

CONVERGENCE OF THE FINITE DIFFERENCE METHOD FOR AN AGE-STRUCTURED TWO-SEX POPULATION DYNAMICS MODEL OF THALASSEMIA TRANSMISSION

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Thalassemia is an inherited blood disorder that affects the production of haemoglobin and red blood cells. Symptoms include anaemia, jaundice, chest pain, and breathing problems. It is an autosomal recessive disorder, meaning both parents must have the disease or be carriers for it to be passed down to the next generation. Thalassemia is native to a wide but restricted geographical area. Nevertheless, migration is spreading to formerly unaffected areas. Consequently, tracking and forecasting disease prevalence is important for effective healthcare planning. Structured models are essential for studying multicellular organism populations and hereditary diseases in which age and sex play a role. The previously published work established and analysed a two-sex age-structured continuous type population dynamics model for thalassemia transmission that describes the genotype composition of the population resulting from the thalassemia trait and is based on the Fredrickson-Hoppensteadt model, which is a system of semi-linear partial differential equations with nonlocal boundary conditions. To make projections about a population, we must generate numbers from them to compare with data. The model's answer must then be approximated using numerical methods. The objective of this research is to present a numerical algorithm for approximating the solution of the model and to demonstrate that this method converges ideally to the exact answer. The Crank-Nicolson form of the finite difference method of characteristics, combined with the trapezoidal rule for the quadrature of the integrals that describe births and densities of married individuals of each sex, is developed to approximate the solutions of the model. The optimal rate of convergence of the numerical method is discussed to the maximum norm. The work presented here can potentially be beneficial in both mathematical and biological contexts.

Keywords: Age structured, Finite difference, Numerical methods, Thalassemia, Two sex