

Rubbish Bin Placement and Pickup Scheduling

at the University of Melbourne

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The University of Melbourne

May 24, 2011

- 1 Introduction
- 2 Model
- 3 Data
- 4 Results
- 5 Conclusion

Overview

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The University of Melbourne

The Recycling and Waste Management Team

- Judith Alcorn:
Waste Project Officer
- Peter Wuelfert:
Operations Manager, Melbourne University, SERCO

The idea

Model and optimize

- Locations of bins on campus
- Schedule for collecting rubbish
- Pickup routes

Approaches & first Questions

- Close look at the current situation
- What are possible bin locations?
- How do they collect the rubbish at the moment?
- Can we separate the whole problem into smaller parts?
- How can we model it?

Assumptions & Simplifications

- Focus on outdoor bins at the Parkville campus
- Bins will be placed at network vertices
- Ignore special types of rubbish (hazardous etc)
- Consider only two different types
- Ignore bin purchase and maintenance

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Implementation via GUI in *Xpress^{MP}*

Network Model: A graph $G = (V, E)$

- V = set of vertices (possible bin locations, seating location etc)
- E = set of edges (road or pathway between locations)

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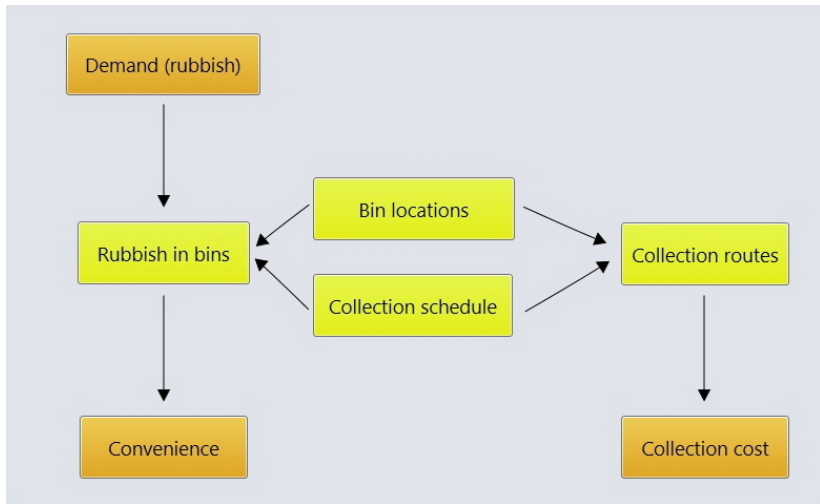
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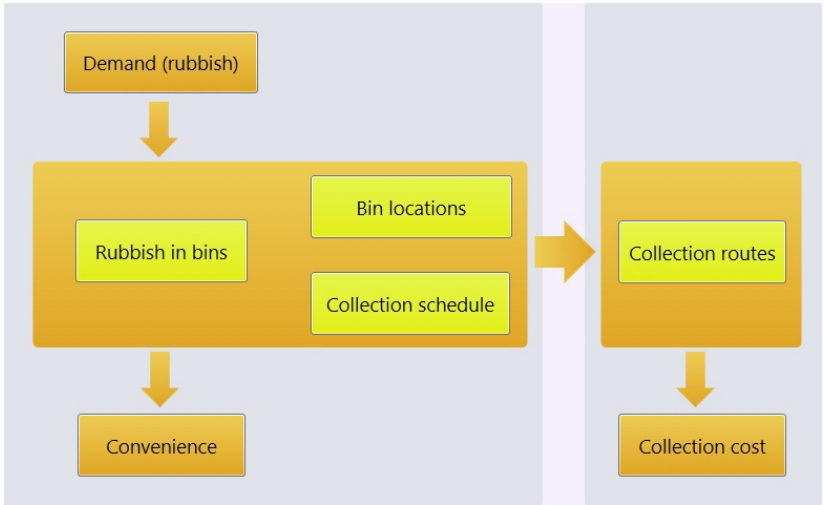


Figure: Section of Campus Map near the Union House

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Objective

- Minimise “inconvenience cost” of putting rubbish in bins

Approach

- Discrete time
- Rubbish in bins
- Demand and capacity
- Limit collection cost
 - Max number of pickups
 - Max number of pickup times

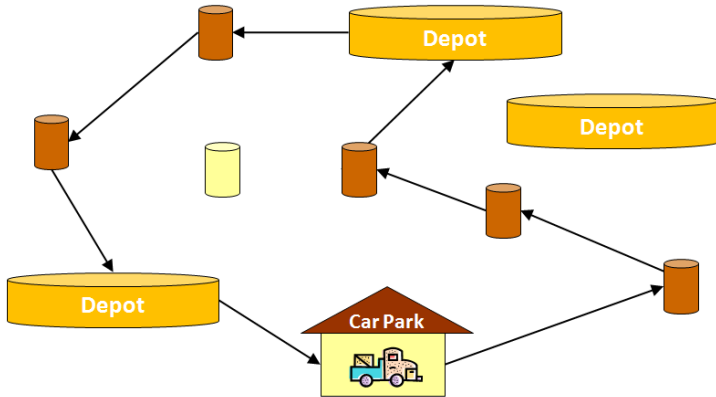


Figure: Routing network

Objective

- Minimise route length

Approach

- Binary variables \Rightarrow Edge used
 - Edges in equals edges out
 - Visit every bin node
- Load of car on each edge

Subtours

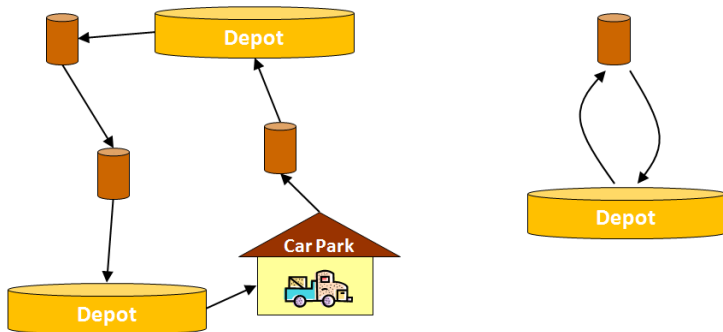


Figure: A subtour in the route

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Rubbish generation

- “Walking rubbish” (e.g. coffee)
- “Sitting rubbish” (e.g. lunch)

Service cost

- Distances of nodes
- Traffic along edges

Problem

Lots of nodes and edges

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Getting data

Samples \Rightarrow Extrapolation

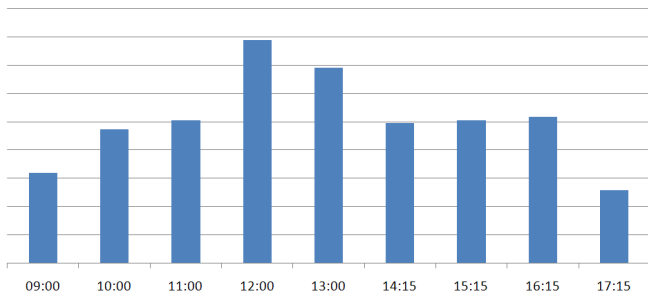


Figure: Data profiles for walking people on campus

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- Bin locations \Rightarrow 40 bins, 24 new locations
- Inconvenience cost \Rightarrow 33.63% improvement
- Bin pickup scheduling and route

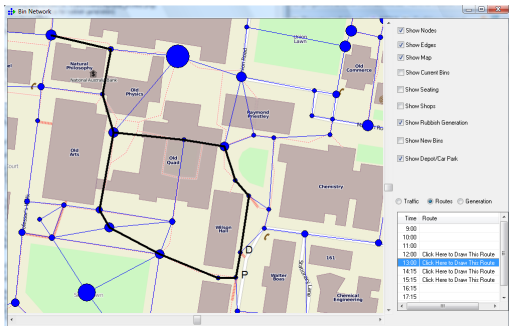


Figure: Section of map showing pickup route at 1pm

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Improving the model

- More comprehensive data collection.
- Stochastic nature of data (e.g. weather).
- Changing from current bin location - bin movement costs.
- Finer time slices, whole week, special events.

Perspectives

- Other situations - vending machines, ATM machines.
- Data gathering challenge.
- Showing real value to client.

Summary

- Data not reliable enough for actual recommendations for client