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 the operations research or statistical model used to analyze the decision or prediction problem.

   For example: if an optimization model is used, (briefly) describe the objective and constraints; if a simulation model is used, describe the system simulated and the performance metrics of concern.
3. The **data** sentence describes the data used as input to the model and where they are obtained.

   Examples of input data: counts of customers, lists of each nurse's schedule preferences, prices of raw materials and labor, social network graphs showing which individuals interact.

   Examples of sources: public data, business records, randomly generated data.
4. The **results** sentence summarizes the outputs of the model. These are the quantities that we did not know before analyzing the operations research or statistical model, but that we know now.
5. The **recommendation** sentence provides an answer to the decision maker based on the results.

   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 describes aspects of the decision or prediction problem that are not completely captured or accurately represented in the model, or should be expanded as the project continues.

Example 1. Opioid addiction can be treated at methadone clinics, but the clinics must be near the patients because patients make daily visits to the clinic. We use 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. Our 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. Our 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. Example 1 is based on Bonifonte, A., & Garcia, E. (2022), Improving geographic access to methadone clinics, *Journal of Substance Abuse Treatment*, 141, 108836. Examples 2 and 3 are based on early drafts from past capstone teams.

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 you have learned about in the Operations Research major.
      Can you answer: In which course(s) would you have studied this or a related model?
    - 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 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?

Example 2. The appraisal pricing of real estate is one of the most important processes of property valuation due to real estate's competitive nature, so ensuring accuracy is vital. The model built reflects methods within the data collection and statistical analysis field, including but not limited to multiple regression analysis, error reduction, and web scraping. The data used comes from the Rhode Island appraisal office which shows all of the appraisals for each city in Rhode Island, which tells us all the relevant information about a property. Based on the data collected, several regressions were built that aim to accurately assess how valuable a property is within the designated city in Rhode Island. This model gives very accurate appraisals of houses so when someone is looking to invest or buy a property, they can see the value of the house and compare it to the listed value for sale. Limitations to this problem that we faced is "overfitting" the data where while the regression may fit the data collected nicely, it may not translate to future sales, and the regression may not adapt to the changing housing market as a whole over time.

Example 3. Determining potential market sites to open a franchise is vital in a constantly changing financial environment. A market potential prediction model is used to determine the best cities to open franchises across the United States. Geographic and demographic data about population statistics and city areas including office, residential, shopping, education, and entertainment information were used to locate the best three cities to open a Culver's franchise. The study determined that cities with strong economic conditions and large customer volume such as Austin, Texas, Charlotte, North Carolina, and Madison, Wisconsin, were the best potential market sites. We recommend that more franchises use this market location predictor program to ensure economic flourishment and increase customer satisfaction across America. This model is simplified and does not account for all elements in location characteristics, such as it cannot predict catastrophic political or natural disaster changes that might affect population movement and business success.