Report on Use of AI

Team #1111111 — 2026 MCM Problem C

This report does not count toward the 25-page limit.

---

1. AI Tools Used

In the development of our solution for the 2026 MCM Problem C ("Data With The Stars"), we utilized the following AI tools:

- **Claude (Anthropic)** — Claude Opus 4.5 via Claude Code CLI
- **ChatGPT (OpenAI)** — GPT-4o for supplementary queries

2. Purpose and Usage

We employed these AI tools for the following specific purposes:

Purpose of AI Use	**Tool Used**	**Description of Usage**
Code Generation & Debugging	Claude Code	We used AI to generate initial Python scripts for data preprocessing (handling N/A values, parsing elimination weeks from the `results` field) and to debug errors in our Bayesian MCMC sampling code (PyMC model convergence issues). All generated code was manually reviewed, tested on sample data, and modified as needed before final implementation.
Algorithm Implementation	Claude Code	We queried AI for implementation guidance on specific algorithms: • Dirichlet-based Bayesian inference for fan vote estimation • SHAP value computation with XGBoost • Cox proportional hazards model setup • Kneedle algorithm for knee point detection The mathematical formulations were derived by team members; AI assisted with translating these into working code.

Purpose of AI Use	**Tool Used**	**Description of Usage**
Visualization Assistance	Claude Code, ChatGPT	We queried AI for Python `matplotlib` and `seaborn` code snippets to create specific visualizations: • Heatmaps for counterfactual survival probabilities • Dumbbell charts comparing judge-only vs fan-only mechanisms • Pareto frontier plots for multi-objective optimization • Diverging bar charts with custom color schemes All visualizations were iteratively refined based on team feedback.
Language Refinement	Claude, ChatGPT	As non-native English speakers, we used AI to refine the grammar, flow, and clarity of our text, particularly for: • The executive memo to producers • Abstract and summary sections • Technical writing in methodology sections We provided our original drafts and asked for "academic polishing" while preserving our intended meaning.
Concept Clarification	ChatGPT	We used AI to quickly clarify conceptual differences, such as: • Rank-based vs percentage-based voting combination • Interpretation of ICC (Intraclass Correlation Coefficient) • MCMC convergence diagnostics ($\hat{R}$, ESS) These clarifications were cross-referenced with academic sources.
LaTeX Formatting	Claude Code	We used AI to troubleshoot LaTeX compilation errors and format complex elements: • Algorithm pseudocode using `algorithm2e` • Multi-column table layouts • Figure placement and minipage alignment

3. Verification of AI Output

Our team is fully aware of the risks associated with generative AI, including hallucinations and incorrect calculations. To ensure accuracy and integrity of our work:

Mathematical Verification

- All mathematical derivations and model formulations (Bayesian posterior inference, sigmoid weight function, multi-objective optimization) were performed and verified by team members independently.
- We did **not** rely on AI for logical reasoning or calculation of final numerical results.
- Key equations were manually derived and cross-checked against textbook references before implementation.

Code Validation

- All AI-generated code was executed in our local Python environment, and outputs were cross-referenced with manual calculations on small data samples.
- We verified the Season 1 Week 4 example provided in the problem statement to ensure our fan vote estimation model produced consistent results.
- Unit tests were written for critical functions (e.g., rank normalization, elimination consistency checking).
- MCMC convergence was verified using standard diagnostics: $\hat{R} < 1.05$ and ESS > 400 for all parameters.

Content Review

- All text suggested by AI was reviewed line-by-line to ensure it accurately reflected our findings and did not introduce fabricated information.
- Statistical claims (e.g., "22% engagement improvement", "correlation $r = -0.320$") were verified against our actual computed results.
- No AI-generated content was used verbatim without team review and modification.

Data Integrity

- We did **not** use AI to generate, fabricate, or modify any data values.
- All analysis was performed on the official `2026_MCM_Problem_C_Data.csv` dataset provided by COMAP.
- Fan vote estimates were generated by our Bayesian model, not by AI prediction.

4. Specific Prompts and Outputs

Below are representative examples of our AI interactions:

Example 1: Data Preprocessing Code

Prompt: "Write Python code to convert the wide-format DWTS data to long format, handling N/A values in judge scores and inferring elimination weeks from the results field."

Usage: The generated code served as a starting template. We modified it extensively to handle edge cases (bonus points, team dances, missing 4th judge scores) identified during testing.

Example 2: Visualization Refinement

Prompt: "Create a diverging bar chart showing survival probability differences between judge-only and fan-only mechanisms. Use coral for positive differences and blue for negative."

Usage: We iteratively refined the visualization through multiple prompts, adjusting label positions, axis ranges, and color schemes based on our design preferences.

Example 3: LaTeX Algorithm Formatting

Prompt: "Convert this Python function into algorithm2e pseudocode format for a LaTeX document."

Usage: The AI output was used as a formatting reference. All algorithm logic and mathematical notation were written by team members.

5. What AI Was NOT Used For

To maintain academic integrity, we explicitly did **not** use AI for:

- **Core mathematical modeling:** The Bayesian fan vote estimation framework, multi-objective optimization formulation, and dynamic weight system were designed entirely by our team.
- **Statistical analysis and interpretation:** All statistical tests, model comparisons, and result interpretations were performed by team members.
- **Strategic recommendations:** The memo recommendations to producers were based on our own analysis and judgment.
- **Data fabrication:** No data points were generated or modified by AI.
- **Literature review:** All referenced sources were found and read by team members.

6. Summary

AI tools served as **productivity aids** in our workflow, primarily for:

1. Accelerating code implementation of well-defined algorithms
2. Improving English language quality in written sections

3. Troubleshooting technical issues in Python and LaTeX

The intellectual contributions—problem formulation, mathematical modeling, analysis design, and strategic recommendations—are entirely the work of our team. All AI outputs were critically evaluated, verified against ground truth where possible, and modified to meet our specific needs.

Team #1111111
February 3, 2026