Supervisor meeting 15/05/2024: Graham, Rob, Dashi, Dave

Justification for using a simulation model: agreed that certain real-world complexities are important to include in a full model of the system which are beyond the realm of analytical modelling and require a simulation model. Examples (not an exhaustive list) below. Care will be needed when deciding which complications to include/exclude.

- Partial re-entry to the system following service completion
- Non-Markovian service time distribution
- Blocking of customers in shelter while waiting for service in housing
- Priority queueing

Dealing with uncertainty in model inputs: agreed that the system under consideration exhibits high uncertainty beyond just stochastic uncertainty. To incorporate this high uncertainty (of model inputs) into both the modelling and the optimisation will be interesting to address at a later date, but initial focus should be to build a framework to model and optimise a system with known inputs, allowing the user to experiment with different scenarios (i.e. different potential model inputs). Distributionally Robust Optimisation could be an interesting avenue to explore to deal with model inputs with unknown distributions.

Specific / General approach: Graham indicated a preference for developing an SO methodology which was general and applicable to a range of problems of a similar type to the specific case of Alameda County. Graham suggested that our current problem was interesting because multi-fidelity models were available to aid with the SO, so a SO methodology for problems with multi-fidelity models is desirable. Dashi / Dave indicated that SO not typically used for capacity planning problems - SO more typically used for optimising service rates in queueing, and 'what-if' modelling more typically used for capacity planning in healthcare. So a SO methodology for capacity planning problems is desirable.

Current strand of work with deterministic optimisation: Graham shared current work on solving new deterministic optimisation formulations using the deterministic fluid flow model and using the solvers available in Pyomo.

- Solving linear objective functions gives trivial results where any flexible budget should be assigned either all to shelter or all to housing, depending on model parameters.
- Solving a quadratic objective function gives a more interesting result where an optimal use of the flexible budget is on a mixture of housing/shelter.

Graham to include annual budget constraints, shape constraints on the build functions and time-dependent weighting of the penalty on shelter to explore further interesting solutions.