Workforce management in periodic routing

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Can library operations help UPS?

- Commercial Applications
  - Operations Research Models
- Non-profit Applications
  - Operations Research Models
Period Vehicle Routing Problem (PVRP)

Serve customers over a period of time (days in week)

Given
- customer locations
- a depot location
- customer demands
- vehicle capacities
- service requirements

Find a set of tours that visits all customers with minimum length over a period of time and observes capacity restrictions

Commercial applications: grocery delivery; waste collection of waste, etc.
Operational complexity

Difficulty of solution implementation from the perspective of the service provider and its customers

**Customer Familiarity**
Reduce the cost per visit to a customer as the frequency of visits to that customer increases

**Region Familiarity**
Reduce the cost per visit to a region as the frequency of visits to that region increases
Why does operational complexity matter?

Zhong, Hall, and Dessouky (2004)
- Learning/forgetting behavior for drivers
- Dispatching drivers consistently to the same geographic areas results in driver familiarity and improved driver performance.

Groer, Golden, and Wasil (2008)
- The Consistent Vehicle Routing Problem
- Enforcing consistency in periodic routing
- Applications for UPS

Smilowitz, Nowak, Jiang (2010)
- Including workforce metrics in the PVRP objective
Example: how objectives change solutions

**Demand**
- Day 1 = 1 unit
- Day 2 = no units

**Region 1**
- Day 1 = 1 unit
- Day 2 = 1 unit

**Region 2**
- Day 1 = 1 unit
- Day 2 = 1 unit

**Vehicle capacity**
- driver A = 2
- driver B = 2

**Depot**
Comparison of sample solutions

Day 1 solution
Day 2 solution
Day 1 solution
Day 2 solution
Day 1 solution
Day 2 solution

(a) Minimize distance
(b) Maximize customer familiarity
(c) Maximize region familiarity

Partition drivers by customers; increases number of drivers used
Partition drivers by regions; also increases number of drivers used
Observations

- Focusing solely on travel distance will not achieve satisfactory levels of workforce metrics.
- Using multi-objective models, one can obtain a satisfactory balance between workforce metrics and travel distance.
Next steps

• Analysis with UPS data
  – Should operational complexity be a constraint or an objective in the problem?