**Analytical Solutions for Advection and Advection-Diffusion Equations with Spatially Variable Coefficients**

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The Advection Diffusion Reaction equation:



Has an analytical solution of:



 (26)

will be solved in the spatial interval *0.1 ≤ x ≤ 1* using the following Neumann boundary condition at *x = 0.1*:

 (27)

and a Dirichlet boundary condition of *C* = 2 @ *X* = 1. The dispersion models were tested for two incremental spatial spans between *3* to *192* and *25* to *3200* (number of volumes), inclusive, using a dispersivity of *D = 1* and time spans and theta which guarantees stability. The results were compared against the following analytical solution to find the error. Then the three norms of error where calculated to perform test convergence and accuracy order tests



**Solution by Zoppou and Knight 1997**





Solution is



dsolve ('Du\*(3+cos(t))\*(2+sin(t))\*x+u\*(3+cos(t))\*(2+sin(t))-u\*sin(t)','x')

ans =

C1\*x^((-cos(3\*t)-15\*cos(t)-4\*cos(2\*t)-44+8\*sin(t))/(cos(3\*t)+15\*cos(t)+6\*cos(2\*t)+42))

>> syms A

>> A=ans

A =

C1\*x^((-cos(3\*t)-15\*cos(t)-4\*cos(2\*t)-44+8\*sin(t))/(cos(3\*t)+15\*cos(t)+6\*cos(2\*t)+42))