From Prosecuted to Job Recruited: An Exploratory and Machine Learning Approach to Employment after Prison

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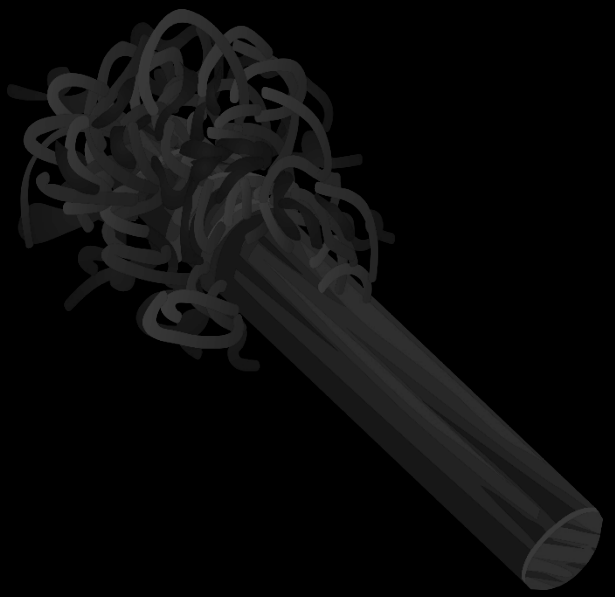
Employment after Prison

- Estimated that more than 6 million working-age people are former prisoners (CEPR, 2016)
- Incarceration reduces employment and earnings (Holzer et al., 2003; Pager, 2003)
- Barriers from limited skills, poor health, race, area of residence, lack of employer willingness to hire former prisoners (Holzer et al., 2003)
- Employment reduces recidivism but may be selection effects, recidivism reduction may be greater for older offenders (Uggen, 2000)
- Employment may also generate income, enhance social supports, and reduce reliance on public assistance

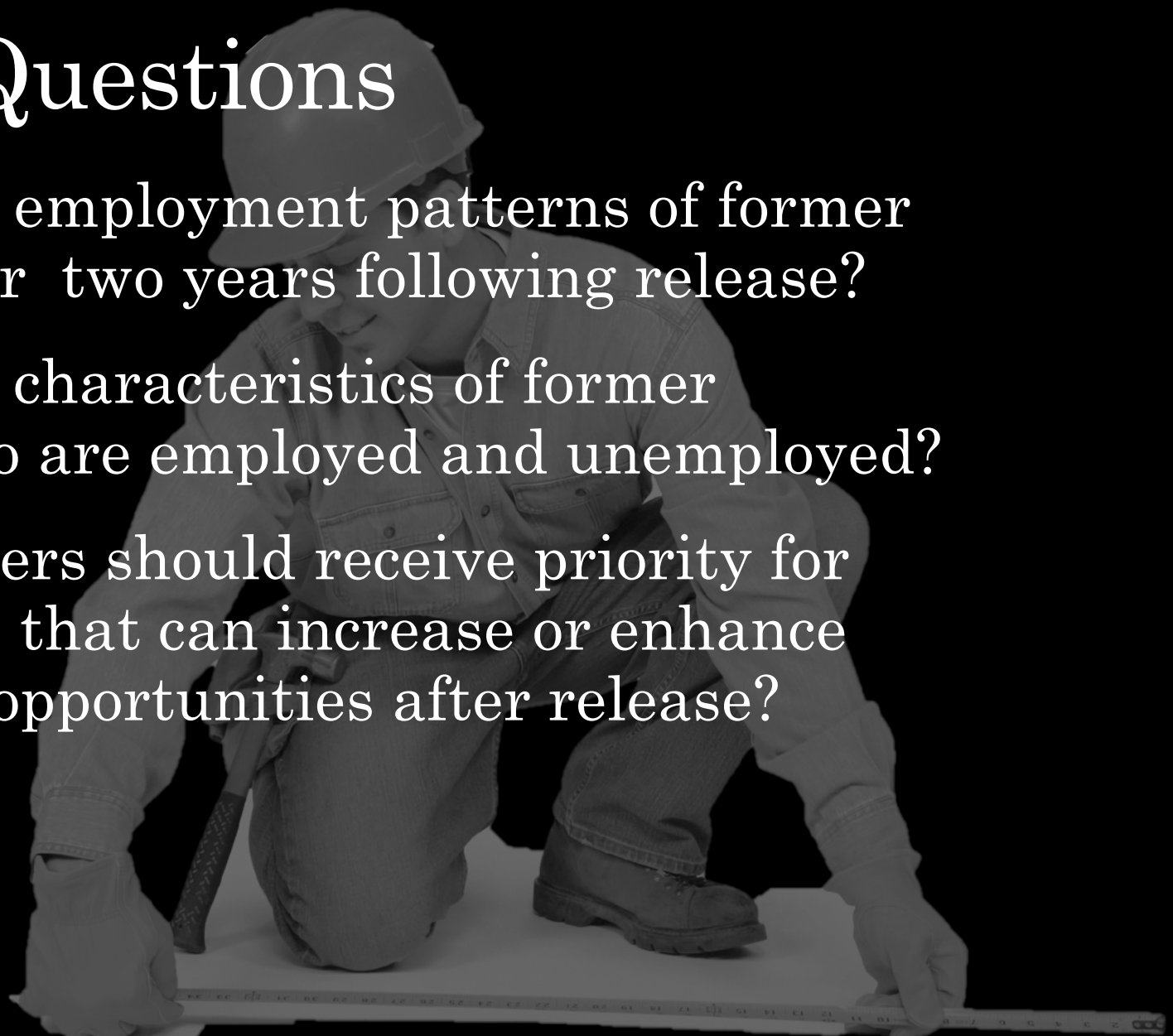
Risk principle of effective intervention

- Using scarce correctional treatment program resources on low-risk offenders that do not need them is a poor use of resources
- Placing low-risk offenders in more intense programs may have adverse effects (Latessa and Lowenkamp, 2005)



Research Questions

1. What are the employment patterns of former prisoners over two years following release?
2. What are the characteristics of former prisoners who are employed and unemployed?
3. Which prisoners should receive priority for interventions that can increase or enhance employment opportunities after release?



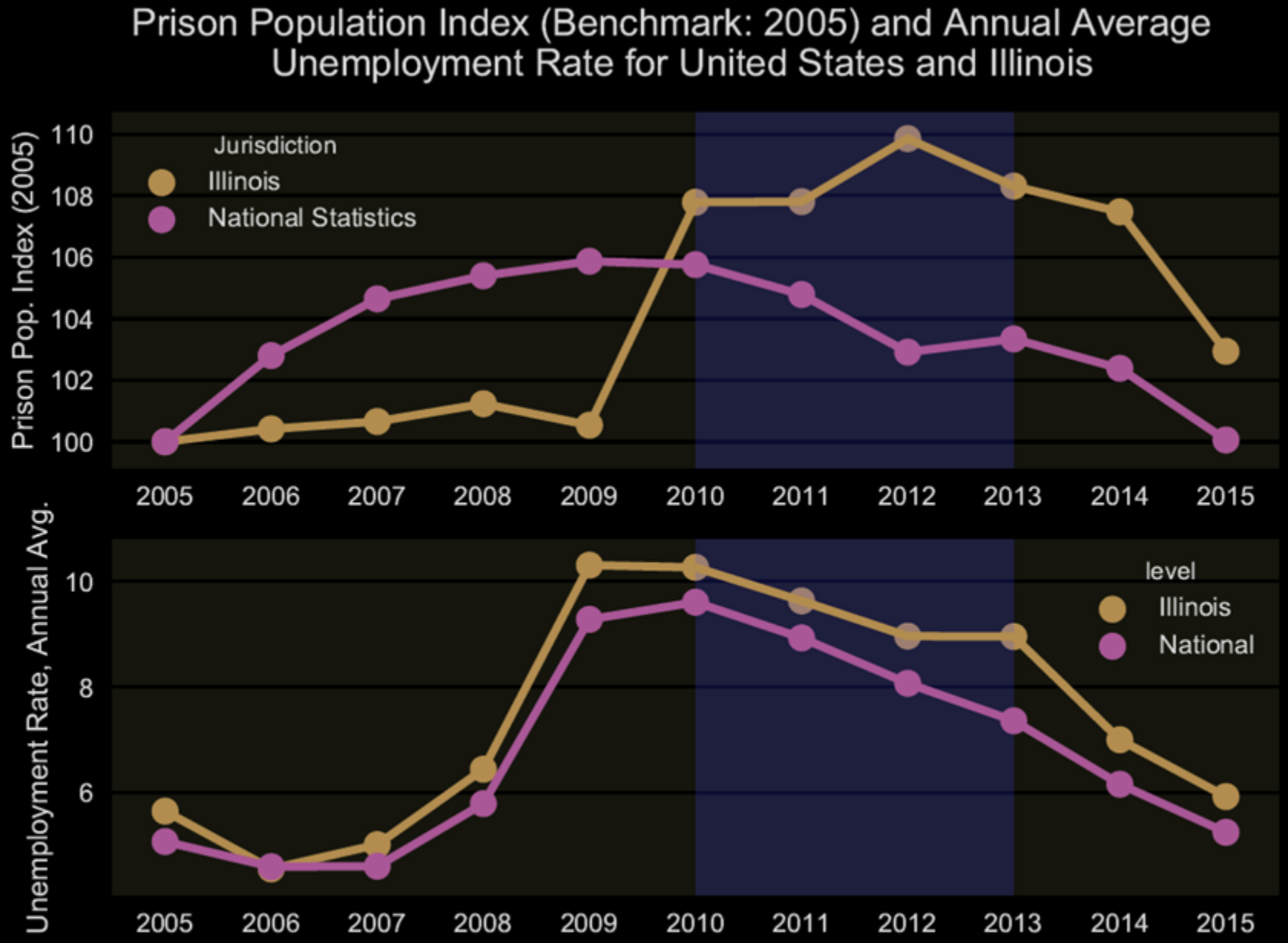
Data

- Data sources:
  - Illinois Department of Corrections (ILDOC) data on exits from prison (1990-2015)
  - Illinois Department of Employment Security (IDES) quarterly wage data (2005 to 2015)
- Cohort: All exits from prison from 2010 through 2013
  - More recent data was better quality
  - Job market changes over time

- **89,580** unique individuals exited prison during this timeframe
- Followed cohort for 2 years (8 quarters) after prison release, including the quarter of release

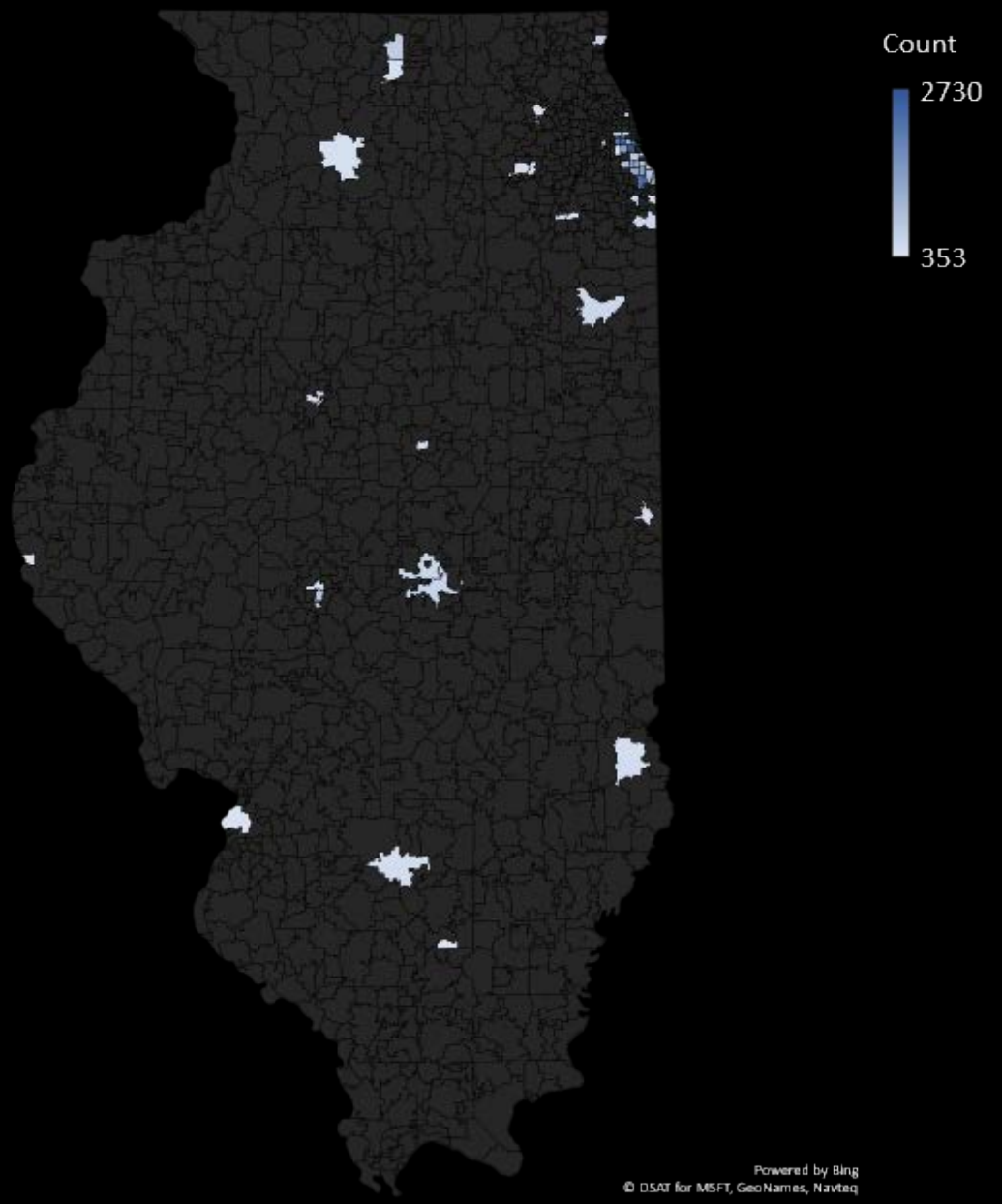
Data

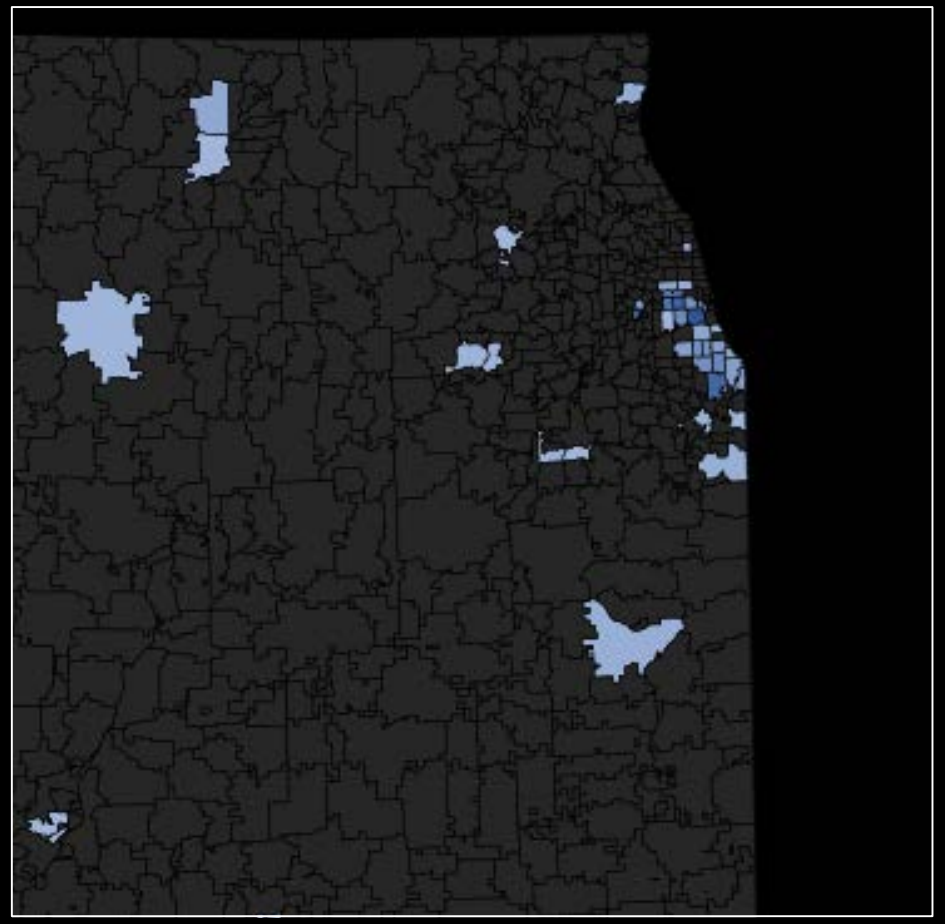
- Merged quarterly wage data to prison exit data
  - Removed ex-offenders with more than 30 unique jobs in any one quarter.
  - Removed ex-offenders with quarterly wage > $100,000
  - These removals were a minimal amount of our overall group
  - Many cases with more than one record per person-quarter
    - May have multiple jobs
    - Totaled all wages for each person/quarter and kept the employer associated with the largest wage.



Source: Bureau of Justice Statistics National Prisoner Statistics, Count of Total Jurisdiction Population 2005-2015 (top) & Bureau of Labor Statistics Local Area Unemployment Statistics (Illinois, seasonally adjusted) and Labor Force Statistics from Current Population Survey 2005-2015 (bottom, seasonally adjusted),

Top 50 Zip Codes of Prisoners

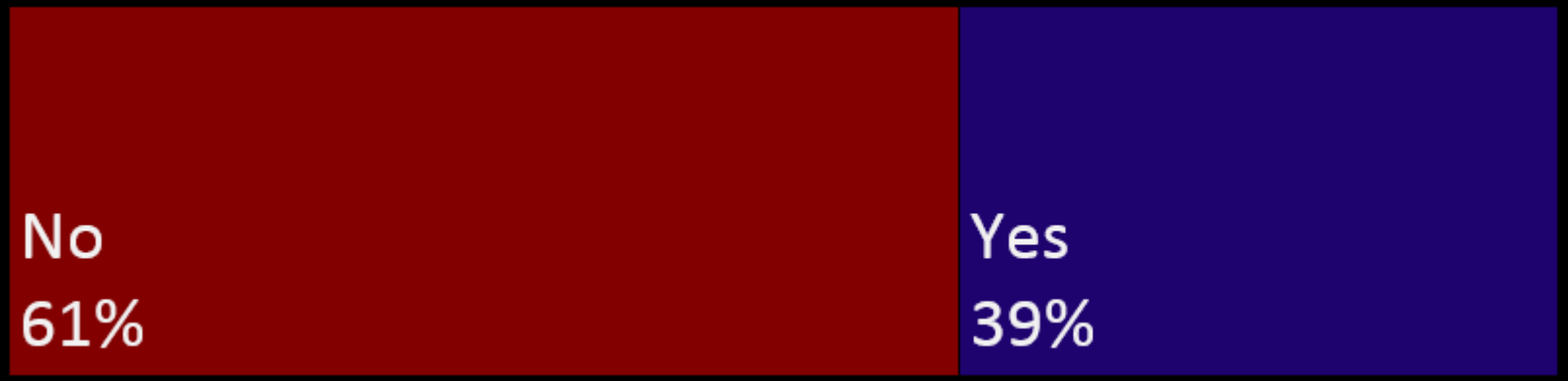




Research Question #1

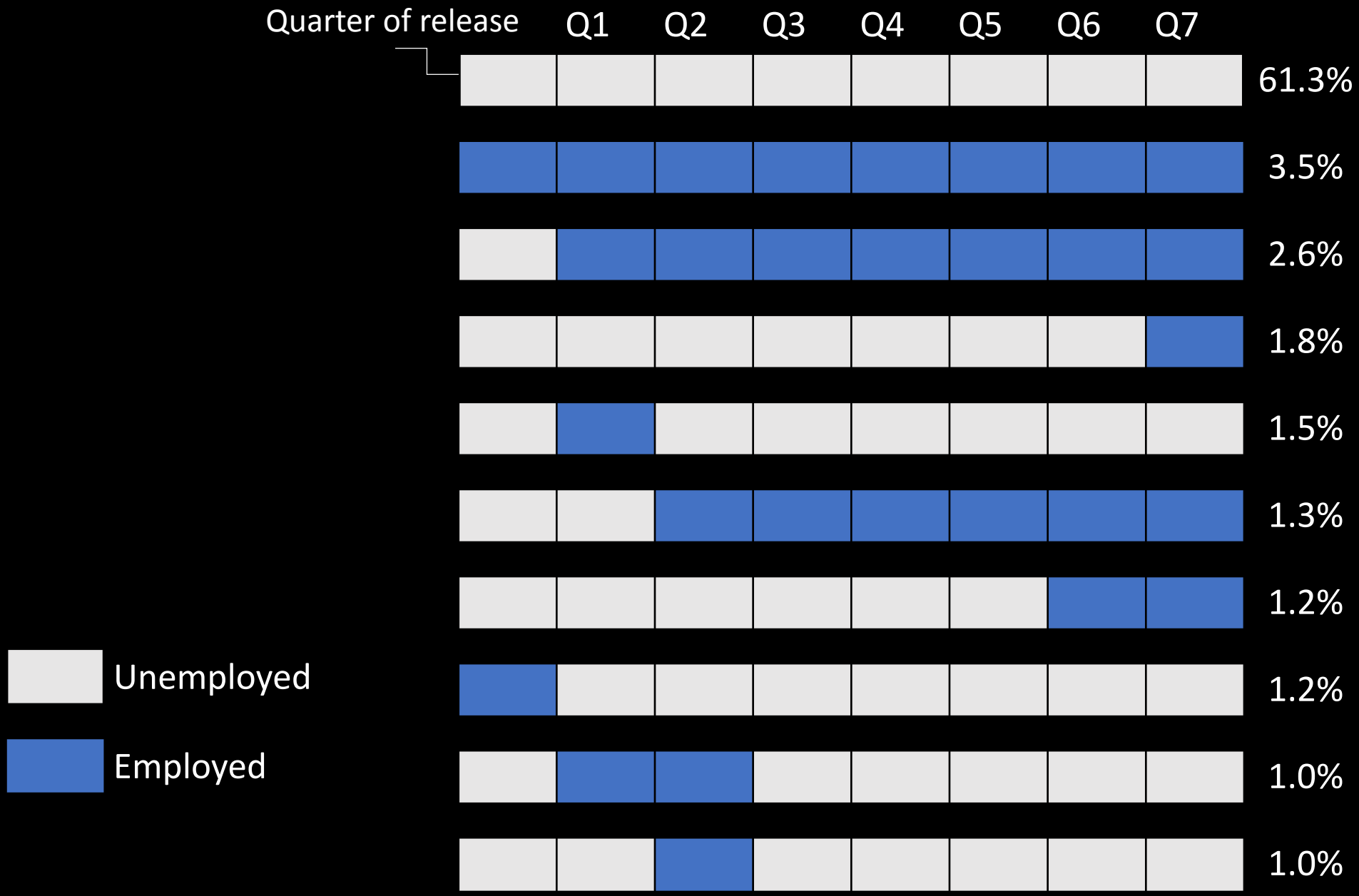
What are the employment patterns of former prisoners over two years following release?

Any Employment During 8 Quarters After Release



Below Poverty Line for 1 Person Household on Average During 8 Quarters After Release

Most Common Employment Patterns



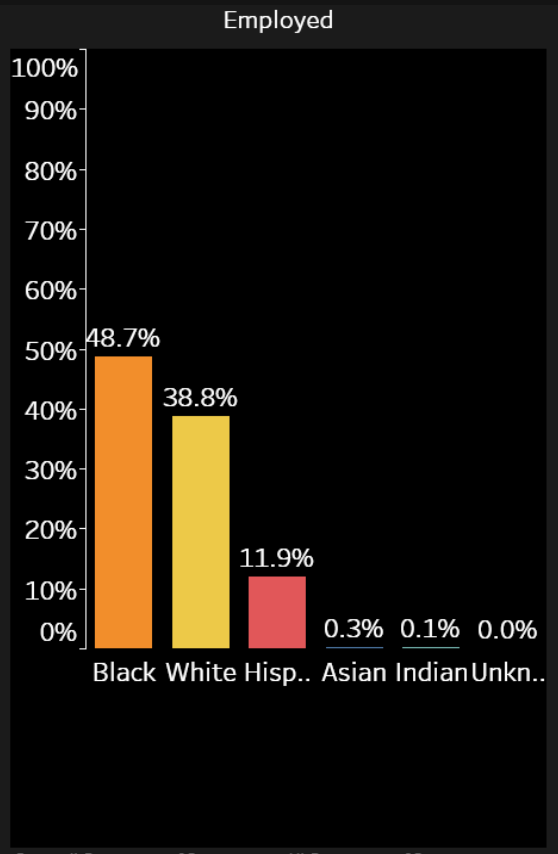
	Employed Persons
	Mean Quarterly Wage
Release quarter	$2,850.88
Quarter 1	$3,021.18
Quarter 2	$3,412.74
Quarter 3	$3,632.26
Quarter 4	$3,801.64
Quarter 5	$3,947.57
Quarter 6	$4,047.96
Quarter 7	$4,122.07

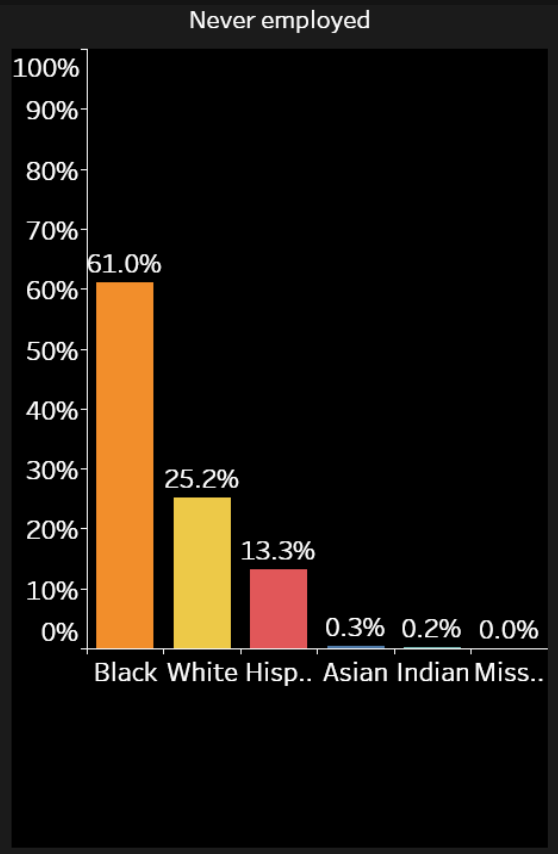
Research Question #2

What are the characteristics of former prisoners who are employed vs. unemployed?

Employed former prisoners more likely to be white or female

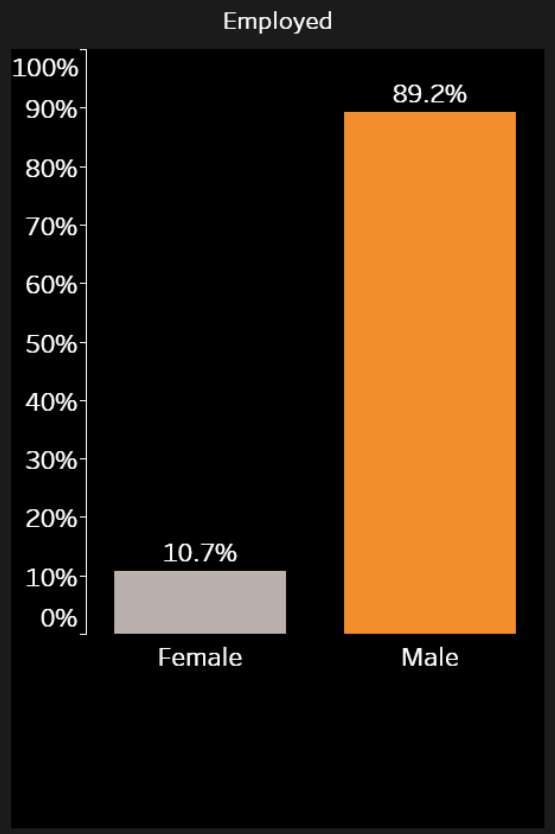
Race

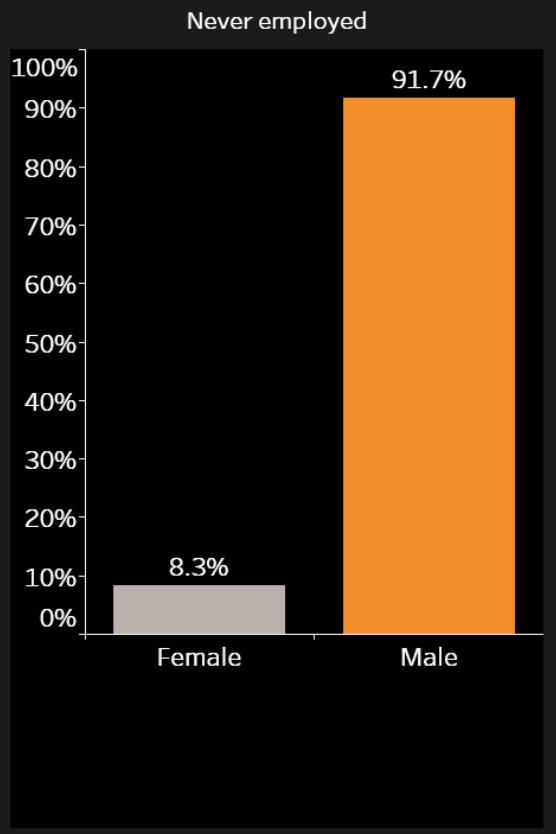




Source: IL Department of Corrections and IL Department of Commerce

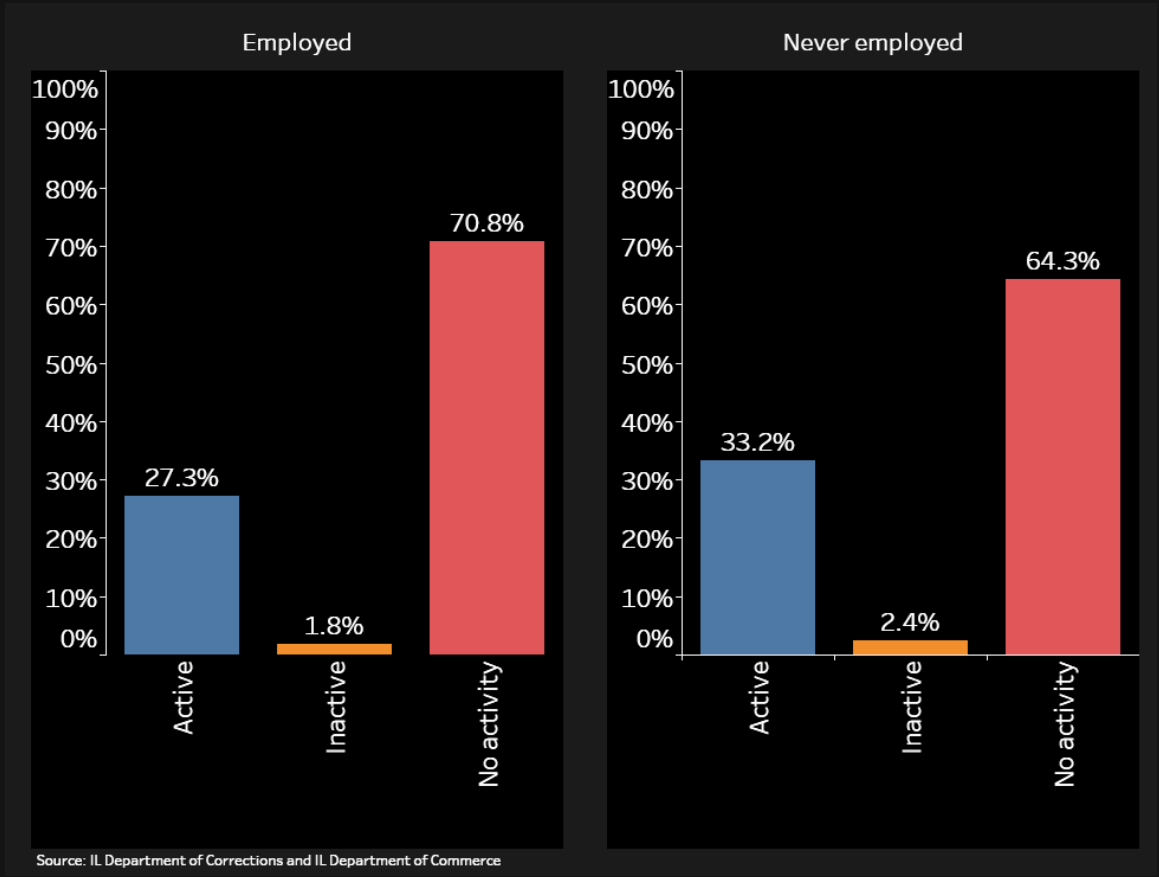
Sex





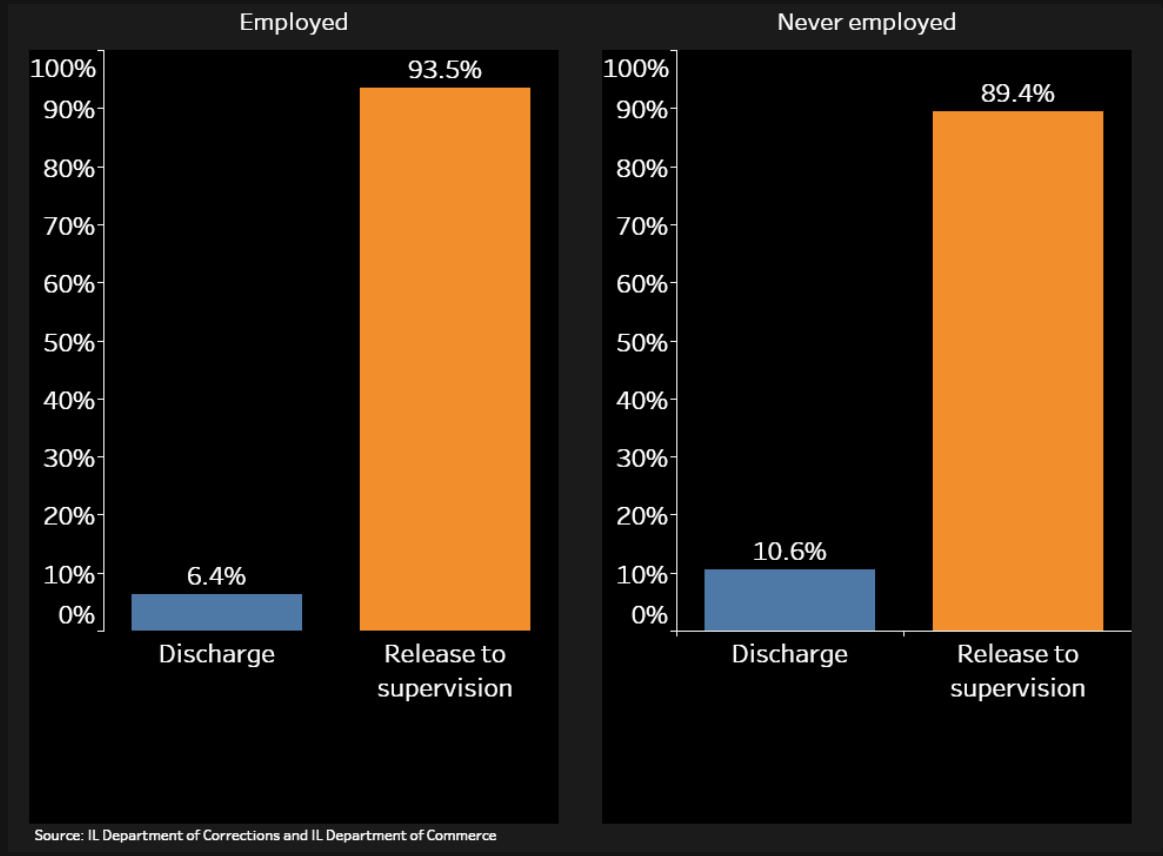
Source: IL Department of Corrections and IL Department of Commerce

Employed former prisoners less likely to be in a gang

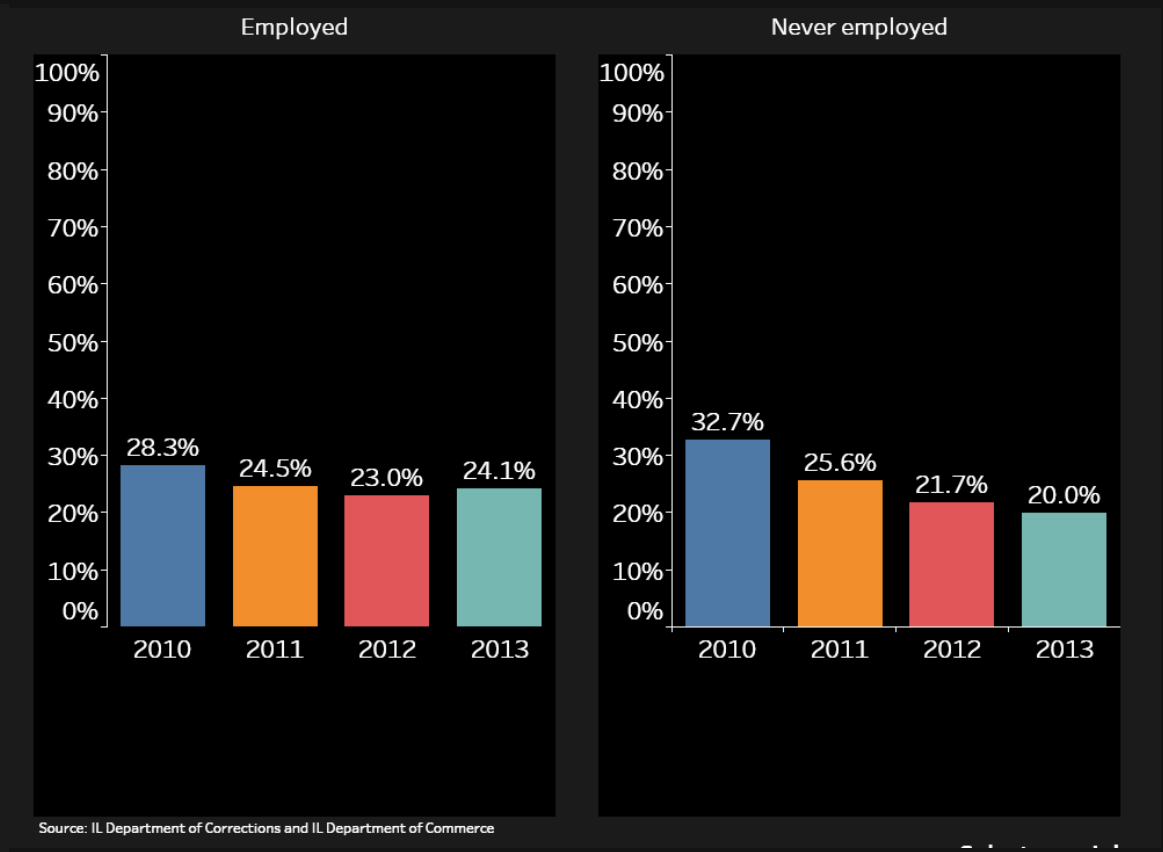


Employed former prisoners more likely to be released to supervision or released in later years

Release type

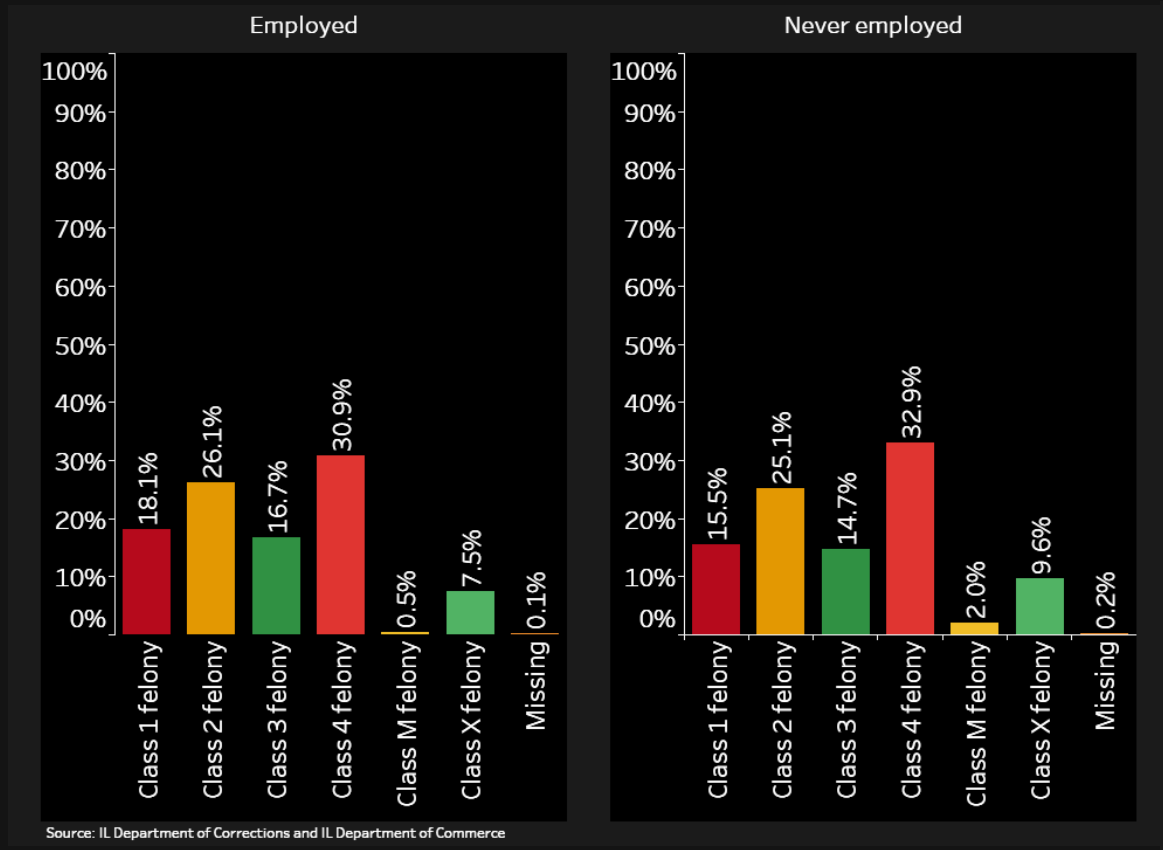


Release year

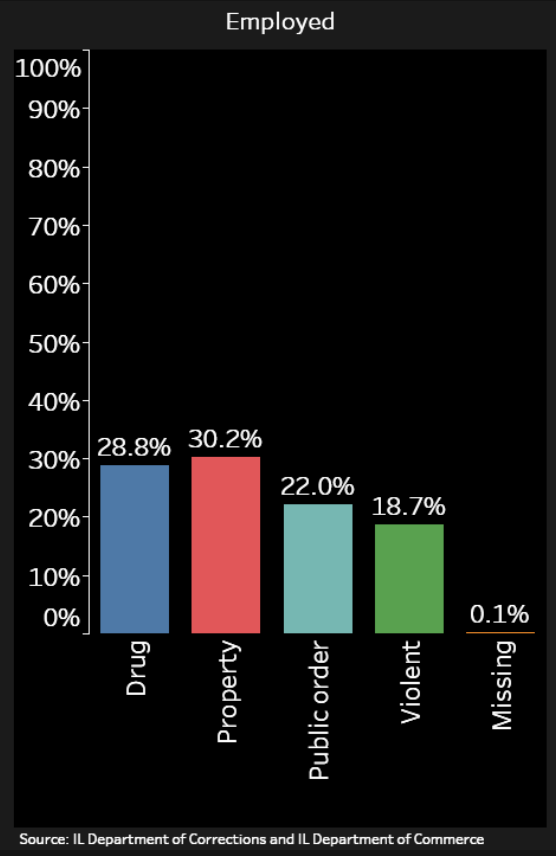


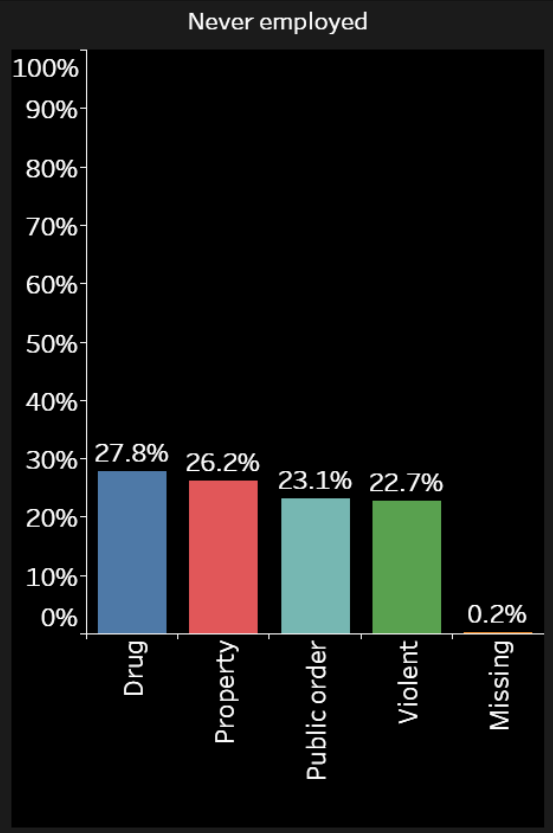
Employed former prisoners less likely to be in prison for the most serious offense types or a violent crime and are more likely to be in prison for a property crime

Holding class



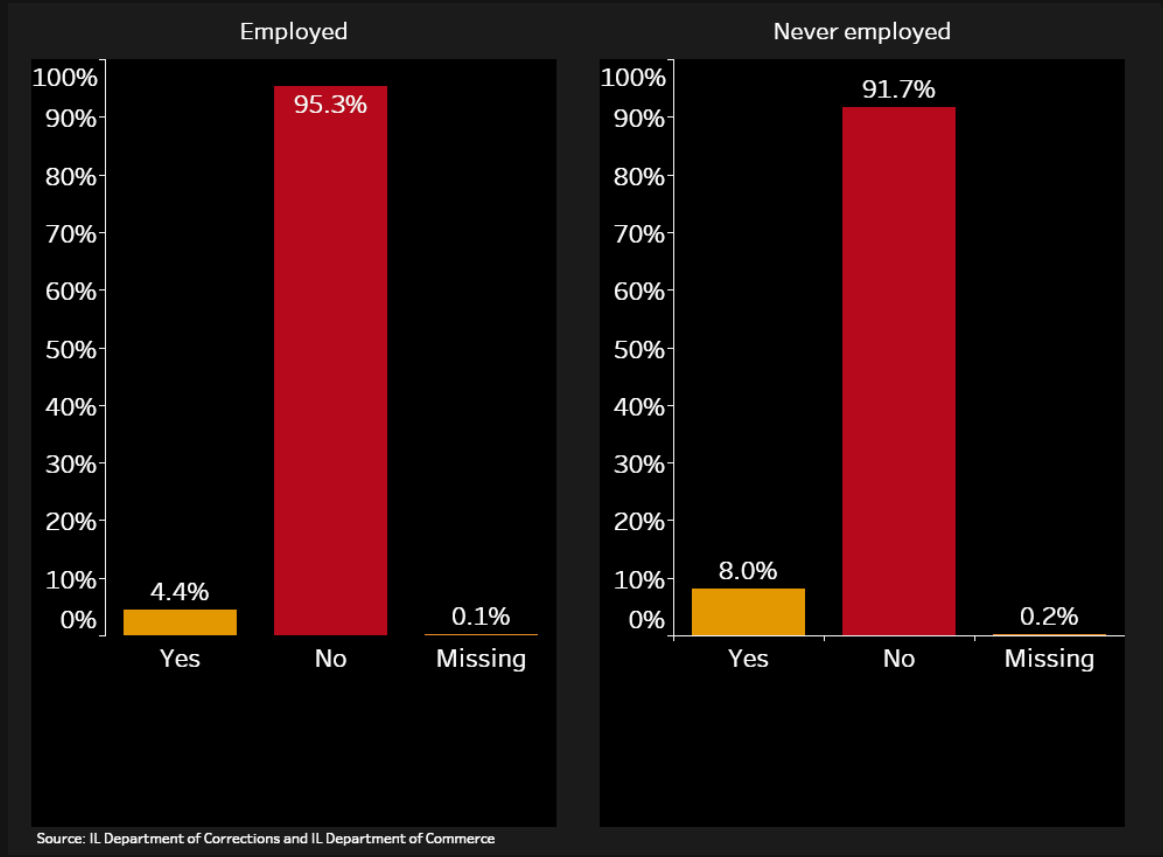
Offense type



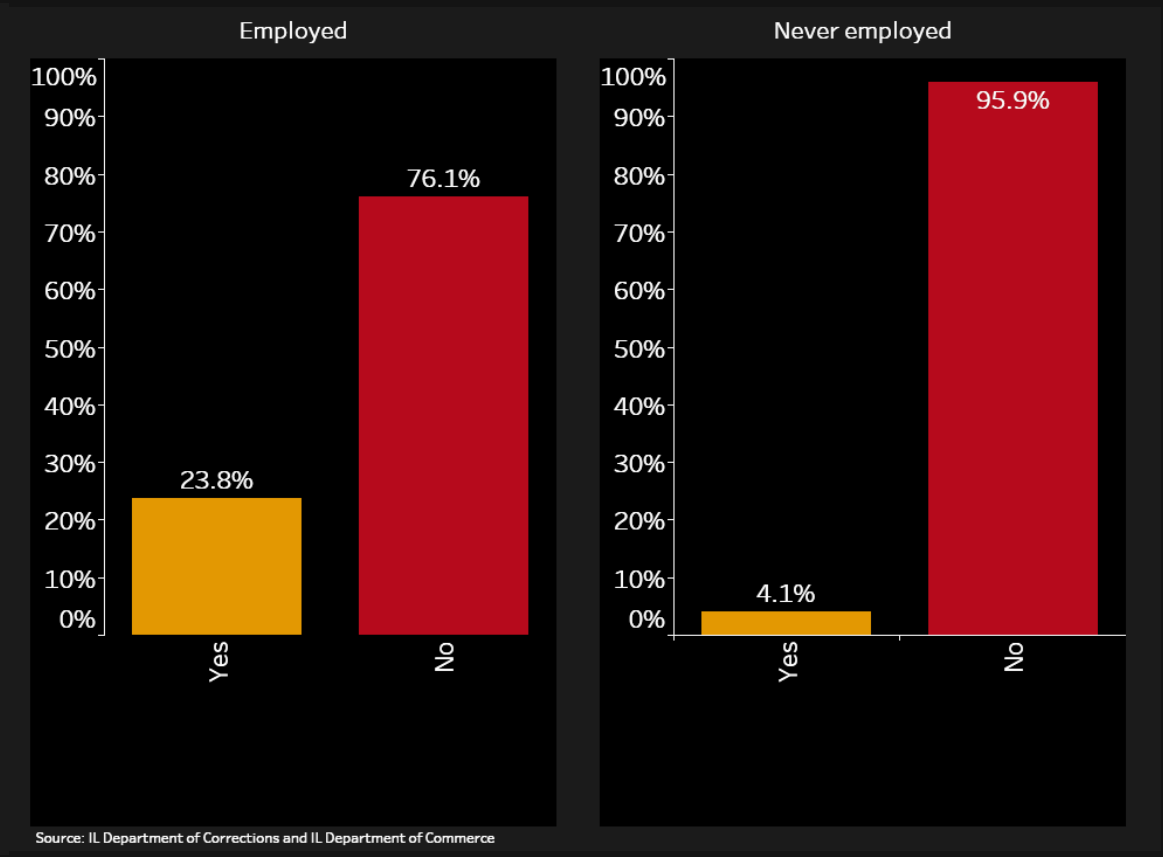


Employed former prisoners less likely to be in prison for a sex offense and more likely to have been employed in the quarter prior to imprisonment

Holding offense sexual

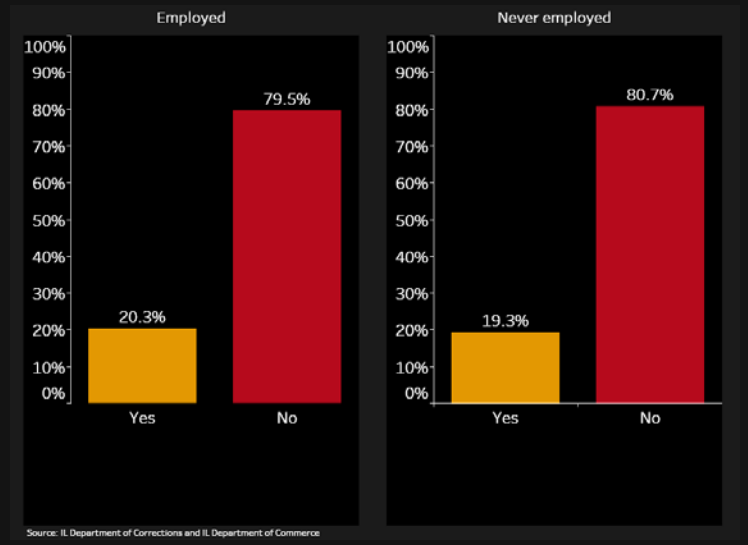


Employed prior to imprisonment

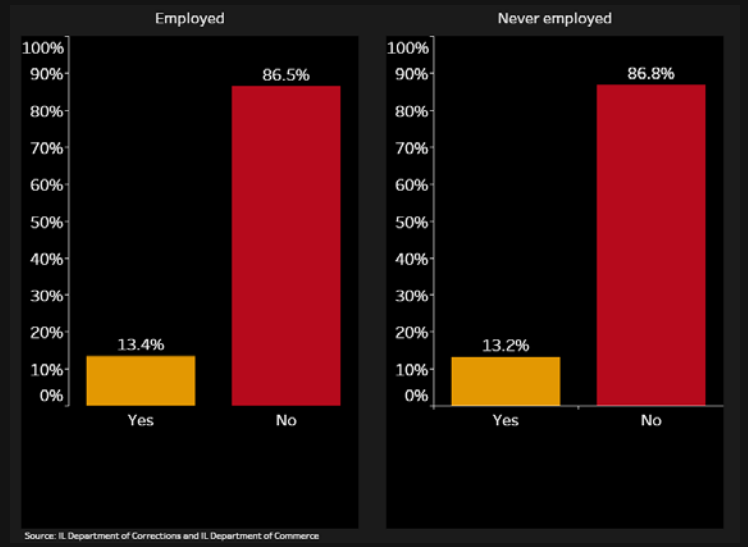


Heroin use more common in those not employed, marijuana and amphetamines more common for employed

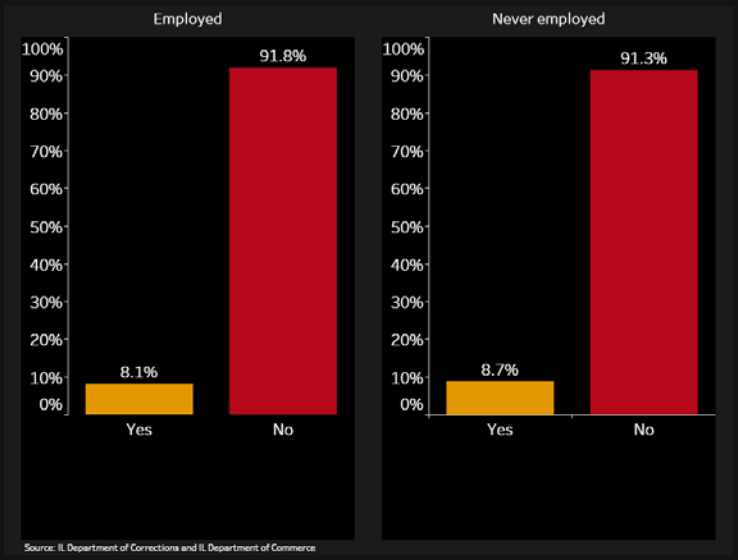
Alcohol



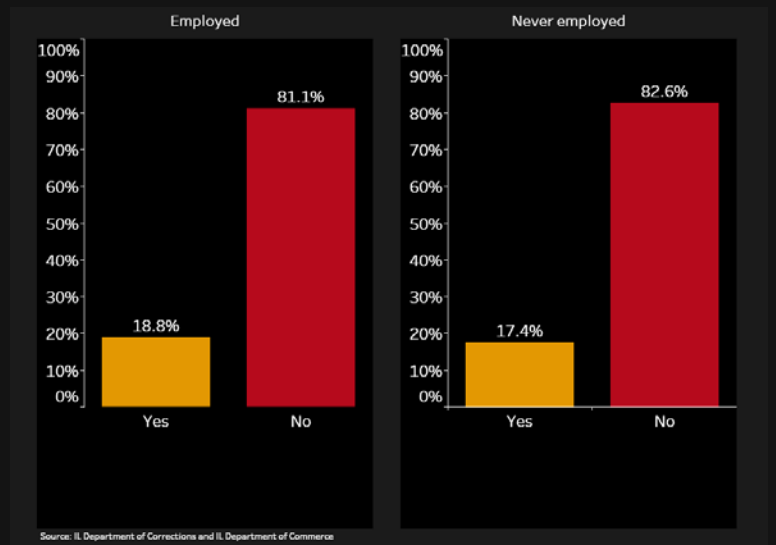
Cocaine



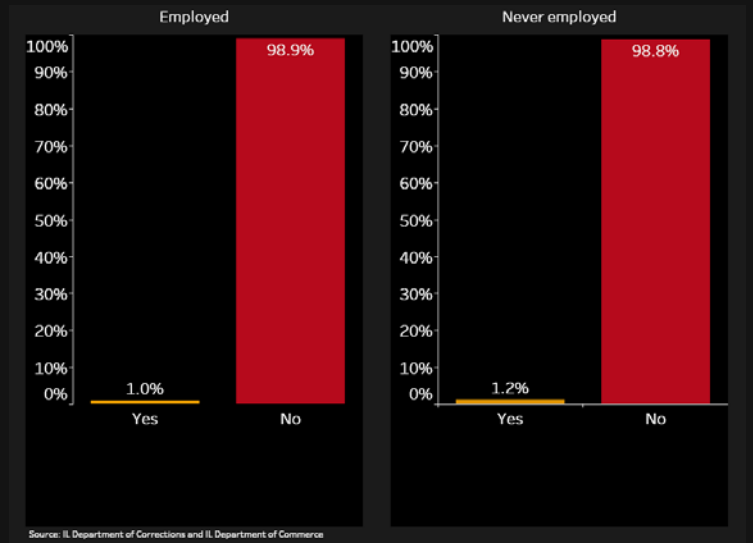
Heroin



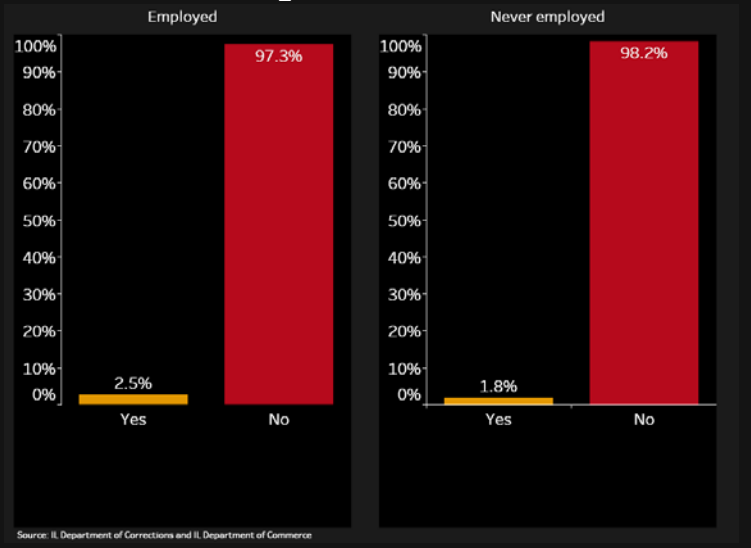
Marijuana



PCP

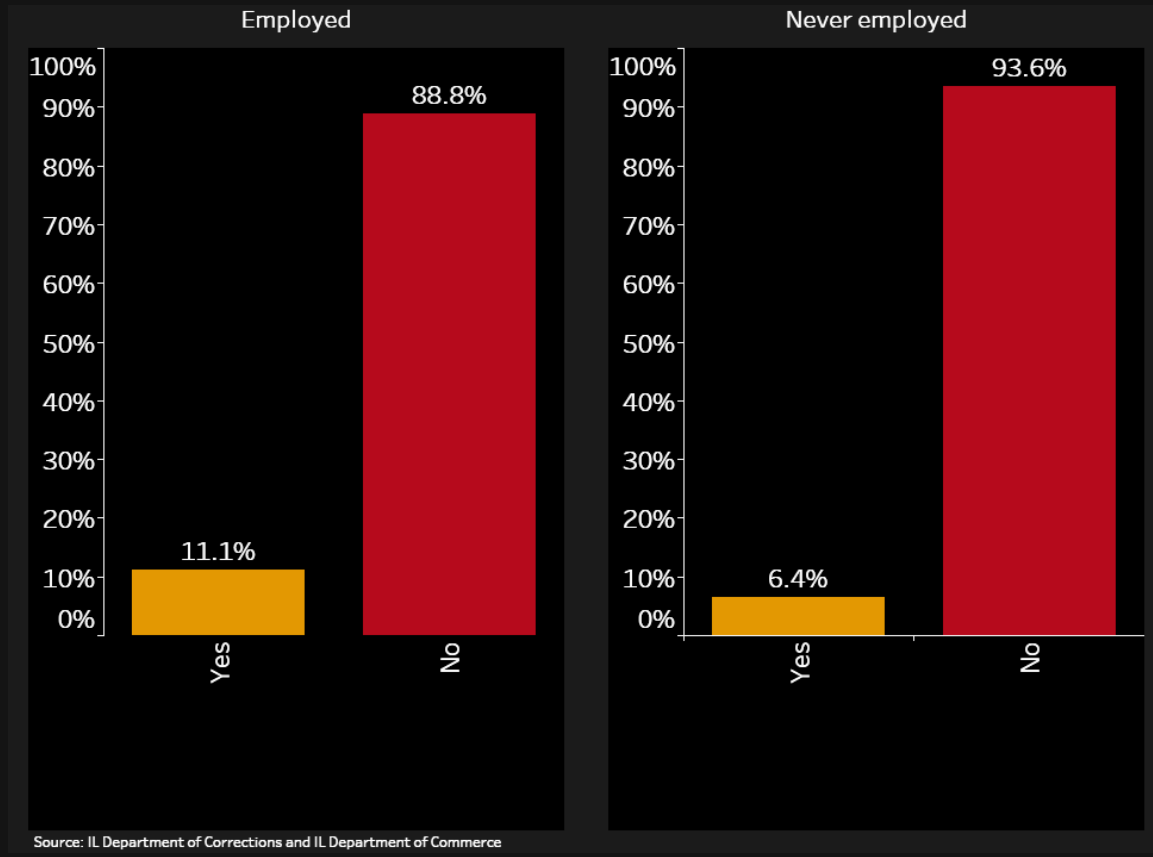


Amphetamines

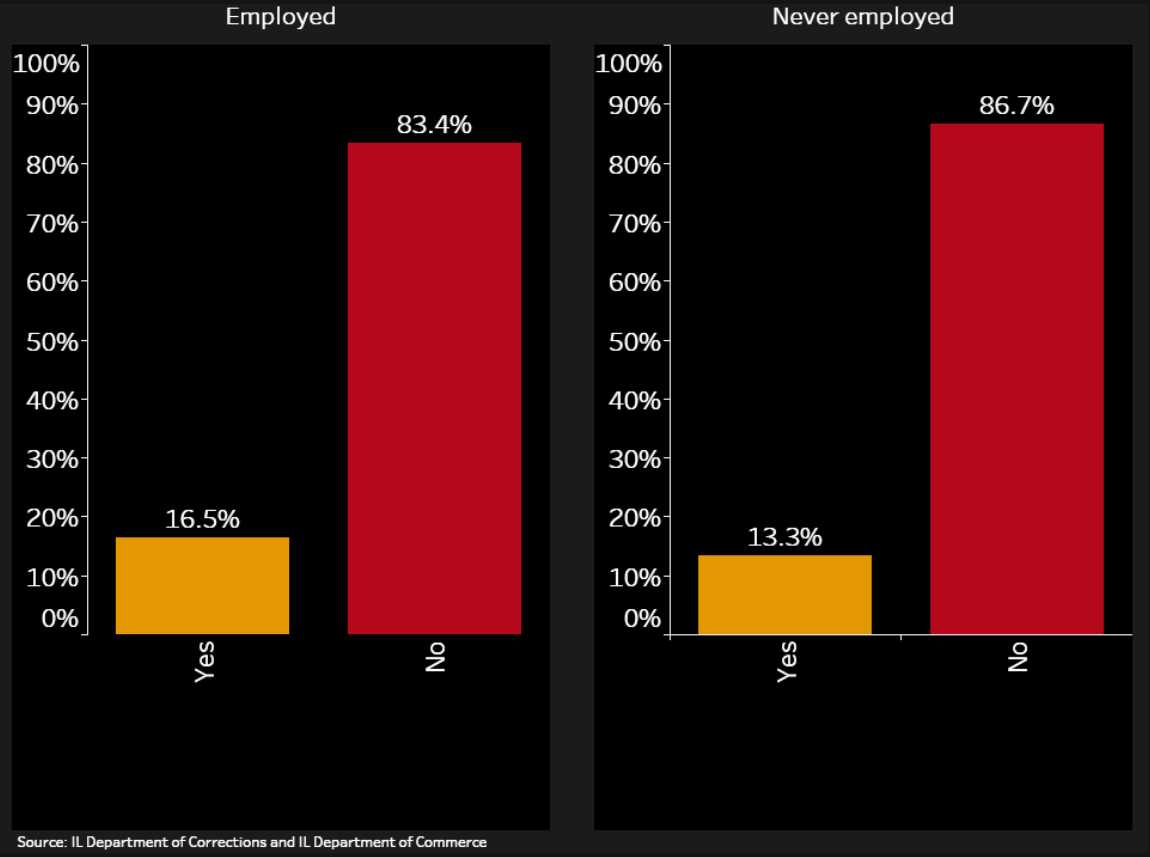


Employed former prisoners more likely to have received substance abuse treatment or education in prison

Substance abuse treatment



Education in prison



Research Question #3

Which prisoners should receive priority for interventions that can increase or enhance employment opportunities after release?

Machine Learning Modelling

- Never-employed (binary outcome) as function of individual characteristics
- Two motivations
  - Who succeeds or fails in the legal labor market post-release? (Exploratory)
    - Can include features describing race/ethnicity
    - E.g., do different disparities persist across racial/ethnic groups?
  - What model best estimates the likelihood of success or failure when considering employment-focused interventions? (Prediction)
    - Best to exclude race/ethnicity (ethical and legal implications)
    - E.g., can observable prisoner characteristics inform program decisions?

Machine Learning Modelling

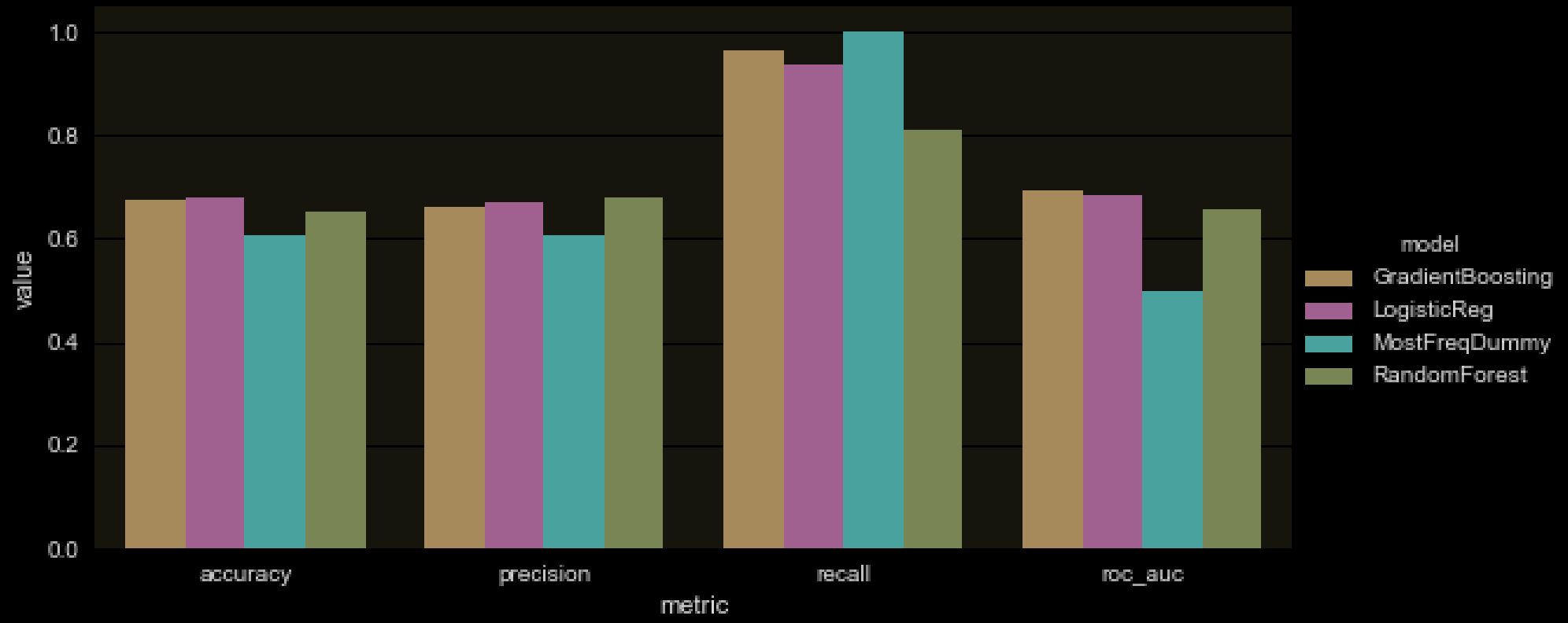
- Selected ML classifiers
  - Logistic regression
    - $y = \Lambda(\alpha + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_K x_K + \epsilon)$
    - Explicitly specify structure of feature interactions
  - Random Forest
    - Ensemble classification method; independent bootstrapping; consecutive and independent (k-dimensional) linear splits of sample spaces
    - Flexible interactions. What are the most important features?
  - Gradient Boosting
    - Repeatedly fitting a tree to classification residual, each tree depends on past trees
  - Most Frequent Dummy
    - Assume everyone obtains the most common outcome (no one get's a job)
    - Benchmark model

Machine Learning Modelling

- Assessing model performance
  - Four measures of classifier performance
    - Accuracy (percentage of outcomes correctly classified)
    - Precision (ratio of true positives to true and false positives)
    - Recall (ratio of true positives to true positives+false negatives)
    - ROC_AUC (Receiver Operating Characteristic_Area under the Curve; how much better or worse is the model doing compared to random assignment?)
  - Group K-fold cross-validation
    - Step 1: Train the classifier with 2011-2013 data, test the model with 2010
    - Step 2: Record model performance measures and model estimates
    - Step 3: Repeat steps 1 and 2 for each year having a turn to be the testing year
    - Step 4: Average measures across years

Model Performance

Group K-fold Cross-Validated Measures of Model Performance for Each Selected Classifier



Relative Feature Importance

Most important features

Predicting being never-employed:

- longer prison time
- being older
- having self-reported use of alcohol and some drugs (e.g., cocaine)
- active gang member

Predicting being employed:

- having employment prior to prison
- having kids
- receiving education in prison

Least important features

- working in prison
- receiving substance abuse treatment
- having self-reported use of some drugs (e.g., PCP, amphetamines)

Limitations

- Wage limitations: no unofficial employment, no out of state, wrong SSN/duplicate issues by SSN
- Quarterly wages (employment may vary within quarter)
- DOC uses some of the information in the prediction models to assign people to job training programs which could introduce bias in the predictions
- May not be valid for other states or other times

Conclusions and Next Steps

- Increasing employment after prison and targeting resources to increase employment can
  - Fulfill the goals of the DOC by reducing recidivism
  - Provide a better return on taxpayer money by targeting resources
  - Can reduce reliance on public assistance
  - Can improve the lives of former prisoners by generating income and enhancing social supports
- Just under 40% of prisoners were ever employed over two years
  - Half of these prisoners were employed by the end of the first full quarter after release
- More than 90% of prisoners were below poverty over two years
  - Compared to 14% in Illinois
  - Wages increased over the quarters but remained low

Conclusions and Next Steps

- Common classification techniques appear to be informative but perhaps more data beyond observed individual characteristics may be needed to increase precision
- Next steps: merge employer data, type of job (industry), wages by industry, length of tenure at job, effect of employment on recidivism, additional geographic analysis