

Writing About Operations Research – Model and Results

1 Overview

- The purpose of the **model** section is to describe the operations research or statistical model you used to analyze your problem.
- The purpose of the **results** section is to present and interpret your results in a reader-friendly way.
- How you write these sections depends partly on the types of models you used in your study – see Sections 2-4 below.
- See Section 5 for guidance on presenting figures and tables.

2 Regression models

2.1 The model section

- Suggested outline (1-2 paragraphs):
 1. **Model type.** State the type of regression model you are using.
 2. **Model variables.**
 - Describe the response variable.
 - Describe the explanatory variables you considered putting into your regression model.
 3. **Variable selection.** Describe how you selected which explanatory variables ended up in your final regression model.
 - For example, if you used an automated procedure for selecting your regression model (e.g., best subsets regression), state that here.
 4. **Final regression model.** State your final regression model mathematically as an equation.
 5. **Assumptions.** Discuss any simplifying assumptions you made.

2.2 The results section

- Suggested outline:
 1. **Computing environment.** (1 paragraph)
 - Describe the software and/or programming language you used to fit your model.
 - Describe the computer you used to fit your model (i.e., CPU model and speed, amount of RAM, operating system)
 2. **Diagnostics.** (1 paragraph + figures)
 - Discuss whether the diagnostics indicate that the conditions for the model have been reasonably met.
 - Include any diagnostic plots and values you used.
 3. **Fitted model and test statistics.** (1 table + 1 paragraph)
 - In a table, report the fitted coefficients, associated test statistics and p -values, and overall goodness-of-fit statistics (e.g. R^2 , AIC, BIC).
 - Describe what the p -values and goodness-of-fit statistics mean.

4. **Interpretation.** (1-2 paragraphs)

- Identify the coefficients of interest, and explain what they mean in the context of your problem.
- Describe how the model can be used to solve your decision or prediction problem.
- *Note.* Your interpretation of the results should support the overall goal of your problem.
 - ◇ If you are analyzing a decision problem, you are (likely) using regression as an explanatory model to discover the underlying relationships in the data, for example: “Does exercising 30 minutes a day lead to lower blood pressure?”
 - ◇ If you are analyzing a prediction problem, then you are using regression as a predictive model to use existing data to determine unknown quantities, for example: “If I were to exercise 1 hour per day, what will my blood pressure be?”

3 Optimization models

3.1 The model section

- Suggested outline:

1. **Model components.**

- State all the components of your model mathematically:
 - a. Sets
 - b. Parameters
 - c. Decision variables
 - d. Objective function
 - e. Constraints
- Use the standard convention for formatting an optimization model.

2. **Model description.** (1-2 paragraphs)

- Describe what the objective function means in words.
- Describe what each of the constraints means in words.

3. **Assumptions.** (1 paragraph) Describe any simplifying assumptions you made.

3.2 The results section

- Suggested outline:

1. **Computing environment.** (1 paragraph)

- Describe the programming language and optimization solver you used to solve your model.
- Describe the computer you used to solve your model (i.e., CPU model and speed, amount of RAM, operating system)

2. **Solution and objective function value.** (1-2 paragraphs + figures or tables as appropriate)

- Display the solution you found in a user-friendly format for each instance you solved.
 - ◇ For example: a timetable for a schedule, a table of stops for a route, a map for a set of selected facilities.
- Display the objective function value you found in a user-friendly format for each instance you solved.

3. **Interpretation.** (1-2 paragraphs)

- Interpret the solutions you found.
- Describe any interesting or surprising features.

4 Simulation models

4.1 The model section

- Suggested outline:
 1. **Model description.** (1-2 paragraphs + flow chart)
 - Provide a flow chart of the simulation model.
 - In words, walk the reader through each step of the flow chart, describing the process in depth.
 2. **Assumptions.** (1 paragraph) Discuss any simplifying assumptions you made.

4.2 The results section

- Suggested outline:
 1. **Computing environment.** (1 paragraph)
 - Describe the software and/or programming language you used to run your model.
 - Describe the computer you used to run your model (i.e., CPU model and speed, amount of RAM, operating system)
 2. **Scenarios.** (1 paragraph) Describe the alternative scenarios that you considered.
 3. **Performance metrics.** (1 paragraph + tables + figures)
 - Identify performance metrics that will be used to evaluate the model.
 - In a table, provide the simulated average performance metrics and their confidence intervals for all alternative scenarios.
 - Provide graphs of the performance metrics that highlight interesting trends or trade-offs.
 4. **Interpretation.** (1-2 paragraphs)
 - Interpret the performance metrics in words, pointing the reader to the appropriate tables and graphs. Describe any interesting trends or trade-offs. Describe which alternative is the best and why.

5 Presenting figures and tables

- Introduce every table or figure to your reader in the main text. For example:

Figure 7 shows a histogram of the cashier service time data, along with the density of the fitted exponential distribution.

Table 8 shows the optimal production quantities we obtained from our model.
- Use a descriptive title for every table column.
 - For example, instead of raw variable names like `beer_consumption_us`, use reader-friendly column titles like US Beer Consumption (millions of gallons).
- Label all of the axes in every graph.
- Give a brief descriptive caption for each table or figure, including the table or figure number.
- See the *Example Report* and *Formatting Checklist* for additional guidance on presenting figures and tables.