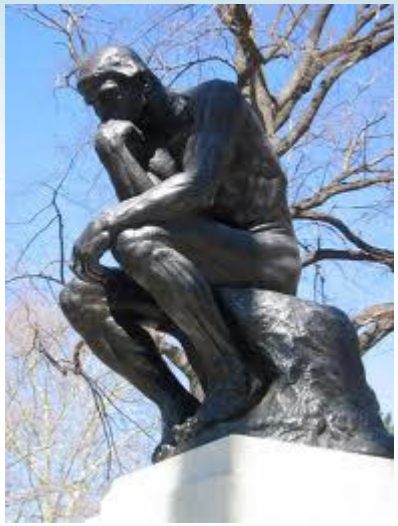
ORAC Introduction

1 Aug 2022



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The evidence behind your decisions

WELCOME

Course objective

- Facilitator: Explain the theory & application of OR decision models, illustrated with healthcare examples (domains)
- Participant: Know frameworks, identify applications
- ORAC is an appreciation course – not for expert modelers.
- Format: Lectures, Cases, Group work, Demos & Papers (no computer hands-on)

How can OR help you (and career)?

- Use OR for service planning and operations analysis, clinical decision support

- Use OR to frame issues from a model driven & systems perspective to complement data analysis

Operations Research (O.R.)

- Definition
  - O.R. is the discipline of applying analytical methods to help make better decisions and to build decision models with a *systems perspective*.
- History
  - Defense -> Production -> Service

informs online
Institute for Operations Research and the Management Sciences

- OR education
  - Operations Research/Industrial Engineering, Maths, Decision Science etc

Knowing you better

Your background?

Your department and role at work?

What are your ‘analysis / model’ needs?

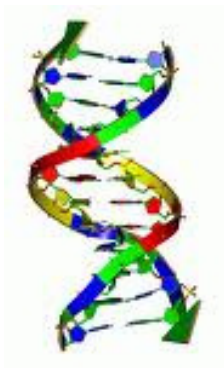
Sponsor	End user
Financing/approver/decision maker	Analyst
Domain expertise	Model builder

Where do I apply OR?

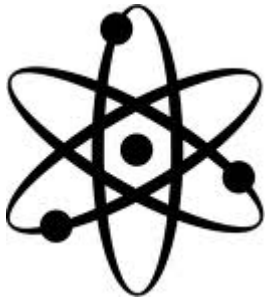
Problem type	Examples
Demand projection	How will ED attendance due to hospital A opening & scaling up in north in 3 years time impact us? (0-3,3+) How do I forecast my bed census for the next few days to highlight any bottlenecks? (DOW, holidays, LOS, history) How many CKD5 patients do we expect in 10 years time?
Capacity planning	How many recovery beds / appointment slots / .. do I need? What is the trade-off of having more resources versus "idle" time?
Waiting time	How will the waiting time be like if we increase 1 counter / machine / pharmacist etc?
Location planning	Where and when do I site my polyclinics to meet a growing ageing population in the next few years?
Operations scheduling	How do I plan the surgery / doctor / nurses schedule to meet the demand?

Model

- What is a model?
  - Models are **abstractions** (theory) of reality, built to improve understanding and **decision** making (practice) because we cannot experiment with reality.
- Model types*



Physical



Analogy

$$L = \lambda W$$

Maths

* Understanding scientific reasoning (4th ed.), Ronald N. Giere, 1997, Harcourt Brace

Model attributes (& perspectives)

- Continuous versus Discrete (integer?)
  - Gas consumption, No. of patients waiting.
- Deterministic versus Stochastic (outcome is certain?)
  - Time of news broadcasting, Time of the next bus.
- Static versus Dynamic (changes with time?)
  - Location of a bus-stop, bus.
- With and without feedback (stability?)
  - Temperature control, uncontrolled disease

Stages in analysis and management expectations

Management response at this stage

- Describe
  - Define measurable variables (x) and outcome (y)

Ok I am clearer

- Explain
  - Explain cause and effect

Ok I understand

- Predict/Forecast (1 hour) and Project (10 years)
  - Describe the future scenarios (how many?)

To prepare for future

- Control/Optimize/Prescribe
  - Control outcomes by adjusting inputs.

Let's take action

Planning your time for analysis

- Define problem ~ 30-40%
  - Question, outcome, patient impact, sponsor, scenario. Lit review/history, meetings. This is the most important step.
- Data collection ~ 10-30%
  - Depends..
- Model building ~ 10-30%
  - Use the appropriate technique and depth (for analyst)
- Model analysis ~ 10%
  - What are the results and implications? Sensitivity analysis?
- Communicate results for decision ~ 10%
  - Present at various forums, report, limitations/assumptions

OR & Data Science (risk of being simplistic)

- **Operations research** is a problem centric discipline, in which a mathematical model of a problem or system is created **to improve or optimize that problem or system**
- **Data science** is a data centric discipline, in which a mathematical model of a dataset is created to **discover insights or make a prediction**

http://www.humancenteredor.com/tag/data-science/

..**Data Science** tries to **extract knowledge** from the available data and uses mostly Statistical, Machine Learning techniques. On the other hand, **OR** uses the data in order **to make decisions** based on the data, for example by optimizing some objective function (criterion) over the data (input)

https://cs.stackexchange.com/questions/71525/data-science-vs-operations-research

Example: No-show prediction

- Data science
  - Predicts probability of no-show of an attendance (factors could be age, gender, discipline, FV/RV, time of appointment, history of no-show etc)
- Operations Research
  - How can we use the results? Reduce waiting time, increase number of slots?

Course outline

- Day 1

Introduction / Warm up	– What, Why,… Operations Research?
Systems Thinking & Dynamics	– Stock & Flow, Causal Loops, Feedback Control
Queueing Theory	– Demand, Capacity & Waiting time
Simulation (I)	– Discrete Event Simulation

- Day 2

Simulation (II)	– Microsimulation
Optimization	– Getting the most with what you have
Case studies	– More of our work
Group hands-on session	– Structure problem with OR
Group quiz	– Have some fun

And breaks in-between

Closing for the Opening

OR can be useful, but does not solve all issues

If all you have is a hammer, everything looks like a nail

- Check out:
  + Europe/UK: https://www.theorsociety.com/
  + US: https://www.informs.org/
  + HSOR: https://hsor.nhg.com.sg