A game theoretic model of emergency department and ambulance service interactions

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THIS.

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Ambulance blockage problem in UK

Patients forced to wait for 24 hours in ambulances, data shows

Ambulance crews forced to wait outside A&Es for 24 hours, according to chiefs

Rebecca Thomas Health Correspondent • Tuesday 17 May 2022 08:26 • Comments

(AFP/Getty)

'Appalling' waits for ambulances in England leaving lives at risk

Exclusive: Royal College of Emergency Medicine president says NHS is breaking its agreement to treat sickest in a timely way

'For staff, this is heartbreaking': senior doctor's view on crisis
'I feel so let down': long waits for ambulances in south-west

Ambulance handover delays highest since start of winter

NHS 'on its knees' as ambulance response times for life-threatening calls rise to record high

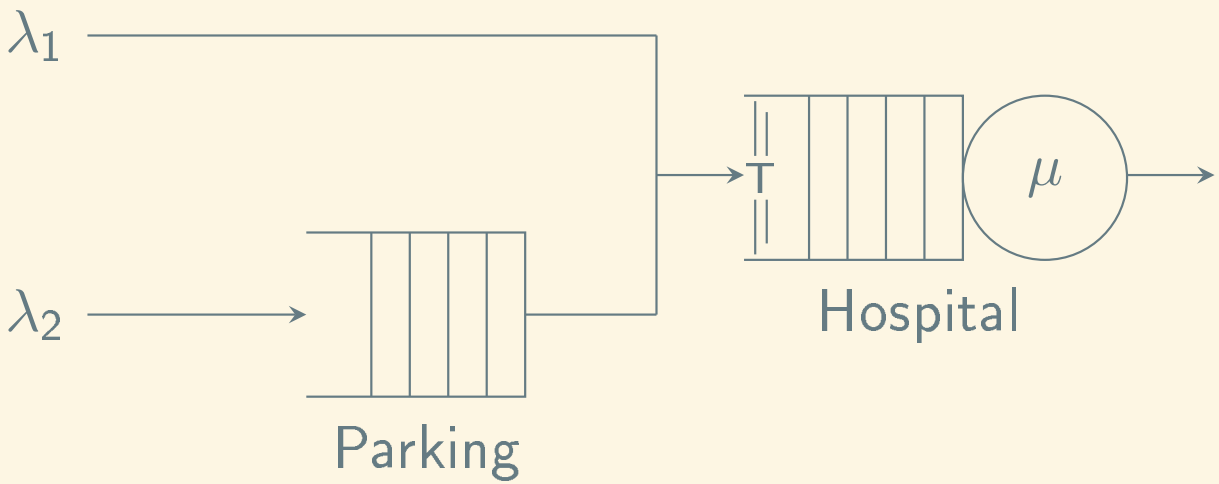
Average response time to deal with Category 1 cases – such as cardiac arrests – is now nine minutes and 20 seconds with rises across all categories.

Queueing theory

$\times$

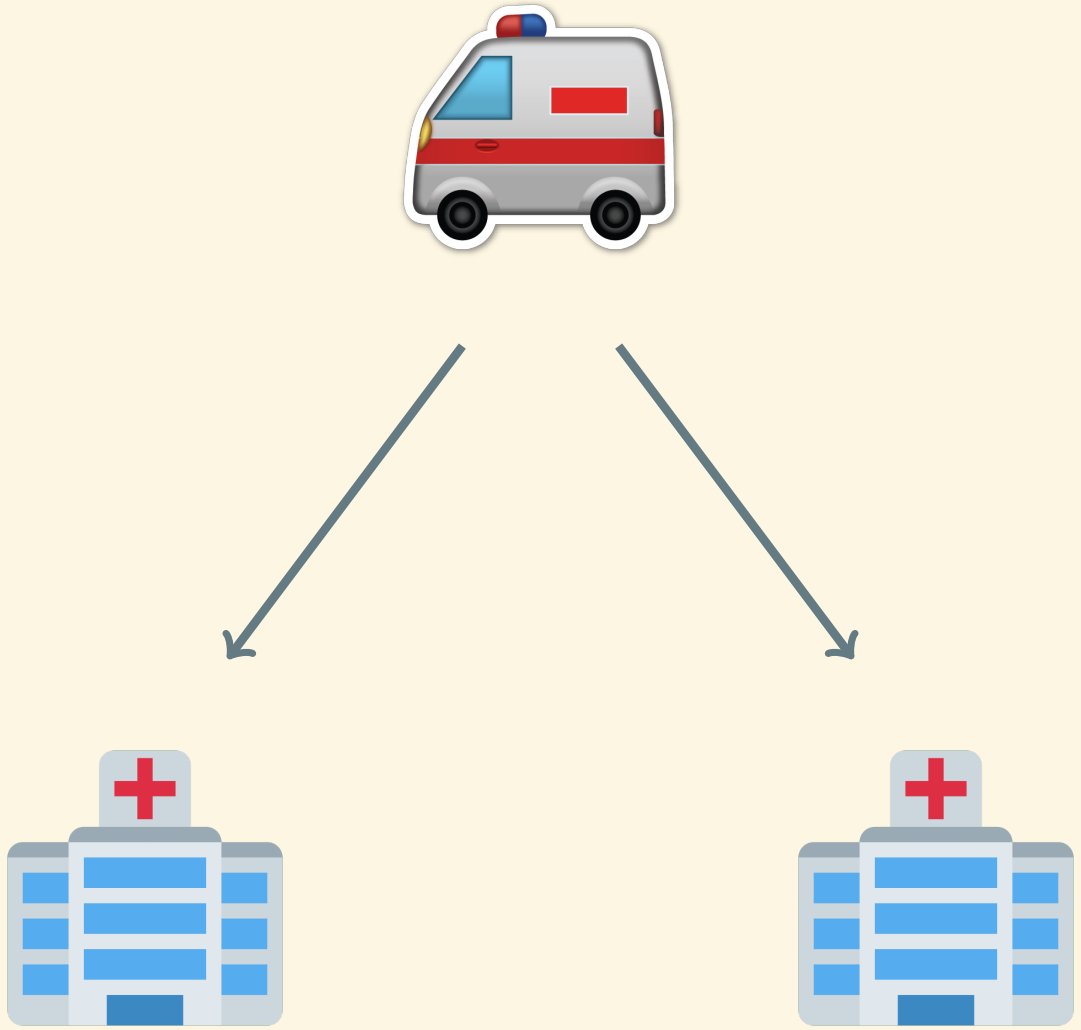
Game theory

Queueing representation of hospital

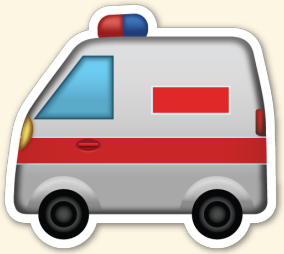


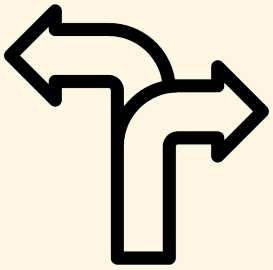
- λ_1: Arrival rate of non-ambulance patients
- λ_2: Arrival rate of ambulance patients
- μ: Service rate
- T: Threshold

The game

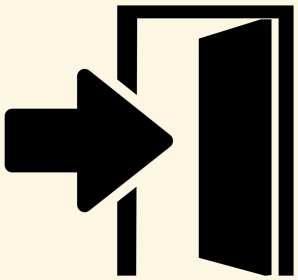


Players - Strategies - Objectives

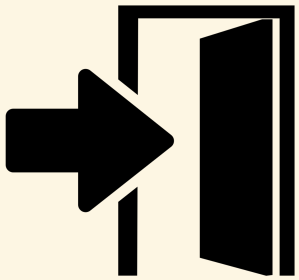




$p_A, p_B \in [0, 1]$
$p_A + p_B = 1$



$T_A \in [1, N_A]$



$T_B \in [1, N_B]$

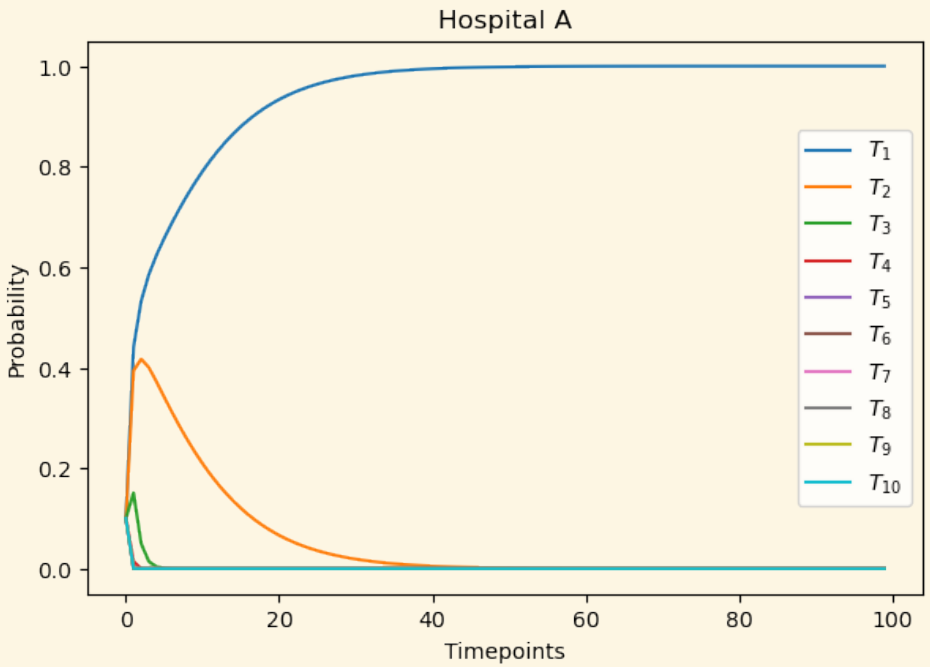
$\min \bar{B}$

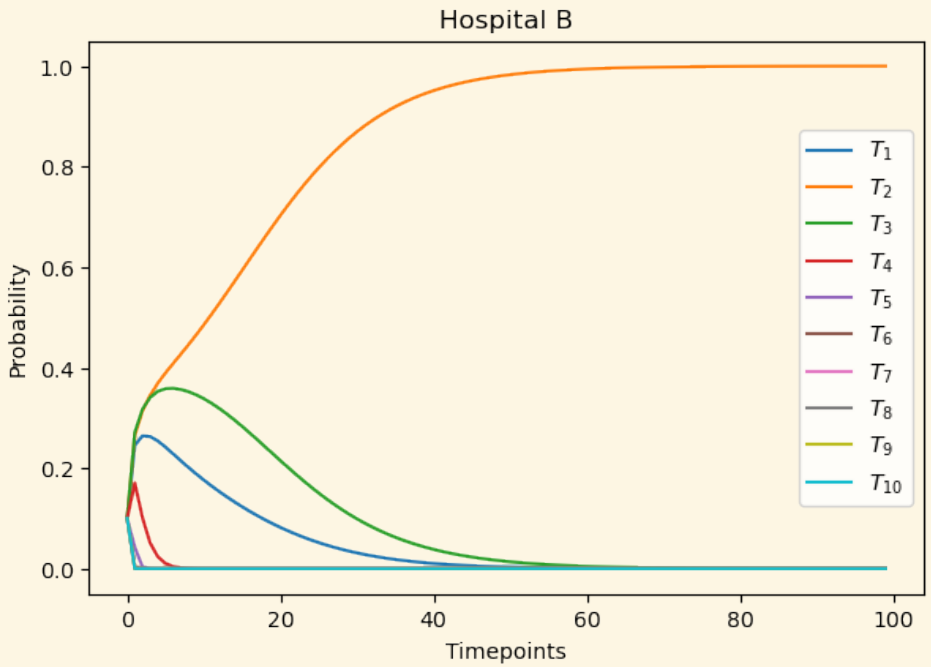
$P(W^{(A)} < t) > 0.95$

$P(W^{(B)} < t) > 0.95$

Evolutionary Game Theory

Asymmetric replicator dynamics - $t = 1.5$

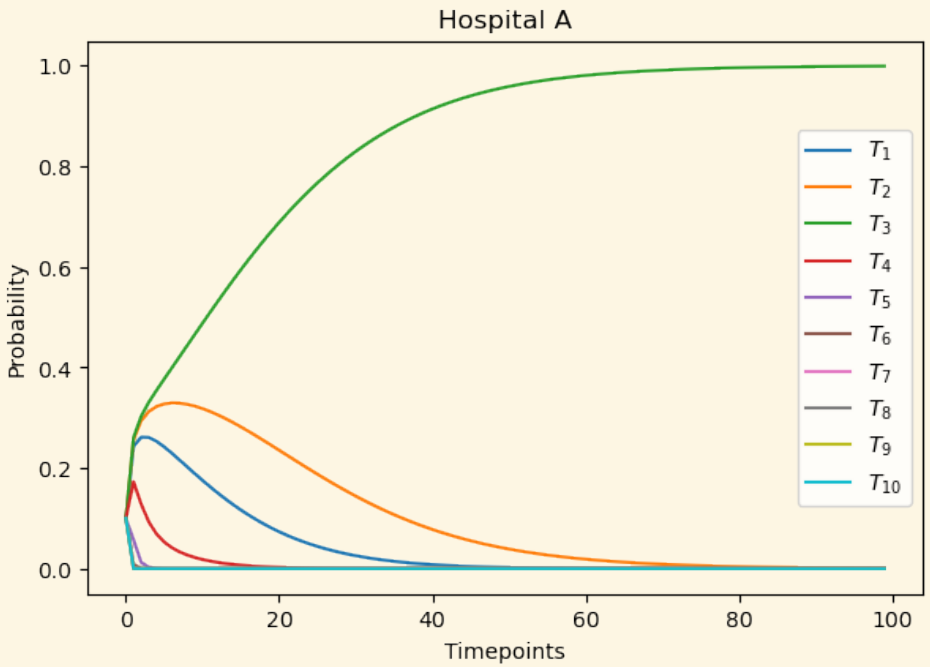


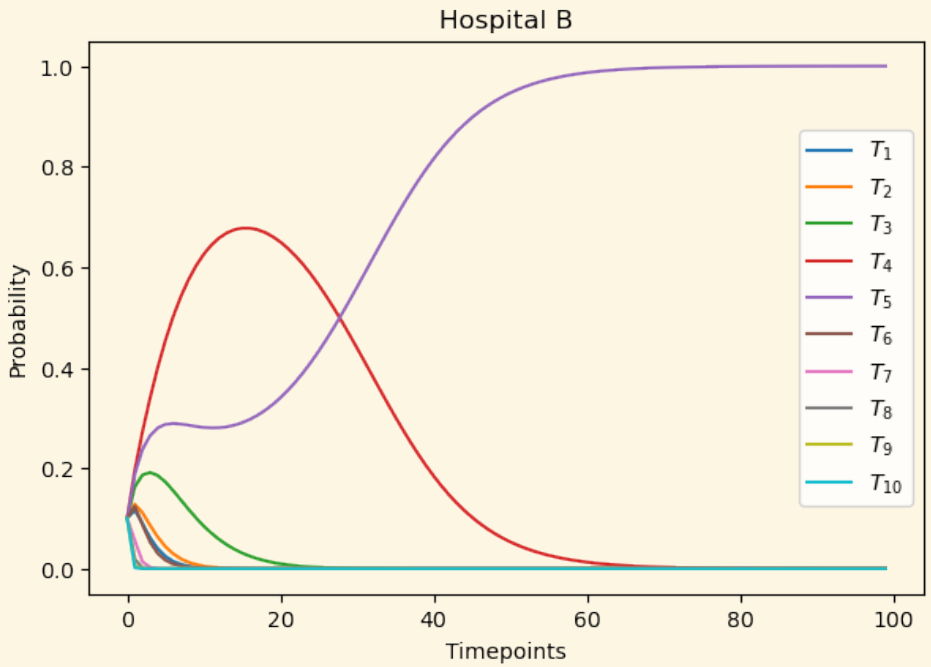


$T_A = 1$

$T_B = 2$

Asymmetric replicator dynamics - $t = 1.7$

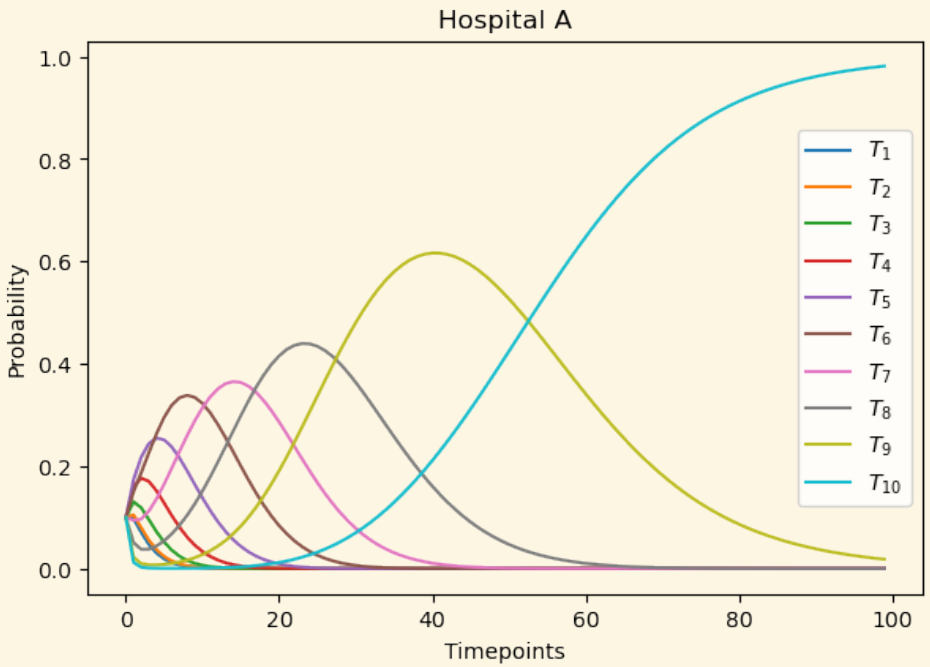


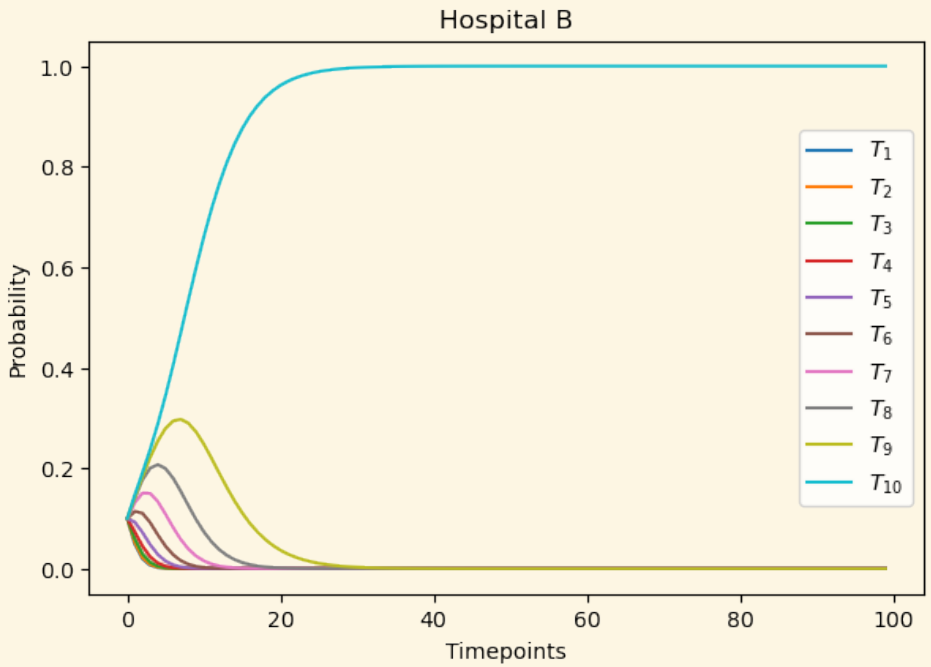


$T_A = 3$

$T_B = 5$

Asymmetric replicator dynamics - $t = 2$

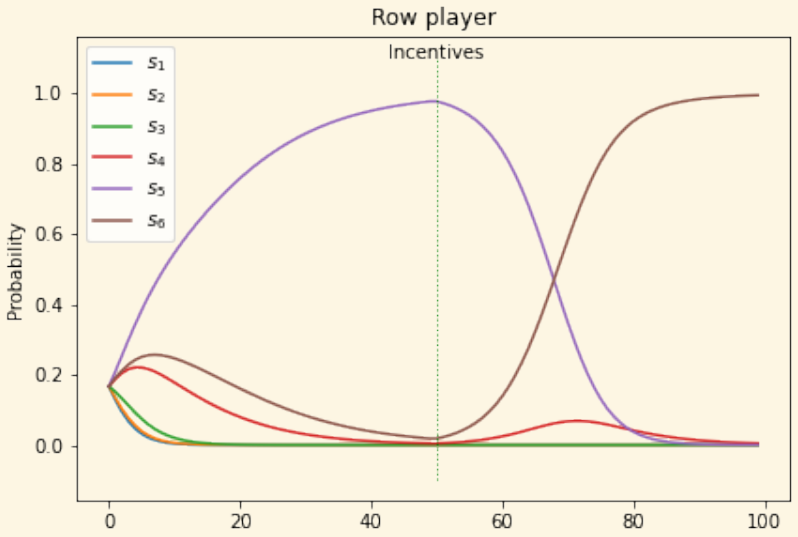


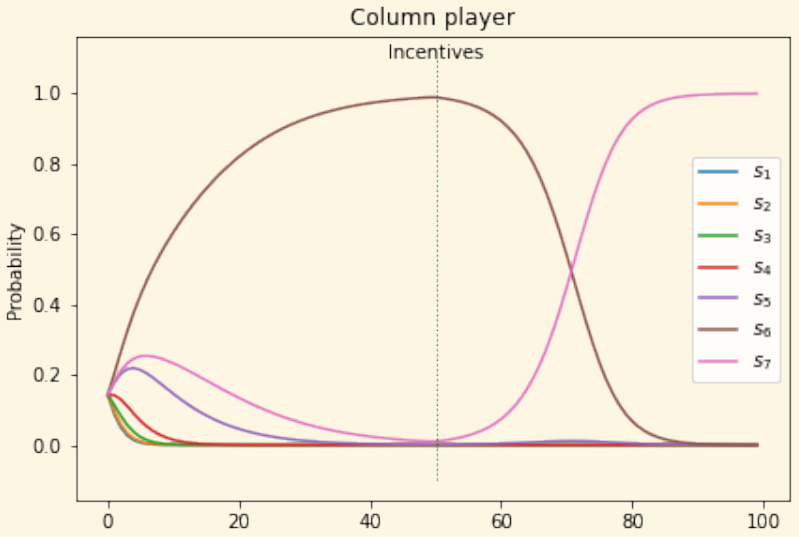


$T_A = 10$

$T_B = 10$

Asymmetric replicator dynamics - Incentives





$T_A = 5 \rightarrow T_A = 6$

$T_B = 6 \rightarrow T_B = 7$

Thank you!

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https://github.com/MichalisPanayides/Thesis
https://github.com/MichalisPanayides/AmbulanceDecisionGame
$ pip install ambulance_game