Template for the project

[Students' names]

2025 - 10 - 31

Abstract

Provide a concise summary (150-200 words) of the study:

- What is the main statistical question or computational problem?
- Which methods or algorithms are compared?
- What is the simulation setup?
- What are the key findings and conclusions?

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1 Introduction

Clearly introduce the context and motivation:

- Explain the broader statistical problem (e.g., estimation, model selection, computational efficiency).
- Identify the specific question your simulation addresses.
- Summarize relevant background or prior work (with citations).
- Describe briefly what your report will do (outline of sections).

The introduction should make it clear why the computational aspect of the method matters.

2 Theory / Background

Provide the theoretical background necessary to understand your methods.

- Summarize the key ideas behind the statistical method(s) you study.
- Define relevant notation.
- Derive or restate key equations (as needed).
- Explain any algorithms (e.g., EM, cross-validation, etc.) with clear intuition and mathematical description.
- If multiple methods are compared, dedicate subsections to each.

3 Simulation setup

Describe your experimental design in detail so results are reproducible. Here are some aspects you might want to include in this section.

3.1 Model or data-generating process

- Describe the model you simulate from (e.g., Bayesian hierarchical model, PCA data matrix, regression setup, etc.).
- Include equations or data-generating schemes.
- Specify parameters, sample sizes, number of groups, and sources of variability.

3.2 Methods or algorithms implemented

- Describe how each computational method is applied.
- Mention software or libraries (e.g., R, Python, PyMC, numpy, etc.).
- Explain any assumptions (e.g., Gaussianity, known variances).

3.3 Evaluation metrics

- Define the metrics used to compare methods (e.g., MSE, bias, runtime, convergence rate).
- Describe the number of simulation replications.
- Mention baseline configurations and which parameters are varied.

4 Results

Present your simulation results clearly.

4.1 Main comparisons

- Compare performance across methods under baseline settings.
- Use well-labeled figures and tables (e.g., boxplots, convergence curves).

4.2 Sensitivity analyses

- Show how results change when varying sample size, model parameters, or hyperparameters.
- Interpret trends (e.g., robustness, scalability, stability).

4.3 Real data example (optional)

- If applicable, demonstrate the method(s) on a real dataset.
- Describe preprocessing steps.
- Discuss practical implications of findings.

5 Discussion

Interpret and synthesize the results:

- What are the key takeaways?
- How do the findings align with theoretical expectations?
- What are the strengths and limitations of each method?
- Are there practical recommendations?

6 Conclusion

Summarize the main contributions and insights in a few concise paragraphs:

- Restate the computational/statistical question.
- Highlight the main results.
- Mention possible extensions or future work.

7 References

List all references cited in the report, formatted consistently (e.g., APA, IEEE).

8 Appendix (optional)

Include:

- Additional figures or diagnostics (so the main text remains focused).
- Details on derivations, code snippets (if helpful), or implementation notes.