Modeling opioid use using Bayesian methods and understanding drug gateways through network analysis

Team: Datafest2

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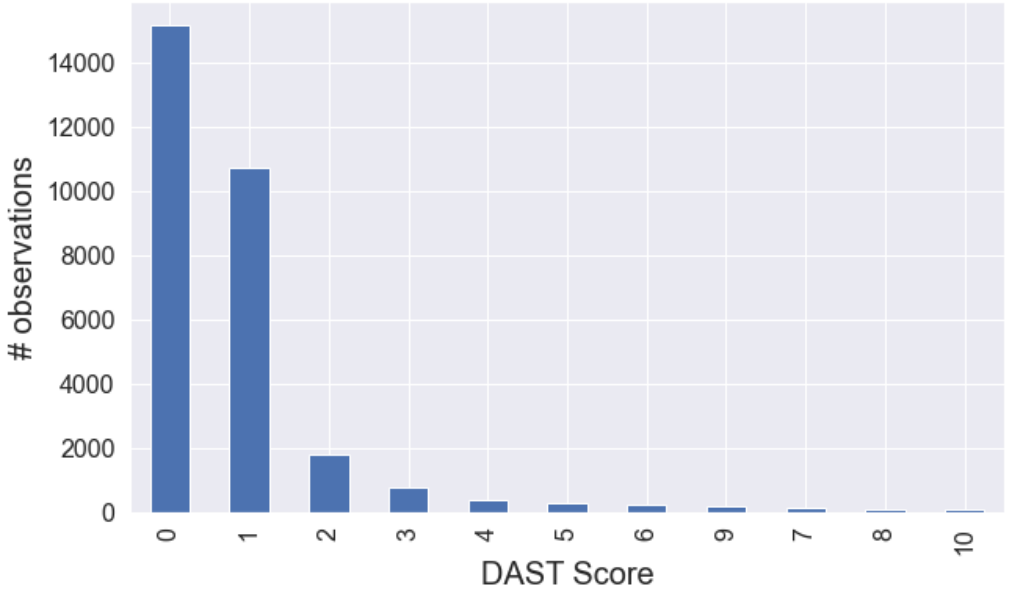
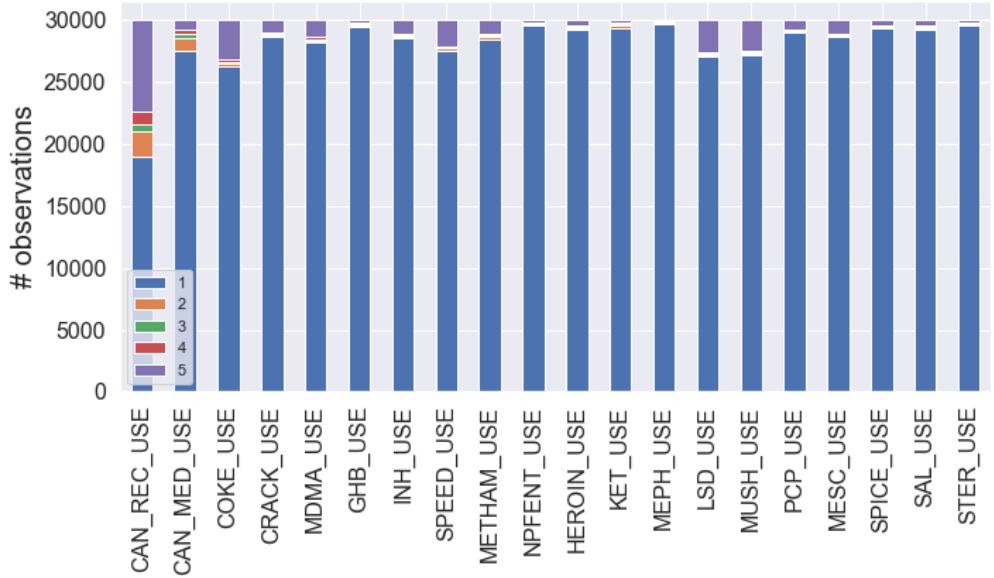
Introduction and Data

- Multiple countries and years of surveys sent out to general population collecting information on:
  - Demographics
  - Drug usage
  - Seeking help
  - DAST scores
- We limit the scope of our analysis to the 2018 U.S. survey
- Frequent drug usage is exceptionally rare, except in the case of cannabis
- Individuals appear to generally "try" drugs but not stick with them, indicated by high lifetime use and low frequent use
- DAST scores appear to follow an exponential distribution with very infrequent high scores





Bayesian Logistic Regression

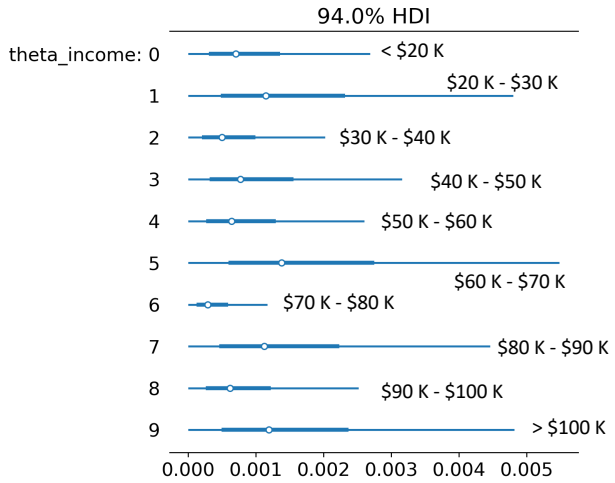
We fit a Bayesian logistic regression model for lifetime non-medical opioid use counts of the form

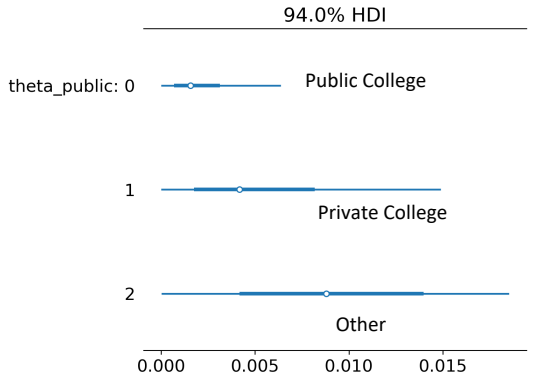
$$
\begin{aligned}
C_i &\sim \text{Binomial}(N_i, p_i) \\
\text{logit}(p_i) &= \alpha_{\textbf{factor}_1}[i] + \delta_{\textbf{factor}_2}[i] \\
\alpha_{\textbf{factor}_1}[j] &\sim \text{Uniform} \\
\delta_{\textbf{factor}_2}[k] &\sim \text{Uniform}
\end{aligned}
$$

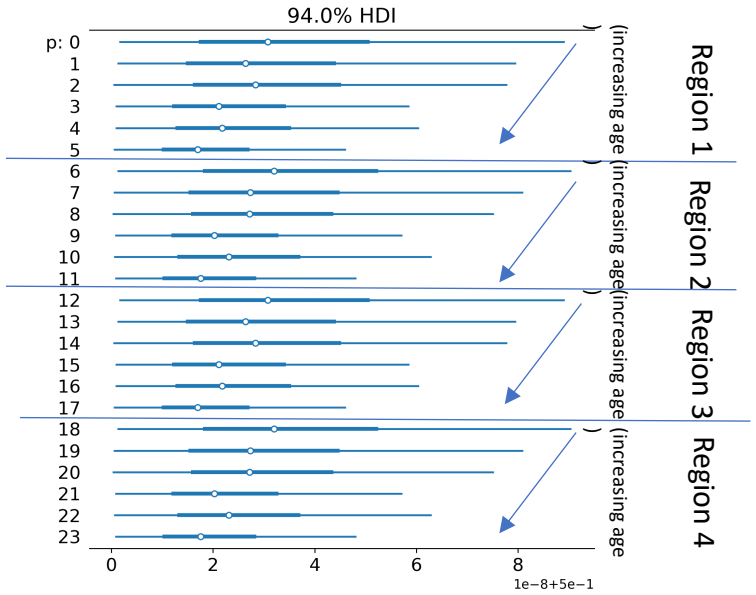
using Markov chain Monte Carlo (MCMC) in PyMC3. We use demographic factors income, marital status, age, region, and university type as covariates to opioid use.

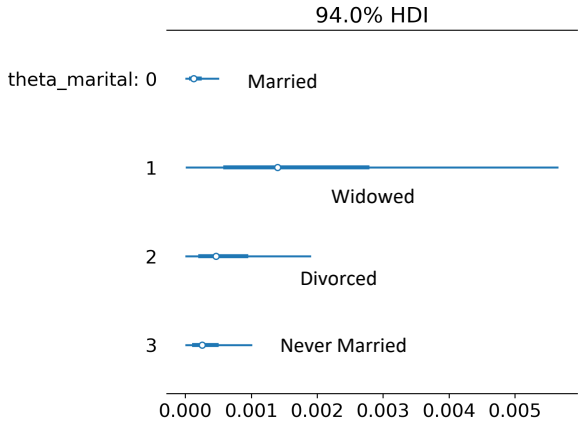
Findings

- Younger individuals appear more likely to use opioids
- Widowers and divorcees appear to use more opioids than married and non-married individuals
- Opioid use appears more prevalent at private universities than public









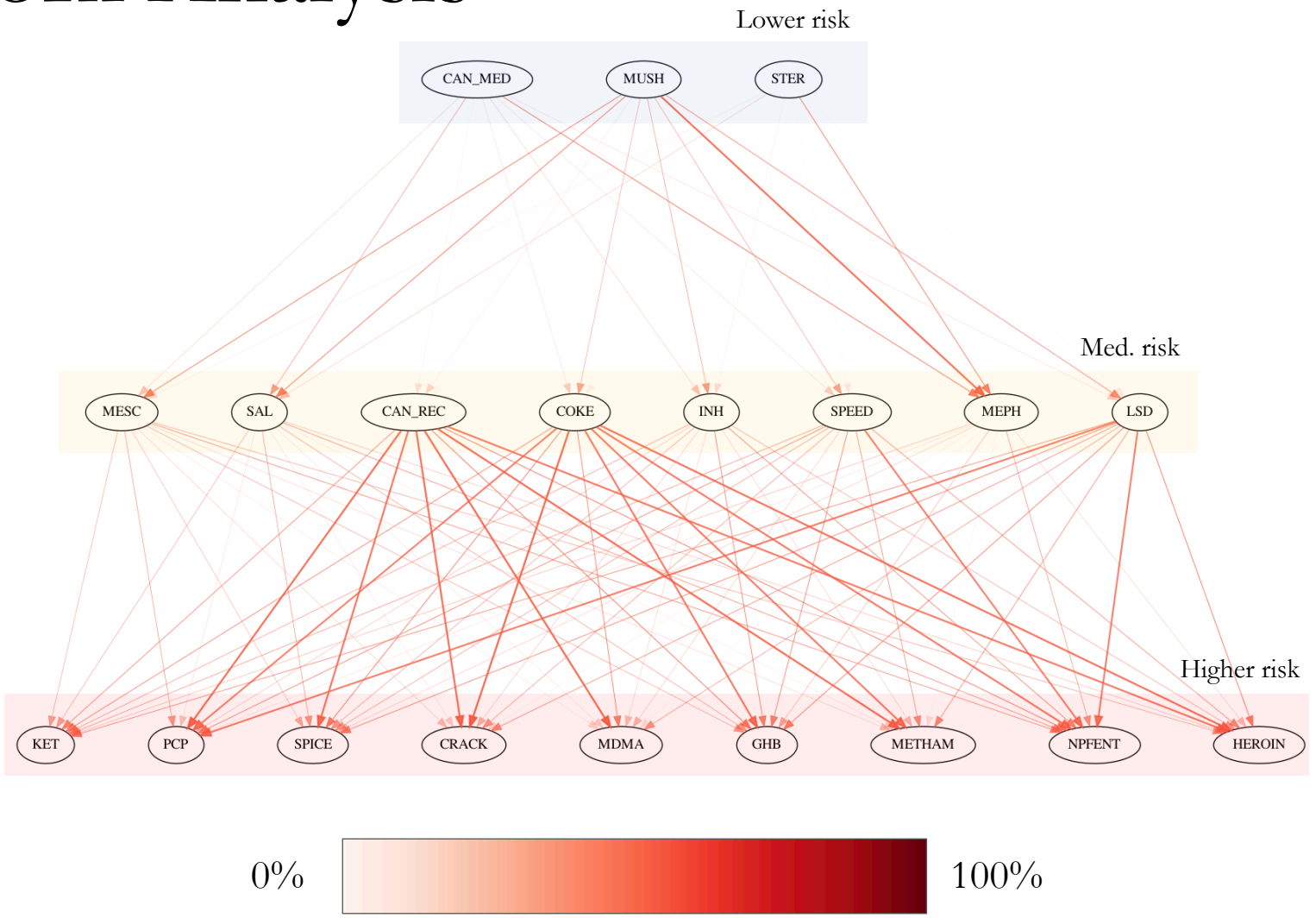
Drug Usage Network Analysis

Overview

- Drugs classified according to ease of acquisition and overall likelihood for potential adverse effects. Assisted by Controlled Substances Act scheduling
- Each edge of the graph represents the proportion of users who use the end node from the subpopulation of users who use the beginning node
  - Ex: CAN_REC -> PCP has an edge of ~0.8 means 80% PCP users are cannabis users

Findings

- **Recreational cannabis, cocaine, and LSD appear to be "gateway drugs"** for other highly addictive drugs
- Difficult to explain uptake in medium-risk drugs



Conclusion and Recommendations

Monitor for cocaine, marijuana, and LSD usage

- Most high-risk drug usage appears to come from individuals who are already using cocaine, marijuana, and LSD
- Health professionals who can identify individuals in these risk groups can educate and dissuade against higher risk drug usage

Support programs for widowers & divorcees

- Drug usage appears disproportionately high in widowed and divorced individuals
- Edwards, *et al.* (2018) confirm these findings, demonstrating higher drug usage in divorced individuals
- Support programs (local meetups, counseling, etc.) could mitigate this

Private university support programs

- Students in Greek life and at private institutions signals higher likelihood of drug abuse
- Colleges should understand and monitor drug usage among their students, particularly those in Greek life