Set - 8 : Battles and war games: Iwo Jima (land) and Trafalgar (naval)

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CS302, Modeling and Simulation

I. BATTLE OF IWO JIMA

$$\dot{J} = -aA \tag{1}$$

$$\dot{A} = -jJ \tag{2}$$

A.

By integrating both Eq: 1 and Eq: 2 we get,

$$aA^2 - jJ^2 = k \tag{3}$$

where,

$$k = aA_0^2 - jJ_0^2 \tag{4}$$

By, putting all the values we get $k > 0$ means, we can say that American soldiers won the battle.

B.

Now we have taken the time step $\Delta t = 1$ day, and integrated the coupled equations by Euler's method.

- The number of days till last soldier remains: 31 days
- Number of active troops of US army(victorious army): 51,527
- Number of casualties in US army(victorious army): 14,927

C.

Here the value of $\sqrt{a_j} = 0.024$ and the slope of A vs t graph is 0.0116 and that of J vs t is 0.0327

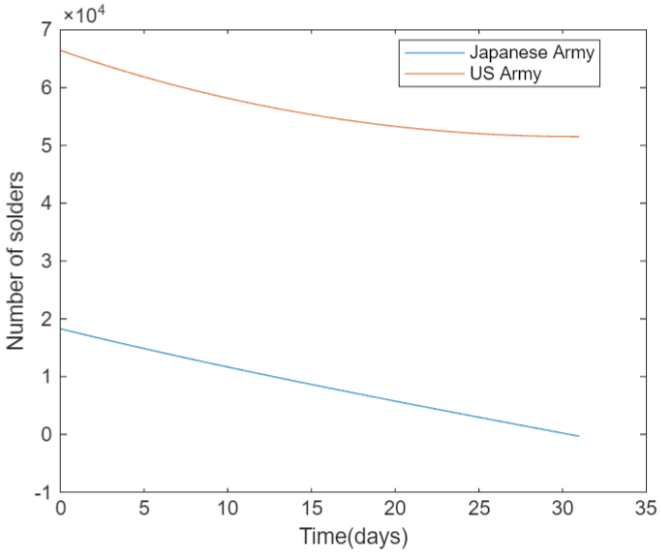

FIG. 1: For this graph we have taken a = 0.0106 and j = 0.0544, $J(0) = J_0 = 18274$, $A(0) = A_0 = 66454$ army troops. $\Delta t = 1$ day

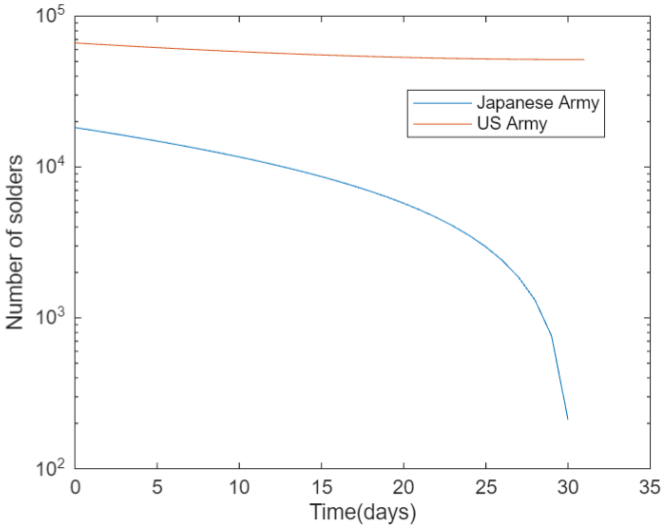

FIG. 2: For this graph we have taken a = 0.0106 and j = 0.0544, $J(0) = J_0 = 18274$, $A(0) = A_0 = 66454$ army troops. $\Delta t = 1$ day

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D.

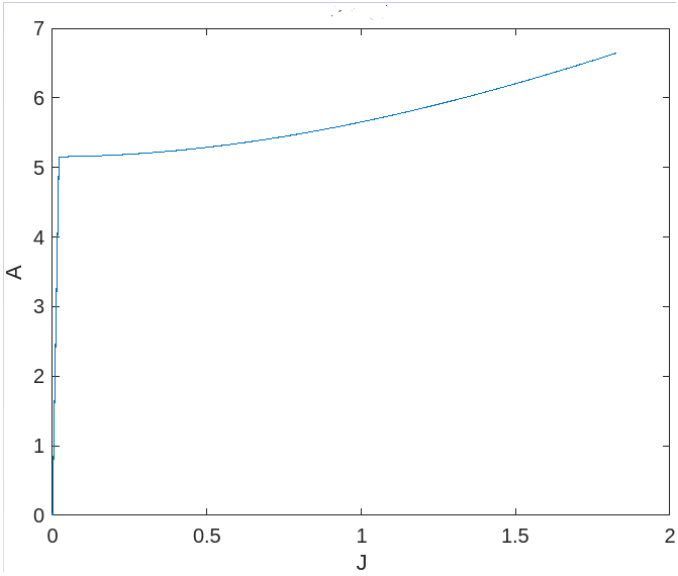

FIG. 3: For this graph we have taken a = 0.0106 and j = 0.0544, $J(0) = J_0 = 18274$, $A(0) = A_0 = 66454$ army troops. $\Delta t = 1$ day

II. BATTLE OF TRAFALGAR

$$\dot{F} = -bB \tag{5}$$

$$\dot{B} = -fF \tag{6}$$

A. FIRST STAGE

Here, in first stage 13 British ships engaged with 3 French ships in the battle

- Time: 2 days
- No.of survived British ships: 12.7325

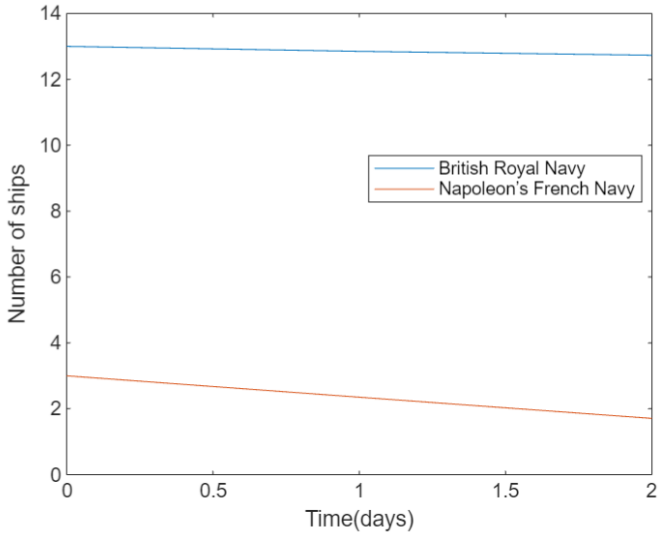

FIG. 4: Here $f = b = 0.05$, $F_0 = 3$, $B_0 = 13$ and $\Delta t = 1$ day

B.

Here, in second stage surviving British ships of the first stage join forces with the 14 ships kept in reserve, and similarly the surviving French ships join other 17 ships.

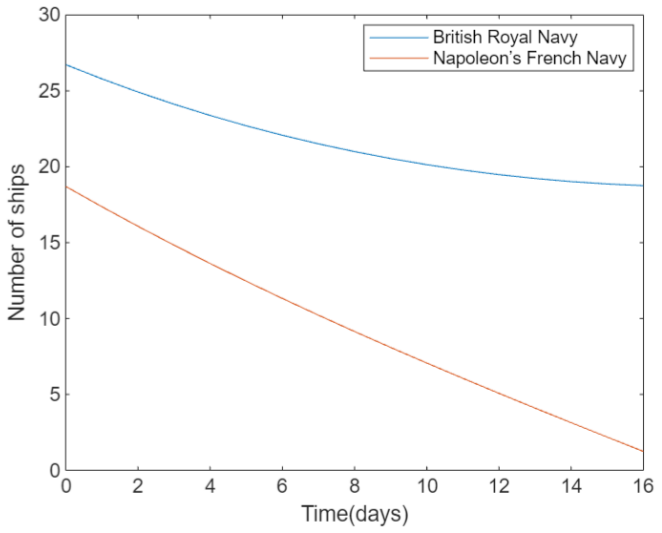

FIG. 5: Here $f = b = 0.05$, $F_0 = 18.0709$, $B_0 = 26.6471$ and $\Delta t = 1$ day

- Time: 16 days
- No.of survived British ships: 18.7585

C.

In third(final) stage, the remaining French ships of the second stage join the group of remaining 13 French ships.

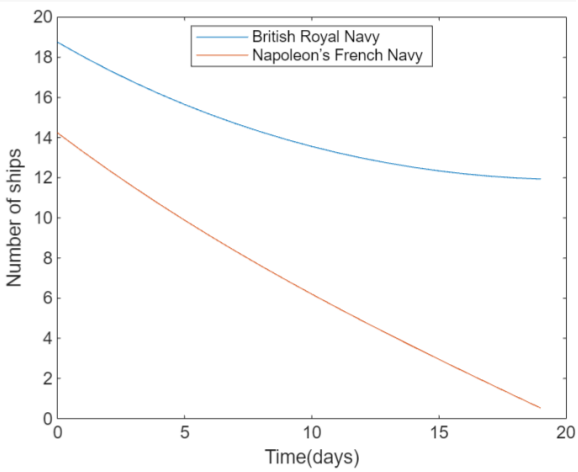

FIG. 6: Here $f = b = 0.05$, $F_0 = 14.4440$, $B_0 = 19.2734$ and $\Delta t = 1$ day

- Time: 19 days
- No.of survived British ships: 11.9340

Here, British army won the battle despite the less number of ships at initial time.

D.

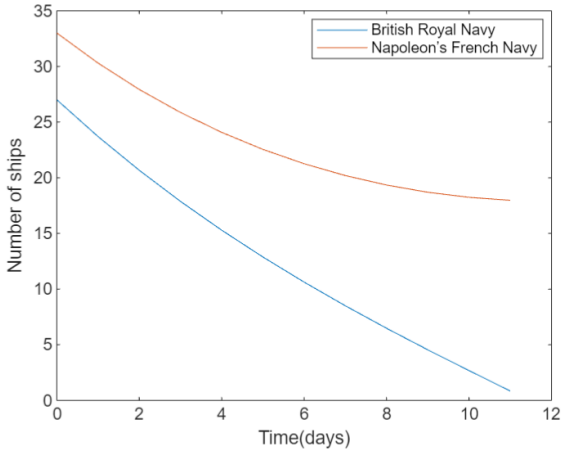

FIG. 7: : Here $f = b = 0.1$, $F_0 = 33$, $B_0 = 27$ and $\Delta t = 1$ day

- Time: 11 days
- No.of survived French ships: 17.9737

The French army is going to win in the war if they engage in an all-out war from the beginning.