MEMORANDUM

TO:	Mayor Lightfoot and Members of the Chicago City Council
FROM:	Anna Duan, Data Scientist
RE:	Allocate ex-offender job training program more effectively with use of an algorithm
DATE:	November 12, 2020

Today, I write to recommend that the city adopt an algorithm for allocating JobCorps spots to ex-offenders at high risk of recidivism. In Illinois, an estimated 40-55% of incarcerated individuals recidivate -- reoffend -- upon release and return to prison[1]. Over the next 5 years, this will cost our state $13 billion[2], not including recidivism's immeasurable social cost[3]. We simply cannot afford this.

The best way to curb recidivism is job training. People miss crucial educational and employment opportunities in prison, making it challenging to find employment and education. This increases their odds of recidivating[4]. Job training removes these barriers and makes participants more likely to pursue education and less likely to re-commit crime[5,6].

Chicago's JobCorps program offers ex-offenders job referrals, application support, and interview training. It costs $3025 to enroll one person[7]. However, JobCorps selects participants randomly, therefore unintentionally missing some ex-offenders who can benefit. Our algorithm identifies likely recidivists to help JobCorps target the most high-need cases. We found that offering this group job training is more

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[1] http://www.icjia.state.il.us/publications/examining-the-extent-of-recidivism-in-illinois-after-juvenile-incarceration

[2] Illinois, victims, and taxpayers $151,700 in damages, incarceration and legal costs, and lost economic activity per recidivism case. See: https://www.illinoispolicy.org/report-recidivism-to-cost-illinois-more-than-13b-over-next-5-years/

[3] Recidivists' families spend longer experiencing reduced income, increased spending, and separation from their loved ones, and their communities lose public services in favor of higher incarceration and policing spending. See: https://www.themarshallproject.org/2019/12/17/the-hidden-cost-of-incarceration

[4] http://www.icjia.state.il.us/publications/examining-the-extent-of-recidivism-in-illinois-after-juvenile-incarceration

[5] http://urban.org/sites/default/files/publication/59406/410853-Reentry-and-Prison-Work-Programs.PDF

[6] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5669259/#bibr8-0306624X16636141

[7] $3025 is the per participant cost of a very similar program. See: https://www.ncjrs.gov/pdffiles/168102.pdf

effective and cost-efficient than the city's current random allocation method. Consequently, we expect that 70% of graduates will find above minimum wage jobs and only 15.5% will recidivate[8].

It is true that recidivism risk classification algorithms can be problematic. Black people disproportionately experience incarceration and recidivism due to systemic racism[9]. Algorithms trained with prior data are prone to perpetuate this bias in their predictions. One algorithm which is widely used to inform pre-trial release and parole decisions predicts White and Black individuals' recidivism risk with similar accuracy[10]. However, it under-predicts White people's recidivism risk and over-predicts for Black people. Clearly, over-predictions are more harmful: these errors contribute to excessive prison time for Black ex-offenders and miss high-risk White ones who are likely to reoffend.

Therefore, we define fairness as equitable outcomes rather than high overall accuracy, the former algorithmic fairness gold standard. To account for the fact that past data has more cases of Black recidivists, we use different standards to classify White and Black ex-offenders' recidivism risk[11]. The following figure compares our algorithm's outcomes (Equitable Thresholds) with one similar to the aforementioned algorithm (Equal Thresholds). As previously discussed, existing algorithms grossly underestimate Caucasians' propensity to recidivate (False_No_Recidivate), therefore they miss likely recidivists. This is harmful: if we allocate JobCorps this way, we miss opportunities to intervene and prevent recidivism among high-risk Caucasians. By contrast, because we account for racial disparities, our algorithm consistently predicts recidivists better (True_Recidivate) and misses fewer cases (False_No_Recidivate).

Figure 1: Two Algorithms' Recidivism Outcome Predictions

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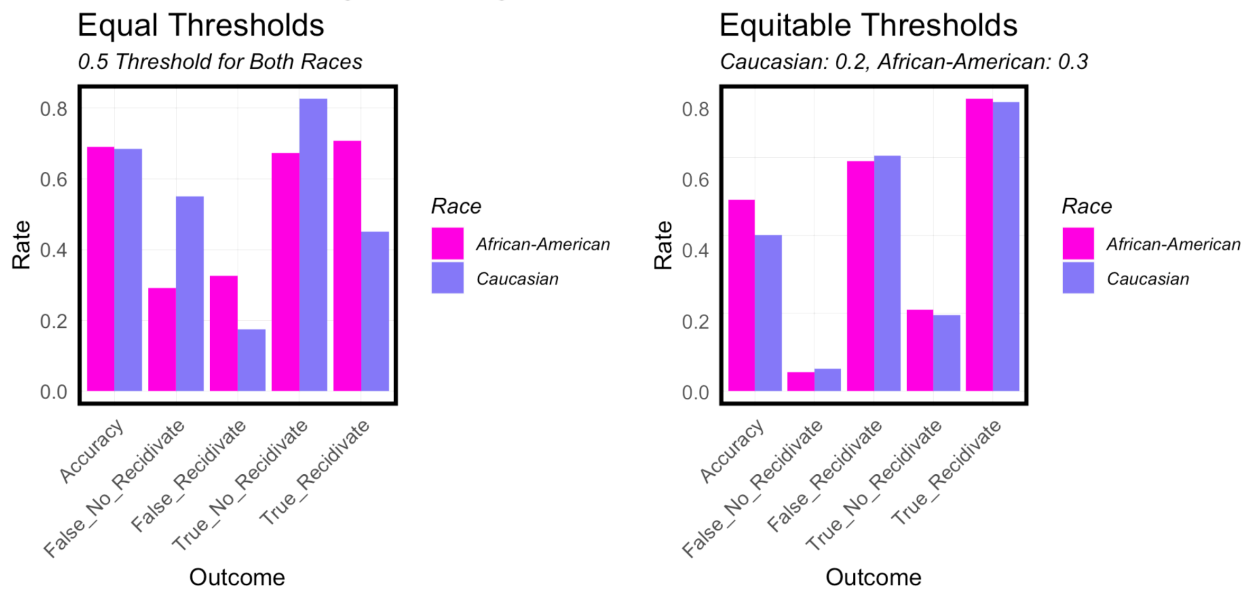
[8] An ex-offender job training program administered by the Center for Employment in New York saw these outcomes. This program, like our algorithm, targets higher risk individuals and recruits participants from drug treatment and prison bootcamp programs. We presume that its relative success comes from its selection of high-impact cases. See: https://www.ncjrs.gov/pdffiles/168102.pdf

[9] https://phys.org/news/2018-10-black-men-higher-recidivism-factors.html

[10] https://www.propublica.org/article/how-we-analyzed-the-compas-recidivism-algorithm

[11] I use the equitable threshold provided by Ken to identify a pair of thresholds which yields the smallest difference in the rate of true positives and false negatives across both races (0.2 for Caucasians, 0.3 for African Americans)

Our algorithm also makes JobCorps more cost-effective. Using our algorithm, every JobCorps dollar spent returns $16 more in income, tax revenue, reduced incarceration, and reduced crime to Chicago and Illinois than if JobCorps were randomly allocated[12]. This year, 21,000 ex-offenders will be released[13]. Using this algorithm, JobCorps accepts 17,511[14] and finds jobs for 12,257 -- 40% more than with random allocation[15].

Table 1: Returns of Algorithm vs Randomly Distributed JobCorps Program

	Chicago	Illinois	Individuals	Total Returns	Per-Dollar Returns
Random	$163,381,132	-$440,871,022	-$478,971,711	-$756,461,601	-$14
Algorithm	$249,921,895	-$40,811,914	-$102,451,940	$106,658,041	$2
Algorithm Advantage	**$86,540,763**	**$400,059,108**	**$376,519,771**	**$863,119,642**	**$16**

Chicago gains $87 million more in income tax revenue and Illinois, $86 million[16]. Illinois additionally saves $314 million in costs and lost economic activity related to recidivism[17]. Further, participants and their families gain $233 million in income, $66 million more than without the algorithm[18]. Victims also suffer $310 million less in recidivism-related costs. All in all, Chicago, Illinois, and individuals experience a significant increase in returns when we allocate JobCorps spots with our algorithm. Over time, increased tax revenue brings increased funding for public programs to support our region's residents. Additionally, society enjoys more racially equitable distribution of income and increased family cohesion, education, and reduced crime and incarceration[19].

Inevitably, our algorithm has tradeoffs. Our use of race-specific thresholds compromises our overall accuracy. However, this is acceptable because the algorithm's most frequent error is wrongly identifying individuals as likely recidivists, leading us to allocate JobCorps to non-high risk individuals. As previously mentioned, all ex-offenders face employment barriers upon release. Therefore, most can likely

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[12] See Table 1 for returns for each stakeholder and the difference between random and algorithm allocation of JobCorps. For these calculations, I used Chicago's current income tax rate of 4.95%, Illinois's rate of 4.9% for individuals earning minimum wage, $75,300 as the average financial cost to victims of one recidivism case, and the hourly minimum wage of $10 in Illinois. The average age of inmates in in Illinois is 36, the average retirement age is 60, and the average number of hours worked per year is 2,080. Therefore, participants who successfully find a job are assumed to work for 24 years, earning $20,800 per year.

[13] https://www.chicago.gov/city/en/depts/mayor/supp_info/ex-offender_re-entryinitiatives.html

[14] Based on the share of our test set sample that was predicted to recidivate and therefore qualified for the program. I projected this percentage onto the 21,000 ex-offenders projected to be released in 2020. See: footnote 13

[15] Based on success rates of similar programs - research suggests less than 50% typically gain employment. I assume JobCorps takes in 17,511 randomly selected participants. See: http://urban.org/sites/default/files/publication/59406/410853-Reentry-and-Prison-Work-Programs.PDF

[16] Illinois and Chicago's applicable income tax rates are 4.9% and 4.95%, respectively. See: https://taxfoundation.org/illinois-fair-tax/

[17] Each case of recidivism costs Illinois $51,000 in imprisonment and legal fees and $25,400 in lost economic activity. See: https://www.illinoispolicy.org/report-recidivism-to-cost-illinois-more-than-13b-over-next-5-years/#:~:text=A%20report%20released%20July%2023,over%20the%20next%20five%20years.

[18] Over the working lifetime of each program class, which is 24 years because the average inmate is 36 years old and expected to work until age 60. See: http://www.icjia.org/cjreform2015/research/illinois-prison-overview.html

[19] https://www.mdrc.org/sites/default/files/ETJD_STED_Benefit_Cost_Brief_508.pdf#:~:text=2%20Reducing%20this%20recidivism%20can,the%20reoffenders%20and%20their%20families.

benefit from job training and its positive employment and education outcomes. For the city, while each of these errors costs $3025 more, most[20] bring in $25,000 in lifetime income tax and contribute to the intangible societal benefits of a more educated and employable population. In other words, no program spot is "wasted" and we all benefit most when we maximize the number of likely recidivists in JobCorps, which our algorithm achieves.

Using our algorithm to allocate JobCorps strongly supports Mayor Lightfoot's goals of inclusive economic growth, public safety, and long term financial stability[21]. For the benefit of Chicago and the Illinois region, I strongly urge Chicago to adopt this algorithm effective immediately.

For any questions regarding these matters, please contact Anna Duan, Head of Data Science, at annaduan@sas.upenn.edu or (267) 901-5152.

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[20] 70% of program participants successfully gain at least minimum wage employment. See: footnote 8

[21] https://www.chicago.gov/city/en/depts/mayor/supp_info/about_the_mayor.html