Methodology for evaluating cost and accuracy of parking patrol surveys

Jin Cao, Monica Menendez  
Swiss Federal Institute of Technology Zurich (ETH)

Patrolling observers check the parking area every δ minutes and record parking information, in order to find the average parking duration T. However, the estimated value Ŵ is biased and accuracy is unknown to the surveyor.

Research Questions

As the accuracy is unknown, it is impossible to evaluate the survey. However, very often, a trade-off between accuracy and survey cost must be made.

1. Is the survey result usable?
2. What is the survey accuracy?
3. Is it worth to invest more money?
4. How to obtain high quality results from the patrol survey while keeping costs to a minimum?

Solutions/Conclusions

With this method:

1. An estimation system is provided for patrol surveys:
   • One can find out if the result is usable (the value of survey intensity X must be greater than 1/3).
   • One can estimate the accuracy given the survey data.
2. One can recommend the minimum budget to guarantee results with predictable accuracy.
3. One can estimate the gain in accuracy that could be achieved by increasing the budget.
4. One can correct the results, so a higher accuracy can be achieved with a lower budget.

Methodology and Results

i. Define three dimensionless variables
   \[ X \text{- survey intensity} \]
   \[ Y \text{- survey error} \]
   \[ Z \text{- relative cost} \]

ii. Identify relation between \( X, Y \) and \( Z \) for the three most typical distributions of parking duration:
   • Uniform
   • Gamma
   • Hyper-exponential

The shape of the curves is quite similar, the result based on gamma distribution are presented.

iii. Build an analytical model, extend it with simulations, and validate it with read data.

Validation

Data from two parking garages are used:
• Ballston garage (2800 stalls)
• Max-bill-Platz (60 stalls)

\[ \text{PDF of parking duration} \]

\[ \text{POF of parking duration} \]

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Methods/Conclusions

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Application Example

In the case of Max-bill-platz, it is possible to keep the survey error at 6% with a budget of only 95 units using our method (only need to assume a lower bound of \( \hat{w} \)), while a budget of 150 units would generate an error of 18% when using the traditional method.

Patrol Survey

Patrolling observers check the parking area every \( \delta \) minutes and record parking information, in order to find the average parking duration \( T \). However, the estimated value \( \hat{W} \) is biased and accuracy is unknown to the surveyor.

Biased Data

• Short duration parkers are under sampled
• Estimated duration of observed vehicle is imprecise

Unobserved Parker

Imprecise estimate of duration

Actual

Estimated

Figure 2. Example of biased data collected in the survey

Solution

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