Homework 4

1. The plots of log – transformed data against the best-fitting log-transformed model for each of the parameter is shown below:

A graph of a function

Description automatically generated with medium confidence

Figure 1: Log – transformed data for each parameter ( a) Development rate, theta; b) Mortality rate, mu; c) Transmission rate, rho) plotted against best-fitting log-transformed model with the y axis representing the natural log of the data, and the x axis representing 1/TK – 1/T0K. The blue circles represent the log-transformed data points, while the red lines show the linear fit obtained through least-squares regression.

The best estimates for θ0 and Eθ, μ0 and Eμ, and ρ0 and Eρ obtained from MATLAB are:

A number with numbers and symbols

Description automatically generated with medium confidence

1. The four subplots are plotted below, where the first three show he original data  
   and best-fitting thermal performance curves θ(T), μ(T), and ρ(T), and the fourth subplot shows the basic reproductive number R0 as a function of temperature

A graph of a temperature

Description automatically generated with medium confidence

Figure 2: Four-panel plot displaying thermal performance and reproductive metrics as a function of temperature. The first three subplots (a, b, and c) show the original data points and best-fit thermal performance curves for the three processes: Development θ(T), Mortality μ(T), and Transmission ρ(T), represented by blue circles for data points and solid red lines for the fitted curves. The fourth subplot (d) shows the basic reproductive number R0​(T) as a function of temperature.

1. The figure that shows the abundance of adult parasites over time until equilibrium is reached when temperature is at 5°C, 15°C, 25°C, and 35°C is plotted below:

A graph of a graph

Description automatically generated with medium confidence

Figure 3: Time Series Plot that shows the abundance of adult parasites in a host-parasite model across different temperatures at T = 5°C, T = 15°C, T = 25°C, and T = 35°C. Each line represents the dynamic growth of adult parasites starting with one free-living larva, plotted over time from the differential model until an equilibrium is reached.

1. Based on the results obtained from part b), we can see that the development, mortality, and transmission rates all increase with rising temperature. As for the basic reproductive number R0, it rises steadily from 0°C to a peak around 23°C , after which it declines as temperatures continue to rise beyond that point.

As for the result obtained from part c), we can see that the adult parasite is most abundant when temperature is 25°C from 200 days onwards, while the lowest abundance occurs at 5°C. Furthermore, the population has greater abundant when at 15°C compared to 35°C in the long run. The results are consistent with the result of R0 obtained from part b), as the parasite’s reproductive capacity is maximized at 25°C, significantly diminished at 5°C, and relatively higher at 15°C than at 35°C.