Better Ambulance Rostering Technology (BART) Project

- Auckland University/St John Collaboration
- The Problem
  - Modify staff rosters to better meet targets
  - But how many crews do we need to get the work done?

Simulation with BartSim

- BartSim system written in C and C++
  - Handles complex ambulance dispatch and routing
  - Specialised data visualisation capabilities
- Replays actual historical calls in the simulation
  - Detailed historical time stamps for each call
  - Locations for calls and destination hospitals
- Detailed travel time modelling
  - Predict travel times under time-varying congestion
  - No automatic vehicle location GPS data available
  - Use AM, PM, and off-peak travel speeds from ARC equilibrium model

Travel Model

- Nodes identify both joins & positions
- But only 800 decision nodes
  - 800² pre-computed routes to store

Generating Simulated Trips

- Choose fastest route traveling via decision nodes
  - use pre-computed routes between decision nodes
  - use interpolated speeds given by trip start time
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Generating Simulated Trips

Metropolitan Ambulance Service (MAS)
- Formal international tender process
- Tender secured
- Partner: Optimal Decision Technologies (ODT)
- BartSim re-born as SIREN
- Simulation for Improving Response of Emergency Networks

The Melbourne Operation
- Bigger Problem
  - Population of 3.5 million (3 times Auckland’s)
  - Approx 70 bases (4 times Auckland)
- Bigger Road Network
  - Union of two different networks
  - Limited speed information - tuning required
  - Network approx 2.5 times bigger than Auckland model
  - Many pre-computed routes!

The Melbourne Operation
- Many More Vehicle Types (not one!)
- MC 2 MICA officers
- PR Paramedic Response Unit
- AP 2 Ambulance Paramedic officers
- MR MICA Responder
- OC On call
The Melbourne Operation

- Detailed Case Classification System
  - Many case types
- Complex Dispatch Rules
  - Depend on case type
  - Multiple vehicle dispatch
    - More than 1 vehicle often sent to a scene

Better Base Locations using Siren
Sarah Kirkpatrick, Engineering Science, 2004

- Exploit realism of simulation and historical call data
- Start with existing base locations and repeatedly test small base movements for improvement
- Only consider effect on calls responded to “from base”
  - these calls will be impacted most by changed base locations

Local Search Process

% of calls in a cell responded to by selected base
(randomised simulation run – not actual data)

Candidate Base Location Nodes
Move each base to candidate location with best predicted performance for associated calls
Simulate to identify how calls are responded to from new base locations
Simulation gives response times & identifies “from base” calls for each base

Global
Target time met
Target time not met
Calls assigned to base
Base
Changed response
Local Search Results

- All call data was randomised so the results presented do not reflect the actual performance of the Melbourne Metropolitan Ambulance Service
- New base locations were tested using a second independent set of calls
- Improvements made in all response targets
  - 9.0% more priority code 1 calls reached within 8 minutes
  - 2.0% more priority code 1 calls reached within 13 minutes
  - 1.5% more priority code 2 calls reached within 25 minutes
  - 0.5% more priority code 3 calls reached within 60 minutes

Cumulative Percentage Graph of Call Response Times

Base locations from the Local Search resulted in a higher percentage of calls with shorter response times (randomised data - actual results will vary)

Ongoing Siren Developments

- New implementations planned for
  - Australia
  - Canada
  - United Kingdom
- New research challenges
  - Faster simulation results
  - Using GPS vehicle data