Memorandum to the Mayor

December 21, 2022

Equitable Algorithms Lead to Cost Savings and Increased Participation When Applied to Ex-Prisoner Job Program Recruitment

To save money and equip the formerly incarcerated with tools to lead successful lives outside of the justice system, the Department of Prisons should recruit ex-offenders to a job training program with the aid of a tuned recidivism prediction algorithm, which will offer greater accuracy in predictions while increasing participation in the program.

Job Program Background

The Job Training Program (JTP) is modeled off the successful New York City-based Center for Employment Opportunities (CEO), a "highly regarded" program for ex-prisoners that was shown in studies to reduce re-incarceration by up to 12%.[1] The state of Pennsylvania, with 18,000 inmates, estimates a 5% reduction in recidivism alone would save the department approximately $1.9 million in one year, and a 10% reduction would reduce it by $9.1 million .[2] Reduced costs to individuals and communities who receive tools to operate effectively in a difficult job market. Despite reservations, the benefits are clear.

Like CEO, the JTP will recruit ex-prisoners within three months of their release and give participants a number of transitional job benefits. In addition to a $250 recruitment administration cost, these features sum to a total of $6400 average per participant. Based on similar job program numbers, we estimate the JTP to have a 70% participation rate among those it attempts to recruit.

Key Findings Regarding the Use of a Recruitment Algorithm

Choosing the right participants is essential to reduce costs to the prison system and society, as training those who are likely to recidivate is very costly to the city. Using an algorithm will help the city reach more successful participants while keeping costs to society low when compared to other techniques.

If, for instance, the Department of Prisons were to establish quotas for the program based on contemporary recidivism rates, it should expect 45% of the formerly incarcerated to *not* recidivate within the two years of their release. Even with standardized surveys, we estimate as many as 25% of recruits may still recidivate over that period.

Algorithm Advantages

Compare this to our algorithm, which measures a person's criminal history (previous charges, length of stays, juvenile records) and personal attributes (age ranges and sex [M/F at the time]) and predicts

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[1] "Transitional Jobs for Ex-PrisonersImplementation, Two-Year Impacts, and Costs of the Center for Employment Opportunities (CEO) Prisoner Reentry Program" by C. Redcross, D. Bloom, G. Azurdia, J. Zweig, N. Pundus, 2009, *MDRC*, p.71 <https://www.mdrc.org/sites/default/files/full_592.pdf>

[2] "Recidivism Report 2022" K. Bret Bucklen, M. Sheets, C. Bohm, N. Bell, J. Campbell, R. Flaherty, K. Vander Wiede, 2022, Pennsylvania Dept. of Corrections. https://www.cor.pa.gov/About%20Us/Statistics/Documents/Reports/Recidivism%202022%20Report.pdf

whether they will recidivate or not. We can tune the model's Positive (will recidivate) and Negative (will not recidivate) based on how strict we want to be, but for now we set it at a generic halfway point. In a basic test, our algorithm recruited only 18% of those who would still recidivate, and saves nearly $650,000.

Again, this tool should be used in concert with qualitative methods of analysis. Some predictive aspects are beyond the person's control, like age and sex at birth. Qualitative measures, like attitude and future outlook are best determined through surveys and interviews. Still, other algorithms offer 10% more accuracy than experts predicting without such tools.[3]

Figure 1: Cost/Benefit Table, Comparing 45% Random Quota With Untuned Model

Results (By Error Type)	Individual Cost	Count (Quota)	Cost (Quota)	Count (Model)	Cost (Model)
True Negative: We correctly predicted no recidivism, recruited 70% for jobs programs, and saved cost on re-incarceration through 12% reduction.	**Cost: $4,770** 250 Recruitment Cost 70% Recruitment Rate $6400 Program **Savings: $3,360** $42000/year/inmate cost 8 months avg re-incarceration 12% less re-incarceration	308 (20%)	$421,960	639	$875,430
True Positive We correctly predicted recidivism, did not recruit, no effect of program.	**No Costs or Savings**	462 (30%)	$0	419	$0
False Negative We incorrectly predicted no recidivism, recruited 70% for jobs program, individuals recidivate.	**Cost: $4770** 250 Recruitment Cost 70% Recruitment Rate $6400 Program	385 (25%)	$1,821,050	284	$1,343,320
False Positive We incorrectly predicted recidivism, and missed saved cost on re-incarceration through static re-incarceration rate.	**Lost Savings: $3,360** $42000/year/inmate cost 8 months avg re-incarceration 12% less re-incarceration	385 (25%)	-$1,293,600	198	-$665,280
Net Total Cost	N/A	**1540**	**$3,536,610**	**1540**	**$2,884,030**

[3] " Training To See Risk: Measuring the Accuracy of Clinical and Actuarial Risk Assessment Among Federal Probation" , J.C. Oleson; Scott W. VanBenschoten; Charles R. Robinson; Christopher T. Lowenkamp, *Federal Probation* Volume: 75 Issue: 2 Dated: September 2011 Pages: 52-56. https://www.ojp.gov/ncjrs/virtual-library/abstracts/training-see-risk-measuring-accuracy-clinical-and-actuarial-risk

Algorithmic Fairness

Despite this good news, I want to bring to your attention the issue of algorithmic fairness, then present what we're doing to address it. The model is trained using data that has a large population of African American former prisoners, and certain variables correlate strongly with race, such as prior incarceration count (Figure 2). As such, while the model has a similar hit rate across groups, it's more wrong when predicting that African Americans will recidivate, while falsely predicting Caucasians and other groups will not. If put into practice, fewer good candidates are recruited from African American groups, a personal cost to them and their families, while Caucasians and other groups recidivate despite the jobs training and cost us and crime victims more money. This is a situation to be avoided, as it would perpetuate existing disparities between these racial groups.

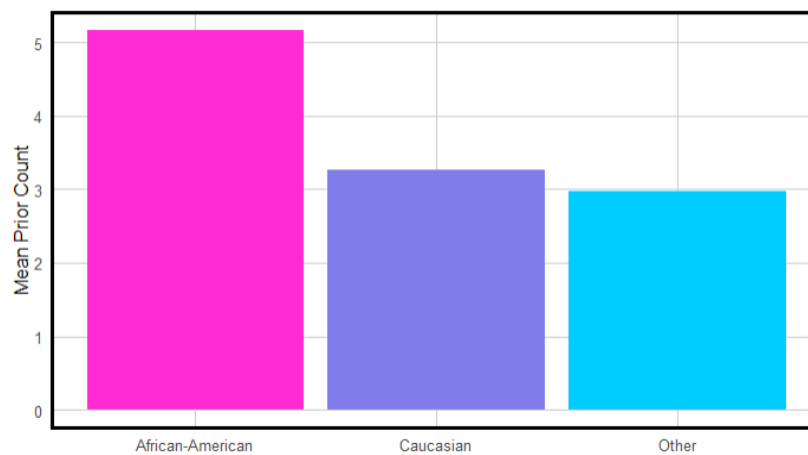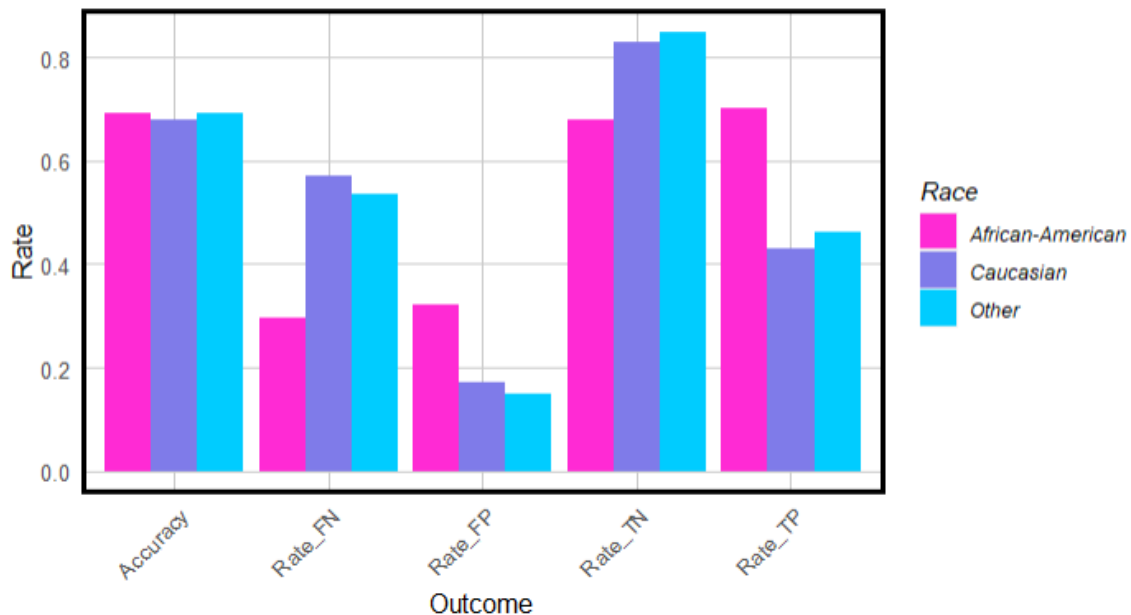**Figure 2: Average Prior Incarceration Count, by Race**

Figure 3: Error Rates by Error Types, by Racial Category
50% Threshold Across All Groups (Average Strictness)

Recommendations for An Equitable Recruitment Algorithm

Fortunately, our model can be adjusted to account for this problem. To address this disparity, the Department of Prisons should use a tuned model for recruitment, one that adjusts for slightly more generous predictions of African Americans when compared to other groups. Compare the below chart to the one above. By increasing the tolerance for African Americans, we maintain a similar level of 68% accuracy and equalize errors across racial groups. This adjustment does increase our costs by due to more participants, but is still cheaper than random selection.

Figure 4: Error Rates by Error Types, by Racial Category
60% Threshold (Below-Average Strictness) for African Americans
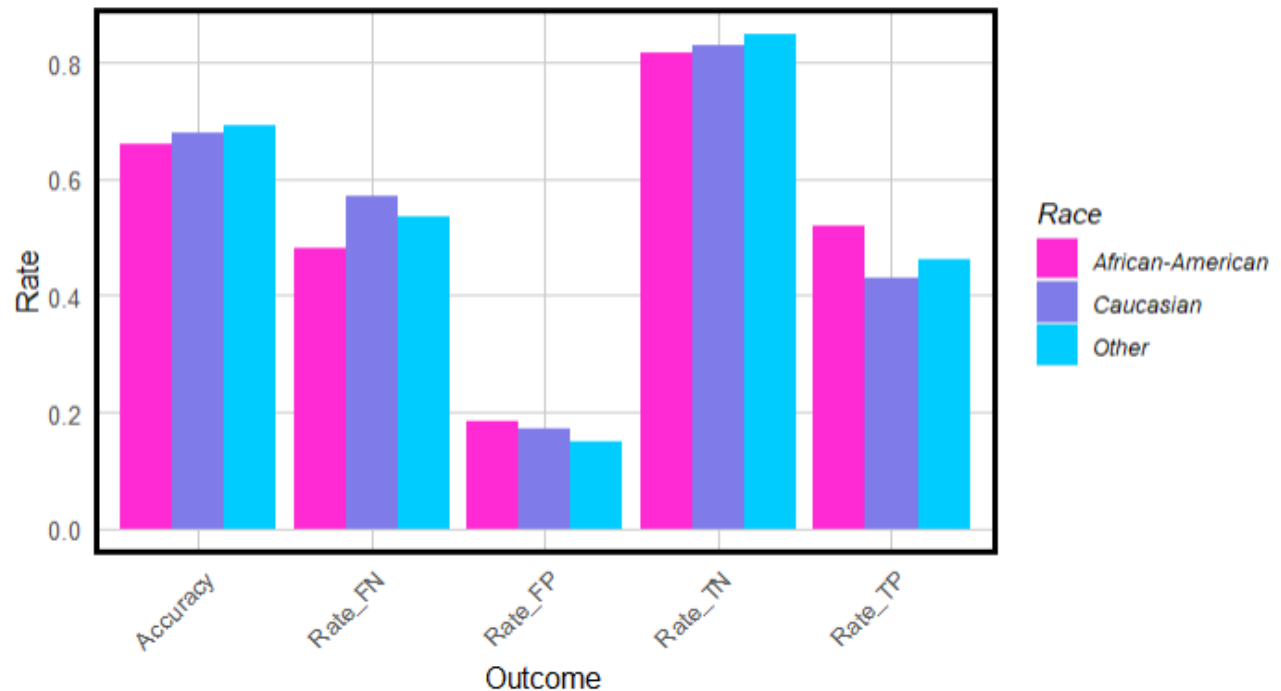50% Threshold Across Caucasians and Other Groups (Average Strictness)

Figure 5: Cost/Benefit Table, Comparing Untuned Model With Equitable Model

Results (By Error Type)	Individual Cost	Count Untuned Model	Cost Untuned Model	Count Equitable Model	Cost Equitable Model
True Negative: We correctly predicted no recidivism, recruited 70% for jobs programs, and saved cost on re-incarceration through 12% reduction.	**Cost: $4,770** 250 Recruitment Cost 70% Recruitment Rate $6400 Program **Savings: $3,360** $42000/year/inmate cost 8 months avg re-incarceration 12% less re-incarceration	639	$875,430	692	$948,040
True Positive We correctly predicted recidivism, did not recruit, no effect of program.	**No Costs or Savings**	419	$0	342	$0
False Negative We incorrectly predicted no recidivism, recruited 70% for jobs program, individuals recidivate.	**Cost: $4770** 250 Recruitment Cost 70% Recruitment Rate $6400 Program	284	$1,343,320	361	$1,707,530
False Positive We incorrectly predicted recidivism, and missed saved cost on re-incarceration through static re-incarceration rate.	**Lost Savings: $3,360** $42000/year/inmate cost 8 months avg re-incarceration 12% less re-incarceration	198	-$665,280	145	-$487,200
Net Total Cost	N/A	**1540**	**$2,884,030**	**1540**	**$3,142,770**

Conclusion

Many citizens are wary of algorithms these days, and for good reason. However, even with a skeptical approach, we can be optimistic about the benefits when this tool is applied alongside our standard practices. Some acting in bad faith may criticize the adjustment toward leniency for African Americans, but in truth, not adjusting makes the model apply unfairly to them instead. This method offers more opportunity to former prisoners and can save the city plenty of money, especially in the long term.

Sincere thanks for your time and attention on this matter.

Signed,

Ben Keel
Fictional Dept. of Prisons