A Fractıonal-Order Two-Straın Epıdemıc Model wıth Two Vaccınatıons

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Abstract: In this research paper, we extended an existing SIR epidemic integer model containing two strains and two vaccinations by using a system of fractional ordinary differential equations in the sense of Caputo derivative of order $\alpha \in (0,1]$. Four equilibrium points were established: disease free equilibrium, strain1 disease free equilibrium, strain2 disease free equilibrium and endemic equilibrium. Explicit analysis of the equilibrium points of the model was given applying fractional calculus and Routh-Hurwitz criterion. Stability analysis of the equilibrium points was carried out employing the Jacobian matrix. Numerical simulations were iterated to support the analytic results. It was shown that when the two reproduction number R_1 and R_2 are less than one, the disease die out over time and when either of them are greater than one, the disease persist in relation to the thriving strain. The effect of vaccine was also studied. With the fractional order technique, the memory effect of the system is made visible and hence easier to predict.

Keywords: Two strain, vaccine, fractional-order model,basic reproduction number, stability

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