

# **QUEUING MODEL: HARBOUR SYSTEM**

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BSc Sem 6 Maths (Hons)

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# AGENDA

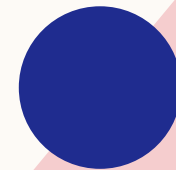
Introduction

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Diagram

Summary of Simulation

Summary



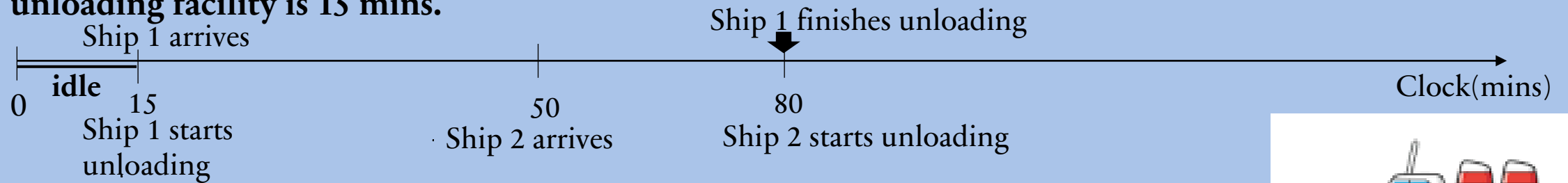
# INTRODUCTION

A **mathematical model** is an abstract description of a concrete system using mathematical concepts and language. The process of developing a mathematical model is termed *mathematical modeling*. Mathematical models are used in applied mathematics and in the natural sciences and engineering disciplines (such as computer science, electrical engineering), as well as in non-physical systems such as the social sciences (such as economics, psychology, sociology, political science). It can also be taught as a subject in its own right.

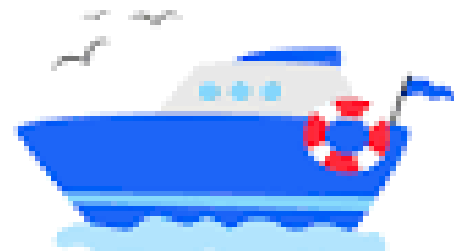
	Ship 1	Ship 2	Ship 3	Ship 4	Ship 5
Time between successive ships	15	35	20	100	35
Unloading time	65	55	60	70	80

### Timeline 1

Ship 1 arrives 15 min after clock starts at  $t = 0$  mins i.e at  $t = 15$  mins and starts unloading. Ship 1 finishes unloading at  $t = 15 + 65 = 80$  mins. Ship 2 arrives at  $t = 15 + 35 = 50$  mins. Hence idle time of unloading facility is 15 mins.

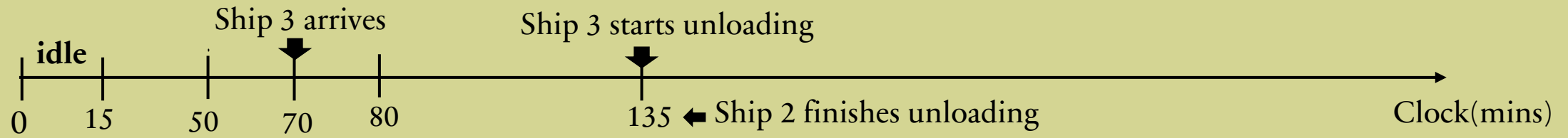


# TIMELINE

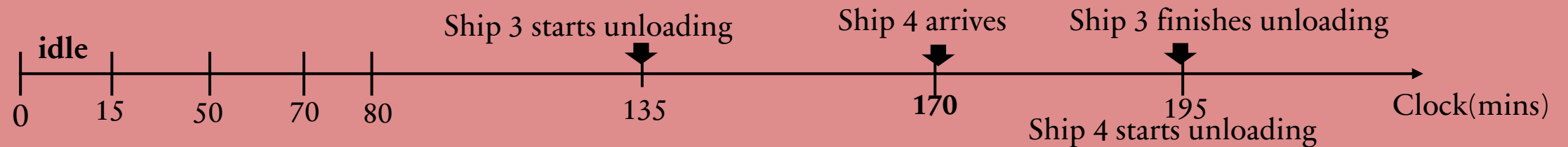


**Timeline 2**

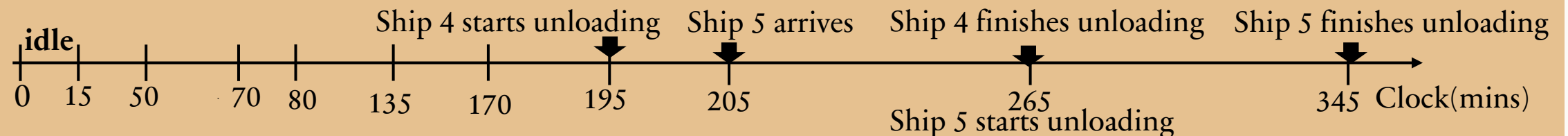
Ship 2 arrives at  $t = 50$  mins, starts unloading at  $t = 80$  mins and completes unloading at  $t = 80 + 55 = 135$  mins. Ship 3 arrives at  $t = 50 + 20 = 70$  mins and waits for  $135 - 70 = 65$  mins to start unloading.

**Timeline 3**

Ship 3 starts unloading at  $t = 135$  mins and completes at  $t = 135 + 60 = 195$  mins. Ship 4 arrives at  $t = 70 + 100 = 170$  mins and waits  $195 - 170 = 25$  mins to start unloading.

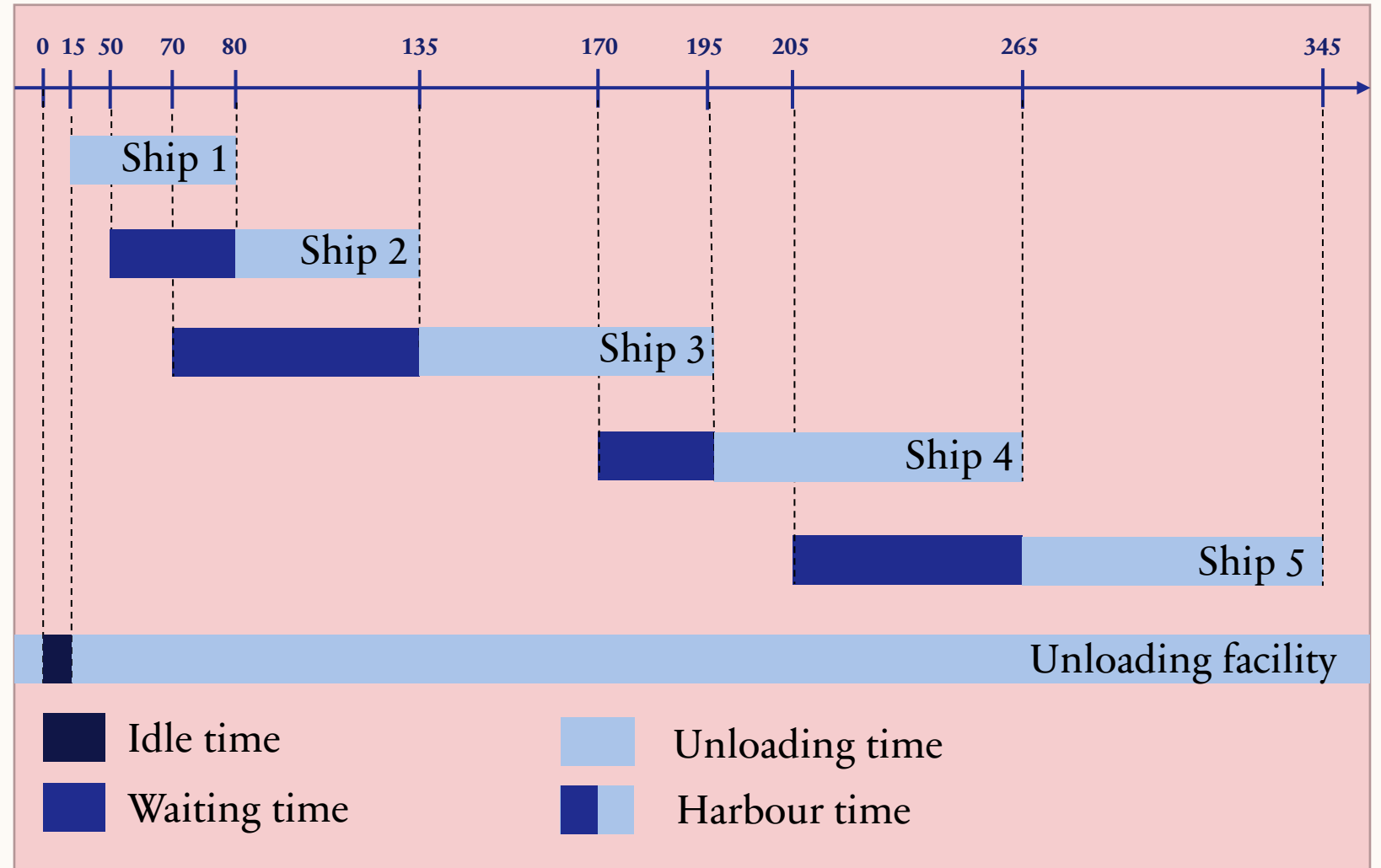
**Timeline 4**

Ship 4 starts unloading at  $t = 195$  mins and finishes at  $t = 195 + 70 = 265$  mins. Ship 5 arrives at  $t = 205$  mins, waits for 60 mins to start unloading at  $t = 265$  mins and completes at  $t = 265 + 80 = 345$  mins.



# DIAGRAM

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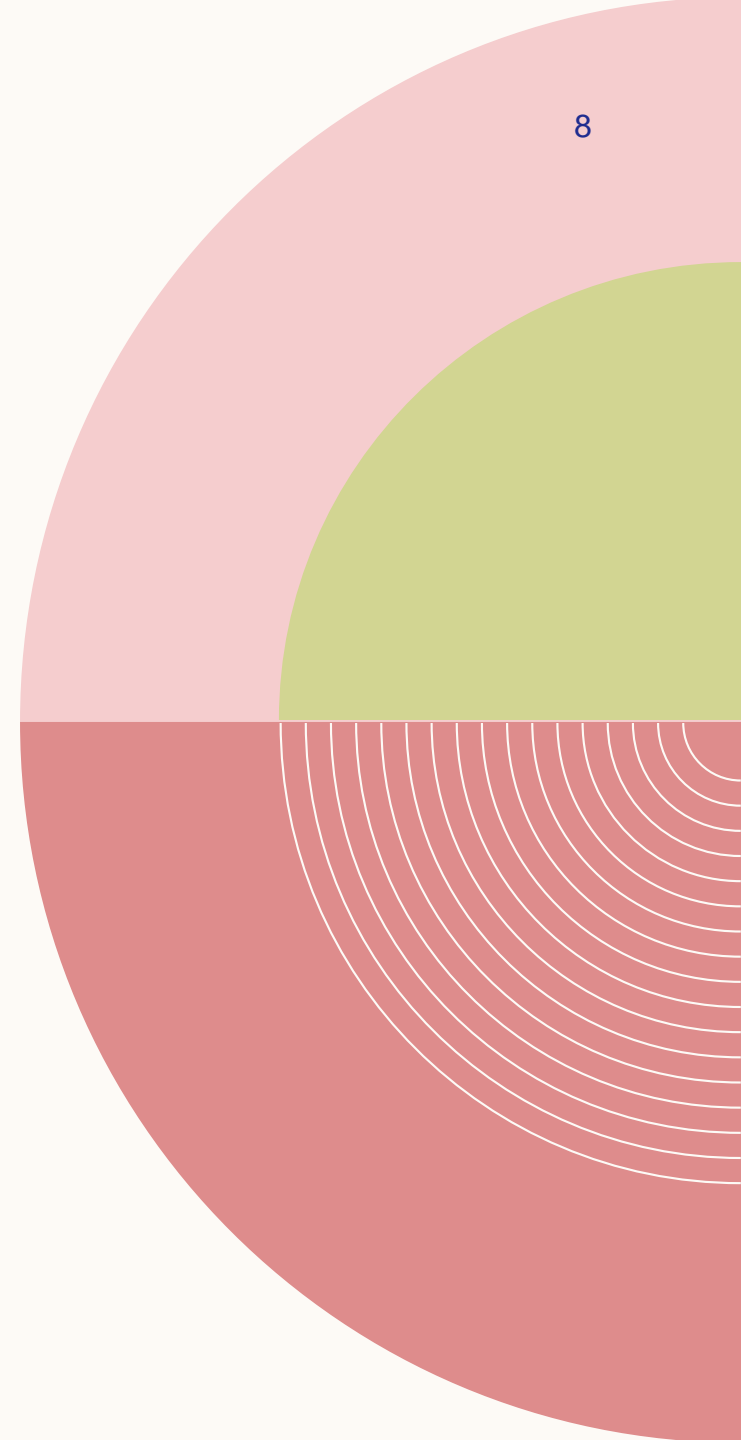
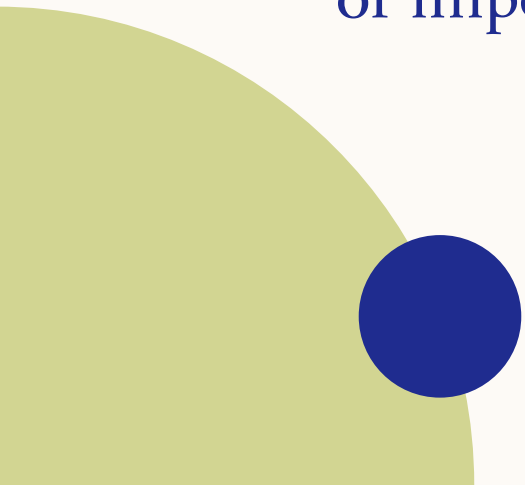


# Summary of simulation

Ship No	Random time btw successive ship arrival	Arrival time	Start Service	Queue length at arrival	Wait time	Random unload time	Time in harbour	Dock idle time
1	15	15	15	0	0	65	65	15
2	35	50	80	1	30	55	85	0
3	20	70	135	2	65	60	125	0
4	100	170	195	1	25	70	95	0
5	35	205	265	1	60	80	140	0
<b>Total (mins)</b>					180	330	510	15
<b>Averages (mins)</b>					36	66	102	

# SUMMARY

The mathematical model used for harbour system simulation consists of not one model, but a series of many models, each representing a particular piece of hardware or important physics.







**THANK YOU**