CLAIMS

1. A data processing system for generating a future behaviour simulation comprising a set of output parameters, the data processing system comprising one or more processors configured to implement:

an approximation module configured to determine an approximated value of a parameter in a first domain, the parameter being dependent on one or more variables which vary in a second domain, and the parameter being determined by a function which relates sets of values of the one or more variables in the second domain to corresponding values in the first domain; and

a metric module configured to calculate one or more standard metrics based on the approximated parameter in the first domain so as to generate the set of output parameters,

in which the approximation module is configured to:

determine a plurality of anchor points in the second domain, each anchor point comprising a set of values of the one or more variables in the second domain, and the anchor points being the zeros of each of a series of orthogonal functions, or a subset of the zeros;

evaluate, at each anchor point, the function to generate corresponding values of the parameter in the first domain;

generate an approximation function to the function by fitting the series of orthogonal functions or an approximation to the series of orthogonal functions to the corresponding values of the parameter in the first domain; and

use the approximation function to generate the approximated value of the parameter in the first domain.

2. A data processing system according to Claim 1,in which the approximation module is configured to: transform the function into an intermediary function before generating the approximation function, in which the intermediary function is a linear transformation of the function, and in which the approximation module is configured to approximate the intermediary function to generate the approximation function.

3. A data processing system according to Claim 2, in which the function comprises linearly transforming the function into a predetermined range.

4. A data processing system according to Claim 1, 2 or 3, in which the series of orthogonal functions is one of the group comprising: sines, cosines, sines and cosines, Bessel functions, Gegenbauer polynomials, Hermite polynomials, Laguerre polynomials, Chebyshev polynomials, Jacobi polynomials, Spherical harmonics, Walsh functions, Legendre polynomials, Zernike polynomials, Wilson polynomials, Meixner–Pollaczek polynomials, continuous Hahn polynomials, continuous dual Hahn polynomials, a classical polynomials described by the Askey scheme, Askey–Wilson polynomials, Racah polynomials, dual Hahn polynomials, Meixner polynomials, piecewise constant interpolants, linear interpolants, polynomial interpolants, gaussian process based interpolants, spline interpolants, barycentric interpolants, Krawtchouk polynomials, Charlier polynomials, sieved ultraspherical polynomials, sieved Jacobi polynomials, sieved Pollaczek polynomials, Rational interpolants, Trigonometric interpolants, Hermite interpolants, Cubic interpolants, and Rogers–Szegő polynomials.

5. A data processing system according to any preceding claim, in which the series of orthogonal functions is a series of orthogonal polynomials.

6. A data processing system according to any preceding claim, in which the approximation to the series of orthogonal functions is an approximation to a series of orthogonal polynomials.

7. A data processing system according to any preceding claim in which the approximation module is configured to select a series of orthogonal functions or an approximation to a series of orthogonal functions before generating the approximation function, and in which the approximation module is configured to use the selected series of orthogonal functions or the approximation to the series of orthogonal functions to generate the approximation function.

8. A data processing system according to any preceding claim, in which the number of anchor points, N_E, is so that:

$$\frac{N_S \cdot T}{N_E \cdot T + N_S \cdot t} > 1$$

in which N_S is the number of scenarios, t is the time taken to run the approximation function, and T is the time taken to run the function.

9. A data processing system according to any preceding claim, in which the approximation module is configured to hold the values of all but one variable in the set to be constant when evaluating the function.

10. A data processing system according to any preceding claim, in which the speed of the calculation is increased with no loss of accuracy in the standard metrics, and/or the accuracy of the standard metrics increase with no decrease in the speed of the calculation when using the approximation function.

11. A data processing system according to any preceding claim, in which there is a difference between the approximated value of the parameter and the parameter in the 2nd significant figure when compared at the same point in the first domain.

12. A data processing system according to any of Claims 1 to 10, in which there is a difference between the approximated value of the parameter and the parameter in between the 4th and the 6th significant figure when compared at the same point in the first domain.

13. A data processing system according to any of Claims 1 to 10, in which there is a difference between the approximated value of the parameter and the parameter in the 15th significant figure when compared at the same point in the first domain.

14. A data processing system according to any preceding claim, in which the values of the variables vary stochastically.

15. A data processing system according to any preceding claim, in which the approximation module is configured to use the approximation function a plurality of times to generate at least one scenario or one time step, each scenario or each time step comprising a plurality of approximated values.

16. A data processing system according to Claim 15, in which the number of scenarios or time steps is significantly greater than the number of anchor points.

17. A data processing system according to any preceding claim, in which the function is one of the group comprising: a Black–Scholes model, a Longstaff-Schwartz model, a binomial options pricing model, a Black model, a Garman–Kohlhagen model, a Vanna–Volga method, a Chen model, a Merton's model, a Vasicek model, a Rendleman–Bartter model, a Cox–Ingersoll–Ross model, a Ho–Lee model, a Hull–White model, a Black–Derman–Toy model, a Black–Karasinski model, a Heston model, a Monte Carlo based pricing model, a binomial

pricing model, a trinomial pricing model, a tree based pricing model, a finite-difference based pricing model, a Heath–Jarrow–Morton model, a variance gamma model, a Fuzzy pay-off method, a Single-index model, a Chepakovich valuation model, a Markov switching multifractal, a Datar Mathews method, and a Kalotay–Williams–Fabozzi model.

18. A data processing system according to any preceding claim, in which the approximation module is configured to generate the approximating function using an interpolation scheme.

19. A data processing system according to Claim 18, in which the interpolation scheme is one from the group comprising: piecewise constant interpolants, linear interpolants, polynomial interpolants, gaussian process based interpolants, spline interpolants, barycentric interpolants, Rational interpolants, Trigonometric interpolants, Hermite interpolants and Cubic interpolants,.

20. A data processing system according to any preceding claim, in which the anchor points are integration points of a numerical integration scheme.

21. A data processing system according to Claim 20, in which the numerical integration scheme is one from the group comprising: Newton-Cotes methods, a trapezoidal method, a Simpson's method, a Boole's method, a Romberg integration method, Gaussian quadrature methods, Chenshaw-Curtis methods, a Fejer method, a Gaus-Kronrod method, Fourier Transform methods, an Adaptive quadrature method, a Richardson extrapolation, a Monte Carlo and Quasi Monte Carlo method, a Markov chain Monte Carlo, a Metropolis Hastings algorithm, a Gibbs Sampling, and Fast Fourier Transform methods.