Optimising care workers' schedules

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Introduction

Currently over 50,000 people in Scotland receive Home Care services. Whilst this number has decreased in recent years, Councils are increasingly purchasing services from the private and voluntary sector rather than providing it themselves. In 2016, 48% of Home Care clients received a service solely from their Local Authority, compared to 73% in 2007.[1]

Glasgow's Home Care provider, Cordia, would like to reduce the number of visits made by agency workers whilst continuing to provide their high standard of care.

Method

To address this problem it was decided that a model would be created where it would possible to evaluate the financial effect of having agency workers within the workforce and to minimise the number of agency workers used.

Different techniques were considered:
- Bin Packing Problem
- Job Shop Scheduling
- Travelling Salesman Problem
- Network Simplex Algorithm

Linear Programming

The approach shown here is "Linear Programming", a method of reaching an optimal result in a mathematical model that is represented by linear relationships.

Our aim is to minimize the number of carers used whilst having enough carers on shift to make the number of visits required. In this example, the requirement for carers varies from hour to hour and it is assumed that this will continue over an indefinite number of days.
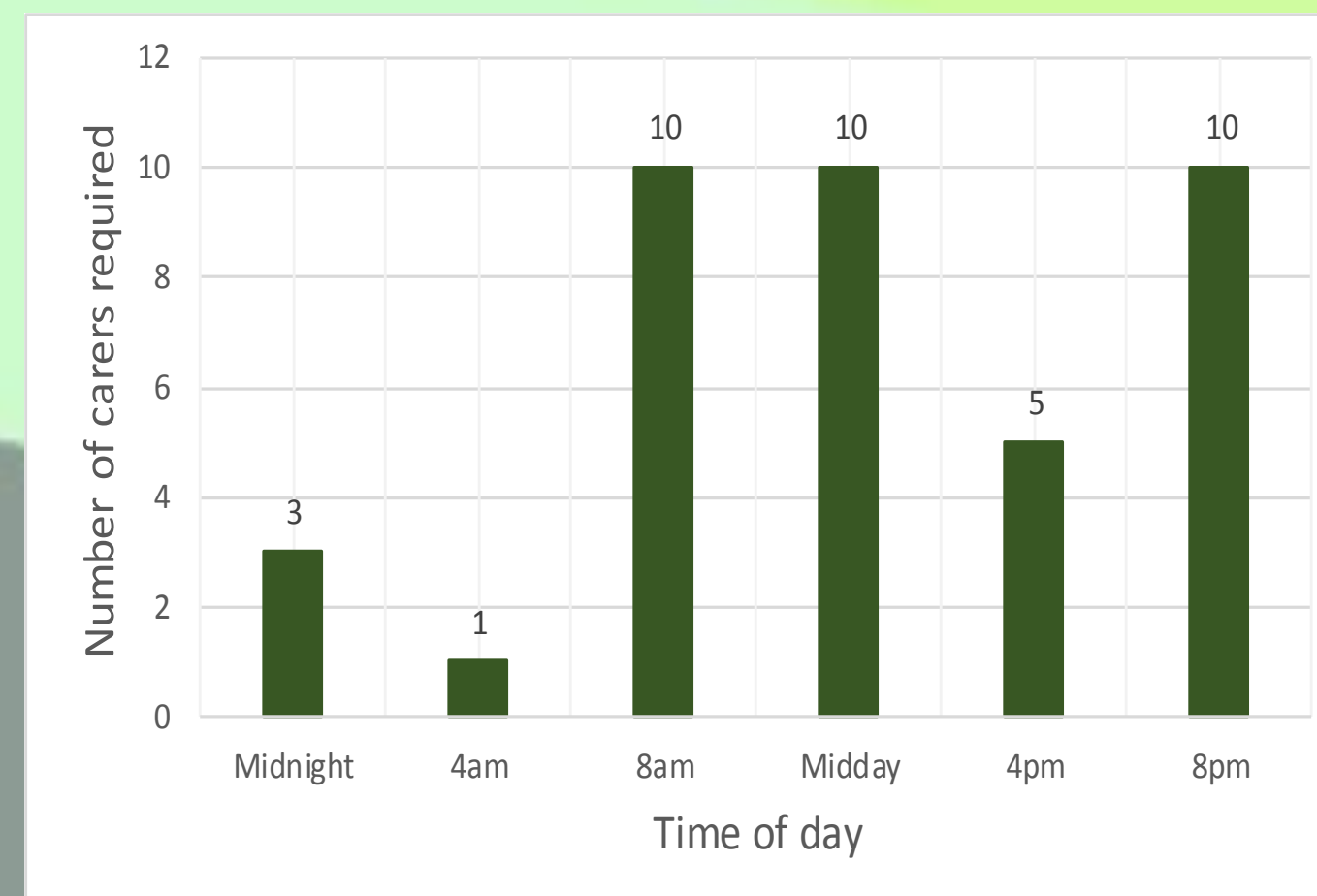
It is assumed that each carer will work an 8 hour shift however they may have some time where they are not required. Ideally we would like to minimise the gaps however, in some situations it may not be possible.

Minimise cost : $z = \sum_{j-1}^{n} c_j x_j$

Subject to: $\sum_{j=1}^{n} a_{ij}\, x_j \geq r_i$ for $i = 1 \dots t$

$x_j \geq 0$ for $j = 1 \dots n$

Using this method we have found that the minimum number of carers required for this particular example is 23. This example could be extended by adjusting the number of carers required at each time and including the costs of using an agency worker compared to a Cordia employee.

Next steps

It is expected that this model, and the others mentioned, will be explored in more detail. The effectiveness of each model will be evaluated, one will be pursued and then presented to Cordia.

References

[1] Social Care Services, Scotland, 2016
http://www.gov.scot/Resource/0051/00510699.pdf

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Glasgow CITY COUNCIL