**Assignment 4 – Oisin Mc Laughlin 22441106**

Thank you for the extension until Friday.

SIR.m

function dydt = SIR(t, y, c, i, alpha, beta, gamma)

% Extract the current state variables from the input vector y

S = y(1);

I = y(2);

R = y(3);

H = y(4);

RH = y(5);

% Total population

N = S + I + R + H + RH;

% Define the derivatives for each state variable

dSdt = -c \* S \* (I / N) \* i;

dIdt = c \* S \* (I / N) \* i - alpha \* I;

dRdt = alpha \* I - beta \* R;

dHdt = beta \* R - gamma \* H;

dRHdt = gamma \* H;

%debugging because idk why it wont work

% disp(['Size of dSdt: ', mat2str(size(dSdt))]);

% disp(['Size of dIdt: ', mat2str(size(dIdt))]);

% disp(['Size of dRdt: ', mat2str(size(dRdt))]);

% disp(['Size of dHdt: ', mat2str(size(dHdt))]);

% disp(['Size of dRHdt: ', mat2str(size(dRHdt))]);

% Return the derivatives as a column vector

dydt = [dSdt; dIdt; dRdt; dHdt; dRHdt];

end

Simulation.m

% Define the time vector and initial conditions

time\_vec = 0:.25:100;

init\_vec = [9999 1 0 0 0];

% Define the other parameters

infectivity = 0.125;

alpha = 0.25;

beta = 0.02;

gamma = 0.10;

% Define the contacts values

contacts = linspace(3, 8, 20);

% Preallocate the output arrays

out\_infected = zeros(length(time\_vec), length(contacts));

out\_in\_hospital = zeros(length(time\_vec), length(contacts));

% Run the model for each contacts value

for contactsv = 1:length(contacts)

c = contacts(contactsv);

[t, y] = ode45(@(t, x) SIR(t, x, c, infectivity, alpha, beta, gamma), time\_vec, init\_vec);

out\_infected(:, contactsv) = y(:, 2);

out\_in\_hospital(:, contactsv) = y(:, 4);

end

figure;

plot(time\_vec, out\_infected, 'LineWidth', 1.5);

title('Infected Stock');

A graph of colored lines

Description automatically generated

subplot(3,1,2);

plot(time\_vec, out\_in\_hospital, 'LineWidth', 1.5);

title('People in Hospital');

A graph of different colored lines

Description automatically generated

peak\_hospitalized = max(out\_in\_hospital, [], 1);

subplot(3,1,3);

plot(contacts, peak\_hospitalized, 'o');

title('Contacts v Peak in Hospital');

A graph of contact tracing

Description automatically generated with medium confidence