

CAREERS THROUGH MATHS: GAMING DESIGN



JOB DESCRIPTION

A gaming designer, often referred to as a games designer in the UK, is the creative and technical architect behind a video game's core experience. Their day-to-day work is a blend of creative vision and rigorous mathematical application, far removed from simply playing games. They work within multidisciplinary teams in environments ranging from large, established studios like Rocksteady (London) or Rockstar North (Edinburgh) to small, agile indie developers clustered in hubs like Leamington Spa, Dundee, or Brighton. The role involves creating detailed design documents (GDDs), prototyping mechanics, and collaborating closely with artists, programmers, and audio engineers to bring a cohesive and engaging game world to life.

Central to the role is the use of mathematics to translate abstract ideas into functional, balanced, and predictable systems. A designer's responsibilities include defining the rules of the game, which are fundamentally mathematical models. For instance, they must calculate the exact damage output of a weapon based on a player's stats, model the economy of an in-game shop to ensure longevity, or script the behaviour patterns (AI) of non-player characters using state machines and probability. A designer at a UK mobile games company, such as Mediatonic, would use mathematical progression curves to plan how long it takes a player to reach a new level, ensuring player retention.

The work is highly iterative and collaborative. Designers use specialised software to create prototypes, analyse player data post-launch, and continuously tweak variables

to optimise the player experience. Whether designing a complex puzzle for a narrative adventure by a studio like Ninja Theory or balancing the competitive gameplay for a sports title from Codemasters, the gaming designer ensures that the mathematical framework supporting the game is robust, fair, and, most importantly, fun.

HOW MATHEMATICS IS USED

Linear Algebra and Vector Mathematics: *This is the fundamental language of 3D game engines. Vectors are used to represent positions, directions, and velocities of every object in the game world. For example, calculating the trajectory of a projectile in a game by Frontier Developments like Elite Dangerous* involves vector addition and scalar multiplication. Dot products are used to determine if an enemy character is facing the player (for a stealth game mechanic), while matrix transformations are essential for rendering a character model from any camera angle, a core function in any 3D title developed in the UK.*

- **Calculus (Differential):** Calculus is used extensively for modelling smooth change over time, which is critical for creating realistic motion and dynamic systems. The concept of derivatives is used to calculate instantaneous rates of change, such as the precise acceleration of a car in a racing sim by Codemasters or the smooth, easing motion of a camera following a character. When designing a physics-based puzzle game, designers use calculus to model how forces like gravity and momentum affect objects, ensuring the behaviour feels natural and predictable to the player.

Probability and Statistics: *These are vital for creating uncertainty, reward systems, and for analysing player behaviour. A designer at a studio like Jagex, working on RuneScape*, would use probability distributions to define loot drop rates from bosses, ensuring long-term engagement. Statistics are crucial post-launch; designers analyse vast datasets of player metrics to identify if a certain level is too difficult (a high player failure rate) or if a weapon is over-powered (analysing win-rate data), leading to data-driven patches and updates.*

- **Discrete Mathematics and Logic:** This area underpins all game logic and artificial intelligence. Boolean algebra is used to create complex conditional statements that govern game events (e.g., IF the player has the key AND the door is locked, THEN unlock the door). Graph theory can be used to design complex dialogue trees in narrative games or to map out waypoint paths for AI navigation

in a strategy game. Finite state machines, a concept from discrete maths, are used to define the behaviour of AI enemies, such as a guard switching between 'patrol', 'alert', and 'attack' states.

Balancing and Economics (Algebra and Game Theory): *A huge part of a designer's job is balancing game systems to ensure fairness and longevity. This involves solving complex systems of equations. For example, balancing a real-time strategy game requires creating a "rock-paper-scissors" dynamic between unit types, where each unit's cost, build time, health, and damage must be carefully calculated against all others. Game theory principles are applied to design in-game economies, such as the auction house in a game like Football Manager*, ensuring that the market does not become inflated or broken, which requires modelling supply, demand, and player interaction.*

KEY SKILLS & TOOLS

Skill/Tool	Application
Game Engines (Unity, Unreal Engine)	These are the primary tools where mathematical concepts are applied practically. A designer uses Unity's built-in vector maths functions to script object movement or Unreal Engine's Blueprint visual scripting to create complex game logic using algebraic operations and logical gates, forming the core gameplay of titles developed by UK studios.
Spreadsheet Software (Microsoft Excel/Google Sheets)	Surprisingly vital. Used for data modelling and balancing. Designers build complex spreadsheets to calculate character stat progression, weapon damage curves, and economic models. For example, modelling the cost of every building in a city-builder game against the income generated, using algebraic formulae to ensure a balanced economy.
Data Analysis & BI Tools (Tableau, Google Analytics)	Used to analyse post-launch player data. A designer at a mobile game company might use these tools to perform statistical analysis on player retention funnels, identifying at which level players are churning, and then using that data to mathematically adjust the difficulty curve.

Programming/ Scripting (C#, Python, C++)	Essential for implementing and prototyping game mechanics. C# is used for scripting in Unity, where a designer writes functions to calculate damage based on formula: <code>`FinalDamage = (BaseDamage * ArmourPenetration) / (TargetArmour + 100)`</code> . Python is often used for writing data analysis scripts to process playtest results.
Version Control (Git, Perforce)	Industry-standard tools for collaboration. While not directly mathematical, they are essential for managing the complex, iterative process of tweaking numerical values and scripts across a team without creating conflicts, a standard practice in UK development studios.
Communication & Documentation (Confluence, Miro)	Used to present mathematical models and design rationale to non-technical stakeholders. A designer must clearly explain why a statistical analysis of player behaviour necessitates a specific change to the game's progression system, ensuring buy-in from producers and directors.
Playtesting & QA Methodologies	The application of the scientific method. Designers formulate hypotheses about game balance, define measurable outcomes, and use structured playtesting sessions to gather quantitative and qualitative data. This data is then statistically analysed to validate or refute their initial mathematical models.

Typical Pathway: The most common route is through higher education. Aspiring designers typically take A-levels (or Scottish Highers) in Mathematics and Physics, which provide the essential foundational knowledge, alongside subjects like Computing or Art. This is followed by a specialised undergraduate degree, such as a BSc in Game Design or Computer Science from a UK institution like Abertay University (a pioneer in the field), the National Film and Television School (NFTS), or Goldsmiths, University of London. Entry-level positions include Junior Designer or QA Tester, where individuals prove their aptitude for systems thinking. Career progression leads to roles like Senior Designer, Lead Designer, and eventually Creative Director. Key UK qualifications are often degree-based, but professional development through courses offered by organisations like Ukie (The Association for UK Interactive Entertainment) is highly valuable for networking and skills updates.

Industry Demand: The UK video games industry is a major economic and cultural contributor, with hubs across the country reporting consistent growth. According to Ukie's UK Games Industry Census, the sector directly employs over 20,000 people, with strong demand for skilled technical and creative talent. The rise of mobile

gaming, esports, and immersive technologies (VR/AR) continues to drive demand for designers who possess strong mathematical skills to create complex, engaging, and data-informed experiences. The UK government's recognition of the sector through Video Games Tax Relief further stimulates growth and job creation.

Real-World Impact: Gaming designers contribute significantly to the UK's £7 billion+ games market, creating world-renowned entertainment like the *Grand Theft Auto* series (Rockstar North) and *Total War* (Creative Assembly). Their work drives technological innovation, with UK studios at the forefront of graphics, AI, and physics simulation. Beyond entertainment, the mathematical and systems-thinking skills developed in games design are increasingly applied in "serious games" for education, healthcare simulation, and corporate training, showcasing the broader impact of this technical and creative discipline on UK society.