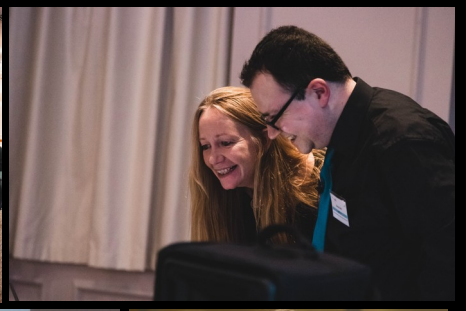
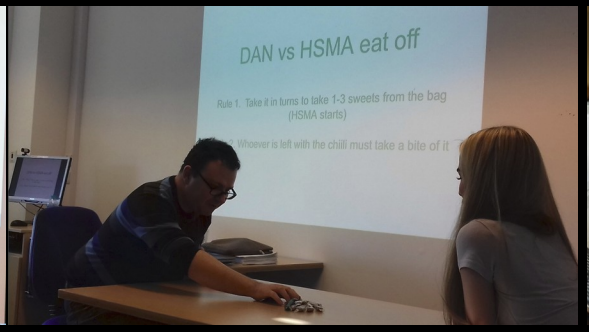


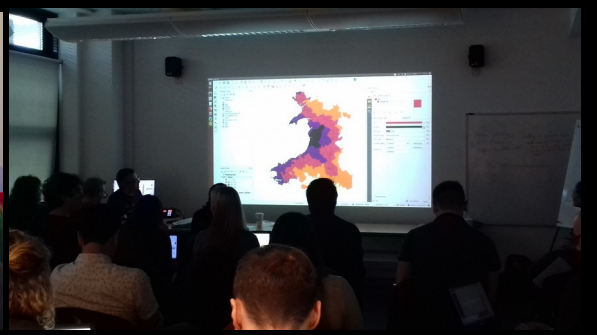


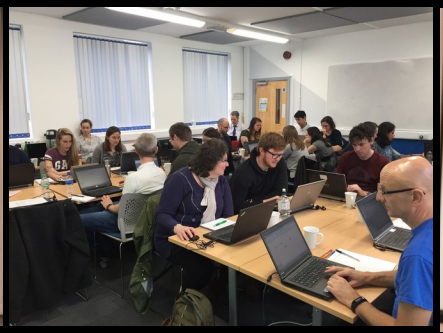


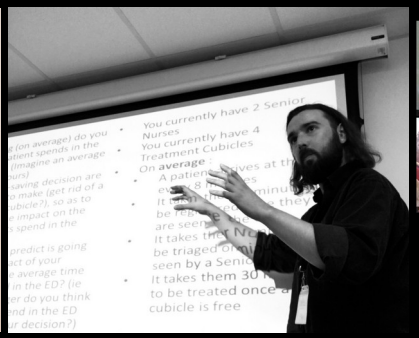














This session is being recorded and will be shared online. If you become part of the recording, and do not want to be, please email penarc@exeter.ac.uk so your contribution can be removed. Please use the chat facility to introduce yourselves and post questions, and remain muted except during sections where you have been asked to interact.

NIHR | Applied Research Collaboration South West Peninsula

@peninsula_ARC #HSMA4

HSMA 4

HSMA 4 Everyone

HSMA 4 Everyone

Virtual Open Day 2021

Dr Daniel Chalk
Senior Research Fellow & HSMA Programme Lead

#HSMA4
@peninsula_ARC

HSMA 4 Virtual Open Day

1035 – 1040	Welcome to the HSMA 4 Open Day (Dr Daniel Chalk, HSMA Programme Lead)
1040 – 1045	HSMA and PenARC (Prof Stuart Logan, PenARC Director) HSMA Origins (Prof Martin Pitt, PenCHORD Director)
1045 – 1110	HSMA 4 – Details of the Programme and the Application Process (Dr Daniel Chalk)
1110 – 1115	Q & A
1115 – 1120	Short comfort break
1120 – 1145	HSMA 4 Mini-Lecture Taster : A Taste of Discrete Event Simulation and Conceptual Modelling (Dr Daniel Chalk)
1145 – 1220	HSMA 4 Mini-Lecture Group Exercise : Design a Discrete Event Simulation Model
1220 – 1230	HSMA 4 Mini-Lecture Group Discussion : Presenting Model Ideas

Optional

1230 – 1300	Optional space for those wishing to stay on to speak to the Programme Lead / other trainers directly

HSMA and PenARC
Professor Stuart Logan
(Director of NIHR PenARC)

HSMA Origins
Professor Martin Pitt
(Director of PenCHORD)

HSMA 4

What is HSMA?

HSMA 4

The HSMA Programme

- For analytical staff (or staff with demonstrable analytical, advanced computing or mathematical skills) working in health, social care and policing organisations

- Released from usual role for a day a week for 1 year

- Extensive training course teaching programming, Operational Research and Data Science methods (Phase 1 – 3 months)

- Apply skills to a project of importance to their organisation with mentoring and guidance from us (Phase 2 – 9 months)

HSMA 4

Aims of the HSMA Programme

1. To embed Operational Research (OR) and Advanced Data Science within health, social care and policing organisations

2. To increase evidence-based decision making in the health, social care and policing organisations

3. To develop the skills of health, social care and policing analysts

4. To create embedded “OR Ambassadors”

5. To develop and foster collaboration between health, social care and policing organisations

HSMA 4

OR and Data Science

Operational Research uses modelling, simulation and analysis techniques to help *inform decisions* about the *operational management* of an organisation.

e.g. *Where are the delays in our Emergency Department processes, and how do we reduce them?*

Data Science uses data-led approaches such as Artificial Intelligence and Data Analysis to generate insights from data.

e.g. *Can we teach a machine to predict when an Emergency Department is going to breach the four hour target?*

HSMA Programme History

- Pilot Programme (Apr 2016 – Mar 17)
- 6 HSMAs
- Focus on pathway modelling
- 2 day training programme

- Second round (Jan – Dec 2018)
- 26 HSMAs
- Introduced 2-phase programme structure and “project pitches”
- Introduced patient involvement in project selection
- Gradual transition to Free and Open Source (FOSS) approaches
- Expanded scope of OR methods taught
- 6 day training programme

- Third round (Oct 2020 – Sep 21)
- 52 HSMAs
- Moved to virtual delivery model
- Exclusively FOSS approaches taught
- Introduction of PSMAs (Police Service Modelling Associates)
- Introduction of Slack Workspace and Peer Support Groups
- Vastly expanded scope of methods taught, and introduction of Data Science
- 17 day training programme

Current and Previous HSMA Projects

- Building an AI to assist surgical cancellation decisions
- Using modelling to predict stroke bed requirements
- Using Natural Language Processing to identify clues in GP patient notes that might predict imminent admissions
- Modelling resource requirements for new mental health services
- Using Network Analysis and Natural Language Processing to identify the relationships between offenders and their victims
- Analysing the positive and negative things people are saying about the organisation on Twitter using Sentiment Analysis
- Modelling the carbon and patient impact of virtualising outpatient clinics
- Modelling the provision of paediatric care in the South West

HSMA 4

Vaccination Demo Model

Here’s an example of a model developed by one of our current HSMAs.

The model is a generic free and open source model that estimates the time in system, waiting times and likelihood of overcrowding for a vaccination site.

Let’s have a look :

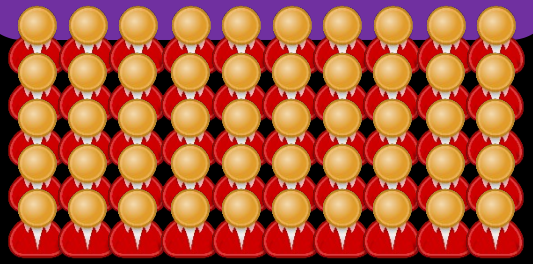
https://colab.research.google.com/drive/1d7AFLHy6XWvz-_l6MPb2U2bOew6lwk5f?invite=CM3zt9AG

HSMA 4

Programme Structure

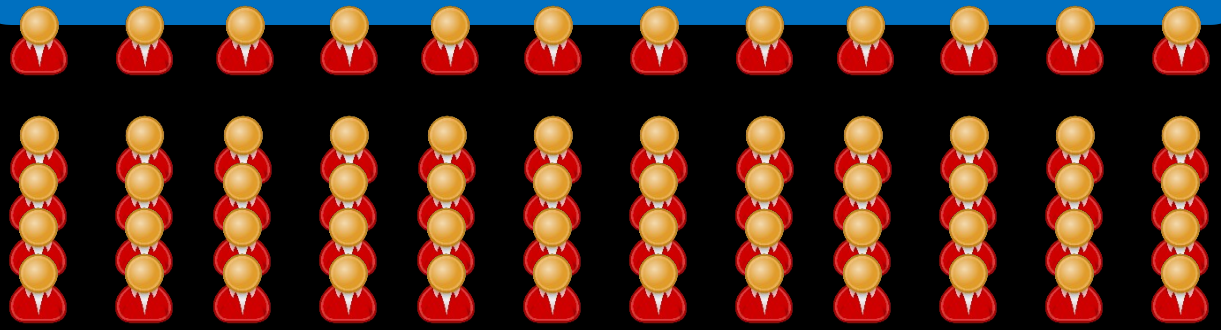
3 Months (OCT – DEC)

PHASE 1 : Training Programme



9 Months (JAN – SEP)

PHASE 2 : Project Work



HSMA 4 will be delivered virtually.

HSMA 4 will take forward 7 - 17 projects (depending on the number of external mentors in the Trainee Mentor Scheme). Each project will see a HSMA act as project manager leading a team of national associates

HSMAs will be encouraged to consider collaborative projects that address issues of common national interest and / or which span the health, social care and policing sectors.

HSMA 4

Phase 1 Training Programme

- Introduction to OR, Data Science and Programming (Python and R)
- Modelling Pathway And Queuing Problems
- Modelling Whole Systems
- Geographic Modelling and Visualisation
- Modelling Behaviour
- Machine Learning
- Natural Language Processing
- Forecasting
- Open Source Collaborative Development

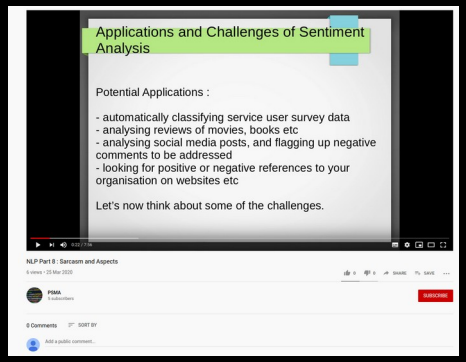
Over 140 hours of training content – 9 modules – over 3 months

Online delivery using combination of :
- Live Lectures and Group Exercises via Zoom
- Support via Slack (Peer Support Groups and access to Trainers)
- Pre-recorded bonus tutorials on HSMA YouTube channel

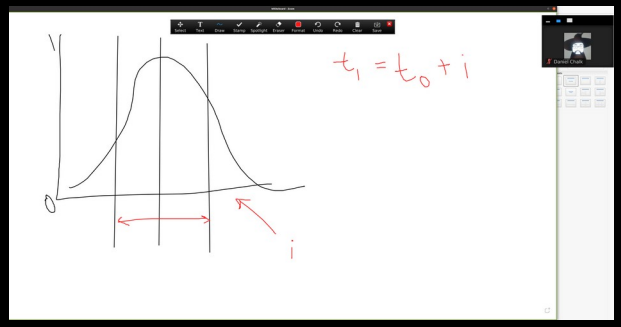
Technical assessment at end of Phase 1

HSMA 4

Virtual Delivery of Training

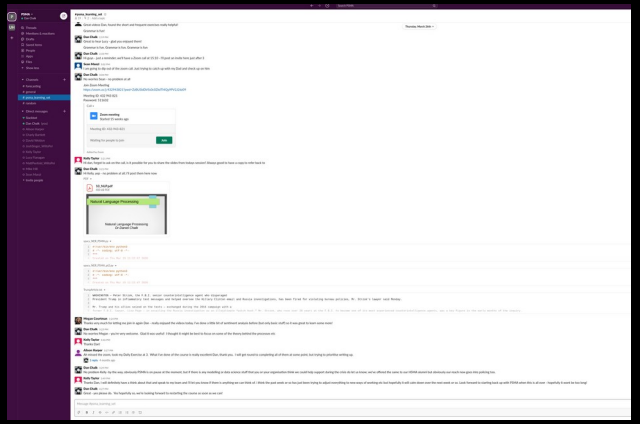


Pre-recorded tutorials (YouTube)

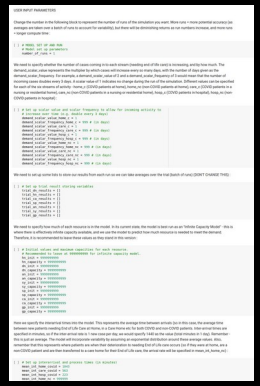


Live lectures (Zoom)

Group discussions (Zoom)



Peer and Mentor Support (Slack)



Jupyter Notebooks / Google CoLab for exercises and additional reading

HSMA 4

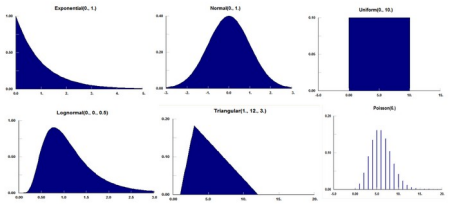
Sample Training Day

3A Python Programming Part 1					
Trainer :	Dan Chalk				
From	*To*	*Format*	*Name of Activity*	*Link (if applicable)*	
0930	0955	Live Lecture (Zoom)	Hello World!		
0955	1005	Individual Exercise (Spyder)	Exercise 1 – Print and Input		
1005	1015	Live Lecture (Zoom)	Operators and Conditional Logic		
1015	1045	Individual Exercise (Jupyter Lab)	Exercise 2 – Workbook (python_prog_workbook_1)		
1045	1055	Comfort Break			
1055	1100	Live Lecture (Zoom)	Solutions to Exercise 2		
1100	1120	Live Lecture (Zoom)	For and While Loops		
1120	1150	Individual Exercise (Jupyter Lab)	Exercise 3 – Workbook (python_prog_workbook_2)		
1150	1155	Live Lecture (Zoom)	Solutions to Exercise 3		
1155	1230	Live Lecture (Zoom)	Lists and Dictionaries		
1230	1330	LUNCH BREAK			
1330	1410	Individual Exercise (Jupyter Lab)	Exercise 4 – Workbook (python_prog_workbook_3)		
1410	1415	Live Lecture (Zoom)	Solutions to Exercise 4		
1415	1430	Live Lecture (Zoom)	Libraries and Imports		
1430	1440	Comfort Break			
1440	1525	Individual Exercise (Jupyter Lab)	Exercise 5 – Are You Smarter than Dan as a 4 year Old?		
1525	1530	Live Lecture (Zoom)	Solution to Exercise 5		
1530	1610	Group Exercise (Spyder)	Group Coding Competition		
1610	1630	Group Discussion (Zoom)	Groups present their programs, and we judge the entrants to find a winner		
		FURTHER WORK			
		Online Reading	Python Sets	https://pythonhealthcare.org/2018/03/15/5-sets/	
		Online Reading	Python Tuples	https://pythonhealthcare.org/2018/03/14/4-python-basics-tuples/	

HSMA 4

Sample Training Day

Some Distributions



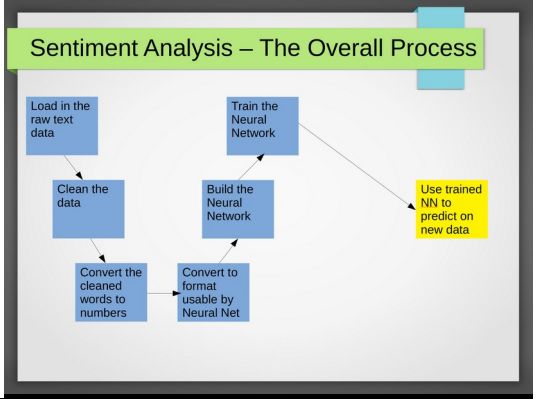
Exponential – common for inter-arrival times

Log Normal – common for process times

Poisson – describes the number of arrivals in any given period if arrival is random

Triangular – useful when data is limited

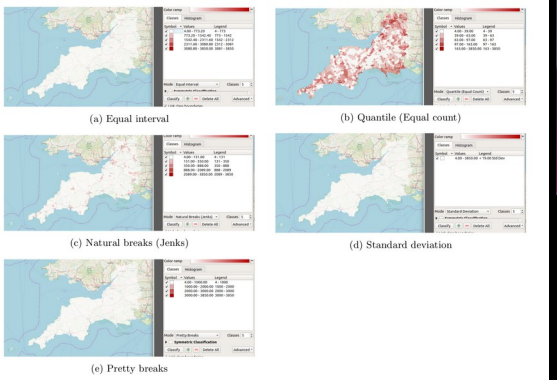
Sentiment Analysis – The Overall Process



15.3.2 Use predefined algorithms

QGIS has 5 modes (predefined methods) to divide your data into discrete classes:
Equal Interval, Quantile (equal count), Natural breaks (Jenks), Standard deviation and Pretty breaks.

For our case, we had Equal Interval where the full range of the values are divided by the number of classes. For this field there is a large outlier and so most of the polygons fall in the smallest colour band. So for this data, this mode is not suitable.

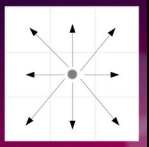


(a) Equal interval (b) Quantile (Equal count) (c) Natural breaks (Jenks) (d) Standard deviation (e) Pretty breaks

Figure 15.6: The five different algorithms to automatically create graduated bands

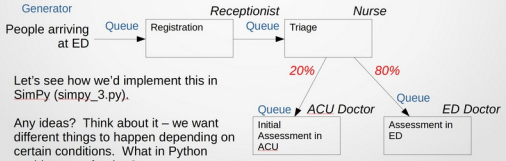
Movement

- We need to write a movement function in the Person Agent class to specify how our agents will move around the grid of cells in our environment.
- In this model, agents will move to a random neighbouring cell (including diagonals – a "Moore" Neighbourhood), chosen at random. More than one agent can be in any one cell.
- We first work out what the possible movement locations are, based on the cells around the agent, then pick one at random, then tell the model to move the agent to that cell.



More than one sequential activity - Non-Linear

Often in real world systems, not everything is linear. Different things might happen depending on certain conditions. For example, after triage a patient might be referred to a Ambulatory Care to diagnose and treat the patient without being admitted to the hospital overnight.



Let's see how we'd implement this in SimPy (simpy_3.py).

Any ideas? Think about it – we want different things to happen depending on certain conditions. What in Python could we use for that?

```
data.drop('PassengerId', inplace=True, axis=1)
X = data.drop('Survived',axis=1) # X = all 'data' except the 'survived' column
y = data['Survived'] # y = 'survived' column from 'data'
# Convert to NumPy as required for k-fold splits
X_np = X.values
y_np = y.values
```

Set up neural net

Here we use the api-based method to set up a TensorFlow neural network. This method allows us to more flexibly define the in

We will put construction of the neural net into a separate function.

The neural net is a relatively simple network. The inputs are connected to two hidden layers (of 240 and 50 nodes) before bein below. The layers of the network are:

1) An input layer (which does need to be defined)

2) A fully-connected (dense) layer.This is defined by the number of inputs (the number of input features) and the number of out inner layers of a neural network. Negative input values are set to zero. Positive input values are left unchanged.

3) A batch normalisation layer. This is not usually used for small models, but can increase the speed of training for larger mode number of inputs to normalise.

4) A dropout layer. This layer randomly sets outputs from the preceding layer to zero during training (a different set of outputs i 10% of outputs are set to zero).

5) A second fully connected layer which reduces the network down to 50 nodes. This again uses ReLU activation and is follow

6) A final fully connected linear layer of one nodes (more nodes could be used for more classes, in which case use softmax ac

```
def make_net(number_features, learning_rate=0.003):

    # Clear Tensorflow
    K.clear_session()

    # Define layers
    inputs = layers.Input(shape=number_features)
    dense_1 = layers.Dense(240, activation='relu')(inputs)
    norm_1 = layers.BatchNormalization()(dense_1)
    dropout_1 = layers.Dropout(0.25)(norm_1)
    dense_2 = layers.Dense(50, activation='relu')(dropout_1)
    outputs = layers.Dense(1, activation='sigmoid')(dense_2)
    net = Model(inputs, outputs)

    # Compiling model
    opt = Adam(lr=learning_rate)
    net.compile(loss='binary_crossentropy',
    optimizer=opt,
    metrics=['accuracy'])
    return net
```

Show summary of the model structure

Here we will create a model with 10 input features and show the structure of the model as atable and as a graph.

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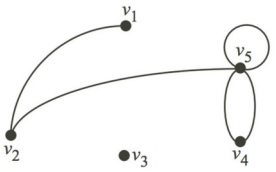
Components of a network graph

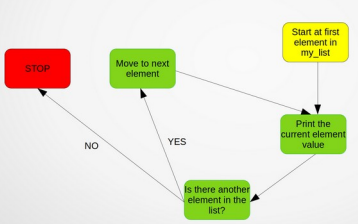
- Node/vertex
- Edge
- Graph - unordered pairs of nodes
- DiGraph - ordered pairs of nodes
- Edge weight
- Node attributes



For Loops – Iterate through a List

```
my_list = [1,10,"Dan", True, "HSMA"]

for element in my_list:
    print(element)
```




```
1
10
Dan
True
HSMA
```

HSMA 4

Core and Option Sessions

The training sessions in Phase 1 of HSMA 4 are split into two categories :

- CORE sessions. These **introduce** the wide range of methods we teach, and are **compulsory for everyone**. There are **72 hours** of CORE sessions. CORE Sessions run predominantly in October and the first half of November, with some additional sessions in early December.

- OPTION sessions. These **dive deeper** into each of the methods taught. It is **strongly recommended** that HSMAs attend all OPTION sessions if possible, but they must attend a **minimum of 30 hours** of OPTION session content (out of a total of 60). OPTION sessions often require attendance at previous OPTION sessions for a module. OPTION sessions begin in mid-November and run until mid-December.

HSMA 4

Peer Support Groups

For Phase 1, all HSMAs will be allocated into one of 10 **Peer Support Groups.**

Each Peer Support Group has a dedicated Slack channel. HSMAs are encouraged to work in their Peer Support Groups for exercises during the training and help each other learn.

If you're stuck on something :
1. ask your Peer Support Group
2. if everyone else in the Peer Support Group is also stuck on it then call for a trainer

Peer Support Groups are also encouraged to set up calls / conversations outside of the course to go through what they've learned so far.

HSMA 4

Software Installation

In order to undertake the HSMA training, a number of pieces of software **must** be installed on a machine to which you have access (ideally a work machine, but we recommend installing on a personal machine too if possible – see below)

Software required includes :
- The Python Programming Language. It is **strongly recommended** that you use the **Anaconda Scientific Package** for Python (link in application pack) as this contains the common scientific packages you will need. It will also install **Spyder** and **Jupyter Lab**, which are the two **Integrated Development Environments (IDEs)** we will be using.
- pip (for installing Python packages adhoc). This should already be installed as long as you have installed a newer version of Python. You will need to ensure there are no **firewall / administrator** issues in using pip.
- The R Programming Language. You are advised to install **Rstudio**.
- **QGIS** Version 3
- The Slack and Zoom apps (recommended – you can access them via a browser if this is not possible, but you will lose some features. These are the **primary means of communication** on the programme.)

You should also create a free account at https://insightmaker.com/ and ensure you have a free Google Account to use Google CoLab.

You are strongly recommended to begin requesting this software is installed now or as early as possible after your application has been approved. IT departments can be reluctant and / or slow to install the necessary software. You should ask your Workplace Supervisor (see shortly) to push this through for you if necessary.

HSMA 4

Computer Specs

The HSMA trainers all use Linux Operating Systems, but we recognise that most people will be using Windows or MacOS. All software we use is compatible with Linux, Windows and MacOS (assuming you are using OS versions that are still supported).

For the training phase, most of the code you will develop will be simple examples that are not computationally expensive, and so the specs of your computer do not need to be high-end.

For high-end Neural Network training, you will be provided with alternatives that run in the cloud if your computer is unable to handle the demands. However, if you do have access to a high-end PC with a CUDA-enabled NVIDIA GPU, you will be able to run Neural Network based software **significantly** faster.

List of CUDA-enabled GPUs : https://developer.nvidia.com/cuda-gpus

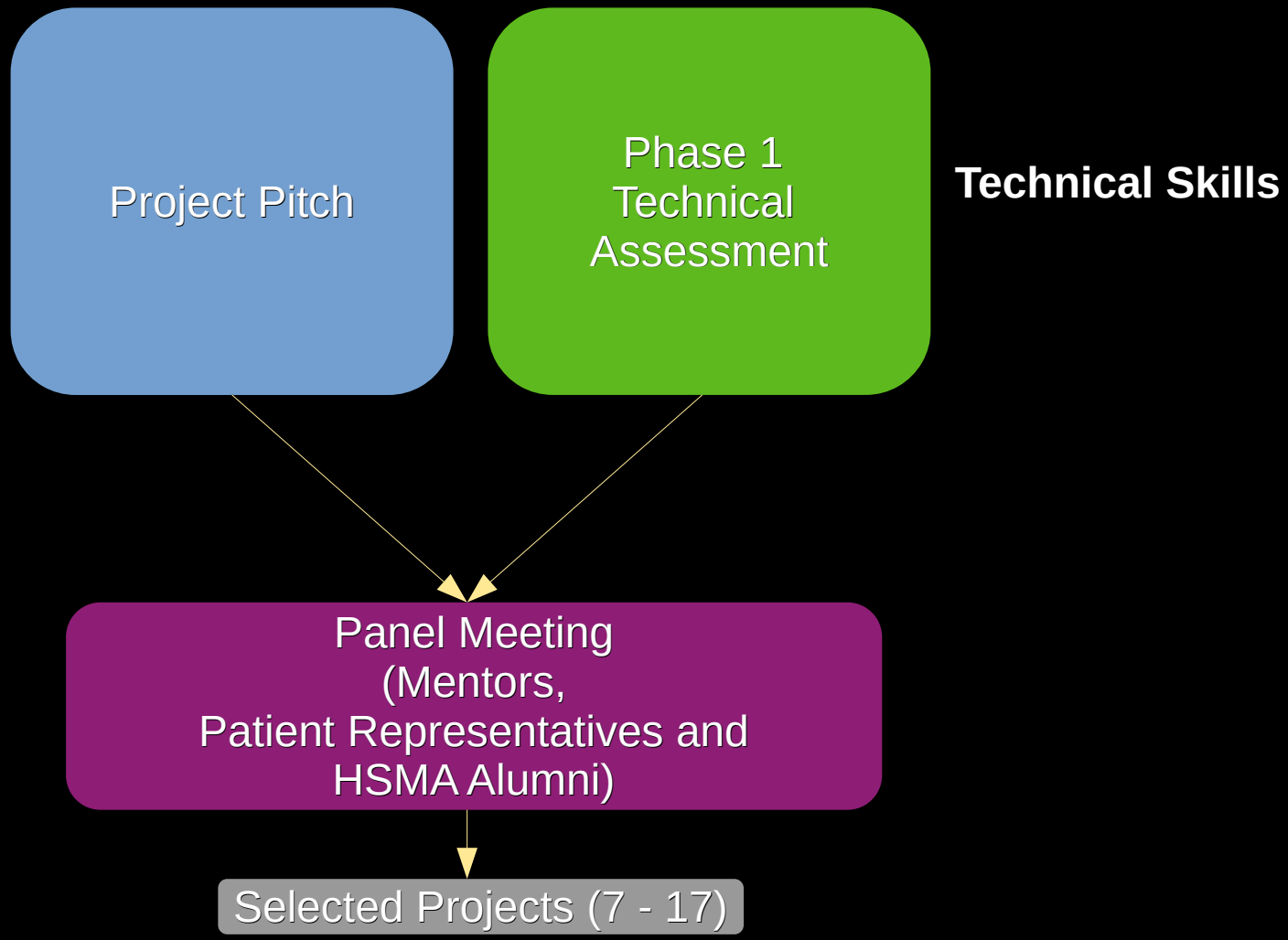
HSMA 4

Progression to Phase 2

Potential Project Impact

Project Practicability

Project Management Skills



Phase 2 : Project Work

Mentor
- Expert in Operational Research and Data Science
- Offers advice, guidance and specialist technical expertise
- Often thinks they're a wizard
- Questionable fashion sense

HSMA
- Manages and owns the project
- Designs and builds the model
- Liaises with key stakeholders
- Delivers the results
- Fashion sense and wizard status TBC

Workplace Supervisor
- Senior Member of HSMA's organisation
- Helps facilitation of project
- Promotes and champions HSMA work
- Protects HSMA time
- Typically better dressed than the Mentor
- May be a wizard

Learning Set Meetings

In Phase 2, once a month all HSMAs and mentors come together for a virtual meeting, in which HSMAs :

- talk about progress they've made on their projects
- share the successes and challenges they've encountered
- share new approaches they're using
- seek feedback and ideas from their peers
- get advice on next steps from their mentors

Learning Set Meetings encourage **collaboration, sharing** and **peer support** – key aspects of the HSMA Programme.

At the end of Phase 2, HSMAs present their project work to a national audience of health, social care, policing and academic staff. The event for the current HSMA 3 programme will be held on **29th September 2021**.

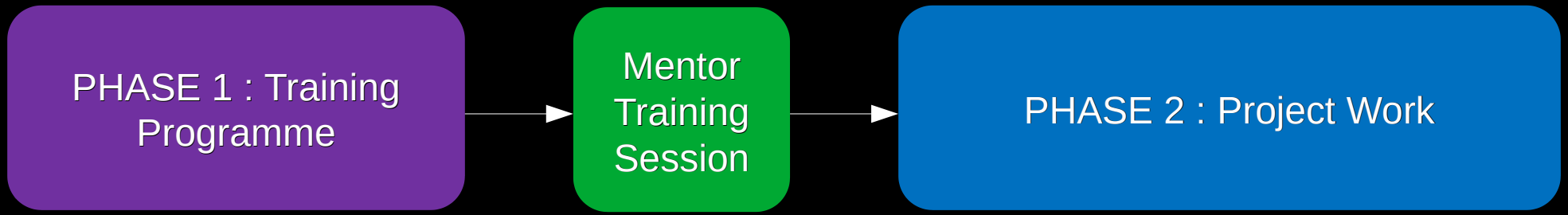
HSMA 4

Trainee Mentor Scheme

We are also opening 10 places on the training programme (Phase 1) to other Operational Researchers and Data Scientists **on the condition that they act as a mentor for a project in Phase 2.** We're calling this the **"Trainee Mentor Scheme"**. These places are also available to HSMA alumni who would like to be trainee mentors.

This will expand the number of projects we can take forward to Phase 2 (7 projects is the minimum based on PenCHORD-only mentoring).

As well as the standard training programme, trainee mentors also have an additional training session where PenCHORD mentors share their expertise and experience in mentoring HSMA projects.



HSMA 4

Mentor Role

Mentors are :
- experienced in Operational Research and / or Data Science methods
- experienced in applying such methods to health, social care or policing settings
- able to provide technical support in Python-based OR and Data Science approaches following training

Expectations of mentors :
- 10% FTE of time for 9 months dedicated to HSMA mentoring + virtual attendance at 8 monthly 2 hour Learning Set Meetings + final presentation event in September. 10 % FTE to include :
    - being available on HSMA Slack channel to respond to adhoc queries from mentees
    - setting up adhoc virtual meetings with mentees when additional support needed
    - providing advice and guidance on the modelling process
    - directing mentees to additional self-learning resources

The “carrots” – what’s in this for you?
- Significant skills development opportunity (free place on a 140 hour+ training programme)
- Opportunity for publication based on mentored project
- Opportunity to work directly with health, social care and policing staff across the country on impactful, applied modelling and data science work

HSMA 4

The Application Process


100 PLACES

HSMA 4

The Application Pack

- Applications launch **TODAY** (16th June) (you will receive an email with a link **this afternoon**)
- Applications close at **23:59 on 28th July**
- 5 parts to application pack :
    - Information for Applicants (**please read this**)
    - Person Specification
    - Key Dates
    - Application form (for those applying to be **students**)
    - Application form (for those applying to be **mentors**)

Let’s look at the key components in turn.

HSMA 4

Eligibility

To be a **student** on HSMA 4, you must :

- be currently based in a health, social care or policing organisation (or related organisation) in **England**
- have full support from your **organisation**
- not have undertaken HSMA previously

To be a **mentor** on HSMA 4, you must :

- be an existing OR / Data Science academic / practitioner / HSMA alumnus
- be able to commit 10% FTE of your time between January and September 2022

HSMA 4

Information for Applicants

HSMA 4 Information for Applicants

Thank you for applying for the fourth round of the Health Service Modelling Associates Programme. Please read the following information carefully before commencing your application.

The HSMA Programme is a hybrid training and mentoring programme funded by the NIHR Applied Research Collaboration South West Peninsula (PenARC) ((https://www.arc-swp.nihr.ac.uk/). Whilst primarily targeted at staff currently working in analytical roles, it is open to all staff working in health, social care, policing and other related organisations (such as Public Health and third sector organisations) who have sufficient analytical and IT skills to be able to undertake the programme. The programme demands a significant commitment – at least one day a week for a period of 12 months (with some weeks in the training phase requiring more than a day a week), in addition to attending 8 virtual Learning Set Meetings and a final presentation event at the end of the programme. Therefore, all applicants must have the full backing of their organisation, and we ask you as part of the application process to name a a senior staff member (someone who has responsibility for your workload who is supportive of your application), to ensure your time to undertake the programme is protected. If successful in moving onto Phase 2 of the programme (see below), this person will adopt the role of your *Workplace Supervisor* – a senior member of your organisation who can help to facilitate the project, champion your work and ensure that your skills become part to the routine analytical function of your organisation.

The commitment outlined above represents the *minimum* level of engagement, and HSMAs will be strongly encouraged to undertake additional exercises and engage in additional learning between training sessions, likely in their own time, to ensure that they are able to cover all the areas they need. Applicants should also be aware that an assessment towards the end of Phase 1 will be set to ensure that HSMAs taking projects forward to Phase 2 of the programme are sufficiently comfortable with the technical methods necessary for their proposed project work. However, applicants should also be assured that the assessment will be as “light touch” as possible.

The aims of the programme are :

1. to embed Operational Research and Data Science methods within health, social care and policing organisations, to improve the level of evidence-based decision making
2. to develop the skills of staff working in analytical roles in health, social care and policing organisations
3. to create embedded ambassadors of Operational Research and Data Science methods
4. to develop and foster collaboration between health, social care and policing organisations

The HSMA programme is split into two phases. In the first phase (October - December), HSMAs are provided with extensive and intensive training in a wide range of modelling, simulation and data science methods. For HSMA 4, 100 places have been made available for Phase 1, which includes 10 places for our Trainee Mentor Scheme, in which experienced Operational Research and Data Science academics or practitioners, or HSMA alumni, are provided trained to support a Phase 2 project as a mentor. Please note that the HSMA programme is not currently available for anyone based outside of England, or those not working in the health, social care or policing sectors (or

HSMA 4

Person Specification

HSMAs should :

- be comfortable learning a wide range of new mathematical and computing approaches
- be creative in their approach to problem solving
- be comfortable managing a project
- be comfortable liaising with key stakeholders to design a project and obtain the necessary data to support the project
- be able to plan and manage their time efficiently
- have an enthusiasm for / interest in the kinds of approaches taught on the programme
- have strong self-learning skills to engage in the further learning necessary to develop their skills using online resources

Key Dates

APPLICATION PROCESS

16/06/21	HSMA 4 Applications Open
20/07/21	Trainee Mentor Scheme : Meet the Applicants 1000-1130 *(all trainee mentor applicants required to attend)*
28/07/21	HSMA 4 Applications Close at 23:59
11/08/21	Deadline for applicants notified of outcome

HSMA 3 SHOWCASE EVENT

29/09/21	HSMA 3 Virtual Showcase Event (0930 – 1530)

HSMA 4 PHASE 1

05/10/21	Phase 1 Commences with first training day (full details of all training days in Oct, Nov and Dec in Key Dates file of the pack)
29/11/21	Phase 2 Pitches and Panel Session (1000 – 1300)
13/12/21	Deadline for notifying outcome of pitches
16/12/21	Final training day (end of Phase 1)

HSMA 4 PHASE 2

17/01/22	Phase 2 Commences
18/01/22	Trainee Mentor Scheme : Training Session (0930 - 1230)
26/01/22	First Learning Set Meeting (full details of all dates in pack)
28/09/22	HSMA 4 Final Seminar Event, Programme Closes

HSMA 4

HSMA 4 Key Dates

Note : AM training sessions run 0930-1230, and PM sessions run 1330-1630
If no AM or PM is specified, the training session is a full day session that spans both 0930-1230 and 1330-1630

Key :

- Core Training Session
- Option Training Session
- Trainee Mentor Scheme Exclusive Session
- Event / Meeting
- Deadline / Milestone / Panel Meeting (HSMAs not required)

June 2021

16/06/21 Virtual Open Day and Applications for HSMA 4 Open

July 2021

20/07/21 Trainee Mentor Scheme : Meet the Trainee Mentor Applicants (1000-1130) *For applicants to the Trainee Mentor Scheme only*
28/07/21 Applications for HSMA 4 Close

August 2021

04/08/21 HSMA 4 Application Panel Decision Meeting
11/08/21 Applicants notified whether they were successful by this date

September 2021

29/09/21 HSMA 3 Virtual Showcase Event (0930-1530) *All welcome to this event to hear about the project work of our HSMAs in HSMA 3*

October 2021	*Session Name*	*Trainer*	*Session Code*	*Core / Option*	*Module*	*Dependencies (for Option modules)*
	05/10/21 HSMA 4 Phase 1 Commencement					
05/10/21	Introduction to Operational Research and Data Science (AM)	Dan Chalk	1A	CORE	M1 – Introduction to OR, Data Science and Programming	
	Principles of Programming (PM)	Dan Chalk	1B	CORE	M1 – Introduction to OR, Data Science and Programming	
07/10/21	Spyder, Jupyter Notebooks and Google CoLab (AM)	Dan Chalk	2A	CORE	M2 – Open Source Collaborative Development	
12/10/21	Python Programming Part 1	Dan Chalk	1C	CORE	M1 – Introduction to OR, Data Science and Programming	
19/10/21	Python Programming Part 2	Dan Chalk	1D	CORE	M1 – Introduction to OR, Data Science and Programming	
26/10/21	Python Programming Part 3	Dan Chalk	1E	CORE	M1 – Introduction to OR, Data Science and Programming	
28/10/21	Version Control, GitHub and Docker (AM)	Dan Chalk	2B	CORE	M2 – Open Source Collaborative Development	
November 2021						
02/11/21	Introduction to Discrete Event Simulation (AM)	Dan Chalk	3A	CORE	M3 – Modelling Pathway and Queuing Problems	
	SimPy for Discrete Event Simulation (Part 1) (PM)	Dan Chalk	3B	CORE	M3 – Modelling Pathway and Queuing Problems	
09/11/21	Introduction to Network Analysis (AM)	Sean Manzi	4A	CORE	M4 – Modelling Whole Systems	
	Introduction to AI and Machine Learning (PM)	Dan Chalk	7A	CORE	M7 – Machine Learning	
16/11/21	Introduction to Modelling Geographic Problems (AM)	Dan Chalk, Kerry Pearn	5A	CORE	M5 – Geographic Modelling and Visualisation	
	Introduction to Natural Language Processing (PM)	Dan Chalk	8A	CORE	M8 – Natural Language Processing	
17/11/21	SimPy for Discrete Event Simulation (Part 2) (AM)	Dan Chalk	3C	CORE	M3 – Modelling Pathway and Queuing Problems	
	Cellular Automata (PM)	Dan Chalk	6A	CORE	M6 – Modelling Behaviour	
18/11/21	Geographic Modelling Algorithms and Evolutionary Computing (Part 1) (AM)	Dan Chalk, Kerry Pearn	5B	OPTION	M5 – Geographic Modelling and Visualisation	5A
	Geographic Modelling Algorithms and Evolutionary Computing (Part 2) (PM)	Dan Chalk, Kerry Pearn	5C	OPTION	M5 – Geographic Modelling and Visualisation	5A, 5B
23/11/21	Introduction to Forecasting (AM)	Tom Monks	9A	CORE	M9 – Forecasting	
	Ethics in AI (PM)	Dan Chalk	7B	CORE	M7 – Machine Learning	
24/11/21	Machine Learning – Who Would Survive the Titanic? (AM)	Dan Chalk	7C	OPTION	M7 – Machine Learning	7A, 7B
	Geographic Visualisation using QGIS (PM)	Kerry Pearn	5D	OPTION	M5 – Geographic Modelling and Visualisation	5A
25/11/21	Deeper into Machine Learning – Introduction to Neural Networks (AM)	Dan Chalk	7D	OPTION	M7 – Machine Learning	7A, 7B, 7C
	Synthetic Data (PM)	Dan Chalk	7E	OPTION	M7 – Machine Learning	7A, 7B, 7C, 7D
29/11/21	HSMA 4 Phase 2 Pitches and Panel Session (1000-1300)	*All HSMAs to attend to present their pitches*				
30/11/21	Named Entity Recognition (AM)	Dan Chalk	8B	OPTION	M8 – Natural Language Processing	8A
	Sentiment Analysis (PM)	Dan Chalk	8C	OPTION	M8 – Natural Language Processing	8A, 8B
December 2021						
01/12/21	Getting to Grips with Programming in R	Sean Manzi	1F	CORE	M1 – Introduction to OR, Data Science and Programming	
02/12/21	Advanced R	Sean Manzi	1G	OPTION – 6	M1 – Introduction to OR, Data Science and Programming	1F
07/12/21	Geopandas (AM)	Kerry Pearn	5E	OPTION	M5 – Geographic Modelling and Visualisation	5A, 5D
	System Dynamics (PM)	Dan Chalk	4B	CORE	M4 – Modelling Whole Systems	
08/12/21	Relation Extraction (AM)	Dan Chalk	8D	OPTION	M8 – Natural Language Processing	8A, 8B, 8C
	A Generic ED Model Using R (PM)	Luca Grieco	3D	CORE	M3 – Modelling Pathway and Queuing Problems	
09/12/21	Advanced Network Analysis (Part 1)	Sean Manzi	4C	OPTION	M4 – Modelling Whole Systems	4A
	Advanced Network Analysis (Part 2)	Sean Manzi	4D	OPTION	M4 – Modelling Whole Systems	4A, 4C
13/12/21	Successful Phase 2 pitches announced by this date					
14/12/21	Simple Forecasting Methods (AM)	Tom Monks	9B	OPTION	M9 – Forecasting	9A
	Advanced Forecasting Methods (PM)	Tom Monks	9C	OPTION	M9 – Forecasting	9A, 9B
15/12/21	Transformers and Pre-Trained Contextualised Word Embedding	Dan Chalk	8E	OPTION – 6	M8 – Natural Language Processing	8A, 8B, 8C, 8D, 8E
16/12/21	Agent Based Simulation using MESA (Part 1) (AM)	Dan Chalk	6B	OPTION	M6 – Modelling Behaviour	6A
	Agent Based Simulation using MESA (Part 2) (PM)	Dan Chalk	6C	OPTION	M6 – Modelling Behaviour	6A, 6B

January 2022

17/01/22 HSMA 4 Phase 2 Commencement
18/01/22 Trainee Mentor Scheme : Training Session (0930-1230) *For Trainee Mentor Scheme participants only*
26/01/22 Learning Set Meeting 1 (1100-1300)

February 2022

23/02/22 Learning Set Meeting 2 (1100-1300)

March 2022

23/03/22 Learning Set Meeting 3 (1100-1300)

April 2022

27/04/22 Learning Set Meeting 4 (1100-1300)

May 2022

25/05/22 Learning Set Meeting 5 (1100-1300)

June 2022

29/06/22 Learning Set Meeting 6 (1100-1300)

July 2022

27/06/22 Learning Set Meeting 7 (1100-1300)

August 2022

24/08/22 Learning Set Meeting 8 (1100-1300)

September 2022

28/09/22 HSMA 4 Final Presentation Event (FULL DAY, Times TBC)

HSMA 4

Application Form (Student Version)

1) Eligibility checks
2) Technical Skills (tick box with **brief** details for each – give the best examples of your skills)
3) Problem Response Assessment
    - 3 scenarios
    - understanding your thought processes around model design from a problem, logic, creativity, and the implications of real-world implementation
    - no single “right” answer – show us what you’re thinking
4) Applicant Statement
    - **Why HSMA?** The most important question on the form
5) Organisational Support
    - Details of Line Manager / Senior member of your organisation who will be your Workplace Supervisor (check with them first – you have to sign on their behalf)

HSMA 4

Application Form (Mentor Version)

1) Eligibility checks
2) Technical Skills – tick box for each of the areas covered in HSMA + specify the software you have used and an example of how you have used the method. We're not expecting you to be experts in everything, or to have used the software we teach.
3) Applicant statement – why do you want to be a mentor?
4) Organisational support

Applicants for the Trainee Mentor Scheme need to attend a meeting on 20th July 1000 – 1130 to discuss their applications with the team. **This is only for those applying for the Trainee Mentor Scheme.**

HSMA 4

Demand and HSMA 5

We are expecting a **very high number** of applications for the programme, as we have had **hundreds** of expressions of interest.

All applications will be judged on their merit, but it's likely we will need to turn down a number of **good applications** due to the sheer anticipated volume.

We are intending to run HSMA 5 next year, and to find funding to support the programme that allows us to offer a hugely expanded number of places.

Key messages :
- Please apply - you may be exactly who we're looking for!
- But if you don't make it this time, try again next year
- Also, you may be placed on a **reserve list** for HSMA 4, and you may be offered a place if someone drops out ahead of the course starting.

HSMA 4

Q & A

We're taking a short break, and will resume shortly.

On Twitter? Tweet about the event @peninsula_ARC using #HSMA4

HSMA 4

Sample Mini-Training Session

A Taste of Discrete Event Simulation and Conceptual Modelling

Dr Daniel Chalk

What is Operational Research?

Applying modelling, simulation and analysis techniques to help **inform** decisions, and **improve decision making.**

“What If?” Analysis

Base Case Scenario
A model of the current system. How are things running now?

We can use this to see how well the current system works, validate the model and identify bottlenecks.

- How long do you think a patient spends in the system now?
- Where are the bottlenecks?
- What does our capture of the current system tell us about where we may need to increase / reduce resources, or alter processes?

“What If” Analysis
Adapting the model to reflect potential future scenarios. How might things run if we were to change x, y and / or z?

We can use this to predict the impact of decisions, and help the decision maker to make an **informed evidence-based decision**.

- What is the predicted impact of x, y and z?
- How might things change if a, b and c were also implemented?

The Benefits of Modelling

- **Emulation :** A model is a version of reality that can be altered without risk or consequence

- **Speed :** Typically, models can be designed and built much more quickly than real world changes can be effected.

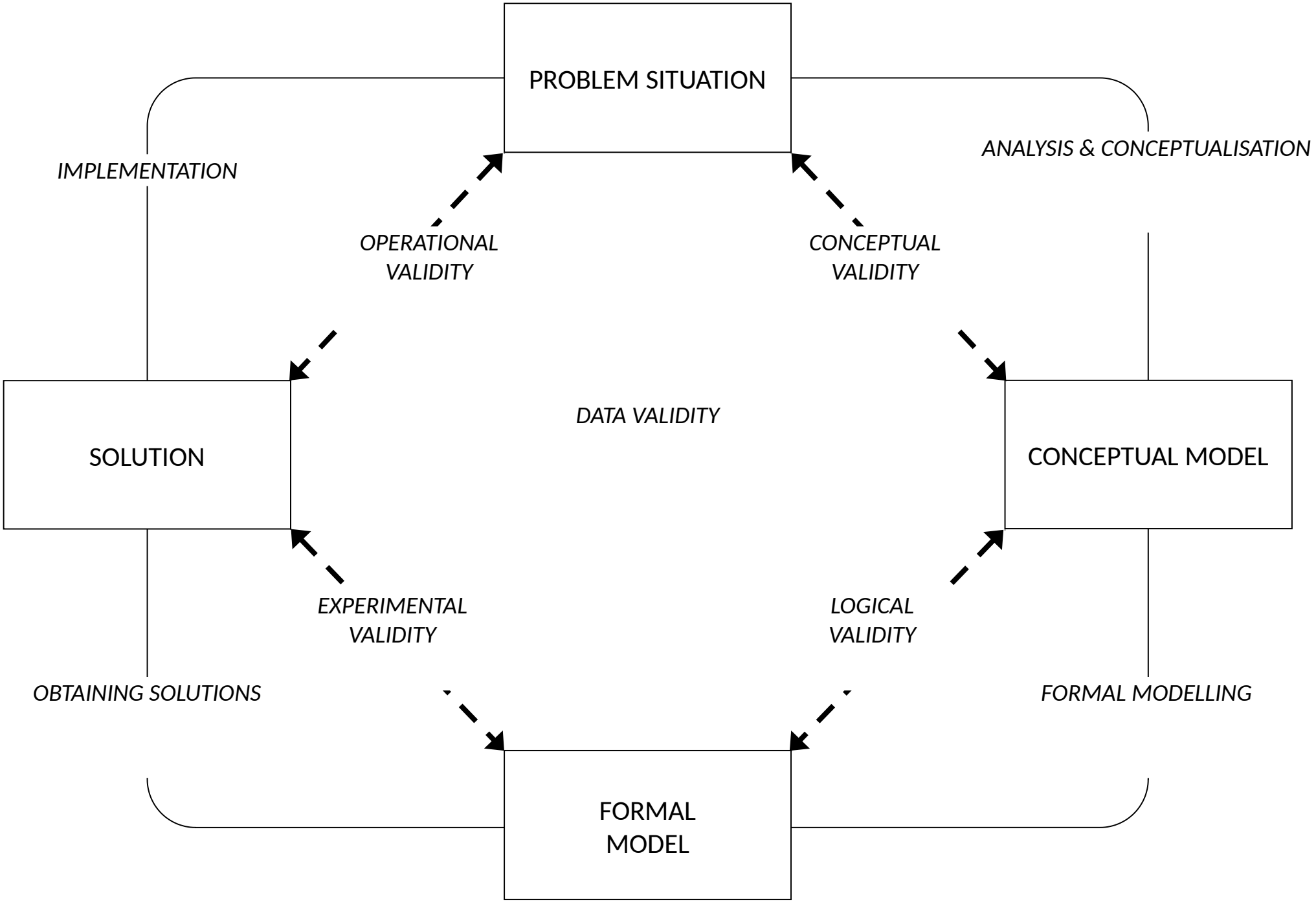
- **Communication :** A model can help people to communicate about a problem using a shared language and point of reference

- **Systems Thinking :** The process of designing the model can help people to think about their systems

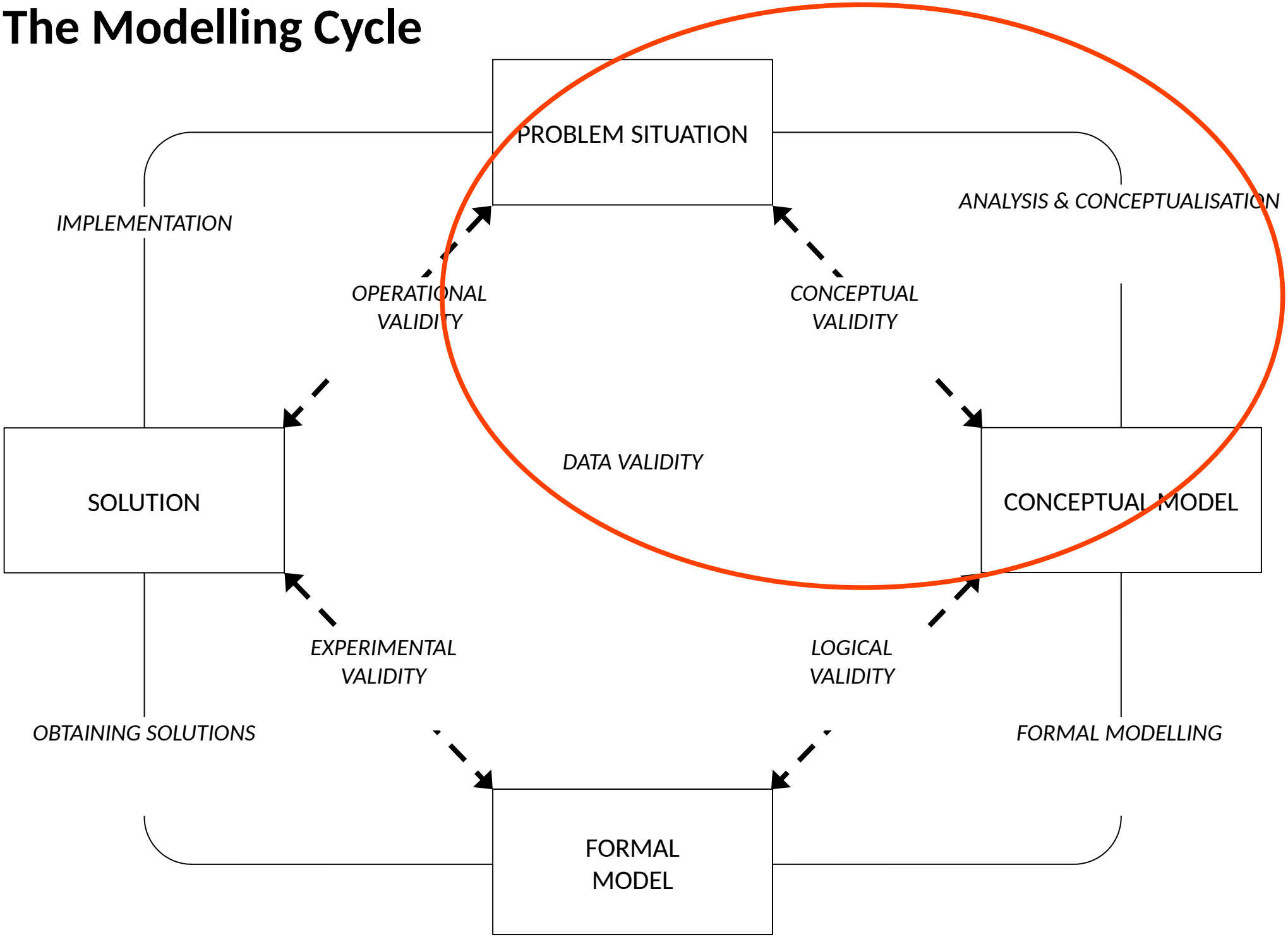
- **Objectivity :** A model can provide objective support for an argument

* assuming the model has been built objectively!

The Modelling Cycle



The Modelling Cycle



Objectives of the Model

- What are you trying to achieve / why are you building the model?

Problem Statement	"What if?" Question(s)	Deliverables	Organisational Impact
There are significant delays in referral to treatment	What if we reorganised the testing priority?	A report outlining the predicted results	More lives saved, targets met




Scope

- What are the boundaries of the system I need to model?

I need to model my ED

But many arrive by ambulance

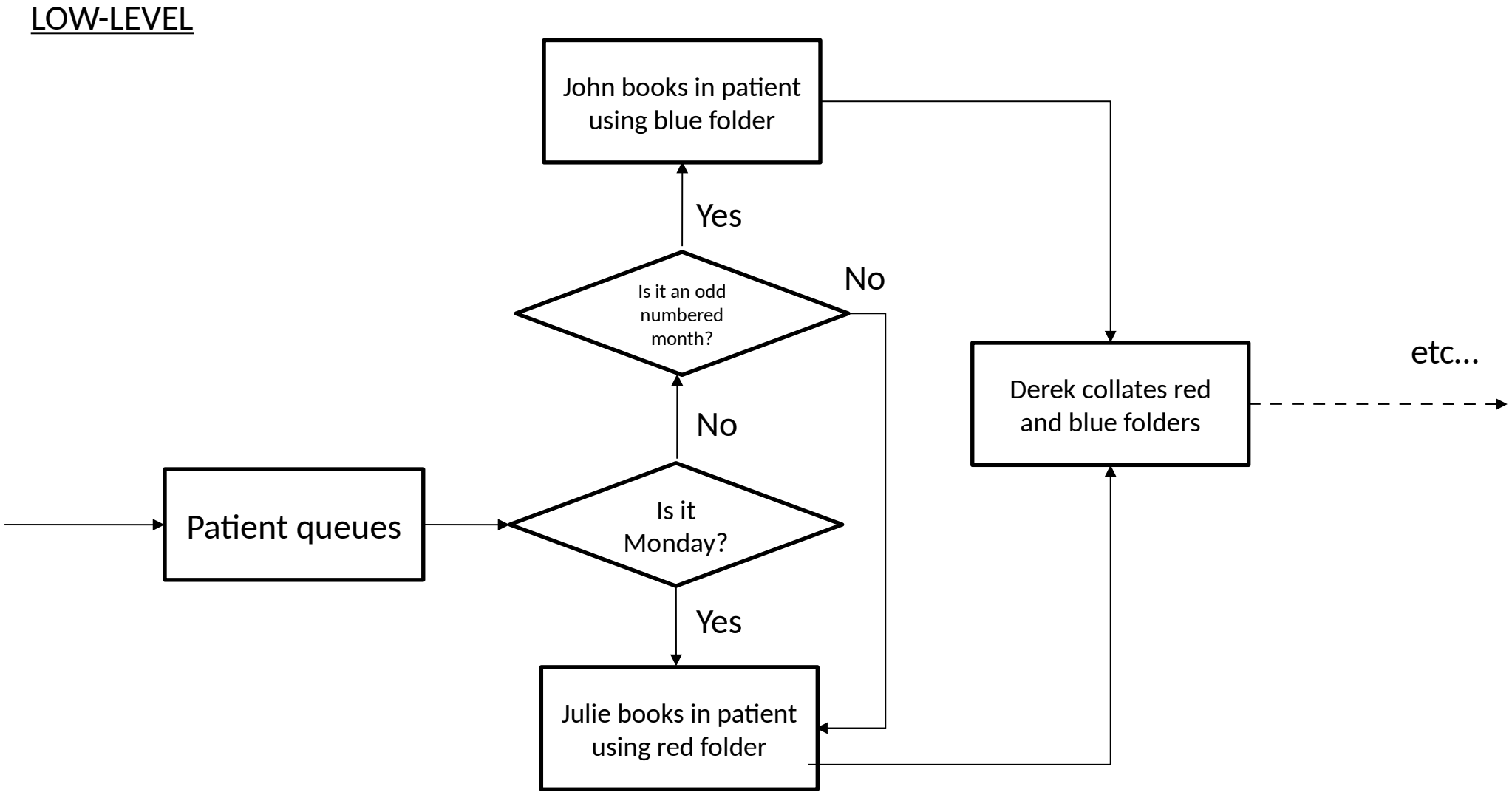
So should I build a model of ambulance dispatch too?

What's the minimum you can model to answer your question?

If I need to model other systems, how can I simplify their representation?

Level of Detail

- How much detail do I need to put into the model?



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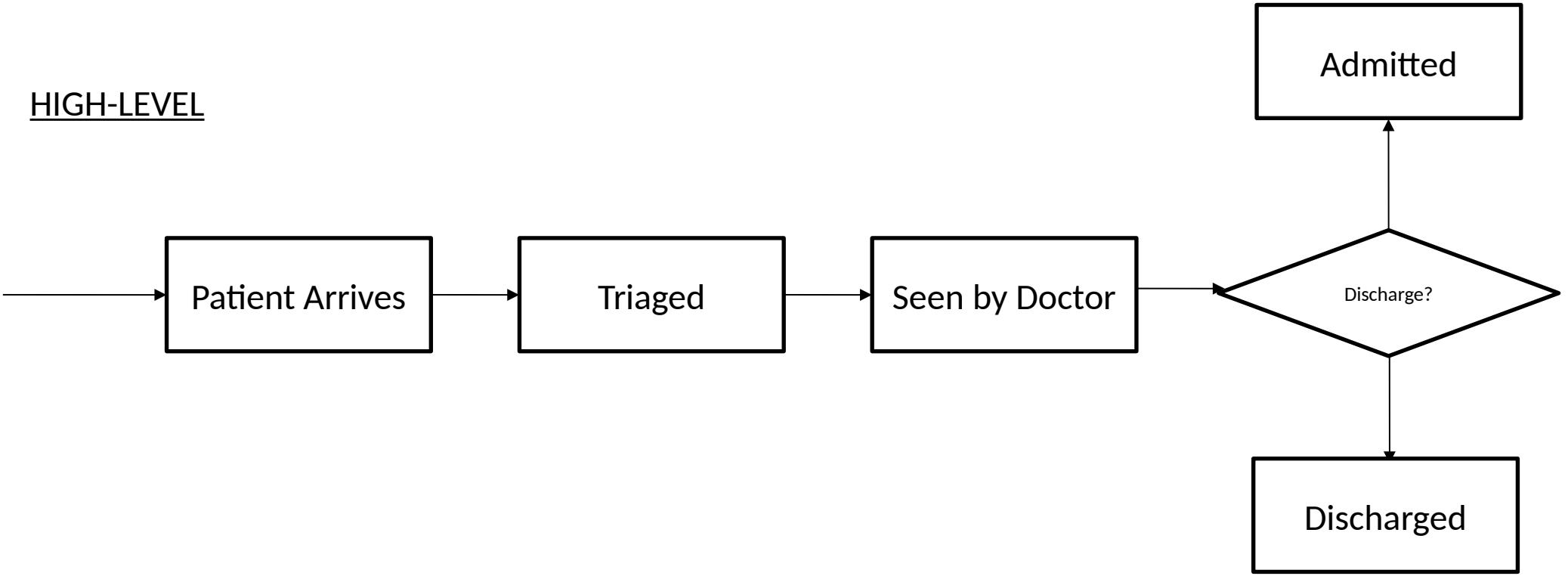

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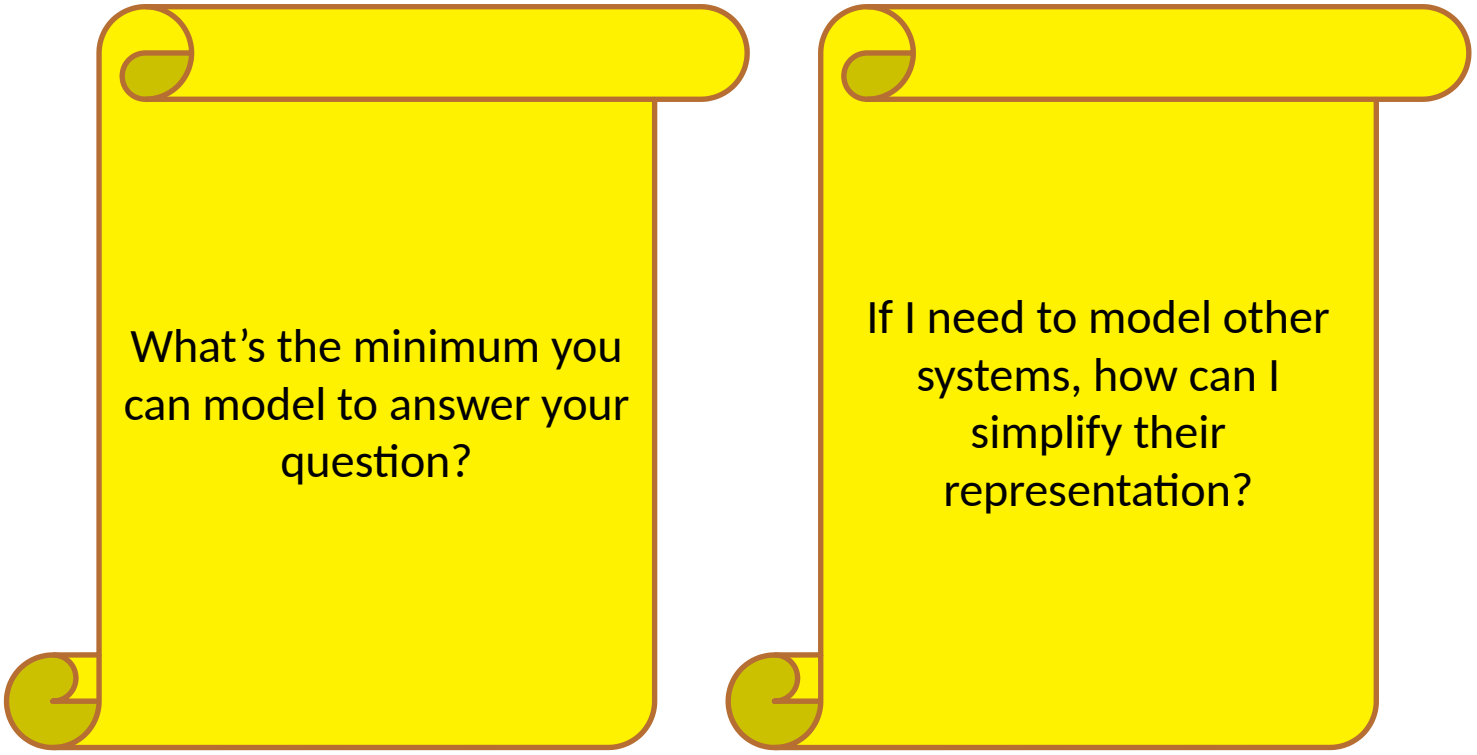


Assumptions and Simplifications

- Assumptions are things that we must assume because we don't / can't know their real world properties
  - We assume that the data we've got is representative
  - We assume there are no travel times within the clinic for staff or patients (or that they're trivial)
- Simplifications are things from the real world that we choose to distil down to simpler elements because we anticipate that added complexity does not provide benefit
  - We simplify the triage process into the patient spending an amount of time with the nurse
  - We simplify such that there are no limits to the queuing time for the MIU

What is Discrete Event Simulation?

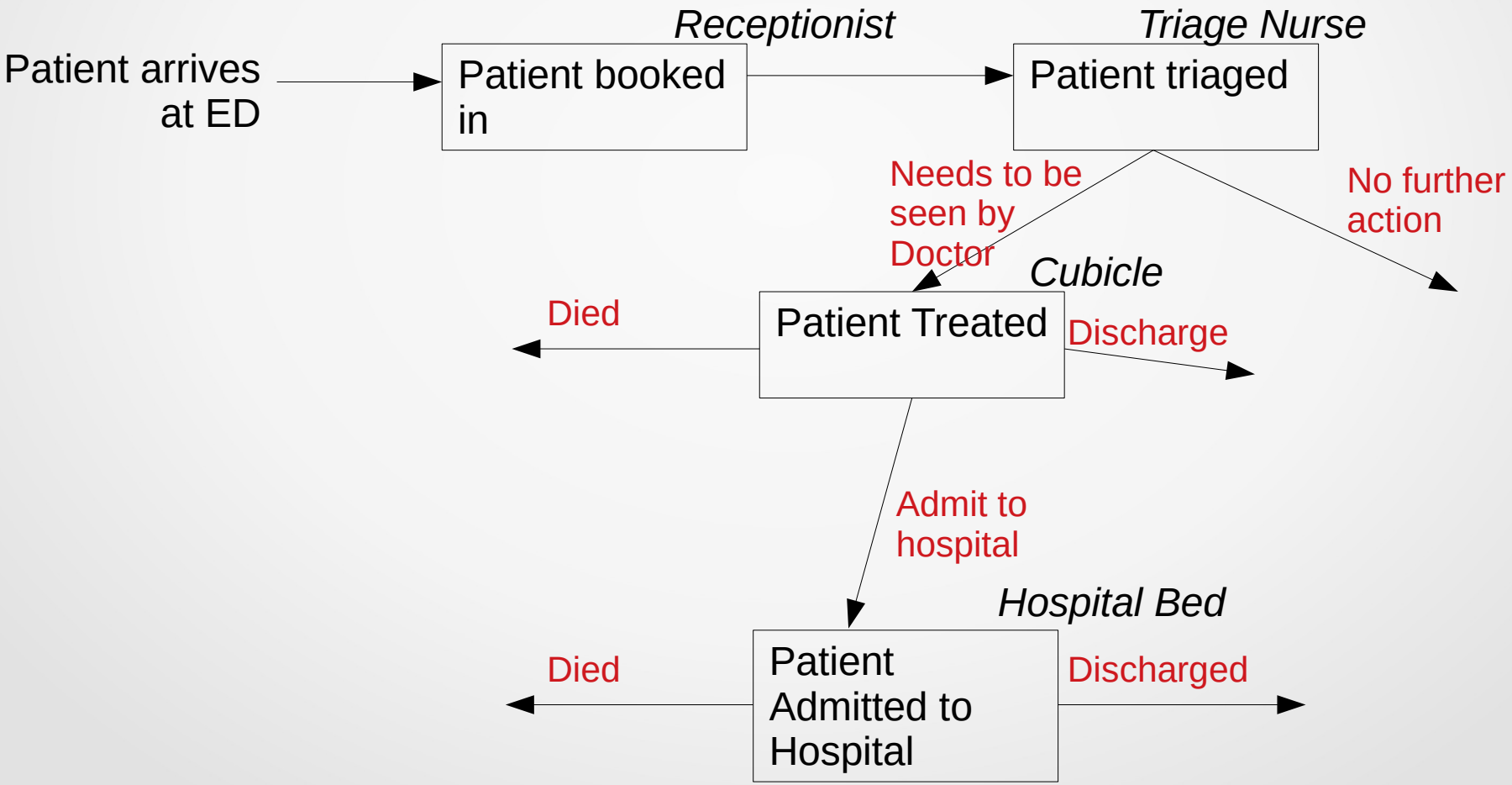
Discrete Event Simulation (DES) is a way of modelling pathways, or more specifically, *queuing problems*.

In a DES, *entities* flow through (and queue for) *discrete sequential processes* that use *resources*.

DES is typically used to model processes and pathways. For example, what happens to patients when they arrive at the Emergency Department.

Therefore, DES is useful for asking “what if?” questions about process / pathway changes.

An Example


Patient arrives at ED
Receptionist
Patient booked in
Triage Nurse
Patient triaged
Needs to be seen by Doctor
No further action
Cubicle
Patient Treated
Died
Discharge
Admit to hospital
Hospital Bed
Patient Admitted to Hospital
Died
Discharged

Components of Discrete Event Simulation

Entities are the things flowing through the sequential processes in the model (e.g. patients, telephone calls, blood test results)

Generators are the way in which entities enter the model and come into being (e.g. brought in by paramedics, self-presenting at the ED)

Inter-arrival Times specify the time between entities being generated (arriving in the model)

Components of Discrete Event Simulation

Activities / Servers represent the activities that happen to entities (e.g. triage, treatment, ward admission)

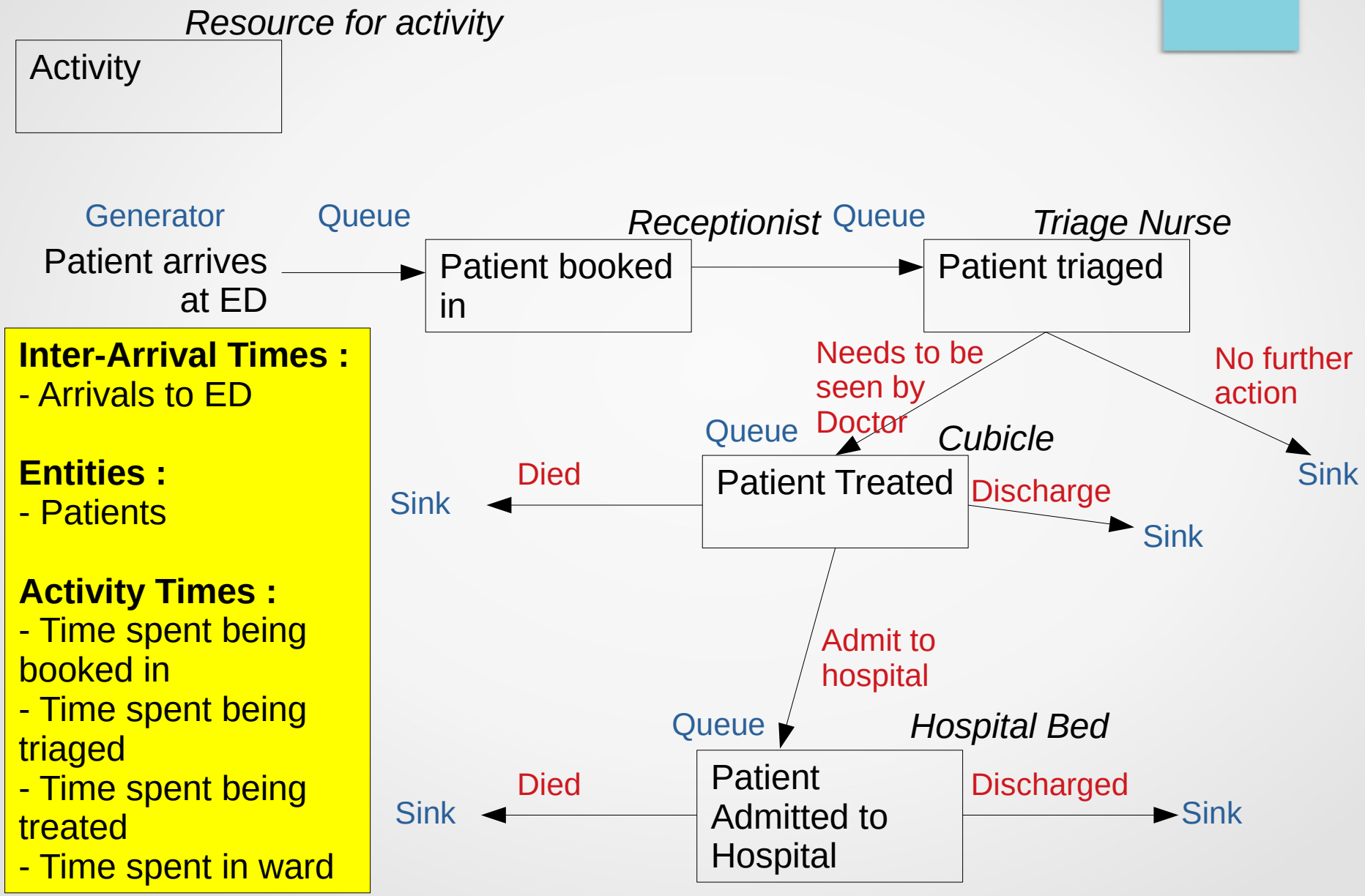
Activity / Server Time represents the amount of time it takes for an activity to happen to an entity.

Resources are required for activities to take place and may be shared between activities (e.g. nurse, doctor, receptionist, bed)

Queues are where entities are held until an activity has capacity and the required resources to begin.

Sinks are how entities leave the model.

An Example



Inter-Arrival Times :
- Arrivals to ED

Entities :
- Patients

Activity Times :
- Time spent being booked in
- Time spent being triaged
- Time spent being treated
- Time spent in ward

Group Exercise

You will now be split into groups in breakout rooms. In your groups, you should :

- come up with some ideas of queuing systems in the real world. These might be work-related but they don't have to be – think about other queuing systems you encounter in the wider world too
- select one of these systems, and come up with one or more "what if?" questions you might want a model of that system to address
- draw up a design for a Discrete Event Simulation of your chosen system that you would build to answer your "what if?" questions. Consider the scope and level of detail of your model design. Your model design should include :
    - a drawing of the generators, processes, flows, queues, resources and sinks that you would model
    - a list of the inter-arrival times, entities and activity times that would be captured by your model

You have **until 12.20**. At the end of the exercise, someone from your group will present what you came up with, so please ensure that your group nominates someone to do this.

You can refer to the training materials I've just covered by downloading them from here : https://github.com/hsma-master/hsma4openday

Group Exercise

Let’s hear from a selection of the groups to see what you came up with!

HSMA 4

Final Q & A