authority (PRA), and advising clients on investment and risk management strategies.

Mathematics is the absolute core of the role. Every decision is underpinned by quantitative analysis. For example, when pricing car insurance, an actuary doesn't just look at a driver's age and car model. They build complex generalised linear

models (GLMs) that incorporate dozens of variables—from postcode risk ratings and claims history to weather pattern data and even the likelihood of fraudulent claims—to determine a precise and profitable premium. This rigorous, maths-driven approach ensures that organisations remain financially stable and can meet their future promises to policyholders and pensioners.

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## HOW MATHEMATICS IS USED

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- **Probability and Statistics:** This is the bedrock of actuarial science. Actuaries use probability distributions to model uncertain future events. For example, they use mortality tables (like those published by the Continuous Mortality Investigation in the UK) to calculate the probability of a person of a given age dying within the year. They also use extreme value theory to model the risk and potential financial impact of rare but catastrophic events, such as a major flood in the Yorkshire region or a large-scale cyber-attack on UK infrastructure, which is crucial for setting reinsurance strategies.
- **Calculus:** Calculus, particularly differential equations and integration, is used for modelling change over time and valuing long-term financial instruments. A common application is in calculating the reserve capital an insurance company must hold. This involves integrating the probability of future claims payments, discounted back to their present value using a suitable interest rate. For pension actuaries, calculus helps model the complex cash flows of a defined benefit scheme, forecasting contributions needed and benefits paid out over the next 50+ years for a company like BT or Rolls-Royce.
- **Financial Mathematics:** Actuaries are experts in the time value of money. They use compound interest, annuities, and discounting techniques to value long-term liabilities. For instance, when advising a client on their retirement plan, an actuary will calculate the lump sum required today to generate an annual income of £30,000 for life, factoring in expected investment returns, inflation (using the UK Consumer Prices Index), and mortality improvements. This ensures that products are priced correctly and that assets match liabilities.
- **Predictive Modelling and Machine Learning:** Modern actuaries heavily utilise regression analysis, time series forecasting, and machine learning algorithms. A retail insurance actuary might use a gradient boosting machine (GBM) algorithm

on a dataset of millions of past claims to identify subtle, non-linear patterns that predict high-risk customers more accurately than traditional methods. This allows for more dynamic and personalised pricing in highly competitive markets like UK motor insurance.

- **Statistical and Analytical Methods:** Actuaries are masters of data analysis. They use statistical inference to estimate parameters for their models from historical data and hypothesis testing to validate their models' accuracy. For example, after building a model to predict property insurance claims after a storm, they will back-test it against the actual claims data from past UK weather events, like Storm Ciara, to check its predictive power and calibrate it accordingly. This rigorous validation is a regulatory requirement.

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## KEY SKILLS & TOOLS

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Skill/Tool	Application
Microsoft Excel & VBA	The ubiquitous tool for financial modelling, data manipulation, and prototyping. Actuaries use advanced functions, pivot tables, and write VBA macros to automate complex calculations for quarterly reserving exercises or premium rate reviews.
Programming Languages (R/Python)	Used for advanced statistical analysis, machine learning, and automating repetitive tasks. An actuary might write a Python script to scrape economic data from the Bank of England's website or use R to build a generalised linear model (GLM) for pricing a new pet insurance product.
Prophet or MoSes (Actuarial Software)	Specialist software used for performing actuarial valuations and cash flow projections for life insurance and pension products. UK actuaries use it to run thousands of stochastic simulations under different economic scenarios to determine capital requirements under the Solvency II regulatory framework.
SQL & Database Management	Essential for extracting and manipulating large volumes of policy and claims data from corporate databases (e.g., SQL Server, Oracle). An actuary uses SQL queries to pull a specific

	dataset on all motor claims in Manchester from the last five years to analyse trends.
Stochastic Modelling	A mathematical technique itself and a key tool. Actuaries build models that incorporate random variables to simulate a range of possible future outcomes, not just one. This is used for stress-testing a pension fund's assets against various future economic conditions.
Communication & Data Visualisation (Power BI/Tableau)	Crucial for translating complex mathematical results into clear insights for non-technical stakeholders. An actuary might use Power BI to create an interactive dashboard for the board of directors, showing how climate change risks could impact the company's future liability profile.
Risk Management Frameworks	Applying mathematical rigor to qualitative processes. Actuaries use these frameworks to identify, assess, and quantify operational risks, ensuring the mathematical models are used within a robust and controlled business environment.

**Typical Pathway:** To become an actuary in the UK, strong performance in Mathematics and Further Mathematics at A-Level is typically essential for securing a place on a relevant undergraduate degree. Many pursue a university degree in mathematics, statistics, economics, or actuarial science (offered by institutions like the London School of Economics, Cass Business School, or Heriot-Watt University). The primary pathway is through a graduate scheme with a major employer (e.g., Lloyd's of London syndicates, consultancy firms like Willis Towers Watson, or life insurers like Scottish Widows). These schemes provide a salary while you study for the professional exams set by the **Institute and Faculty of Actuaries (IFoA)**. Achieving Fellowship of the IFoA (FIA) typically takes 3-6 years of exams alongside work, leading to a chartered status. Career progression moves from student actuary to qualified actuary, then to senior roles such as Chief Actuary or Head of Risk, with opportunities in insurance, pensions, investment, and banking.

**Industry Demand:** The demand for actuaries in the UK remains strong, driven by complex financial regulation (e.g., Solvency II), the need to manage new risks like climate change and cybercrime, and an increasing reliance on data-driven decision-making. According to the UK Government's National Careers Service, the role has good prospects, with starting salaries for graduates being highly competitive. The rise of 'insurtech' and data science has also created new, innovative roles for actuaries with strong technical skills.

**Real-World Impact:** Actuaries play a critical role in safeguarding the UK's financial

security. They ensure that millions of people receive their pension payments, that insurance claims are paid out after accidents or illnesses, and that financial institutions remain solvent. Their work on climate risk modelling helps insurers and the government prepare for and price the impacts of flooding and extreme weather events. Furthermore, by developing innovative insurance products for emerging risks like autonomous vehicles or telehealth, they directly contribute to economic stability and social protection across the UK.