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Fuzzy cost-profit tradeoff model for locating a vehicle inspection station considering region constraints

Key words: Cost-profit tradeoff, Credibility theory, Fuzzy simulation, Fuzzy programming, Genetic algorithm

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Motivation

- ➤ Use a fuzzy cost-profit tradeoff approach to locate a vehicle inspection station considering regional constraints, so as to describe its actual condition.
- Disadvantages of existing methods:
 - Do not consider regional constraints
 - Do not consider tradeoff between cost and profit
 - Do not consider uncertainty of expert opinions

Model (I)

Fuzzy expected cost-profit tradeoff model with regional constraints:

$$\min E(C)$$

subject to

expected cost-profit tradeoff model with regardints:
$$\min E(C)$$
 abject to
$$\left\{E\Big[\sum\sum b_j\xi_{ij}-\sum e_j\Big]\geq B^0,\\ h(x,y)\leq 0,\ g(x,y)\geq 0,\\ x\in (x_{\rm l},x_{\rm u}),\ y\in (y_{\rm l},y_{\rm u}), \right\}$$

Model (II)

Fuzzy chance-constrained cost-profit tradeoff model with regional constraints:

 $\min \overline{C}$

subject to

$$\begin{cases} \operatorname{Cr}\left\{\sum\sum \xi_{ij}c_{ij}d_{ij} \leq \overline{C}\right\} \geq \alpha, \\ \operatorname{Cr}\left\{\left(\sum\sum b_{j}\xi_{ij} - \sum e_{j}\right) \geq \overline{B}\right\} \geq \beta, \\ h(x,y) \leq 0, \quad g(x,y) \geq 0, \\ x \in (x_{1},x_{u}), \quad y \in (y_{1},y_{u}), \end{cases}$$

Results of model (I)

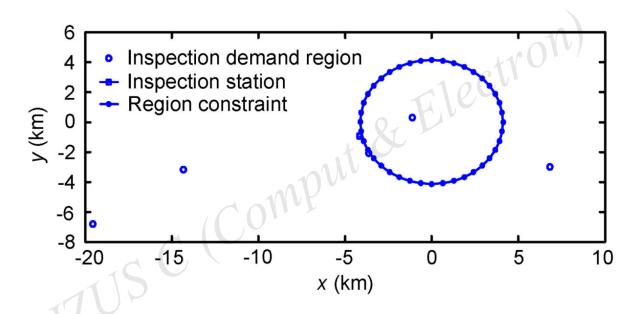


Fig. 2 Plane distribution graph for locating a vehicle inspection station

Results of model (II)

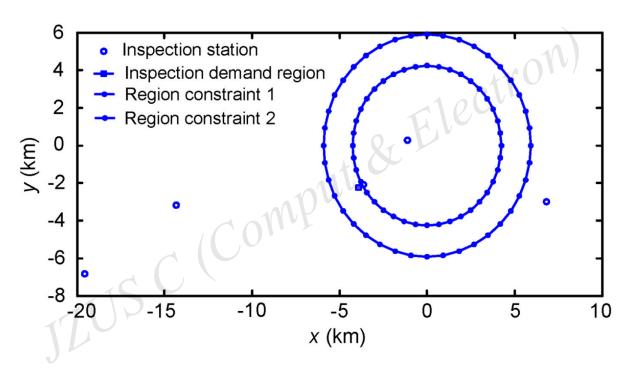


Fig. 3 Plane distribution graph for locating a vehicle inspection station

Comparison results

We compared the our results for the example with those of the previous method:

| | | | Quasi-optimal solution | | |
|---------|----------|-------------------|------------------------|----------|---------------|
| Case | pop_size | pr_{c} | pr_{m} | Proposed | Deterministic |
| | | | M2 | method | method |
| 1 | 40 | 0.3 | 0.3 | 326 839 | 319213 |
| 2 | 25 | 0.2 | 0.4 | 327 703 | 321316 |
| 3 | 35 | 0.2 | 0.3 | 327 047 | 319213 |
| 4 | 40 | 0.2 | 0.3 | 326 515 | 319 244 |
| Average | | | | 327 026 | 319 746 |