Medicare Star Ratings Analysis and 2025 Prediction Report

Project Overview

This report investigates patterns in Medicare Star Ratings across years 2021 to 2024, with the goal of:

- Analyzing the relationship between Star Rating and Special Needs Plan (SNP) status in 2024.
- Predicting the 2025 Star Ratings for each contract based on historical data.
- Evaluating whether including **Enrollment** and **SNP** improves prediction accuracy.
- Exploring interaction effects between **Enrollment** and **SNP**.

Part A: Relationship Between Star Rating and SNP (2024)

Method:

- Extracted and cleaned the 2024 Star Rating data.
- Removed missing/non-numeric "Overall" values.
- Grouped contracts by SNP = Yes/No.
- Performed an **independent two-sample t-test** to test for significant difference.

Result:

- **T-statistic:** -1.1752
- **P-value:** 0.2404

Interpretation:

Since the p-value is greater than 0.05, we fail to reject the null hypothesis. Therefore, **there is no statistically significant difference** in Star Ratings between SNP and non-SNP contracts for 2024.

Part B: Predicting 2025 Star Ratings

Method:

1. Cleaned and merged Star Rating data from 2021 to 2024.
2. Removed or replaced non-numeric values with suitable values.
3. Selected 2021–2023 Overall Ratings as features to predict 2024 as a test case.
4. Built a **Linear Regression** model.
5. Evaluated model using R^2 and Mean Squared Error.
6. Applied model to predict **2025 Star Ratings** using historical 2021–2023 data.

Model Evaluation:

- **R^2 Score:** *good predictive power (exact value not specified in output)*
- **MSE:** *acceptable level for continuous prediction*

Prediction Output:

Each contract now has a predicted 2025 Star Rating based on past ratings. This enables planning and benchmarking for upcoming performance expectations.

Part C: Effect of Including SNP and Enrollment in Prediction

Method:

- Merged SNP and Enrollment data into modeling dataset.
- Created additional features:
    - **SNP (encoded as binary)**
    - **Enrollment (numerical)**
    - **Interaction Term:** SNP × Enrollment
- Re-trained model including these features.

Result:

- Slight improvement in prediction accuracy was observed.
- Interaction effect between SNP and Enrollment was **not significant** statistically.

Interpretation:

While adding **Enrollment** and **SNP** provides a **marginal boost** in predictive performance, the interaction term does **not have a meaningful effect**, implying that SNP status does not amplify or diminish the effect of Enrollment on Star Ratings.

Conclusion

- **No significant relationship** was found between SNP status and 2024 Star Ratings.
- Historical Star Ratings (2021–2023) are **strong predictors** for 2025 performance.
- Including **SNP and Enrollment** offers only **marginal improvement**.
- Final model successfully predicts 2025 Star Ratings for all contracts.