Finding Algorithmic Bias in Retention Analytics and What Can be Done

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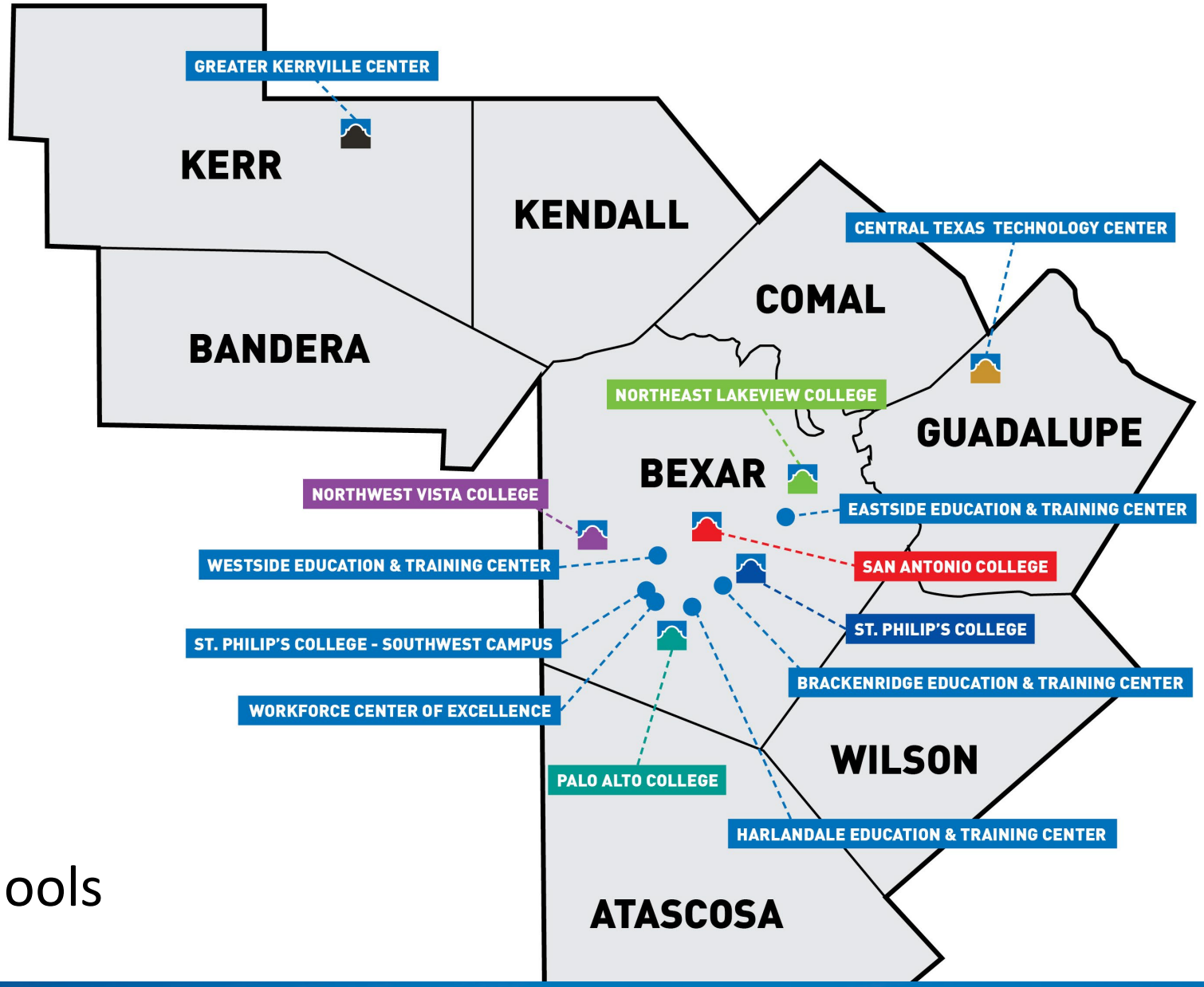
ALAMO COLLEGES DISTRICT

Malcolm Baldrige National Quality Award
2018 Award Recipient

ACHIEVING THE DREAM
LEADER COLLEGE
OF DISTINCTION

THE ALAMO COLLEGES DISTRICT FAMILY

- 5 Colleges
  - San Antonio College
  - St. Philip's College
  - Palo Alto College
  - Northwest Vista College
  - Northeast Lakeview College
- 8 Regional & Neighborhood Centers
- 16 Early College High Schools



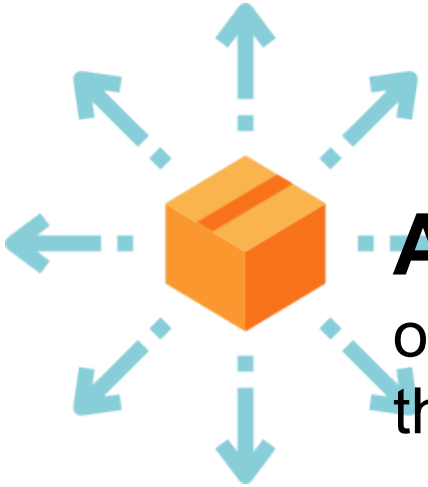
Session Outline

- Analytic modelling in higher education (HE)
- Negative effects of algorithmic bias on operations
- Accuracy and Calibration bias in analytic models
- Exploration of algorithmic bias using ethnicity and Pell status
- Accounting for algorithmic bias through outcome application

1/3 of Higher Education institutions purchased analytic capabilities spending on average $300,000 per year.

Barshay & Aslanion, 2019

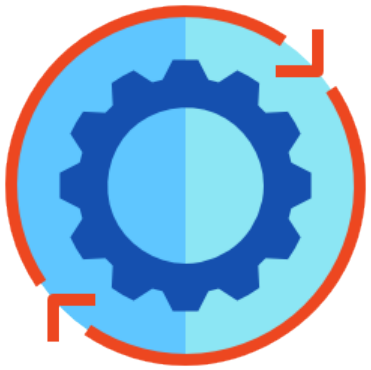
Representational: Systematic representation of some group in a negative light, or in a lack of positive representation.



Allocative: Withholding of some opportunity or resource from specific groups or the unfair distribution of a good across groups

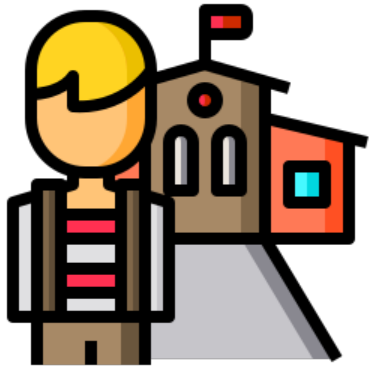
Baker & Hawn, 2021

Model Specification/Setup



Logistic Regression
– time/college fixed effects

Time Frame–
Fall Terms 2014 to 2021



Student Cohorts–
First Time in College (FTIC)

Data – Banner, CBM, FADS, Navigate

Two Primary Equity Co-Variates

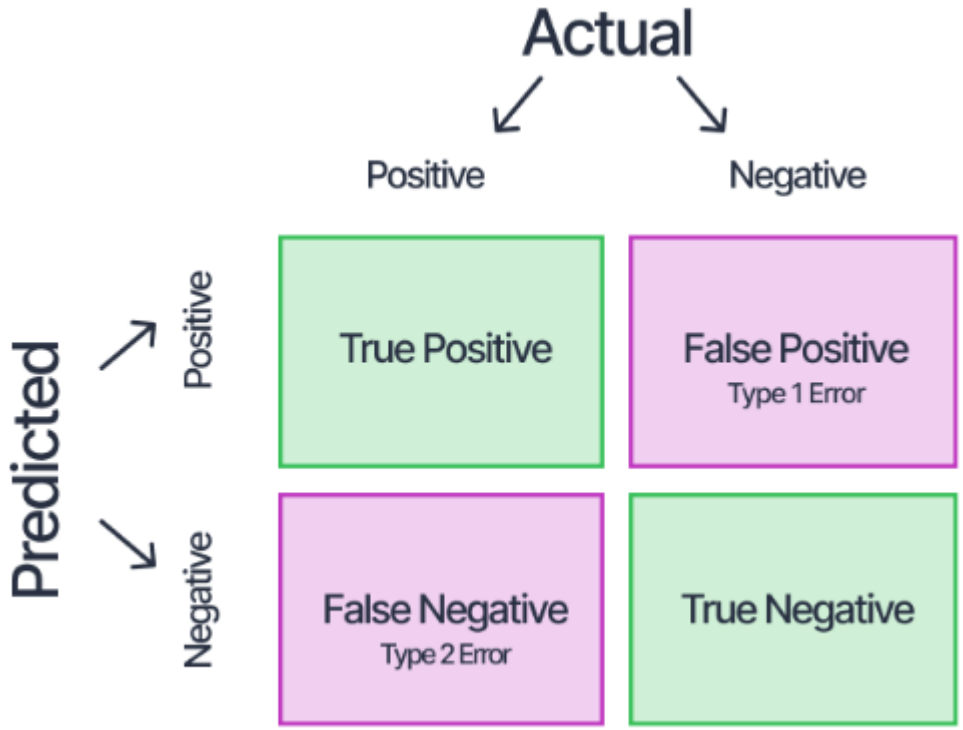
Ethnicity:
Historically Marginalized Students (Hispanic, Black African Americans)

Pell Status:
Dichotomous indicator of received Pell funding

Model Comparison Methodology (1)

Confusion Matrix:

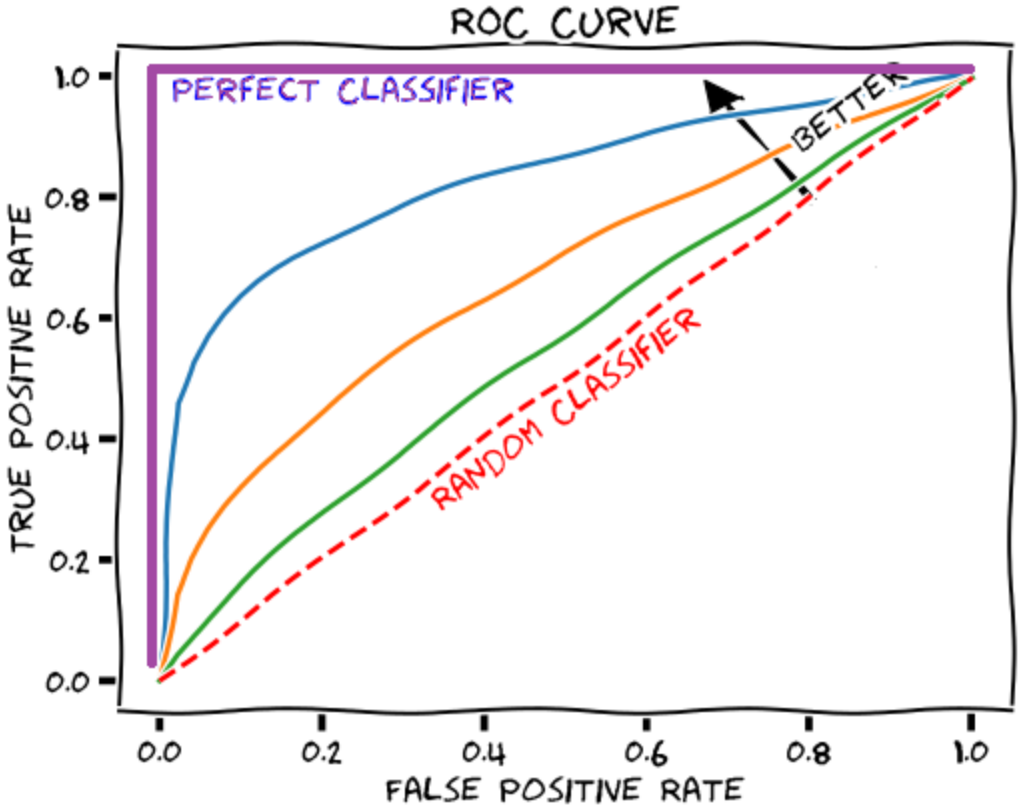
Class-wise distribution of predicted classification against actual classification for a dichotomous response variable.



Model Comparison Methodology (2)

Receiver Operating Characteristic (ROC):

Visualized plot of true positive rates (TPR) and false positive rates (FPR) across a range of threshold settings.



Accuracy Bias -

Would the specification of group specific models lead to wide variations in outcome accuracy?

Use the equity-based identifier as a filter for multiple models instead of a covariate.

Bird, Castleman, & Song 2023

Accuracy Bias Ethnicity

Base model

LROC: 0.8011

Classified	Actual +	-	Total
+	4824	1493	6317
-	436	1623	2059
	5260	3116	8376

Correct Classification
76.97%

Hispanic model

LROC: 0.8114

Classified	Actual +	-	Total
+	3628	1091	4719
-	320	1281	1611
	3958	2372	6330

Correct Classification
77.55%

Blk Afr Amer model

LROC: 0.8532

Classified	Actual +	-	Total
+	201	63	264
-	36	126	162
	237	189	426

Correct Classification
76.76%

NHMP model

LROC: 0.7699

Classified	Actual +	-	Total
+	977	300	1277
-	80	253	333
	1057	553	1610

Correct Classification
76.40%

Accuracy Bias Pell Status-

Base model

LROC: 0.8011

Classified	Actual +	-	Total
+	4824	1493	6317
-	436	1623	2059
	5260	3116	8376

Correct Classification
76.97%

With Pell model

Lroc: 0.8074

Classified	Actual +	-	Total
+	2897	958	3855
-	291	1155	1446
	3188	2113	5301

Correct Classification
76.44%

No Pell model

Lroc: 0.7889

Classified	Actual +	-	Total
+	1921	514	2435
-	151	487	638
	2072	1001	3073

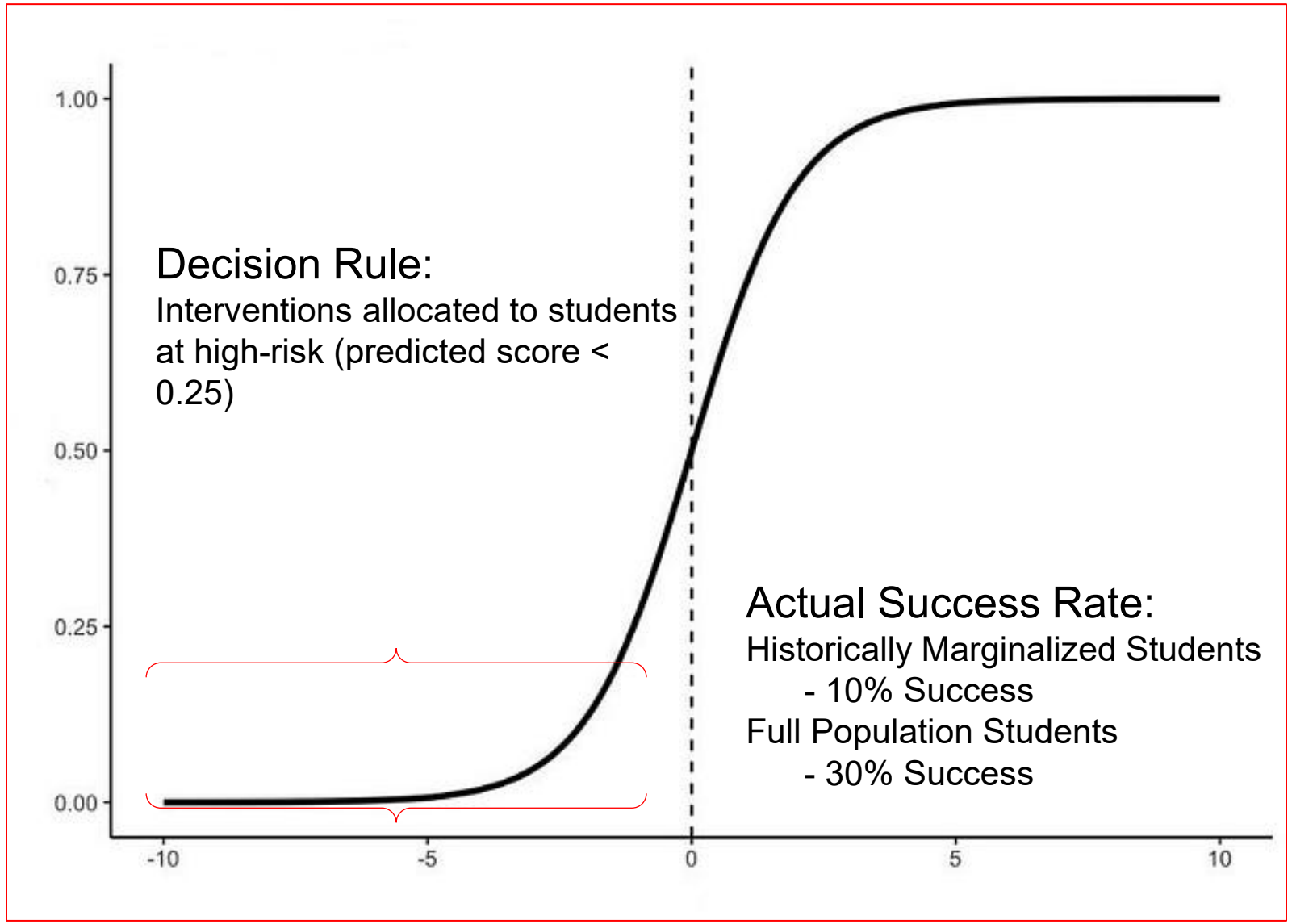
Correct Classification
78.36%

Calibration Bias -

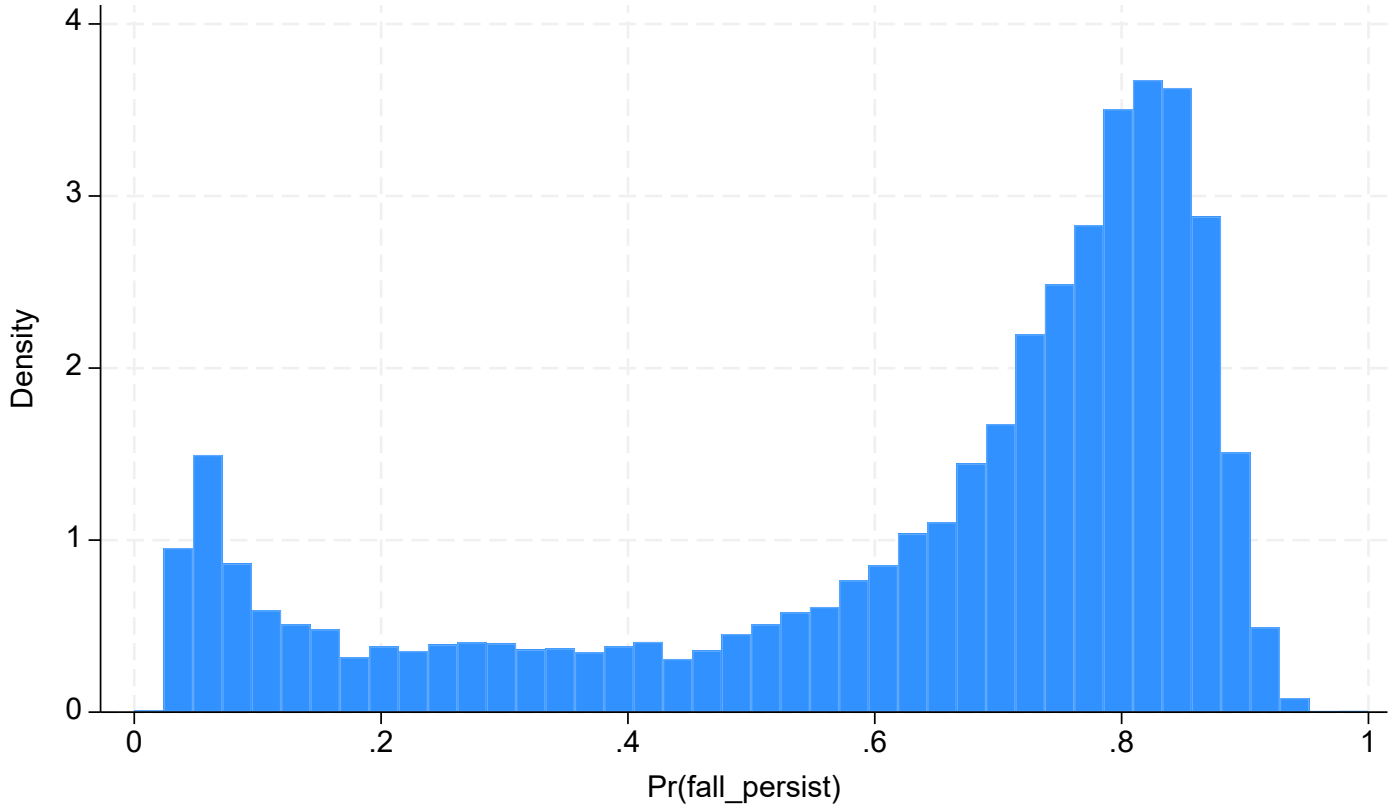
Is there a difference in the predicted outcomes against actual outcomes at various points in the estimated distribution?

If the historically marginalized group shows larger error in key points of the distribution it could lead to allocative bias.

Calibration Bias - Example



Calibration Bias Comparisons



Calibration Bias Variation in predictive accuracy across range of distribution in base model - Low Decile

Ethnicity-based factor

Historically Marginalized Students:

8.0% False Negative

Non-Historically Marginalized

12.8% False Negative

Pell factor

Pell Recipient:

7.3% False Negative

Non-Pell Recipient

12.3% False Negative

Calibration Bias Variation in predictive accuracy across range of distribution in base model - High Decile

Ethnicity-based factor

Historically Marginalized Students:

11.5% False Negative

Non-Historically Marginalized

15.9% False Negative

Pell factor

Pell Recipient:

10.7% False Negative

Non-Pell Recipient

14.0% False Negative

Assessment of Algorithmic Bias

Accuracy bias across ethnicity is limited

Accuracy bias in Pell status is more pronounced but substantively shows a difference between groups of less than 2% in terms of predictive accuracy.

Accuracy bias across ethnicity and Pell status are limited and substantively small

Calibration bias shows a 4-5% difference in predictive accuracy in the bottom and top decile.

Calibration bias was found across ethnicity groups with relatively small overall effect due to ethnicity distribution

Methods to limit algorithmic bias at Alamo Colleges

Explore moving interventions more evenly across the distribution to account for Type I Error

Layer decision rules for interventions to incorporate lexicographic methods against equity factors

Areas for further research

1. Broaden equity co-variate checks beyond ethnicity and Pell status
2. Assess if different modeling methods affects the accuracy and calibration error against the equity co-variates
3. Explore more complex decision rules to limit algorithmic bias beyond lexicographic decision rules

Thank you.

Contact

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