Writing About Operations Research – The Six-Sentence Abstract

The **six-sentence abstract (6SA)** is designed to give a complete, yet concise, overview of an operations research study.

1. The **introduction** tells the reader what is being decided or predicted by the study, and why the study is important.
2. The **model** sentence states which operations research techniques are used to solve the decision or prediction problem and make any recommendations. For example: if the model is optimization, include the objective and constraints; if the method is simulation, describe the system simulated and the performance metrics of concern.
3. The **data** sentence describes the quantities needed to run or solve the model. For example: counts of customers, lists of each nurse's schedule preferences, prices of raw materials and labor, social network graphs showing which individuals interact. Describe what data are used as input and where they are obtained; for example, public data, business records, randomly generated data.
4. The **results** sentence summarizes the quantities produced by solving or running the model. These are the quantities that we did not know before the operations research techniques were applied, but that we know now. Results are sometimes qualitative instead.
5. The **recommendation** sentence provides an answer to the decision maker. For example: "surgery scheduling should proceed on a shortest-case-first heuristic", or "the evacuation should proceed along the routes in the map in Figure 3".
6. The **limitations** sentence describe the aspects of the decision or prediction problem that are not completely captured or accurately represented in the model, or are elements of the work that should be expanded as the project continues.

Example 1. Bike-sharing operators must plan to rebalance the stations by moving some bikes from one station to another, and so Liu et al. predicted hourly demand of bikes picked up and dropped off at each station. Pickup demand was predicted using meteorology-similarity-weighted K-nearest-neighbors method and dropoff demand was predicted using an interstation bike transition model for the distribution of the bike ride times. Data was the historical pickup and dropoff numbers of bikes, along with meteorology (weather) data from each of those days. The pickup demand prediction shows how many bikes will be picked up in each hour of the 24-hour day, and the interstation bike transition model discovered two types of riders, tourists and commuters, that determine when the bikes will be dropped off. The pickup and dropoff demands should be used as inputs to another optimization model to plan how vehicles can move the bikes to rebalance the stations. Collecting more days of data would make the model more accurate.

Example 2. Opioid addiction can be treated at methadone clinics, but the clinics must be near the patients because patients make daily visits to the clinic. Bonifonte and Garcia used an integer programming model to decide which k clinics to open to maximize number of new patients served and minimize total travel distance for all clients. The input data are locations of existing and possible new clinics, plus the numbers of patients served and unserved in each census tract in Indiana, Kentucky, Ohio, Tennessee, and West Virginia. Results show that if serving new patients is most important, then the new clinic(s) will be located in current service deserts. Decision makers should clarify the tradeoff between reaching new clients and minimizing travel distance. This model did not consider actual driving times but used straight-line (Euclidean) distance instead.

Thanks to Prof. Sommer Gentry for the idea of a six-sentence abstract, specifically for operations research.

Evaluation criteria for a 6SA

Some things to think about as you read (and write!) 6SAs:

1. Introduction
    - The introduction clearly states the decision or prediction problem.
      Can you answer: What is the problem about?
    - The introduction makes clear who would be interested and why.
      Can you answer: Who asked for this problem to be studied?
2. Model
    - The model is a framework or technique you have learned about in the Operations Research major.
      Can you answer: In which course(s) would you have studied this or a related technique?
    - The model is clearly and concretely specified for this particular problem.
      Can you answer: What is the objective to be optimized? What is the quantity to be predicted?
3. Data
    - The input data are quantities that you can measure.
      Can you answer: Are these integers or rationals and what are their units?
    - The input data are appropriate for the method specified in model, and can be known or estimated at the start of the project.
      Can you answer: How were these data measured, collected, or estimated?
4. Results
    - The results are the quantities or qualities of the model output.
      Can you answer: Were these results obtained after doing some computation or analysis?
    - The results are appropriate to the goal specified in the introduction.
      Can you answer: How is this related to the decision or prediction problem in the introduction?
5. Recommendation
    - The recommendation gives the decision-maker a suggested course of action.
      Can you answer: What should decision-maker do with these results?
    - The recommended action is within the control of the decision-maker.
      Can you answer: Can the decision-maker take this action?
6. Limitations
    - The sentence clearly states the limitations (that is, the caveats) of the model.
      Can you answer: How is this model less accurate than reality, or less helpful than it could be?
    - The limitations help me better understand whether I should trust the recommendation.
      Can you answer: How do we expand the current study, or why is the study good enough as is?