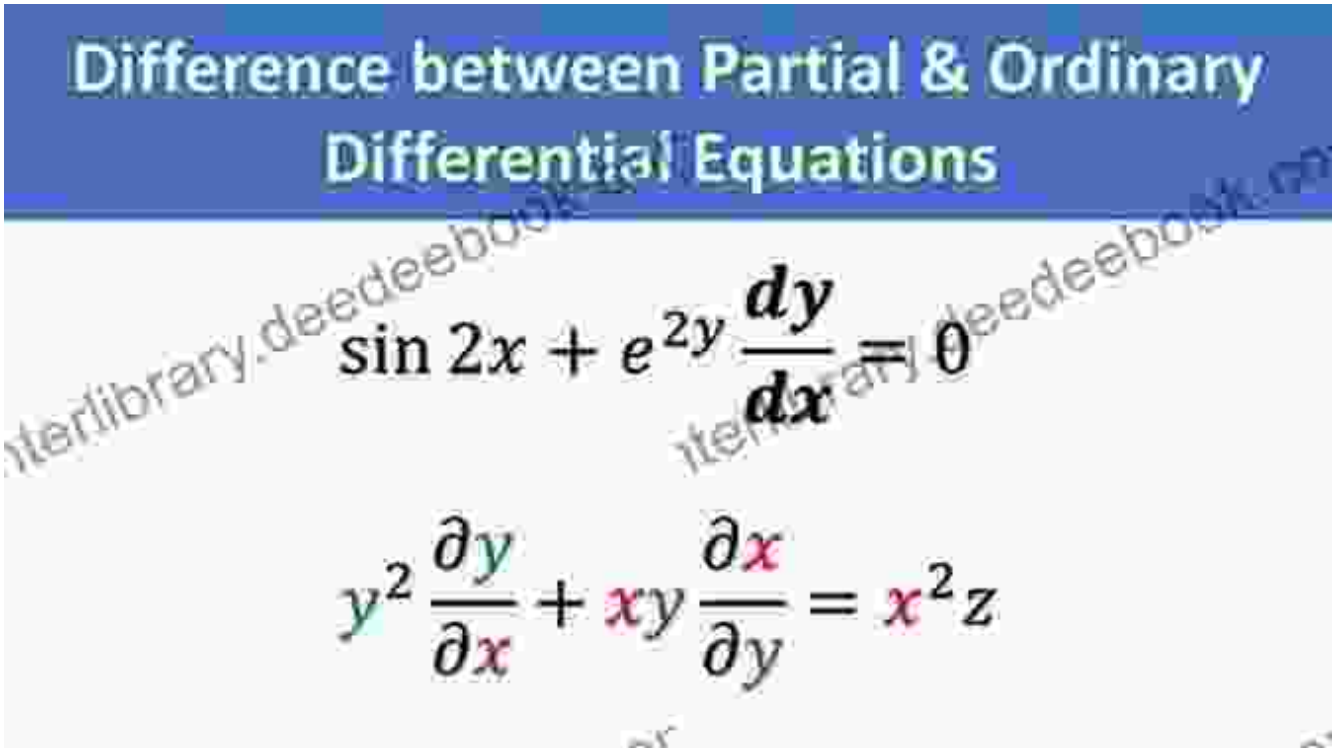
Fractional Differential Equations: Mathematics and Applications



Methods of Mathematical Modelling: Fractional Differential Equations (Mathematics and its Applications) by Noel Streatfeild

4.8 out of 5

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Fractional differential equations (FDEs) are a generalization of ordinary differential equations (ODEs) and partial differential equations (PDEs). They have been used to model a wide variety of phenomena in science and engineering, including fluid flow, heat transfer, and viscoelasticity.

FDEs are characterized by the use of fractional derivatives. Fractional derivatives are generalizations of ordinary derivatives, and they can be defined in a number of different ways. The most common definition of a fractional derivative is the Riemann-Liouville fractional derivative, which is given by the following equation:

^aD^ax^αf(x) = \frac{1}{\Gamma(n-α)}\frac{d^n}{dx^n}\int_0^x (x-t)^{n-α-1}f(t) dt

where \(α\) is the order of the fractional derivative, \(\Gamma(\cdot)\) is the gamma function, and \(n\) is the smallest integer greater than or equal to \(\alpha\).

Mathematical Properties of FDEs

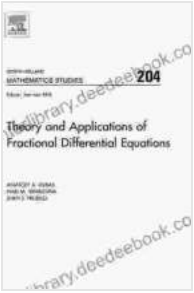
FDEs have a number of interesting mathematical properties. For example, they are not always well-posed, and they can exhibit non-integer order derivatives. Additionally, FDEs can be solved using a variety of different methods, including the Laplace transform, the Fourier transform, and the Adomian decomposition method.

Applications of FDEs

FDEs have been used to model a wide variety of phenomena in science and engineering. Some of the most common applications of FDEs include:

* Fluid flow * Heat transfer * Viscoelasticity * Electrochemistry * Control theory * Signal processing

FDEs are a powerful tool for modeling a wide variety of phenomena in science and engineering. They have a number of interesting mathematical properties, and they can be solved using a variety of different methods. As a result, FDEs are becoming increasingly popular in a variety of fields.



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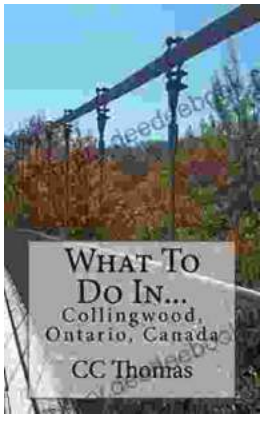

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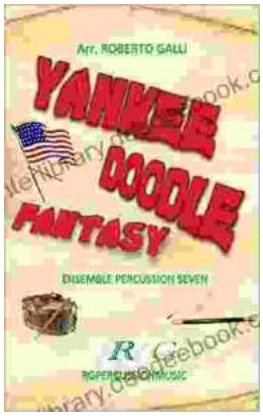

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