

Problem Chosen

A

2025
MCM/ICM
Summary Sheet

Team Control Number

2504496

Enjoy a Cozy and Green Bath

Summary

abstract...

Keywords: Keyword one, Keyword two, Keyword three

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1 Introduction

1.1 Background

The medal table of the 2024 Paris Olympics shows that the United States and China each won 40 gold medals and tied for the top spot, but the United States led with a total of 126 medals. The host country France ranked fifth in gold medals (16) and fourth in total medals (64). Dominica, Saint Lucia and other countries won their first Olympic medals, while 60 countries still have not broken through for any medals.



Figure 1: The medals of the 2024 Paris Olympics

1.2 Restatement and Analysis of the Problem

Based on the provided historical data-set of the Olympic Games from 1896 to 2024, we are employed to analyze and answer the following questions:

1. Develop a **prediction model** to forecast the number of medals each country will win in 2028, and identify countries that may progress or regress.
2. Provide **prediction intervals** and estimates of **uncertainty** and metrics to measure the model's performance.
3. Estimate the number of countries that will win their **first medal** and the probability of this happening.
4. Analyze the **relationship** between specific Olympic events (in terms of quantity and type) and the number of medals, explore which events are more important, and the impact of the host country's event selection strategy on the outcome.
5. Verify whether the **mobility of coaches** significantly enhances a country's performance in specific sports (such as Lang Ping and Bela Karolyi).
6. Quantify the contribution of **coaching effectiveness** to the number of medals, and recommend key sports for investment and expected returns for the three countries.
7. Extract the less-attended-to patterns from the model and provide strategic **suggestions** for the Olympic Committee.

1.3 Overview of Our Work

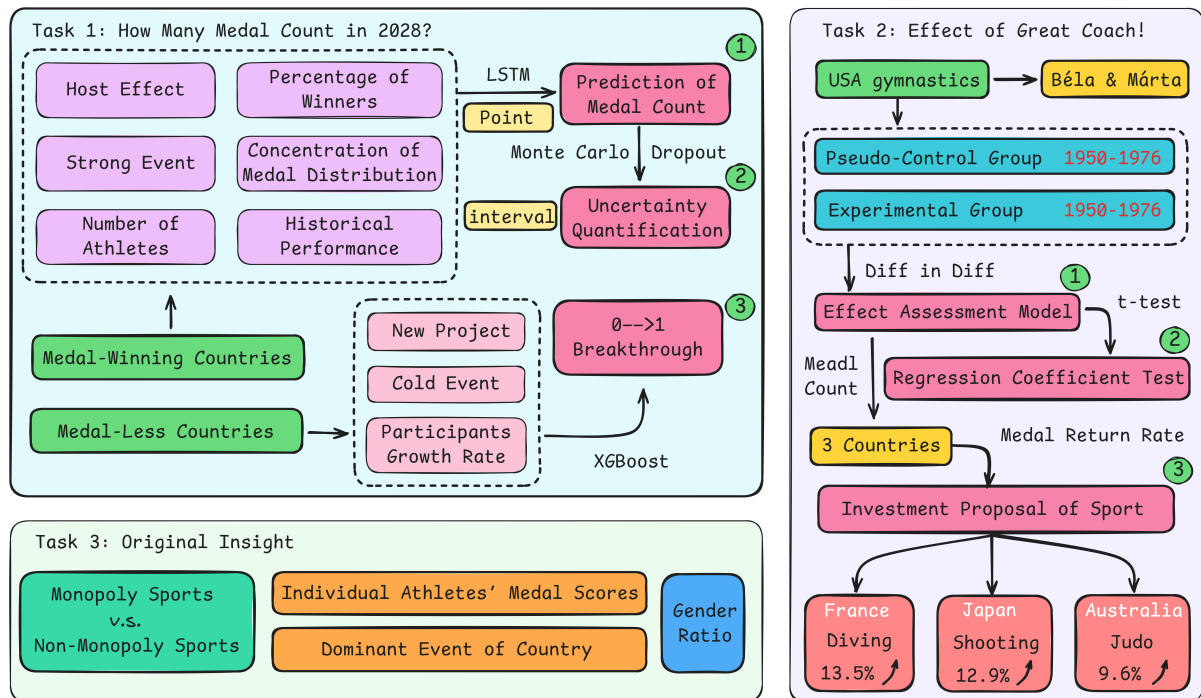


Figure 2: Overview of Our Work

2 Assumptions and Justification

1. Historical medal data exhibits temporal dependencies that reflect future medal trends.

This suggests that historical performance can offer insights into future outcomes, and thus, should be treated as a time series when making predictions.

2. Monte Carlo Dropout approximates Bayesian inference by quantifying prediction uncertainty through multiple stochastic samplings.

This technique provides a robust mechanism for estimating confidence intervals and is useful in scenarios with incomplete or noisy data.

3. Historical data distributions of non-medal-winning countries align with those of future potential medal-winning nations.

This assumption supports the idea that non-medal-winning countries have similar characteristics to those that may perform well in future Olympics, making them a valuable reference for predicting future medal potential.

4. The impact of coaching remains independent of confounding variables (e.g., athlete training conditions, changes in international competition rules).

This assumption isolates the effect of coaching from other factors that might influence performance, ensuring that coaching effects can be accurately assessed.

3 List of Notations

Symbols	Description
A_C, A_S	Set of country, all sports in Olympic.
A_T	$\{1, \dots, 30\}$, representing the ordinal number of year Olympic held.
$A_E(j)$	Represents the set of events inside the sport j .
$A_H(t)$	Set of host country in year t .
$MG_{t,i,j,k}$	Number of gold medals country i won in sport j at event k in year t .
$MS_{t,i,j,k}$	Number of silver medals country i won in sport j at event k in year t .
$MB_{t,i,j,k}$	Number of bronze medals country i won in sport j at event k in year t .
$MT_{t,i}$	Number of total medals country i won in year t .
$N_{athletes}(t, i)$	Total number of athletes from country i in year t .
$N_{award}(t, i)$	Number of athletes who won medals from country i in year t .
$H(t, i)$	Host effect.
$G_{growth}(t, i)$	Growth rate of the number of athletes from country i in year t .
$P_{Medal}(t, i)$	Probability of country i winning a medal in year t .
$P_{Gold}(t, i)$	Probability of country i winning a gold medal in year t .

Note: The Summer Olympics have been held for a total of 32 sessions.

References

- [1] Y. Gal and Z. Ghahramani, “Dropout as a bayesian approximation: Representing model uncertainty in deep learning,” in *International Conference on Machine Learning*, 2015. [Online]. Available: <https://api.semanticscholar.org/CorpusID:160705>.
- [2] Y. Gal and Z. Ghahramani, *Dropout as a bayesian approximation: Representing model uncertainty in deep learning*, 2016. arXiv: 1506.02142 [stat.ML]. [Online]. Available: <https://arxiv.org/abs/1506.02142>.

Appendices

Appendix A First appendix

Appendix B Second appendix

Report on Use of AI

1. OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4,)

Query1: <insert the exact wording you input into the AI tool>

Output: <insert the complete output from the AI tool>

2. OpenAI ChatGPT (Nov 5, 2023 version, ChatGPT-4,)

Query1: <insert the exact wording you input into the AI tool>

Output: <insert the complete output from the AI tool>