Industrial & Systems Engineering, IE3100 Systems Design Project

Predictive model for the waiting time of Elective Surgery

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Summary

Definitions:

Elective Surgery :
A surgery that does not constitute a medical emergency and is scheduled in advance of the operation.

Waiting Time :

Date Operate Requested

WAITING TIME

Date of Operation Given

Problem:

Performance Targets

100% Patients' Waiting Time <= 42 days

Challenges:

How to achieve the target with limited resources

Project Objectives:

To produce a predictive model to predict the waiting time given a fixed set of resources:

1. Availability of hospital beds, classified by Class of accommodation [A, B1, B2, C]
2. Availability of surgeons, classified by the 6 divisions
3. Availability of Operating Theatres

The model is able to identify appropriate adjustments or improvements that can improve the waiting time situation.

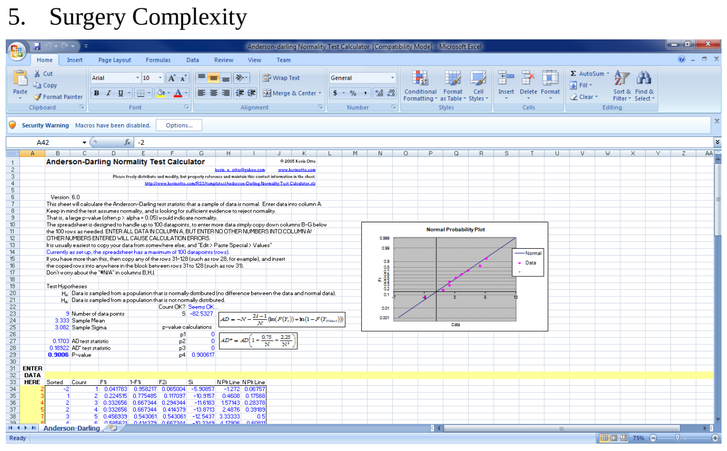
Methodology

Demand

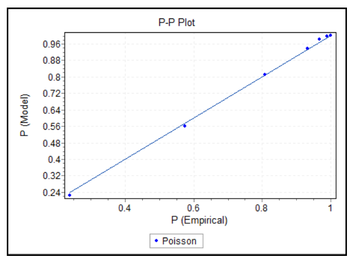
Data Analysis

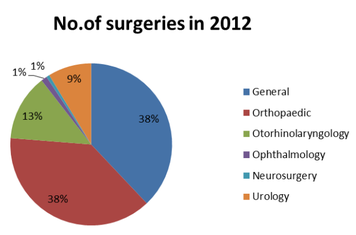
Statistical Approximations done to account for:

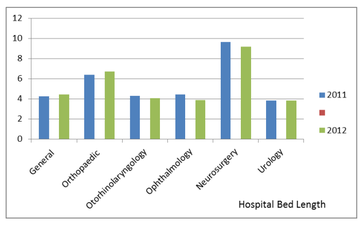
1. Arrival Rate of elective patients from each of the 6 divisions
2. Availability of Surgeons
3. Length of Elective patients' stay
4. Bed Occupancy
5. Surgery Complexity

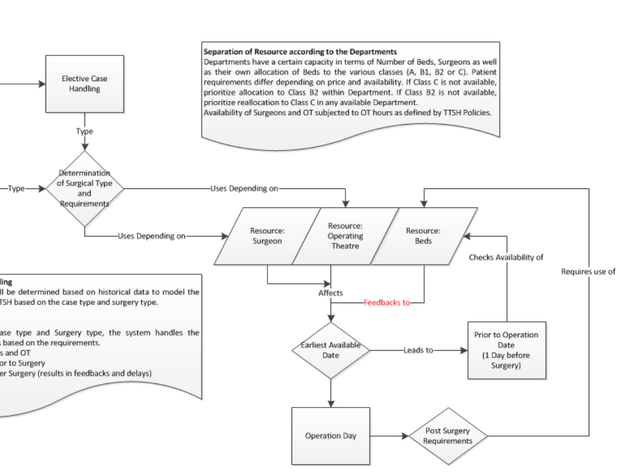


#	Distribution	Kolmogorov Smirnov		Anderson Darling	
		Statistic	Rank	Statistic	Rank
1	D. Uniform	0.26164	1	158.97	4
2	Geometric	0.40349	4	78.229	3
3	Neg. Binomial	0.34878	3	48.503	2
4	Poisson	0.32268	2	40.333	1
5	Bernoulli	No fit (data max > 1)			
6	Binomial	No fit			
7	Hypergeometric	No fit			
8	Logarithmic	No fit (data min < 1)			







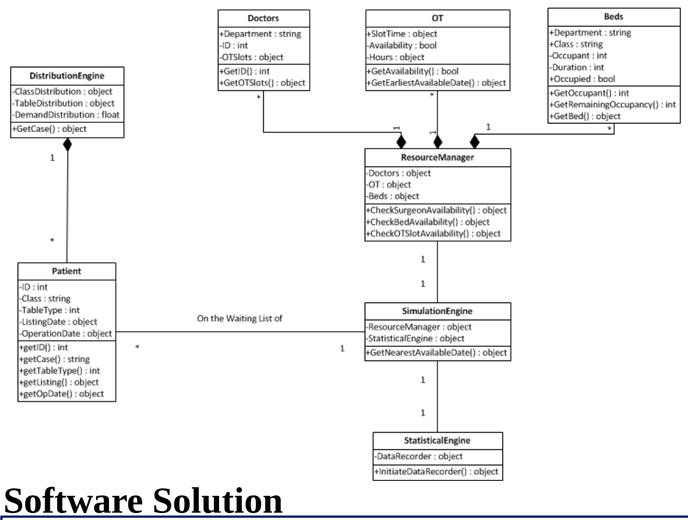


Supply

Model Design

Output

Software Design



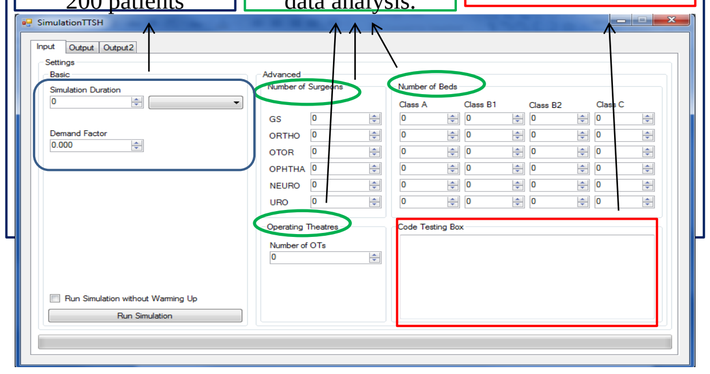
Software Solution

- ✓ Model implementation as a software in C Sharp
- ✓ Utilizes data sets derived through analysis and validation with given historical data

Input Parameters for Simulation. Warm up period = 200 patients

Resources input for Simulation. Input based on data analysis.

Reveals details of Simulation.



Solution

- Operating Theatre
  - 24 OTs
  - Pre-assigned time slots
- Surgeons
  - Number of surgeons
  - Working hours
- Hospital Beds
  - Number of beds
  - Bed Occupancy Rate

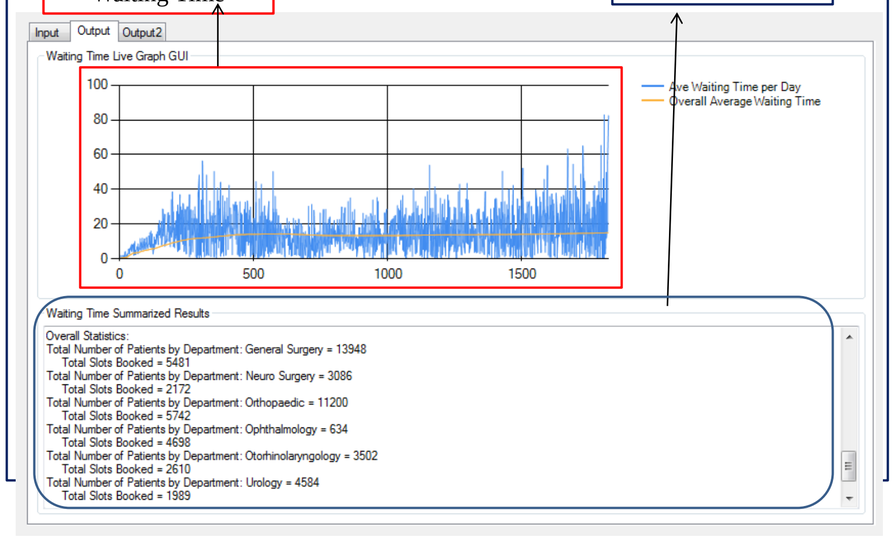
Result Validation

- ❖ Availability of Operating Theatres was the bottleneck resource
- ❖ High sensitivity to small increase

- ✓ Simulation run based on input parameters for Resources as well as Demand based on Statistical Analysis results
- ✓ Outputs Simulation Results

Simulation Results (Waiting Time per Day, Average Waiting Time

Simulation Summary Details Patients, Slots, Waiting Time etc



Limitation and future improvements

Limitations

- ❖ Exact flow of booking system is possibly affected by other determinable factors
- ❖ Hard to model human behavior.
  - ❖ Eg. % no shows

Future Improvements

- ❖ Inclusion of emergency cases as part of input data. i.e. Generate Emergency Cases
- ❖ Extension of software to model in more determinable factors
- ❖ Creating of Software Documentation for subsequent teams to work on and improve upon the software