

# Math 305 Homework 3

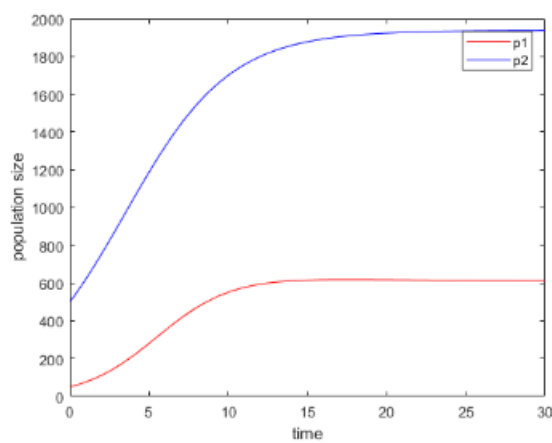
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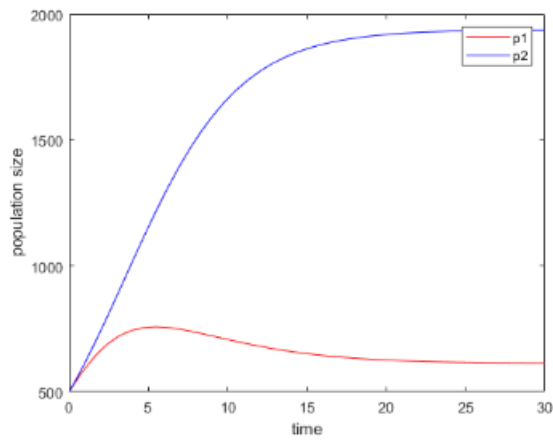
## Section 3: Solving systems of differential equations

### Exercise 3.1

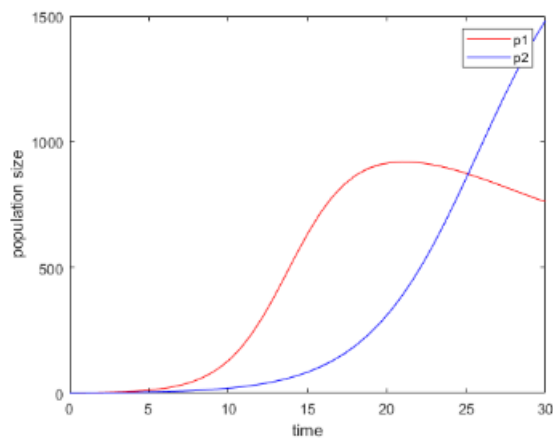
- $v_0 = (50, 500)$ :



- $v_0 = (500, 50)$ :

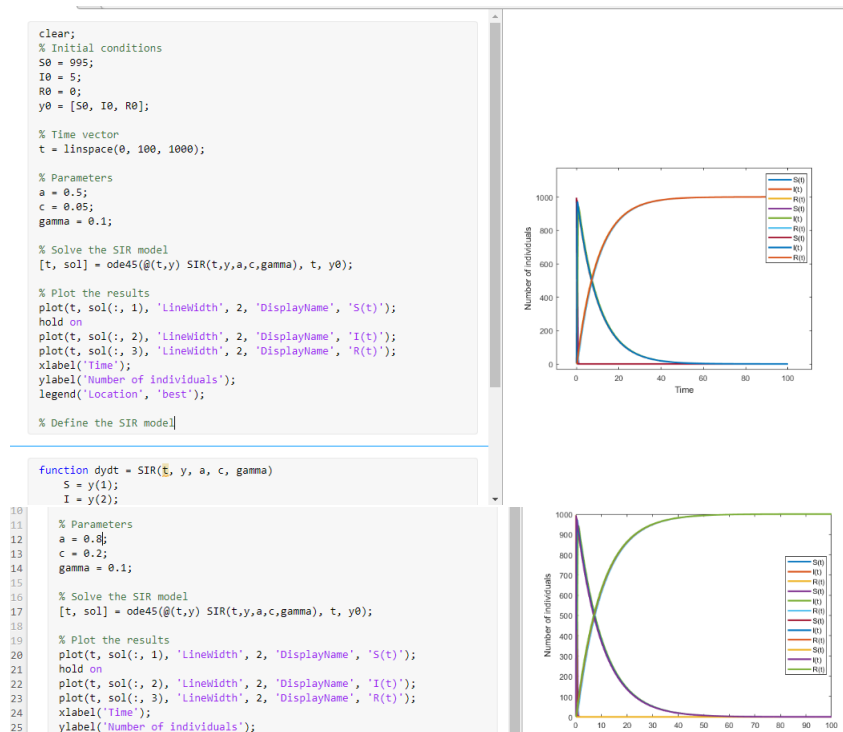


- $v_0 = (1, 1)$ :



- The long-term behaviour of the populations do not change.
- $P_1$  and  $P_2$  do not converge unless the first term of  $v(0)$  is greater than the second. I.e,  $P_1$  starts higher than  $P_2$ .

## Exercise 3.2



The relationship between  $a$ ,  $c$ , and  $\gamma$  to prevent an epidemic must be  $ac < \gamma$ . This can be achieved by increasing gamma, or decreasing  $a$  or  $c$ . Decreasing the rate of transmission ( $a$ ) or the proportion of susceptible individuals who come into contact with infectious individuals ( $c$ ), will reduce the chance of an epidemic. Increasing the recovery rate ( $\gamma$ ) will also reduce the chance of an epidemic.

## Problem 3

Diana is a 160-lb woman who consumes five standard glasses of wine in a short amount of time.

- (a) Estimate her BAC.  $BAC = (A \cdot 5.14/W \cdot r) - 0.015 \cdot H$ , assuming she drank 5 5oz glasses in 1 hr:

$$BAC = (25 \cdot 5.14/160 \cdot 0.55) - 0.015 = 0.1185$$

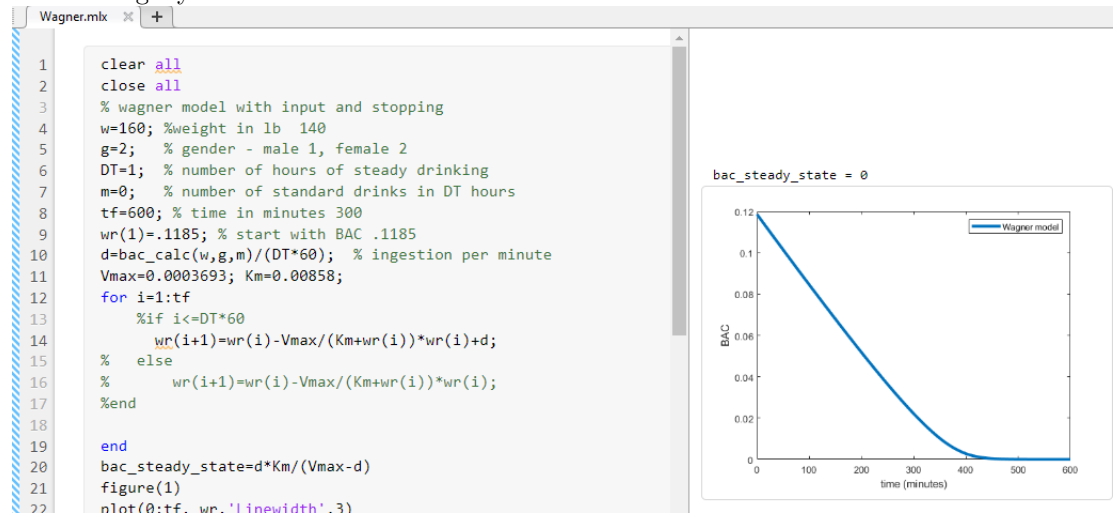
- (b) Use the Widmark model to estimate how long it will take before Diana is legally able to drive. Solving for  $H$ :

$$H = (A \cdot 5.14/W \cdot r - BAC)/0.015$$

Legal BAC is .08, so plugging in:

$$H = (25 \cdot 5.14 / 160 \cdot 0.55 - 0.08) / 0.015 = 3.36 \text{ hours}$$

- (c) Use the Wagner model simulation to estimate how long it will take before Diana is legally able to drive.



About 1 hour and 55 minutes,  $t = 115$  minutes.