

# CAREERS THROUGH MATHS: FORENSIC SCIENTIST



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## JOB DESCRIPTION

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A Forensic Scientist applies scientific principles to analyse evidence from crime scenes, providing impartial evidence for use in courts of law. Their daily responsibilities are highly varied and can range from examining minute traces of DNA in a laboratory to attending a complex crime scene, such as a burglary or serious assault. The work environment is split between the controlled, sterile conditions of the lab—like those at the Forensics Sub-Division of the Metropolitan Police—and the often challenging and unpredictable conditions of a crime scene. Key duties include processing items for fingerprints and DNA, analysing digital evidence, comparing fibres and glass fragments, and providing expert witness testimony in Crown and Magistrates' Courts across the UK.

Mathematics is central to the role, underpinning almost every aspect of the analytical process. It is not merely about calculation but about a fundamental way of thinking: logical, precise, and evidence-based. For instance, when analysing a bloodstain pattern at a scene, a forensic scientist uses trigonometry to calculate the angle of impact, helping to reconstruct the sequence of events. In the digital realm, they use statistical models to determine the strength of a DNA match, which must be presented in a way that is understandable to a jury.

The work is governed by strict procedural frameworks, such as those outlined by the Forensic Science Regulator, to ensure the integrity and admissibility of evidence. A typical project might involve analysing a set of digital devices seized by the National Crime Agency in a fraud investigation, requiring meticulous data extraction and

pattern recognition to trace illicit financial transactions. The role demands meticulous attention to detail, objectivity, and the ability to communicate complex scientific and mathematical concepts clearly and concisely to a non-scientific audience, such as police officers, lawyers, and jurors.

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## HOW MATHEMATICS IS USED

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- **Statistics and Probability:** This is the cornerstone of modern forensic science, particularly in evaluating the significance of evidence. Forensic scientists use probability theory to calculate likelihood ratios, which express how much more likely the evidence is under one proposition (e.g., the defendant is the source of the DNA) compared to an alternative (e.g., the DNA came from an unrelated person in the UK population). For example, when a DNA profile is matched using the UK National DNA Database, a statistician or reporting scientist will calculate the frequency of that profile, which might be 1 in a billion, to provide context for the match. Similarly, in fibre analysis, they might calculate the probability of a random fibre match based on the colour and polymer type's prevalence in the UK.
- **Geometry and Trigonometry:** These areas are vital for crime scene reconstruction. After a shooting or assault, scientists analyse bloodstain patterns. By measuring the shape and size of individual blood droplets, they use trigonometry to calculate their angle of impact. Plotting these angles back to their point of origin in three-dimensional space allows them to determine the position of the victim and assailant at the moment of injury. This geometric reconstruction can be crucial for verifying or challenging witness accounts.
- **Calculus:** Calculus is employed in specialised areas for modelling complex changes over time. In fire investigation, differential equations can be used to model the rate of heat transfer and the spread of a fire through a building, helping to identify the point of origin. In toxicology, pharmacokinetic models—which rely on calculus—are used to determine how a drug or poison is absorbed, distributed, metabolised, and excreted by the body, which can be critical in establishing a timeline of events in a poisoning case.
- **Logic and Set Theory:** Logical reasoning is fundamental to the interpretation of evidence and the formulation of propositions. Scientists use Bayesian logic to

weigh the evidence under competing scenarios proposed by the prosecution and defence. Set theory is applied in digital forensics when sorting through vast datasets; for example, creating a set of all files modified on a specific date and intersecting it with a set of files containing certain keywords to narrow down a search in a corporate fraud investigation.

- **Statistical and Analytical Methods:** Beyond formal statistics, data analysis is pervasive. In digital forensics, analysts use data mining techniques to identify patterns of suspicious behaviour within gigabytes of data from a suspect's computer. In forensic archaeology, statistical analysis of soil composition data can link a suspect to a specific burial site. Mathematical modelling is also used to predict the degradation of evidence, such as how long a body has been decomposing based on temperature and environmental data, a process known as taphonomy.

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## KEY SKILLS & TOOLS

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Skill/Tool	Application
Laboratory Information Management System (LIMS)	Used to track the chain of custody and all analytical data associated with a case. Every mathematical calculation, from DNA statistics to toxicology concentrations, is managed, stored, and reported through this system, ensuring compliance with the Forensic Science Regulator's Codes of Practice.
Statistical Software (R, SPSS)	Used to perform complex statistical analyses, such as calculating likelihood ratios for DNA evidence or running multivariate analysis on chemical composition data from glass fragments. For example, R might be used to model the probability of a footwear mark matching a specific brand of trainer based on UK market share data.
Data Analysis Tools (Microsoft Excel, Python Pandas)	Excel is used ubiquitously for initial data sorting, basic calculations (e.g., means, standard deviations), and creating charts for reports. Python, with libraries like Pandas, is used for more advanced data manipulation, such as parsing

	through mobile phone mast data to triangulate a suspect's location over time.
Programming Languages (Python, SQL)	Python is used to automate repetitive tasks, build custom analytical models, and process large digital datasets (e.g., scraping data from social media in an investigation). SQL is essential for querying large forensic databases, such as those holding DNA profiles or fingerprint records, to find potential matches.
Specialised Equipment (Microscopes, Mass Spectrometers)	A comparison microscope is used to side-by-side analyse ballistic evidence; the mathematical concept of congruence is key to identifying matching striations. Mass spectrometers generate complex data spectra, and the interpretation of peaks and troughs relies on mathematical algorithms to identify unknown substances.
Communication Tools (Microsoft PowerPoint, Expert Witness Reports)	The ability to distil complex mathematical findings into clear, understandable visuals and statements is critical. A scientist may use PowerPoint to create a diagram explaining Bayesian inference to a jury or write a detailed report for the Crown Prosecution Service, stating the statistical weight of the evidence in a clear and unbiased manner.
Quality Control Methods (Control Charts, Standard Operating Procedures)	To ensure analytical precision, scientists use statistical process control charts to monitor the performance of their equipment over time. This involves plotting control measurements and calculating warning and action limits, ensuring all results are reliable and legally defensible.

**Typical Pathway:** The most common route is a good honours degree (2:1 or above) in a relevant science subject such as chemistry, biology, or forensic science itself, accredited by The Chartered Society of Forensic Sciences. Strong performance in A-levels (or Scottish Highers) in Sciences and Mathematics is typically required, alongside GCSEs in English, Maths, and Sciences. Entry-level positions, such as a Forensic Assistant or Reporting Scientist, are often with police force scientific support units (e.g., the Metropolitan Police Forensic Services) or private providers like Eurofins Forensic Services. Career progression leads to roles such as Reporting Officer, Casework Examiner, and ultimately, Senior/Managerial positions. Many scientists work towards becoming a Chartered Scientist (CSci) through the Society, which enhances professional standing. Continuous professional development is

mandatory, often provided through the College of Policing and other specialist training providers.

**Industry Demand:** The UK forensic science market is stable, with core demand driven by police and government requirements. While direct employment in traditional forensic roles is competitive, the digital forensics sector is experiencing significant growth due to the rise in cybercrime, with organisations like the National Crime Agency and regional police cyber-units actively recruiting. The Forensic Science Regulator's ongoing push for increased standardisation and scientific rigour continues to drive demand for professionals with strong analytical and mathematical skills. According to the Office for National Statistics, the broader professional scientific and technical activities sector is projected to grow.

**Real-World Impact:** Forensic Scientists play a critical role in the UK's criminal justice system, helping to convict the guilty and exonerate the innocent. Their work was pivotal in high-profile cases such as the investigation into the Salisbury Novichok poisonings, where complex chemical and spatial analysis was required. By applying mathematical rigour, they ensure that evidence presented in UK courts is robust, reliable, and fair, thereby upholding the integrity of the justice system and contributing to public safety and security across the nation.