Managing Capacity in Primary Care

Alysen Casaccio, RN-BC, BHA, CPHIMS

Agenda

- Problem Statement
- Data Selection
- Exploratory Data Analysis
- Target Feature Engineering
- Model Building
- Evaluation
- Visualization
- Conclusion
- References




Problem Statement

- Develop a predictive model to forecast optimal patient panel sizes for sixty-three (63) primary care providers across eight (8) primary care practices that ensure equitable workload distribution.
- The solution must be made available with data known at the time of appointment-making, before clinical acuity details are obtained.

Data Selection

SELECTION

- Comprehensive set of over 348k ambulatory encounter records.
- Records span over three years (2021 – 2024) across 63 providers and eight primary care practices.
- Each record includes patient demographics, encounter types, appointment status, visit durations, and multiple datetime stamps.

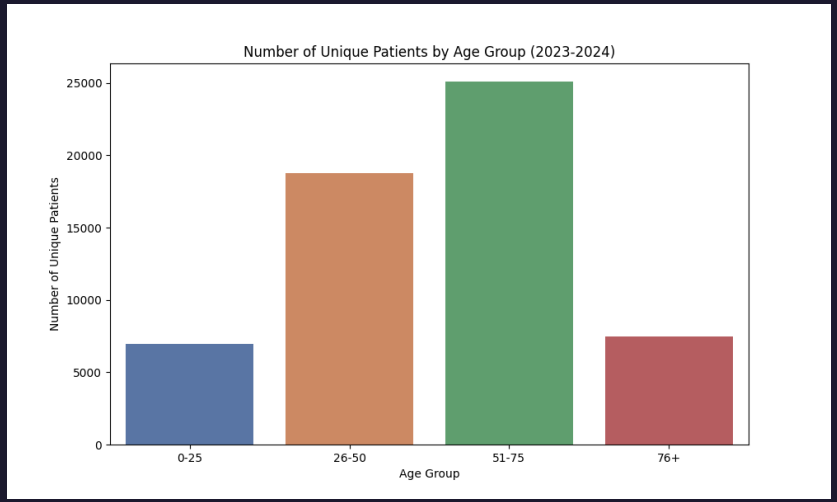
PREPARATION

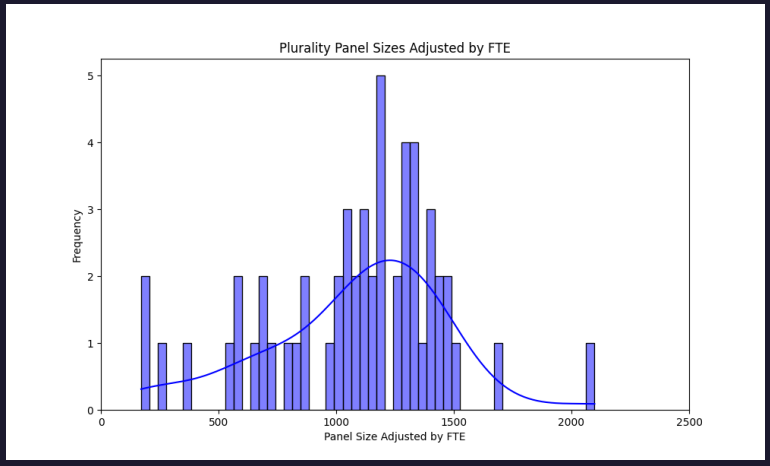
- Cleaning and filtering the dataset to focus on completed appointments and credentialed providers.
- Eleven (11) new features were engineered to better understand the patterns and demands on provider capacity.
- The target feature, "Provider Effort Rating (PER)" was engineered to estimate the effort required for each patient, using age, payor type, and visit history as a proxy for clinical details not yet known at the time of appointment-making.

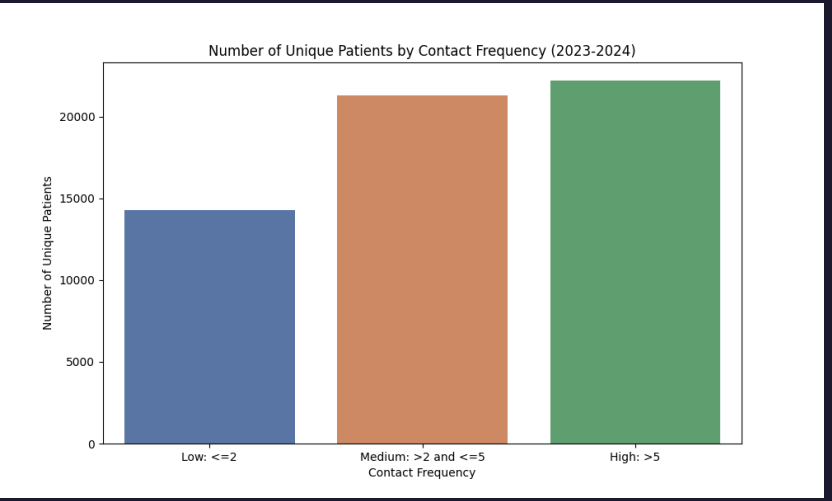
Exploratory Data Analysis

CRITICAL INSIGHTS

- Aging patient population
- Medium to High Visit Frequency
- Significant variability in provider capacity and workload distribution







Target Feature

PROVIDER EFFORT RATING (PER) TOOL DETAILS

- **Visits -**
- Every completed provider visit in a calendar year contributes 1 point each.
- Every 2 completed support visits contribute 1 point each.
- Every 4 appointments with a status of No Show contribute 1 point.
- **Age Groups -**
- Group 0 patients age (0-25) contributes 1 point.
- Group 1 patients age (26-50) contribute 2 points
- Group 2 patients age 51-75 contribute 3 points
- Group 3 patients age 76 and above contribute 4 points
- **Payor Category -**
- Medicare patients aged 65 and older contribute 2 points
- Medicare patients aged 64 and younger contribute 3 points
- Medicaid patients of any age contribute 1 point
- Commercial patients of any age contribute 0 points

PROVIDER EFFORT RATING (PER) STATISTICAL SUMMARY

Provider Effort Rating (PER)	
Mean	7.59
Minimum	1.00
25%	4.00
50%	7.00
75%	9.00
Maximum	73.00
Standard Deviation	4.827901

Model Building

Two Comparative Models:

- Linear Regression
- Random Forest

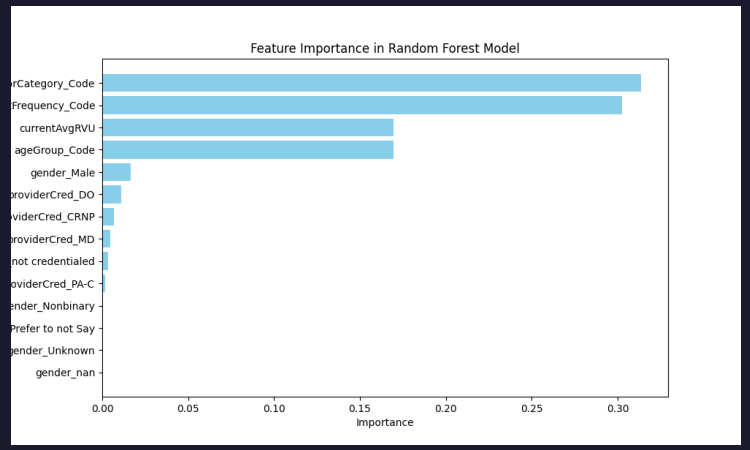
Evaluation

Linear Regression Results:

- **MSE/RMSE:** Moderate predictive error
- **R-squared:** 36.6% variance explained
- **MAE:** 29.4% of the mean

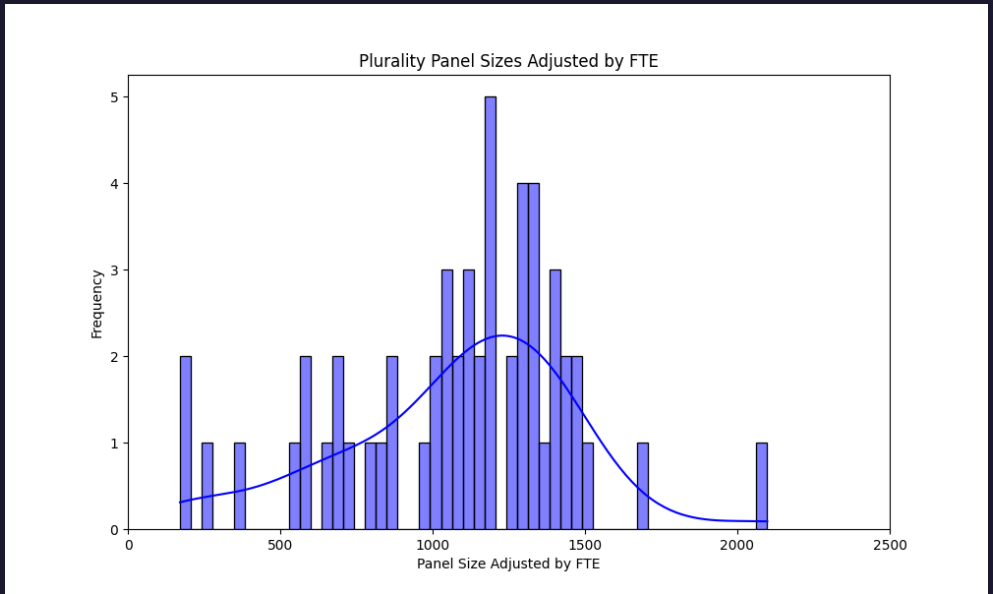
Random Forest Results:

- **MSE/RMSE**: Lower in comparison
- **R-squared**: 49.44% variance explained
- **MAE:** 26.47% of the mean

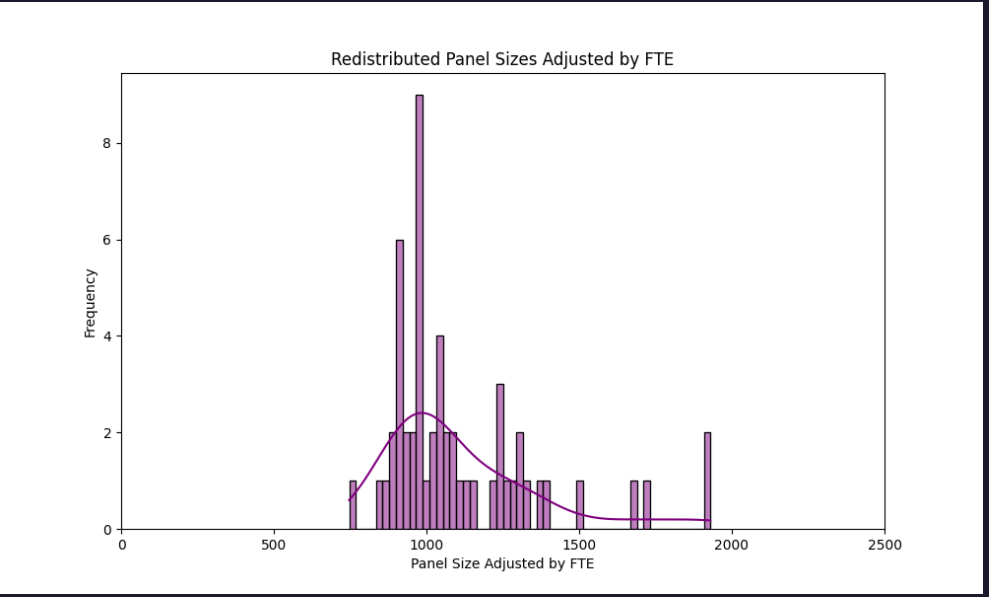


Visualization – Panel Sizes

- Before Redistribution

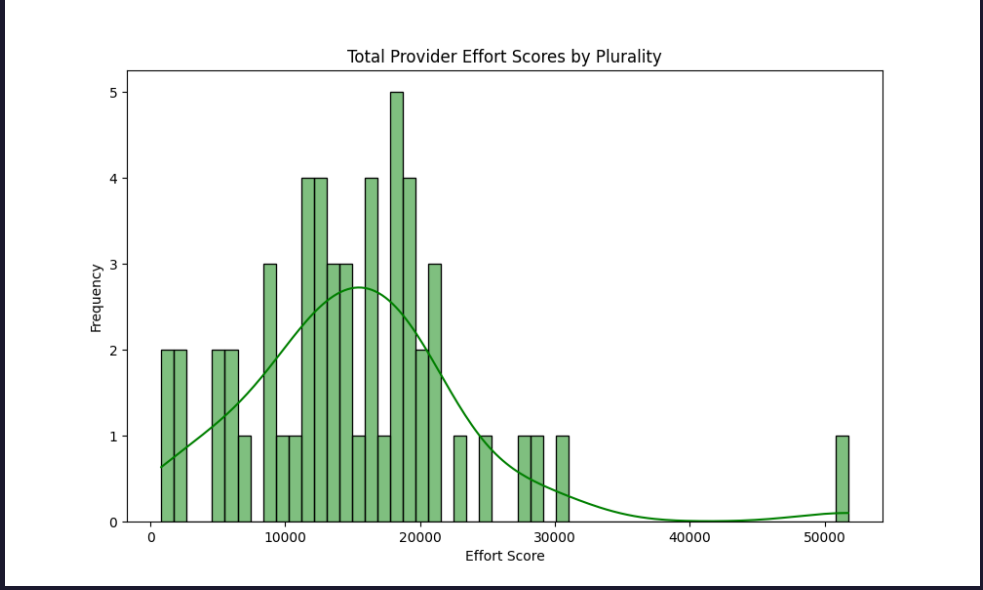


- After Redistribution

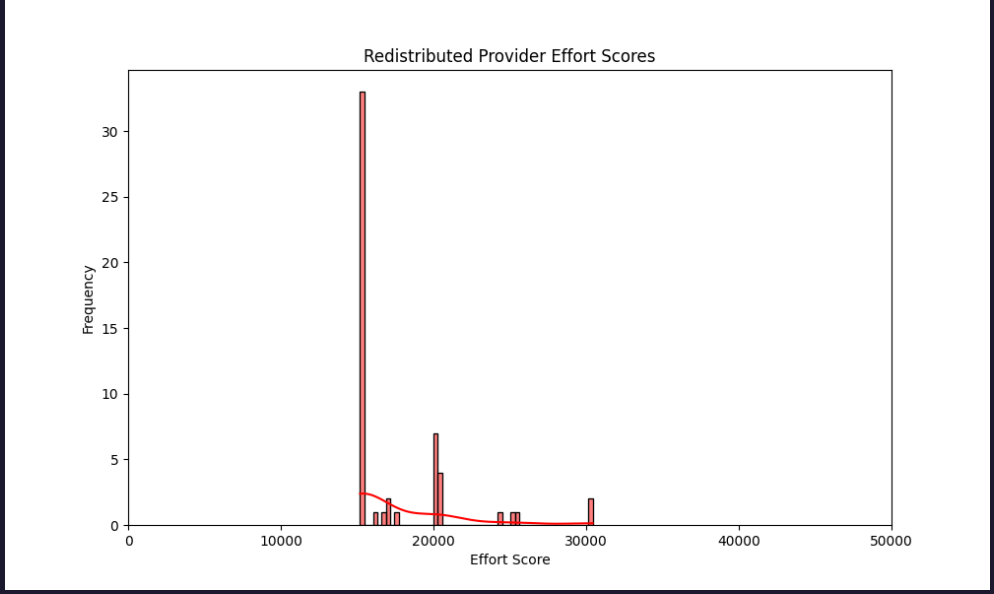


Visualization – Provider Workload

- Before Redistribution



- After Redistribution



Conclusion

Ethical Considerations:

- Maintaining patient privacy and confidentiality
- Ensuring transparency of predictions
- Addressing potential biases in the data

Mitigation Plan:

- Strict adherence to HIPAA Security Rule, clear communication with stakeholders, and monitoring model performance and impact.

Future Recommendations:

- Refine the model with additional data
- Explore the applicability of the LACE (readmission) scoring system or Hospital Index (acuity) score
- Not ready for deployment but shows promise

References

Field, A., & Miles, J. (2012). Discovering Statistics Using R. SAGE Publications.

McLaughlin, D. B., & Olson, J. R. (2009). Healthcare Operations Management. Health Administration Press.

Gallatin, K., & Albro, C. (2023). Machine Learning with Python. O'Reilly Media, Inc.

Harrington, C. (2022). Considerations for Patient Panel Size. Dela Journal of Public Health, 8(5), 154-157. doi:10.32481/djph.2022.12.034

Minemyer, P. (2016). Study Discredits Industry Standard Panel Size for Primary Care Physicians. Fierce Healthcare. Retrieved from Fierce Healthcare

Raffoul, M. M. (2016). A Primary Care Panel Size of 2500 is Neither Accurate nor Reasonable. J Am Board Fam Med, 29(4), 496-499. doi:10.3122/jabfm.2016.04.150317

Thank You

Alysen Casaccio, RN-BC, BHA, CPHIMS

alysencasaccio@gmail.com

acasaccio@my365.bellevue.edu