CAREERS THROUGH MATHS: ACTUARY

JOB DESCRIPTION

Actuaries are highly skilled professionals who analyse the financial consequences of risk and uncertainty. They apply advanced mathematical and statistical techniques to model future events, particularly those where financial security or insurance is needed. A typical day involves analysing large datasets, developing and testing complex statistical models, and preparing reports for senior management, clients, or regulators. The work environment is predominantly office-based, often within the City of London or other major financial hubs like Edinburgh or Manchester, and involves collaboration with underwriters, finance professionals, and senior executives.

The core duties of an actuary are diverse and critical to the functioning of key UK industries. In insurance, they calculate premiums for life, motor, or home insurance policies by assessing the likelihood of claims, ensuring the company remains solvent while being competitive. For pension funds, such as those for large UK companies or public sector bodies like the NHS, actuaries determine the necessary contributions to ensure the fund can meet its future pension payment obligations to retirees. They also play a vital role in banking, managing credit risk and ensuring compliance with financial regulations set by the Prudential Regulation Authority (PRA) and the Financial Conduct Authority (FCA).

Mathematics is the absolute foundation of the actuarial role. It is not merely a tool but the very language used to quantify risk. Every decision, from setting the price of an insurance product to advising on a multi-billion-pound corporate merger, is driven

by mathematical models. For example, when a UK insurer launches a new cyber insurance product, actuaries will use probability theory and historical data on cyber-attacks to model potential losses, ensuring the premiums collected are sufficient to cover future claims and generate a profit for the company. This rigorous, numbers-driven approach provides the financial certainty that allows these essential industries to operate securely.

HOW MATHEMATICS IS USED

- **Probability and Statistics:** This is the bedrock of actuarial work. Actuaries use probability distributions to model uncertain future events, such as the likelihood of a car accident, a person's life expectancy, or the frequency of natural floods in the UK. For instance, to price a life insurance policy for a 40-year-old in the UK, an actuary will use mortality tables (like those published by the Continuous Mortality Investigation) to calculate the probability of death at each future age. They also employ statistical inference to analyse past claims data from a portfolio of motor insurance policies to identify trends, such as an increase in claims severity in a specific region, which directly influences future premium calculations.

- **Financial Mathematics:** Actuaries are experts in the mathematics of finance, particularly the time value of money. They use techniques like discounting to calculate the present value of future financial obligations. A key application is in pension scheme valuations. An actuary working on a defined benefit pension scheme for a FTSE 100 company must calculate the current lump sum needed today to pay pensions that may not be due for 40 years. This involves projecting future pension payments and discounting them back to today's values using an appropriate interest rate, a complex calculation central to the scheme's funding and health.

- **Calculus:** Calculus, especially differential equations, is used for modelling complex, dynamic systems. In general insurance (also known as non-life or property & casualty insurance), actuaries use stochastic calculus to model the accumulation of claims over time for events like major storms or industrial disasters. This helps insurers determine the level of capital reserves they must hold to remain solvent after a catastrophic event. It is fundamental to the internal models that UK insurers use to satisfy the Solvency II regulatory framework.

- **Predictive Modelling and Machine Learning:** Modern actuaries heavily rely on predictive analytics. Using techniques like generalised linear models (GLMs) and machine learning algorithms, they can segment risks more accurately. For example, a UK health insurer might use a predictive model that incorporates postcode data, lifestyle information, and medical history to tailor premiums more precisely for individual customers, moving beyond traditional broad risk categories to a more personalised pricing structure.

- **Data Analysis and Statistical Modelling:** The role involves constant interrogation of large datasets. An actuary at a consultancy like Barnett Waddingham or Hymans Robertson might be tasked with analysing the longevity risk for a pension scheme. This would involve using statistical software to model members' life expectancies based on socio-economic factors, medical advances, and historical data, ultimately advising the trustee on how long the scheme's funds need to last. This modelling directly impacts the company's balance sheet and strategic financial planning.

KEY SKILLS & TOOLS

Skill/Tool	Application
Microsoft Excel & VBA	The indispensable tool for initial data manipulation, prototyping models, and creating reports. Actuaries use advanced functions, pivot tables, and VBA macros to automate complex calculations, such as projecting the cash flows of a new annuity product for a UK life insurer like Legal & General or Aviva.
Prophet or MoSes	These are specialised actuarial modelling software packages used predominantly by life insurers. An actuary uses Prophet to perform complex economic scenario generators to value long-term life insurance and pension liabilities, ensuring compliance with UK Solvency II capital requirements.
R & Python	Open-source programming languages used for advanced statistical analysis, machine learning, and handling very large datasets. A pricing actuary at a firm like Direct Line might use Python to build a

	gradient boosting model that analyses thousands of driver variables to refine motor insurance premium calculations.
SQL Databases	Essential for extracting and managing the vast amounts of policy and claims data stored in corporate databases. An actuary will write SQL queries to extract a specific cohort of data, for example, all property insurance claims in London from the last five years, to analyse flood risk trends.
Communication & Report Writing	The ability to translate complex mathematical findings into clear, actionable advice for non-specialists is paramount. An actuary must present the results of a capital model to a board of directors, explaining the financial risks in a clear way to inform strategic decisions about dividends or expansion.
Stochastic Modelling	A mathematical technique used to model random outcomes. Actuaries use it for Asset-Liability Modelling (ALM), where they run thousands of simulations of future investment returns and liability growth to advise a pension fund trustee on the most appropriate investment strategy to minimise risk.

Typical Pathway: The pathway to becoming a fully qualified actuary in the UK is rigorous and typically takes 3-6 years. It begins with strong A-levels, especially in Mathematics and Further Mathematics, followed by a high-class (often first or 2:1) degree in a mathematical subject like Mathematics, Statistics, or Actuarial Science. Many UK universities, such as the London School of Economics (LSE) and the University of Warwick, offer accredited degrees that provide exemptions from some professional exams. The primary route is through a graduate scheme with an employer, such as an insurance company (e.g., Lloyd's of London syndicates), consultancy (e.g., Willis Towers Watson), or pension fund. While working, graduates study for the professional exams set by the Institute and Faculty of Actuaries (IFoA). Qualification leads to the title of Fellow of the IFoA (FIA), a chartered status recognised globally. Career progression moves from student actuary to qualified actuary, senior manager, and often to executive roles like Chief Risk Officer or Chief Financial Officer.

Industry Demand: The demand for actuaries in the UK remains strong, driven by the complexity of financial regulation, an increasing focus on risk management post-financial crisis, and emerging areas like data analytics and climate risk. The UK is a global leader in insurance and financial services, housing a dense concentration of firms in London and Edinburgh. According to the IFoA, qualified actuaries are in high demand, with competitive starting salaries for graduates and significant earning

potential for Fellows. Growth areas include cyber risk, healthcare analytics, and the application of actuarial principles to non-traditional fields like artificial intelligence ethics.

Real-World Impact: Actuaries play a crucial role in the stability of the UK economy and the financial security of its citizens. Their work ensures that when a family makes a claim on their home insurance after a flood, the insurer has the funds to pay. It guarantees that millions of UK workers receive the pensions they were promised. During the COVID-19 pandemic, actuaries were instrumental in modelling the potential financial impact on the NHS and insurance industries. By quantifying risk, they enable innovation—from insuring the first satellite launches to developing new financial products—making them indispensable to a modern, thriving economy.