Racialized Packages of Punishment

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Package Preamble

```
library(readr)
library(readxl)
library(tidyr)
library(stringr)
library(dplyr)
library(ggplot2)
library(sem)
library(AER)
library(stargazer)
library(tvthemes)
library(kableExtra)
library(dotwhisker)
```

Data Munging

Analysis with Gross Misdemeanor and Felony Highest Charge Cases

```
#data read
monsanc.short <- read_csv("Data/monsanc.short.csv")
```

```
## Warning: One or more parsing issues, call `problems()` on your data frame for details,
## e.g.:
##   dat <- vroom(...)
##   problems(dat)
```

```
## Rows: 192155 Columns: 174
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr   (32): current_case_number, current_case_status_desc, case_wcl_type_des...
## dbl  (130): case_mkey, file_year, fine_ordered, fine_outstanding, fine_colle...
## lgl    (7): incident_id, hf_flag, petty_flag, misdem_flag, intersection, int...
## dttm   (4): case_filed_date, case_first_final_disposition_date, current_case...
```

```
## date   (1): birth_date
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
#fel only in analytic sample for Rob to construct presumptive prison
#fel_only <- monsanc.short[monsanc.short$felony_flag==1,] %>%
 # select(current_case_number)

#write_csv(fel_only, "SCAO_felony_cases.csv")

#joining presumptive prison indicator
mnsg <- read_csv("Data/SCAO_felony_cases_w_presumpt.csv") %>%
  mutate(presum_pris = if_else(presumpt=="Commit", 1, 0))
```

```
## Rows: 67289 Columns: 2
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (2): current_case_number, presumpt
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
monsanc.short <- monsanc.short %>%
  left_join(mnsg, by = "current_case_number") %>%
  mutate(presum_pris = if_else(is.na(presum_pris), 0, presum_pris))
```

Table 1: Descriptive Statistics

```
monsanc.ds <- as.data.frame(monsanc.short[,c("conf_minus_stayed_ts",
                                             "total_ff",
                                    "prob_days",
                                   "white", "black", "hispanic",
                                   "asian", "nativeam",
                                   "other.race", "race.miss",
                                   "male", "age", "trial_flag",
                                   "priors", "pubdef", "perc_credit",
                                   "perc_stayed",
                                   "felony_flag", "gm_flag",
                                   "violent_flag", "drug_flag","alcohol_flag",
                                   "presum_pris",
                                   "filed_district_01", "filed_district_02",
                                   "filed_district_03",
                                   "filed_district_04", "filed_district_05",
                                   "filed_district_06", "filed_district_07",
                                   "filed_district_08", "filed_district_09",
                                   "filed_district_10",
                                   "sentence_year_2004","sentence_year_2005",
```

```
                                  "sentence_year_2006","sentence_year_2007",
                                  "sentence_year_2008","sentence_year_2009",
                                  "sentence_year_2010","sentence_year_2011",
                                  "sentence_year_2012",
                                  "sentence_year_2013", "sentence_year_2014",
                                  "sentence_year_2015", "sentence_year_2016",
                                  "sentence_year_2017",
                                  "cap_ratio")])

stargazer(monsanc.ds,
          covariate.labels = c("Incarceration Days",
                               "Total Fine/Fee Order",
                               "Probation Days",
                                 "White", "Black", "Hispanic",
                                 "Asian", "Native American",
                                 "Other Race", "Missing Race",
                                 "Male", "Age", "Trial",
                                 "Priors", "Public Defender",
                                 "Percent Credit", "Percent Stayed",
                                 "Felony", "Gross Misdemeanor",
                                 "Violent", "Drug","Alcohol/DUI",
                               "Presumptive Prison",
                               "Judicial District 1", "Judicial District 2",
                               "Judicial District 3", "Judicial District 4",
                               "Judicial District 5", "Judicial District 6",
                               "Judicial District 7", "Judicial District 8",
                               "Judicial District 9",
                               "Judicial District 10",
                               "Year - 2004", "Year - 2005",
                               "Year - 2006", "Year - 2007",
                               "Year - 2008", "Year - 2009",
                               "Year - 2010",
                               "Year - 2011", "Year - 2012",
                               "Year - 2013", "Year - 2014", "Year - 2015",
                               "Year - 2016", "Year - 2017",
                               "County-Level Capacity Ratio"),
          type="latex",
          style="asr",
          title="Descriptive Statistics for Variables SCAO, MNSG, and VERA Jail Data",
          summary=T,
          median=T,
          header = F)
```

Figure 1: Punishment Amounts by Race and Type

```
#faceted bar graph
fig1 <- monsanc.short %>%
```

Table 1: Descriptive Statistics for Variables SCAO, MNSG, and VERA Jail Data

Statistic	N	Mean	St. Dev.	Min	Median	Max
Incarceration Days	192,155	198.950	835.039	0	10	62,050
Total Fine/Fee Order	192,155	433.390	917.983	0.000	250.160	318,082.700
Probation Days	192,155	761.887	882.966	0	730	7,300
White	192,155	0.609	0.488	0	1	1
Black	192,155	0.162	0.368	0	0	1
Hispanic	192,155	0.057	0.233	0	0	1
Asian	192,155	0.021	0.143	0	0	1
Native American	192,155	0.059	0.236	0	0	1
Other Race	192,155	0.013	0.112	0	0	1
Missing Race	192,155	0.079	0.269	0	0	1
Male	192,155	0.785	0.411	0	1	1
Age	192,155	33.455	11.247	15	31	100
Trial	192,155	0.0004	0.019	0	0	1
Priors	192,155	2.977	4.015	0	2	84
Public Defender	192,155	0.595	0.491	0	1	1
Percent Credit	192,155	14.251	30.374	0.000	0.274	100.000
Percent Stayed	192,155	43.680	45.792	0.000	0.000	100.000
Felony	192,155	0.350	0.477	0	0	1
Gross Misdemeanor	192,155	0.618	0.486	0	1	1
Violent	192,155	0.197	0.397	0	0	1
Drug	192,155	0.131	0.337	0	0	1
Alcohol/DUI	192,155	0.314	0.464	0	0	1
Presumptive Prison	192,155	0.077	0.266	0	0	1
Judicial District 1	192,155	0.142	0.349	0	0	1
Judicial District 2	192,155	0.081	0.273	0	0	1
Judicial District 3	192,155	0.093	0.290	0	0	1
Judicial District 4	192,155	0.217	0.413	0	0	1
Judicial District 5	192,155	0.065	0.247	0	0	1
Judicial District 6	192,155	0.061	0.239	0	0	1
Judicial District 7	192,155	0.099	0.298	0	0	1
Judicial District 8	192,155	0.032	0.175	0	0	1
Judicial District 9	192,155	0.083	0.276	0	0	1
Judicial District 10	192,155	0.128	0.334	0	0	1
Year - 2004	192,155	0.039	0.193	0	0	1
Year - 2005	192,155	0.082	0.274	0	0	1
Year - 2006	192,155	0.127	0.333	0	0	1
Year - 2007	192,155	0.155	0.362	0	0	1
Year - 2008	192,155	0.052	0.222	0	0	1
Year - 2009	192,155	0.008	0.090	0	0	1
Year - 2010	192,155	0.002	0.048	0	0	1
Year - 2011	192,155	0.029	0.169	0	0	1
Year - 2012	192,155	0.033	0.178	0	0	1
Year - 2013	192,155	0.121	0.326	0	0	1
Year - 2014	192,155	0.172	0.378	0	0	1
Year - 2015	192,155	0.103	0.304	0	0	1
Year - 2016	192,155	0.069	0.254	0	0	1
Year - 2017	192,155	0.008	0.090	0	0	1
County-Level Capacity Ratio	192,155	0.793	0.221	0.200	0.811	2.267

```r
  select(race_impute, total_ff,
         conf_minus_stayed_ts, prob_days) %>%
 mutate(Race = case_when(
    race_impute=="asian"~"Asian",
    race_impute=="black"~"Black",
    race_impute=="hispanic"~"Hispanic",
    race_impute=="nat. am."~"Nat. Am.",
    race_impute=="other"~"Other",
    race_impute=="white"~"White"
  )) %>%
  filter(!is.na(Race)) %>%
  select(-race_impute) %>%
  group_by(Race) %>%
  summarize(LFO = mean(total_ff, na.rm = T),
            Incarceration = mean(conf_minus_stayed_ts, na.rm = T),
            Probation = mean(prob_days, na.rm = T)) %>%
  mutate(Race = factor(Race,
                       levels = c("White", "Black",
                                  "Hispanic", "Asian",
                                  "Nat. Am.", "Other"))) %>%
  pivot_longer(cols = c("LFO", "Incarceration", "Probation"),
               names_to = "punishment",
               values_to = "amount") %>%
  ggplot()+
  geom_bar(aes(x=Race, y=amount, fill = Race),
           color = "black",
           stat="identity",
           position = position_dodge2())+
  geom_text(aes(x=Race, y=amount+25,
              label = round(amount,0)),
          position = position_dodge2(width = 1))+
  facet_wrap(~punishment)+
  labs(title = "Figure 1: Punishment Amounts by Defendant Race",
       subtitle = "MN SCAO 2004-2015",
       y = "Amount (Days/USD/Days)")+
  tvthemes::scale_fill_westeros(palette = "Stark")+
  theme_classic()+
  theme(legend.position = "none"#,
        #text=element_text(family="Times New Roman")
        )

fig1
```

Figure 1: Punishment Amounts by Defendant Race

MN SCAO 2004−2015

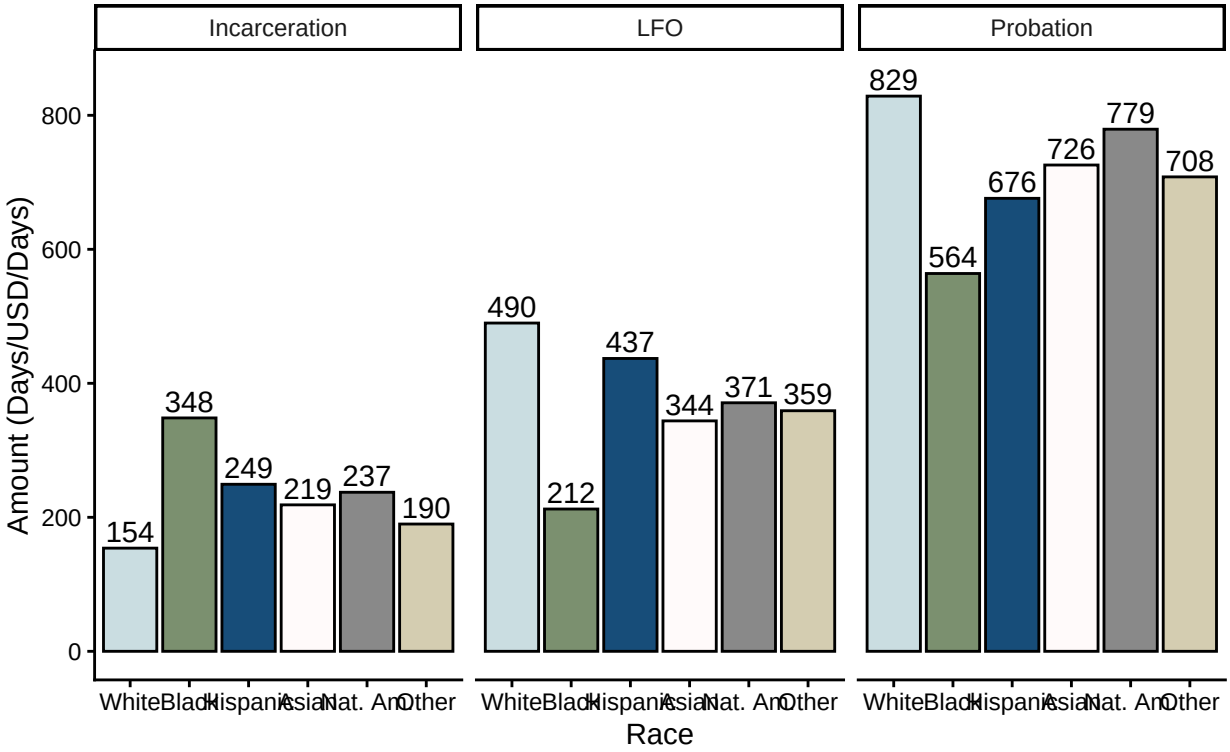


Table 2: Multivariate Regression of Punishment

$$Y_{ik} = \alpha_k + \sum \pi_{jk} Race_{ij} + \sum \beta_{jk} X_{ij} + \theta_{dk} + \lambda_{tk} + \epsilon_{ik}$$

```
#multivariate regression
mv <- lm(cbind(log(conf_minus_stayed_ts_log+1),
               log(prob_days+1),
               log(total_ff+1))~
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
                 male+log(age)+
                  priors+pubdef+perc_credit+
           perc_stayed+trial_flag+
                 felony_flag+gm_flag+
                 violent_flag+drug_flag+alcohol_flag+
                 filed_district+
                 as.factor(sentence_year),
         data = monsanc.short)

summary(mv)
```

```
## Response log(conf_minus_stayed_ts_log + 1) :
##
```

```
## Call:
## lm(formula = `log(conf_minus_stayed_ts_log + 1)` ~ black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     filed_district + as.factor(sentence_year), data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.3250 -0.6240  0.1805  0.5788  2.2837
##
## Coefficients:
##                                  Estimate Std. Error  t value Pr(>|t|)
## (Intercept)                     7.747e-01  2.055e-02   37.706  < 2e-16 ***
## black                           3.715e-03  4.956e-03    0.750  0.45343
## hispanic                        3.414e-02  7.139e-03    4.782 1.74e-06 ***
## asian                          -2.866e-02  1.153e-02   -2.486  0.01293 *
## nativeam                        9.826e-02  7.191e-03   13.665  < 2e-16 ***
## other.race                     -4.551e-02  1.447e-02   -3.145  0.00166 **
## race.miss                      -1.344e-01  6.208e-03  -21.650  < 2e-16 ***
## male                            2.222e-01  4.002e-03   55.515  < 2e-16 ***
## log(age)                        8.414e-02  5.138e-03   16.377  < 2e-16 ***
## priors                          2.092e-02  4.337e-04   48.241  < 2e-16 ***
## pubdef                          1.162e-01  3.614e-03   32.146  < 2e-16 ***
## perc_credit                    -9.774e-03  5.991e-05 -163.130  < 2e-16 ***
## perc_stayed                    -5.095e-03  4.914e-05 -103.694  < 2e-16 ***
## trial_flag                      4.700e-01  8.322e-02    5.648 1.63e-08 ***
## felony_flag                     5.096e-02  5.655e-03    9.011  < 2e-16 ***
## gm_flag                        -2.875e-01  5.524e-03  -52.034  < 2e-16 ***
## violent_flag                    9.629e-02  4.841e-03   19.893  < 2e-16 ***
## drug_flag                      -6.086e-02  5.623e-03  -10.825  < 2e-16 ***
## alcohol_flag                    3.478e-01  4.323e-03   80.449  < 2e-16 ***
## filed_district02                4.207e-01  7.520e-03   55.949  < 2e-16 ***
## filed_district03               -1.161e-03  7.021e-03   -0.165  0.86862
## filed_district04                3.437e-01  6.239e-03   55.085  < 2e-16 ***
## filed_district05                1.386e-01  7.962e-03   17.405  < 2e-16 ***
## filed_district06               -9.576e-03  8.224e-03   -1.164  0.24430
## filed_district07                4.765e-01  7.055e-03   67.532  < 2e-16 ***
## filed_district08                3.167e-01  1.027e-02   30.831  < 2e-16 ***
## filed_district09                3.099e-01  7.556e-03   41.011  < 2e-16 ***
## filed_district10                3.300e-01  6.564e-03   50.278  < 2e-16 ***
## as.factor(sentence_year)2005 -7.747e-02  1.001e-02   -7.736 1.03e-14 ***
## as.factor(sentence_year)2006 -1.555e-01  9.516e-03  -16.342  < 2e-16 ***
## as.factor(sentence_year)2007 -2.185e-01  9.463e-03  -23.095  < 2e-16 ***
## as.factor(sentence_year)2008 -2.830e-01  1.125e-02  -25.158  < 2e-16 ***
## as.factor(sentence_year)2009 -2.932e-01  1.988e-02  -14.751  < 2e-16 ***
## as.factor(sentence_year)2010 -3.235e-01  3.446e-02   -9.386  < 2e-16 ***
## as.factor(sentence_year)2011 -3.607e-01  1.283e-02  -28.102  < 2e-16 ***
```

```
## as.factor(sentence_year)2012 -3.789e-01  1.246e-02  -30.415  < 2e-16 ***
## as.factor(sentence_year)2013 -3.512e-01  9.893e-03  -35.500  < 2e-16 ***
## as.factor(sentence_year)2014 -4.021e-01  9.628e-03  -41.760  < 2e-16 ***
## as.factor(sentence_year)2015 -4.006e-01  1.020e-02  -39.275  < 2e-16 ***
## as.factor(sentence_year)2016 -4.453e-01  1.082e-02  -41.168  < 2e-16 ***
## as.factor(sentence_year)2017 -3.390e-01  1.999e-02  -16.957  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7079 on 192114 degrees of freedom
## Multiple R-squared:  0.2687, Adjusted R-squared:  0.2686
## F-statistic:  1765 on 40 and 192114 DF,  p-value: < 2.2e-16
##
##
## Response log(prob_days + 1) :
##
## Call:
## lm(formula = `log(prob_days + 1)` ~ black + hispanic + asian +
##     nativeam + other.race + race.miss + male + log(age) + priors +
##     pubdef + perc_credit + perc_stayed + trial_flag + felony_flag +
##     gm_flag + violent_flag + drug_flag + alcohol_flag + filed_district +
##     as.factor(sentence_year), data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.6135 -1.5760  0.3494  1.8212  8.7894
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  2.6054690  0.0735869  35.407  < 2e-16 ***
## black                       -0.2089697  0.0177500 -11.773  < 2e-16 ***
## hispanic                    -0.3388478  0.0255709 -13.251  < 2e-16 ***
## asian                        0.0822783  0.0412959   1.992  0.04633 *
## nativeam                    -0.2304067  0.0257546  -8.946  < 2e-16 ***
## other.race                  -0.0124129  0.0518281  -0.240  0.81072
## race.miss                    0.0415446  0.0222350   1.868  0.06170 .
## male                        -0.5913992  0.0143351 -41.255  < 2e-16 ***
## log(age)                    -0.4465255  0.0184026 -24.264  < 2e-16 ***
## priors                      -0.0479442  0.0015532 -30.867  < 2e-16 ***
## pubdef                      -0.0124729  0.0129458  -0.963  0.33531
## perc_credit                  0.0103471  0.0002146  48.217  < 2e-16 ***
## perc_stayed                  0.0191103  0.0001760 108.586  < 2e-16 ***
## trial_flag                  -0.9281100  0.2980525  -3.114  0.00185 **
## felony_flag                  1.1547271  0.0202558  57.007  < 2e-16 ***
## gm_flag                      0.9618783  0.0197866  48.613  < 2e-16 ***
## violent_flag                 0.2808576  0.0173373  16.200  < 2e-16 ***
## drug_flag                    0.9029102  0.0201384  44.835  < 2e-16 ***
## alcohol_flag                 1.4870127  0.0154828  96.043  < 2e-16 ***
```

```
## filed_district02             -1.4017656  0.0269347 -52.043  < 2e-16 ***
## filed_district03             -0.3047171  0.0251468 -12.118  < 2e-16 ***
## filed_district04             -2.0765759  0.0223479 -92.920  < 2e-16 ***
## filed_district05             -0.3131094  0.0285184 -10.979  < 2e-16 ***
## filed_district06             -0.6676371  0.0294570 -22.665  < 2e-16 ***
## filed_district07             -0.7072016  0.0252698 -27.986  < 2e-16 ***
## filed_district08             -0.2328811  0.0367908  -6.330 2.46e-10 ***
## filed_district09             -0.3944672  0.0270644 -14.575  < 2e-16 ***
## filed_district10             -0.2513156  0.0235103 -10.690  < 2e-16 ***
## as.factor(sentence_year)2005  0.9589958  0.0358668  26.738  < 2e-16 ***
## as.factor(sentence_year)2006  1.4405176  0.0340822  42.266  < 2e-16 ***
## as.factor(sentence_year)2007  2.1703744  0.0338924  64.037  < 2e-16 ***
## as.factor(sentence_year)2008  2.7470814  0.0402871  68.188  < 2e-16 ***
## as.factor(sentence_year)2009  2.4963595  0.0712010  35.061  < 2e-16 ***
## as.factor(sentence_year)2010  2.1984531  0.1234297  17.811  < 2e-16 ***
## as.factor(sentence_year)2011  3.1588507  0.0459679  68.719  < 2e-16 ***
## as.factor(sentence_year)2012  3.1283446  0.0446170  70.116  < 2e-16 ***
## as.factor(sentence_year)2013  3.1654652  0.0354325  89.338  < 2e-16 ***
## as.factor(sentence_year)2014  3.1972040  0.0344844  92.714  < 2e-16 ***
## as.factor(sentence_year)2015  3.0991858  0.0365294  84.841  < 2e-16 ***
## as.factor(sentence_year)2016  3.0437276  0.0387427  78.563  < 2e-16 ***
## as.factor(sentence_year)2017  2.2543882  0.0715964  31.487  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.536 on 192114 degrees of freedom
## Multiple R-squared:  0.376,  Adjusted R-squared:  0.3759
## F-statistic:  2894 on 40 and 192114 DF,  p-value: < 2.2e-16
##
##
## Response log(total_ff + 1) :
##
## Call:
## lm(formula = `log(total_ff + 1)` ~ black + hispanic + asian +
##     nativeam + other.race + race.miss + male + log(age) + priors +
##     pubdef + perc_credit + perc_stayed + trial_flag + felony_flag +
##     gm_flag + violent_flag + drug_flag + alcohol_flag + filed_district +
##     as.factor(sentence_year), data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.5126 -0.5374  0.4763  1.2874  8.4253
##
## Coefficients:
##                               Estimate Std. Error  t value Pr(>|t|)
## (Intercept)                  5.7923100  0.0577206  100.351  < 2e-16 ***
## black                       -0.6306964  0.0139229  -45.299  < 2e-16 ***
## hispanic                    -0.2389838  0.0200574  -11.915  < 2e-16 ***
```

```
## asian                          -0.0718643  0.0323920   -2.219 0.026516 *
## nativeam                       -0.6155530  0.0202016  -30.471  < 2e-16 ***
## other.race                     -0.2304793  0.0406533   -5.669 1.44e-08 ***
## race.miss                      -0.0576275  0.0174409   -3.304 0.000953 ***
## male                           -0.0110647  0.0112442   -0.984 0.325100
## log(age)                       -0.0608478  0.0144348   -4.215 2.49e-05 ***
## priors                         -0.0488170  0.0012183  -40.068  < 2e-16 ***
## pubdef                         -0.7557085  0.0101545  -74.421  < 2e-16 ***
## perc_credit                     0.0016452  0.0001683    9.774  < 2e-16 ***
## perc_stayed                     0.0096896  0.0001380   70.190  < 2e-16 ***
## trial_flag                      0.4906342  0.2337884    2.099 0.035851 *
## felony_flag                     0.2601586  0.0158884   16.374  < 2e-16 ***
## gm_flag                         0.5532641  0.0155203   35.648  < 2e-16 ***
## violent_flag                   -0.0029134  0.0135992   -0.214 0.830368
## drug_flag                       0.2684913  0.0157963   16.997  < 2e-16 ***
## alcohol_flag                    0.5408613  0.0121445   44.536  < 2e-16 ***
## filed_district02               -1.1320428  0.0211272  -53.582  < 2e-16 ***
## filed_district03               -0.8733208  0.0197248  -44.275  < 2e-16 ***
## filed_district04               -1.8208668  0.0175294 -103.875  < 2e-16 ***
## filed_district05               -0.3045880  0.0223695  -13.616  < 2e-16 ***
## filed_district06               -0.5646840  0.0231057  -24.439  < 2e-16 ***
## filed_district07               -0.4424184  0.0198213  -22.320  < 2e-16 ***
## filed_district08               -0.5070940  0.0288582  -17.572  < 2e-16 ***
## filed_district09               -0.5054336  0.0212290  -23.809  < 2e-16 ***
## filed_district10               -1.1349212  0.0184412  -61.543  < 2e-16 ***
## as.factor(sentence_year)2005 -0.3948946  0.0281334  -14.036  < 2e-16 ***
## as.factor(sentence_year)2006 -0.4910448  0.0267336  -18.368  < 2e-16 ***
## as.factor(sentence_year)2007 -0.5040109  0.0265848  -18.959  < 2e-16 ***
## as.factor(sentence_year)2008 -0.5118782  0.0316007  -16.198  < 2e-16 ***
## as.factor(sentence_year)2009 -0.4854768  0.0558491   -8.693  < 2e-16 ***
## as.factor(sentence_year)2010 -0.1297855  0.0968166   -1.341 0.180075
## as.factor(sentence_year)2011 -0.1147064  0.0360566   -3.181 0.001466 **
## as.factor(sentence_year)2012 -0.1028951  0.0349969   -2.940 0.003281 **
## as.factor(sentence_year)2013  0.0358778  0.0277928    1.291 0.196738
## as.factor(sentence_year)2014  0.2021884  0.0270491    7.475 7.76e-14 ***
## as.factor(sentence_year)2015  0.2924397  0.0286532   10.206  < 2e-16 ***
## as.factor(sentence_year)2016  0.2826334  0.0303892    9.300  < 2e-16 ***
## as.factor(sentence_year)2017  0.2684945  0.0561593    4.781 1.75e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.989 on 192114 degrees of freedom
## Multiple R-squared:  0.2485, Adjusted R-squared:  0.2483
## F-statistic:  1588 on 40 and 192114 DF,  p-value: < 2.2e-16
```

```
conf_model <- lm(log(conf_minus_stayed_ts+1)~
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
```

```
                male+log(age)+
                 priors+pubdef+perc_credit+
          perc_stayed+trial_flag+
                felony_flag+gm_flag+
                violent_flag+drug_flag+alcohol_flag+
                filed_district+
                as.factor(sentence_year),
        data = monsanc.short)

prob_model <- lm(log(prob_days+1)~
                 black+hispanic+asian+nativeam+other.race+
                race.miss+
                male+log(age)+
                 priors+pubdef+perc_credit+
          perc_stayed+trial_flag+
                felony_flag+gm_flag+
                violent_flag+drug_flag+alcohol_flag+
                filed_district+
                as.factor(sentence_year),
        data = monsanc.short)

lfo_model <- lm(log(total_ff+1)~
                 black+hispanic+asian+nativeam+other.race+
                race.miss+
                male+log(age)+
                 priors+pubdef+perc_credit+
          perc_stayed+trial_flag+
                felony_flag+gm_flag+
                violent_flag+drug_flag+alcohol_flag+
                filed_district+
                as.factor(sentence_year),
        data = monsanc.short)
```

Table 2: Multivariate Model of Punishment, Minnesota 2004-2017

	Punishment Outcome		
	log(Incarceration) Coef(SE)	log(LFO) Coef(SE)	log(Probation) Coef(SE)
Black	0.124^{***} (0.014)	-0.631^{***} (0.014)	-0.209^{***} (0.018)
Hispanic	0.158^{***} (0.020)	-0.239^{***} (0.020)	-0.339^{***} (0.026)
Asian	-0.079^{*} (0.033)	-0.072^{*} (0.032)	0.082^{*} (0.041)
Native American	0.327^{***} (0.021)	-0.616^{***} (0.020)	-0.230^{***} (0.026)
Other Race	-0.103^{*} (0.041)	-0.230^{***} (0.041)	-0.012 (0.052)
Missing Race	-0.314^{***} (0.018)	-0.058^{***} (0.017)	0.042 (0.022)
Male	0.700^{***} (0.011)	-0.011 (0.011)	-0.591^{***} (0.014)
log(Age)	0.339^{***} (0.015)	-0.061^{***} (0.014)	-0.447^{***} (0.018)
Prior Convictions	0.069^{***} (0.001)	-0.049^{***} (0.001)	-0.048^{***} (0.002)
Public Defender	0.384^{***} (0.010)	-0.756^{***} (0.010)	-0.012 (0.013)
Percent Credit	-0.030^{***} (0.0002)	0.002^{***} (0.0002)	0.010^{***} (0.0002)
Percent Stayed	-0.019^{***} (0.0001)	0.010^{***} (0.0001)	0.019^{***} (0.0002)
Trial	2.166^{***} (0.237)	0.491^{*} (0.234)	-0.928^{**} (0.298)
Felony	0.129^{***} (0.016)	0.260^{***} (0.016)	1.155^{***} (0.020)
Gross Misdemeanor	-1.054^{***} (0.016)	0.553^{***} (0.016)	0.962^{***} (0.020)
Violent	0.390^{***} (0.014)	-0.003 (0.014)	0.281^{***} (0.017)
Drug	-0.212^{***} (0.016)	0.268^{***} (0.016)	0.903^{***} (0.020)
Alcohol/DUI	0.956^{***} (0.012)	0.541^{***} (0.012)	1.487^{***} (0.015)
Constant	1.792^{***} (0.059)	5.792^{***} (0.058)	2.605^{***} (0.074)
District FE	*Yes*	*Yes*	*Yes*
Sentence Year FE	*Yes*	*Yes*	*Yes*
Observations	192,155	192,155	192,155
R^2	0.331	0.248	0.376
Adjusted R^2	0.331	0.248	0.376
F Statistic (df = 40; 192114)	$2{,}374.771^{***}$	$1{,}588.104^{***}$	$2{,}893.814^{***}$

Note: *p<0.05; **p<0.01; ***p<0.001
All tests are two-tailed.

Table 3: Instrumental Variable Models of Punishment

$$I_i = \alpha + \phi_1 CR_d + \sum \beta_j X_{ij} + \theta_d + \lambda_t + \epsilon_i$$

$$Y_{ik} = \alpha + \phi_{2k} CR_d + \sum \pi_{jk} Race_{ij} + \sum \beta_{jk} X_{ij} + \theta_{dk} + \lambda_{tk} + \epsilon_{ik}$$

$$\delta_k = \frac{\phi_{2k}}{\phi_1}$$

$$I_i = \alpha + \phi_1 CR_d + \phi_{1F}(CR_d \times F_{ij}) + \phi_{1GM}(CR_d \times GM_{ij}) + \sum_j \beta_j X_{ij} + \theta_d + \lambda_t + \epsilon_i$$

$$Y_{ik} = \alpha + \phi_{2k} I_i + \phi_{2Fk}(I_i \times F_{ij}) + \phi_{2GMk}(I_i \times GM_{ij}) + \sum_j \pi_{jk} Race_{ij} + \sum_j \beta_{jk} X_{ij} + \theta_{dk} + \lambda_{tk} + \epsilon_{ik}$$

$$\delta_k(F_{ij}, GM_{ij}) = \frac{\phi_{2k} + \phi_{2Fk} F_{ij} + \phi_{2GMk} GM_{ij}}{\phi_1 + \phi_{1F} F_{ij} + \phi_{1GM} GM_{ij}}$$

Combined IV Models

```
#instrumental Variables Regression

#LFO
iv.ff <- ivreg(total_ff_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
                 male+log(age)+
                  priors+pubdef+perc_credit+
                 perc_stayed+
                 trial_flag+
                 felony_flag+gm_flag+
                 violent_flag+drug_flag+alcohol_flag+
                 filed_district+
                 as.factor(sentence_year)|
               .-conf_minus_stayed_ts_log+
                 cap_ratio*gm_flag+cap_ratio*felony_flag,
           data = monsanc.short)

summary(iv.ff, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = total_ff_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
```

```
##     trial_flag + felony_flag + gm_flag + violent_flag + drug_flag +
##     alcohol_flag + filed_district + as.factor(sentence_year) |
##     . - conf_minus_stayed_ts_log + cap_ratio * gm_flag + cap_ratio *
##         felony_flag, data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.9154 -0.6800  0.4409  1.3417  9.6923
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     6.2701667  0.1082984  57.897  < 2e-16 ***
## conf_minus_stayed_ts_log       -0.2666857  0.0506237  -5.268 1.38e-07 ***
## black                          -0.5975874  0.0155936 -38.323  < 2e-16 ***
## hispanic                       -0.1969048  0.0220561  -8.927  < 2e-16 ***
## asian                          -0.0929086  0.0334413  -2.778 0.005466 **
## nativeam                       -0.5282666  0.0265199 -19.920  < 2e-16 ***
## other.race                     -0.2578219  0.0419917  -6.140 8.28e-10 ***
## race.miss                      -0.1414332  0.0239304  -5.910 3.42e-09 ***
## male                            0.1755901  0.0372592   4.713 2.45e-06 ***
## log(age)                        0.0296315  0.0226694   1.307 0.191176
## priors                         -0.0303020  0.0037299  -8.124 4.53e-16 ***
## pubdef                         -0.6532619  0.0220572 -29.617  < 2e-16 ***
## perc_credit                    -0.0062394  0.0015066  -4.141 3.45e-05 ***
## perc_stayed                     0.0045826  0.0009797   4.678 2.91e-06 ***
## trial_flag                      1.0683992  0.2635391   4.054 5.04e-05 ***
## felony_flag                     0.2944475  0.0175382  16.789  < 2e-16 ***
## gm_flag                         0.2722046  0.0556735   4.889 1.01e-06 ***
## violent_flag                    0.1010574  0.0241624   4.182 2.89e-05 ***
## drug_flag                       0.2120021  0.0194202  10.917  < 2e-16 ***
## alcohol_flag                    0.7957763  0.0499648  15.927  < 2e-16 ***
## filed_district02               -0.7130380  0.0824331  -8.650  < 2e-16 ***
## filed_district03               -0.8143490  0.0231102 -35.238  < 2e-16 ***
## filed_district04               -1.5405110  0.0561700 -27.426  < 2e-16 ***
## filed_district05               -0.1470851  0.0376779  -3.904 9.47e-05 ***
## filed_district06               -0.4784196  0.0287932 -16.616  < 2e-16 ***
## filed_district07               -0.0371589  0.0795662  -0.467 0.640487
## filed_district08               -0.2204447  0.0619336  -3.559 0.000372 ***
## filed_district09               -0.2147611  0.0593127  -3.621 0.000294 ***
## filed_district10               -0.8499985  0.0572935 -14.836  < 2e-16 ***
## as.factor(sentence_year)2005 -0.4496423  0.0306524 -14.669  < 2e-16 ***
## as.factor(sentence_year)2006 -0.6252161  0.0374105 -16.712  < 2e-16 ***
## as.factor(sentence_year)2007 -0.6920383  0.0449052 -15.411  < 2e-16 ***
## as.factor(sentence_year)2008 -0.7419276  0.0543706 -13.646  < 2e-16 ***
## as.factor(sentence_year)2009 -0.7142364  0.0718521  -9.940  < 2e-16 ***
## as.factor(sentence_year)2010 -0.3710317  0.1092941  -3.395 0.000687 ***
## as.factor(sentence_year)2011 -0.4113076  0.0673489  -6.107 1.02e-09 ***
## as.factor(sentence_year)2012 -0.4031883  0.0673511  -5.986 2.15e-09 ***
```

```
## as.factor(sentence_year)2013 -0.2467404  0.0607427  -4.062 4.87e-05 ***
## as.factor(sentence_year)2014 -0.1211359  0.0673470  -1.799 0.072070 .
## as.factor(sentence_year)2015 -0.0222393  0.0665638  -0.334 0.738300
## as.factor(sentence_year)2016 -0.0593529  0.0720040  -0.824 0.409770
## as.factor(sentence_year)2017  0.0322400  0.0729713   0.442 0.658622
##
## Diagnostic tests:
##                     df1    df2 statistic  p-value
## Weak instruments      3 192111    132.89  < 2e-16 ***
## Wu-Hausman            1 192112     20.92 4.79e-06 ***
## Sargan                2     NA    341.67  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.039 on 192113 degrees of freedom
## Multiple R-Squared: 0.2104,  Adjusted R-squared: 0.2103
## Wald test:  1475 on 41 and 192113 DF,  p-value: < 2.2e-16
```

```
#Probation
iv.prob <- ivreg(prob_days_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
                 male+log(age)+
                 priors+pubdef+perc_credit+
                 perc_stayed+
                 trial_flag+
                 felony_flag+gm_flag+
                 violent_flag+drug_flag+alcohol_flag+
                 filed_district+
                 as.factor(sentence_year)|
               .-conf_minus_stayed_ts_log+
                 cap_ratio,
           data = monsanc.short)

summary(iv.prob, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = prob_days_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + gm_flag + violent_flag + drug_flag +
##     alcohol_flag + filed_district + as.factor(sentence_year) |
##     . - conf_minus_stayed_ts_log + cap_ratio, data = monsanc.short)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -24.18832  -3.90022   0.04407   4.23382  22.77085
```

```
##
## Coefficients:
##                                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     -1.50633    1.65146  -0.912 0.361708
## conf_minus_stayed_ts_log         2.29474    0.91649   2.504 0.012286 *
## black                           -0.49386    0.12133  -4.070 4.70e-05 ***
## hispanic                        -0.70092    0.15683  -4.469 7.85e-06 ***
## asian                            0.26336    0.12181   2.162 0.030621 *
## nativeam                        -0.98148    0.30613  -3.206 0.001346 **
## other.race                       0.22286    0.15480   1.440 0.149967
## race.miss                        0.76266    0.29280   2.605 0.009196 **
## male                            -2.19750    0.64236  -3.421 0.000624 ***
## log(age)                        -1.22507    0.31399  -3.902 9.56e-05 ***
## priors                          -0.20726    0.06374  -3.252 0.001147 **
## pubdef                          -0.89399    0.35341  -2.530 0.011419 *
## perc_credit                      0.07819    0.02710   2.885 0.003912 **
## perc_stayed                      0.06305    0.01756   3.592 0.000329 ***
## trial_flag                      -5.89958    2.10782  -2.799 0.005128 **
## felony_flag                      0.85968    0.12727   6.755 1.43e-11 ***
## gm_flag                          3.38030    0.96703   3.496 0.000473 ***
## violent_flag                    -0.61378    0.35967  -1.707 0.087915 .
## drug_flag                        1.38898    0.19993   6.947 3.73e-12 ***
## alcohol_flag                    -0.70644    0.87681  -0.806 0.420418
## filed_district02                -5.00716    1.44137  -3.474 0.000513 ***
## filed_district03                -0.81215    0.21127  -3.844 0.000121 ***
## filed_district04                -4.48894    0.96493  -4.652 3.29e-06 ***
## filed_district05                -1.66837    0.54549  -3.058 0.002225 **
## filed_district06                -1.40991    0.30459  -4.629 3.68e-06 ***
## filed_district07                -4.19432    1.39400  -3.009 0.002623 **
## filed_district08                -2.69940    0.98896  -2.730 0.006343 **
## filed_district09                -2.89561    1.00099  -2.893 0.003819 **
## filed_district10                -2.70298    0.98075  -2.756 0.005851 **
## as.factor(sentence_year)2005     1.43008    0.20651   6.925 4.37e-12 ***
## as.factor(sentence_year)2006     2.59502    0.46813   5.543 2.97e-08 ***
## as.factor(sentence_year)2007     3.78829    0.65116   5.818 5.97e-09 ***
## as.factor(sentence_year)2008     4.72658    0.79635   5.935 2.94e-09 ***
## as.factor(sentence_year)2009     4.46476    0.80411   5.552 2.82e-08 ***
## as.factor(sentence_year)2010     4.27430    0.87931   4.861 1.17e-06 ***
## as.factor(sentence_year)2011     5.71100    1.02512   5.571 2.54e-08 ***
## as.factor(sentence_year)2012     5.71227    1.03741   5.506 3.67e-08 ***
## as.factor(sentence_year)2013     5.59730    0.97488   5.742 9.40e-09 ***
## as.factor(sentence_year)2014     5.97930    1.11414   5.367 8.03e-08 ***
## as.factor(sentence_year)2015     5.80689    1.08489   5.352 8.68e-08 ***
## as.factor(sentence_year)2016     5.98640    1.17886   5.078 3.82e-07 ***
## as.factor(sentence_year)2017     4.28728    0.82951   5.168 2.36e-07 ***
##
## Diagnostic tests:
##                      df1    df2 statistic p-value
```

```
## Weak instruments      1 192113     10.58 0.00114 **
## Wu-Hausman            1 192112     57.62 3.2e-14 ***
## Sargan                0     NA        NA      NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.019 on 192113 degrees of freedom
## Multiple R-Squared: -2.516,  Adjusted R-squared: -2.517
## Wald test: 501.3 on 41 and 192113 DF,  p-value: < 2.2e-16
```

```
#LFO
iv.ff.int <- ivreg(total_ff_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
                 male+log(age)+
                  priors+pubdef+perc_credit+
                 perc_stayed+
                 trial_flag+
                 felony_flag+gm_flag+
                 violent_flag+drug_flag+alcohol_flag+
                 filed_district+
                 as.factor(sentence_year)|
               .-conf_minus_stayed_ts_log+
                 cap_ratio*gm_flag+cap_ratio*felony_flag,
           data = monsanc.short)

summary(iv.ff.int, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = total_ff_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + gm_flag + violent_flag + drug_flag +
##     alcohol_flag + filed_district + as.factor(sentence_year) |
##     . - conf_minus_stayed_ts_log + cap_ratio * gm_flag + cap_ratio *
##         felony_flag, data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.9154 -0.6800  0.4409  1.3417  9.6923
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  6.2701667  0.1082984  57.897  < 2e-16 ***
## conf_minus_stayed_ts_log    -0.2666857  0.0506237  -5.268 1.38e-07 ***
## black                       -0.5975874  0.0155936 -38.323  < 2e-16 ***
## hispanic                    -0.1969048  0.0220561  -8.927  < 2e-16 ***
```

```
## asian                          -0.0929086  0.0334413  -2.778 0.005466 **
## nativeam                       -0.5282666  0.0265199 -19.920  < 2e-16 ***
## other.race                     -0.2578219  0.0419917  -6.140 8.28e-10 ***
## race.miss                      -0.1414332  0.0239304  -5.910 3.42e-09 ***
## male                            0.1755901  0.0372592   4.713 2.45e-06 ***
## log(age)                        0.0296315  0.0226694   1.307 0.191176
## priors                         -0.0303020  0.0037299  -8.124 4.53e-16 ***
## pubdef                         -0.6532619  0.0220572 -29.617  < 2e-16 ***
## perc_credit                    -0.0062394  0.0015066  -4.141 3.45e-05 ***
## perc_stayed                     0.0045826  0.0009797   4.678 2.91e-06 ***
## trial_flag                      1.0683992  0.2635391   4.054 5.04e-05 ***
## felony_flag                     0.2944475  0.0175382  16.789  < 2e-16 ***
## gm_flag                         0.2722046  0.0556735   4.889 1.01e-06 ***
## violent_flag                    0.1010574  0.0241624   4.182 2.89e-05 ***
## drug_flag                       0.2120021  0.0194202  10.917  < 2e-16 ***
## alcohol_flag                    0.7957763  0.0499648  15.927  < 2e-16 ***
## filed_district02               -0.7130380  0.0824331  -8.650  < 2e-16 ***
## filed_district03               -0.8143490  0.0231102 -35.238  < 2e-16 ***
## filed_district04               -1.5405110  0.0561700 -27.426  < 2e-16 ***
## filed_district05               -0.1470851  0.0376779  -3.904 9.47e-05 ***
## filed_district06               -0.4784196  0.0287932 -16.616  < 2e-16 ***
## filed_district07               -0.0371589  0.0795662  -0.467 0.640487
## filed_district08               -0.2204447  0.0619336  -3.559 0.000372 ***
## filed_district09               -0.2147611  0.0593127  -3.621 0.000294 ***
## filed_district10               -0.8499985  0.0572935 -14.836  < 2e-16 ***
## as.factor(sentence_year)2005 -0.4496423  0.0306524 -14.669  < 2e-16 ***
## as.factor(sentence_year)2006 -0.6252161  0.0374105 -16.712  < 2e-16 ***
## as.factor(sentence_year)2007 -0.6920383  0.0449052 -15.411  < 2e-16 ***
## as.factor(sentence_year)2008 -0.7419276  0.0543706 -13.646  < 2e-16 ***
## as.factor(sentence_year)2009 -0.7142364  0.0718521  -9.940  < 2e-16 ***
## as.factor(sentence_year)2010 -0.3710317  0.1092941  -3.395 0.000687 ***
## as.factor(sentence_year)2011 -0.4113076  0.0673489  -6.107 1.02e-09 ***
## as.factor(sentence_year)2012 -0.4031883  0.0673511  -5.986 2.15e-09 ***
## as.factor(sentence_year)2013 -0.2467404  0.0607427  -4.062 4.87e-05 ***
## as.factor(sentence_year)2014 -0.1211359  0.0673470  -1.799 0.072070 .
## as.factor(sentence_year)2015 -0.0222393  0.0665638  -0.334 0.738300
## as.factor(sentence_year)2016 -0.0593529  0.0720040  -0.824 0.409770
## as.factor(sentence_year)2017  0.0322400  0.0729713   0.442 0.658622
##
## Diagnostic tests:
##                     df1    df2 statistic  p-value
## Weak instruments      3 192111    132.89  < 2e-16 ***
## Wu-Hausman            1 192112     20.92 4.79e-06 ***
## Sargan                2     NA    341.67  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.039 on 192113 degrees of freedom
```

```
## Multiple R-Squared: 0.2104,  Adjusted R-squared: 0.2103
## Wald test:  1475 on 41 and 192113 DF,  p-value: < 2.2e-16
```

```
#Probation
iv.prob.int <- ivreg(prob_days_log~conf_minus_stayed_ts_log+
                  black+hispanic+asian+nativeam+other.race+
                  race.miss+
                  male+log(age)+
                  priors+pubdef+perc_credit+
                  perc_stayed+
                  trial_flag+
                  felony_flag+gm_flag+
                  violent_flag+drug_flag+alcohol_flag+
                  filed_district+
                  as.factor(sentence_year)|
                .-conf_minus_stayed_ts_log+
                  cap_ratio*gm_flag+cap_ratio*felony_flag,
            data = monsanc.short)

summary(iv.prob.int, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = prob_days_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + gm_flag + violent_flag + drug_flag +
##     alcohol_flag + filed_district + as.factor(sentence_year) |
##     . - conf_minus_stayed_ts_log + cap_ratio * gm_flag + cap_ratio *
##         felony_flag, data = monsanc.short)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -18.3874  -3.1270   0.4646   3.2340  19.1253
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   6.653068   0.231735  28.710  < 2e-16 ***
## conf_minus_stayed_ts_log     -2.258913   0.108324 -20.853  < 2e-16 ***
## black                         0.071474   0.033367   2.142 0.032189 *
## hispanic                      0.017575   0.047195   0.372 0.709597
## asian                        -0.095974   0.071557  -1.341 0.179852
## nativeam                      0.508937   0.056747   8.969  < 2e-16 ***
## other.race                   -0.244013   0.089853  -2.716 0.006614 **
## race.miss                    -0.668317   0.051206 -13.052  < 2e-16 ***
## male                          0.989627   0.079727  12.413  < 2e-16 ***
## log(age)                      0.319863   0.048508   6.594 4.29e-11 ***
## priors                        0.108884   0.007981  13.643  < 2e-16 ***
```

```
## pubdef                          0.855282   0.047198  18.121  < 2e-16 ***
## perc_credit                    -0.056438   0.003224 -17.507  < 2e-16 ***
## perc_stayed                    -0.024147   0.002096 -11.519  < 2e-16 ***
## trial_flag                      3.965743   0.563916   7.033 2.04e-12 ***
## felony_flag                     1.445165   0.037528  38.509  < 2e-16 ***
## gm_flag                        -1.418786   0.119129 -11.910  < 2e-16 ***
## violent_flag                    1.161523   0.051702  22.466  < 2e-16 ***
## drug_flag                       0.424429   0.041555  10.214  < 2e-16 ***
## alcohol_flag                    3.646224   0.106914  34.104  < 2e-16 ***
## filed_district02                2.147338   0.176389  12.174  < 2e-16 ***
## filed_district03                0.194792   0.049451   3.939 8.18e-05 ***
## filed_district04                0.298128   0.120192   2.480 0.013123 *
## filed_district05                1.020990   0.080623  12.664  < 2e-16 ***
## filed_district06                0.063049   0.061611   1.023 0.306148
## filed_district07                2.725476   0.170254  16.008  < 2e-16 ***
## filed_district08                2.195130   0.132524  16.564  < 2e-16 ***
## filed_district09                2.067622   0.126916  16.291  < 2e-16 ***
## filed_district10                2.162071   0.122596  17.636  < 2e-16 ***
## as.factor(sentence_year)2005    0.495266   0.065589   7.551 4.34e-14 ***
## as.factor(sentence_year)2006    0.304044   0.080050   3.798 0.000146 ***
## as.factor(sentence_year)2007    0.577722   0.096087   6.012 1.83e-09 ***
## as.factor(sentence_year)2008    0.798489   0.116341   6.863 6.75e-12 ***
## as.factor(sentence_year)2009    0.558693   0.153748   3.634 0.000279 ***
## as.factor(sentence_year)2010    0.155021   0.233866   0.663 0.507420
## as.factor(sentence_year)2011    0.646543   0.144112   4.486 7.25e-06 ***
## as.factor(sentence_year)2012    0.584765   0.144117   4.058 4.96e-05 ***
## as.factor(sentence_year)2013    0.771599   0.129976   5.936 2.92e-09 ***
## as.factor(sentence_year)2014    0.458544   0.144108   3.182 0.001463 **
## as.factor(sentence_year)2015    0.433754   0.142432   3.045 0.002324 **
## as.factor(sentence_year)2016    0.146995   0.154073   0.954 0.340054
## as.factor(sentence_year)2017    0.253236   0.156143   1.622 0.104842
##
## Diagnostic tests:
##                     df1    df2 statistic p-value
## Weak instruments      3 192111    132.89 < 2e-16 ***
## Wu-Hausman            1 192112    955.64 < 2e-16 ***
## Sargan                2     NA     50.47 1.1e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.362 on 192113 degrees of freedom
## Multiple R-Squared: -0.8469, Adjusted R-squared: -0.8473
## Wald test: 964.5 on 41 and 192113 DF,  p-value: < 2.2e-16
```

```
#LFO
iv.ff.int2 <- ivreg(total_ff_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
```

```
                male+log(age)+
                priors+pubdef+perc_credit+
                perc_stayed+
                trial_flag+
                felony_flag+gm_flag+
                violent_flag+drug_flag+alcohol_flag+
                  presum_pris+
                 conf_minus_stayed_ts_log*presum_pris+
                  black*presum_pris+hispanic*presum_pris+asian*presum_pris+nativeam*presum_pri
                filed_district+
                as.factor(sentence_year)|
              .-conf_minus_stayed_ts_log+
                cap_ratio*gm_flag+cap_ratio*felony_flag,
            data = monsanc.short)

summary(iv.ff.int2, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = total_ff_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + gm_flag + violent_flag + drug_flag +
##     alcohol_flag + presum_pris + conf_minus_stayed_ts_log * presum_pris +
##     black * presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | . - conf_minus_stayed_ts_log +
##     cap_ratio * gm_flag + cap_ratio * felony_flag, data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -7.6669 -0.5811  0.4719  1.2919  8.6084
##
## Coefficients:
##                                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         6.1653235  0.1110453  55.521  < 2e-16 ***
## conf_minus_stayed_ts_log           -0.1436987  0.0355517  -4.042 5.30e-05 ***
## black                              -0.7449064  0.0147400 -50.537  < 2e-16 ***
## hispanic                           -0.2500124  0.0209949 -11.908  < 2e-16 ***
## asian                              -0.1112271  0.0339712  -3.274 0.001060 **
## nativeam                           -0.6211157  0.0231544 -26.825  < 2e-16 ***
## other.race                         -0.2860874  0.0425465  -6.724 1.77e-11 ***
## race.miss                          -0.1076897  0.0216209  -4.981 6.34e-07 ***
## male                                0.0686021  0.0220629   3.109 0.001875 **
## log(age)                           -0.0359718  0.0151985  -2.367 0.017943 *
## priors                             -0.0407499  0.0021043 -19.365  < 2e-16 ***
## pubdef                             -0.6976182  0.0157430 -44.313  < 2e-16 ***
```

```
## perc_credit                            -0.0015897  0.0008282  -1.920 0.054919 .
## perc_stayed                             0.0076153  0.0005210  14.616  < 2e-16 ***
## trial_flag                              0.4547527  0.2352986   1.933 0.053279 .
## felony_flag                             0.2004485  0.0248857   8.055 8.01e-16 ***
## gm_flag                                 0.4111472  0.0391393  10.505  < 2e-16 ***
## violent_flag                            0.0132965  0.0146348   0.909 0.363586
## drug_flag                               0.2443907  0.0167702  14.573  < 2e-16 ***
## alcohol_flag                            0.6412548  0.0295622  21.692  < 2e-16 ***
## presum_pris                            -0.9039680  0.0825645 -10.949  < 2e-16 ***
## filed_district02                       -0.9507264  0.0492605 -19.300  < 2e-16 ***
## filed_district03                       -0.8544698  0.0202991 -42.094  < 2e-16 ***
## filed_district04                       -1.7171394  0.0313261 -54.815  < 2e-16 ***
## filed_district05                       -0.2338426  0.0284157  -8.229  < 2e-16 ***
## filed_district06                       -0.5494267  0.0235223 -23.358  < 2e-16 ***
## filed_district07                       -0.2577942  0.0487096  -5.292 1.21e-07 ***
## filed_district08                       -0.3700239  0.0436831  -8.471  < 2e-16 ***
## filed_district09                       -0.3679961  0.0393597  -9.350  < 2e-16 ***
## filed_district10                       -1.0034863  0.0366388 -27.389  < 2e-16 ***
## as.factor(sentence_year)2005           -0.4187202  0.0287573 -14.560  < 2e-16 ***
## as.factor(sentence_year)2006           -0.5549246  0.0310809 -17.854  < 2e-16 ***
## as.factor(sentence_year)2007           -0.5947660  0.0348994 -17.042  < 2e-16 ***
## as.factor(sentence_year)2008           -0.6370797  0.0447446 -14.238  < 2e-16 ***
## as.factor(sentence_year)2009           -0.6099659  0.0646010  -9.442  < 2e-16 ***
## as.factor(sentence_year)2010           -0.2532719  0.1028788  -2.462 0.013823 *
## as.factor(sentence_year)2011           -0.2679910  0.0526196  -5.093 3.53e-07 ***
## as.factor(sentence_year)2012           -0.2632001  0.0531975  -4.948 7.52e-07 ***
## as.factor(sentence_year)2013           -0.1161977  0.0467324  -2.486 0.012903 *
## as.factor(sentence_year)2014            0.0327845  0.0498719   0.657 0.510940
## as.factor(sentence_year)2015            0.1236611  0.0506411   2.442 0.014611 *
## as.factor(sentence_year)2016            0.0989100  0.0547162   1.808 0.070656 .
## as.factor(sentence_year)2017            0.1300740  0.0689707   1.886 0.059306 .
## conf_minus_stayed_ts_log:presum_pris    0.1480784  0.0291761   5.075 3.87e-07 ***
## black:presum_pris                       0.9654946  0.0402622  23.980  < 2e-16 ***
## hispanic:presum_pris                    0.3373595  0.0723321   4.664 3.10e-06 ***
## asian:presum_pris                       0.4256976  0.1184441   3.594 0.000326 ***
## nativeam:presum_pris                    0.5417187  0.0690043   7.851 4.16e-15 ***
## other.race:presum_pris                  0.5909079  0.1522469   3.881 0.000104 ***
##
## Diagnostic tests:
##                      df1    df2 statistic p-value
## Weak instruments       4 192104  2304.596 < 2e-16 ***
## Wu-Hausman             1 192105     7.402 0.00652 **
## Sargan                 3     NA   386.190 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.991 on 192106 degrees of freedom
## Multiple R-Squared: 0.2468,  Adjusted R-squared: 0.2467
```

```
## Wald test:  1335 on 48 and 192106 DF,  p-value: < 2.2e-16
```

```
car::linearHypothesis(iv.ff.int2, "conf_minus_stayed_ts_log + conf_minus_stayed_ts_log:presum_p
```

```
##
## Linear hypothesis test:
## conf_minus_stayed_ts_log  + conf_minus_stayed_ts_log:presum_pris = 0
##
## Model 1: restricted model
## Model 2: total_ff_log ~ conf_minus_stayed_ts_log + black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     presum_pris + conf_minus_stayed_ts_log * presum_pris + black *
##     presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | black + hispanic + asian + nativeam +
##     other.race + race.miss + male + log(age) + priors + pubdef +
##     perc_credit + perc_stayed + trial_flag + felony_flag + gm_flag +
##     violent_flag + drug_flag + alcohol_flag + presum_pris + filed_district +
##     as.factor(sentence_year) + cap_ratio + conf_minus_stayed_ts_log:presum_pris +
##     black:presum_pris + hispanic:presum_pris + asian:presum_pris +
##     nativeam:presum_pris + other.race:presum_pris + gm_flag:cap_ratio +
##     felony_flag:cap_ratio
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1 192107
## 2 192106  1 0.1264     0.7222
```

```
#Probation
iv.prob.int2 <- ivreg(prob_days_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
                 male+log(age)+
                 priors+pubdef+perc_credit+
                 perc_stayed+
                 trial_flag+
                 felony_flag+gm_flag+
                 violent_flag+drug_flag+alcohol_flag+
                   presum_pris+
                   conf_minus_stayed_ts_log*presum_pris+
                   black*presum_pris+hispanic*presum_pris+asian*presum_pris+nativeam*presum_pri
                 filed_district+
                 as.factor(sentence_year)|
               .-conf_minus_stayed_ts_log+
                 cap_ratio*gm_flag+cap_ratio*felony_flag,
           data = monsanc.short)

summary(iv.prob.int2, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = prob_days_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + gm_flag + violent_flag + drug_flag +
##     alcohol_flag + presum_pris + conf_minus_stayed_ts_log * presum_pris +
##     black * presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | . - conf_minus_stayed_ts_log +
##     cap_ratio * gm_flag + cap_ratio * felony_flag, data = monsanc.short)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -15.9544  -2.6793   0.1575   2.8177  15.8448
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                        6.831263   0.216469  31.558  < 2e-16 ***
## conf_minus_stayed_ts_log          -2.008249   0.069304 -28.978  < 2e-16 ***
## black                             -0.106364   0.028734  -3.702 0.000214 ***
## hispanic                          -0.128926   0.040927  -3.150 0.001632 **
## asian                             -0.095122   0.066223  -1.436 0.150889
## nativeam                           0.437616   0.045137   9.695  < 2e-16 ***
## other.race                        -0.261879   0.082939  -3.157 0.001592 **
## race.miss                         -0.623955   0.042147 -14.804  < 2e-16 ***
## male                               0.694693   0.043009  16.152  < 2e-16 ***
## log(age)                           0.083684   0.029627   2.825 0.004735 **
## priors                             0.076498   0.004102  18.649  < 2e-16 ***
## pubdef                             0.727086   0.030689  23.692  < 2e-16 ***
## perc_credit                       -0.043327   0.001614 -26.837  < 2e-16 ***
## perc_stayed                       -0.015391   0.001016 -15.153  < 2e-16 ***
## trial_flag                         2.049049   0.458685   4.467 7.93e-06 ***
## felony_flag                        0.947707   0.048511  19.536  < 2e-16 ***
## gm_flag                           -1.137887   0.076297 -14.914  < 2e-16 ***
## violent_flag                       0.867710   0.028529  30.415  < 2e-16 ***
## drug_flag                          0.488732   0.032691  14.950  < 2e-16 ***
## alcohol_flag                       3.252902   0.057628  56.447  < 2e-16 ***
## presum_pris                       -3.307370   0.160949 -20.549  < 2e-16 ***
## filed_district02                   1.505142   0.096027  15.674  < 2e-16 ***
## filed_district03                   0.072135   0.039571   1.823 0.068313 .
## filed_district04                  -0.203890   0.061066  -3.339 0.000841 ***
## filed_district05                   0.799649   0.055393  14.436  < 2e-16 ***
## filed_district06                  -0.180696   0.045854  -3.941 8.13e-05 ***
## filed_district07                   2.139615   0.094953  22.533  < 2e-16 ***
## filed_district08                   1.812154   0.085155  21.281  < 2e-16 ***
## filed_district09                   1.670837   0.076727  21.776  < 2e-16 ***
## filed_district10                   1.761394   0.071423  24.662  < 2e-16 ***
```

```
## as.factor(sentence_year)2005          0.579123   0.056059  10.331  < 2e-16 ***
## as.factor(sentence_year)2006          0.476398   0.060588   7.863 3.77e-15 ***
## as.factor(sentence_year)2007          0.810561   0.068032  11.914  < 2e-16 ***
## as.factor(sentence_year)2008          0.994654   0.087224  11.403  < 2e-16 ***
## as.factor(sentence_year)2009          0.746598   0.125931   5.929 3.06e-09 ***
## as.factor(sentence_year)2010          0.386964   0.200549   1.930 0.053667 .
## as.factor(sentence_year)2011          0.953986   0.102575   9.300  < 2e-16 ***
## as.factor(sentence_year)2012          0.869945   0.103702   8.389  < 2e-16 ***
## as.factor(sentence_year)2013          1.042356   0.091099  11.442  < 2e-16 ***
## as.factor(sentence_year)2014          0.790305   0.097219   8.129 4.35e-16 ***
## as.factor(sentence_year)2015          0.732741   0.098718   7.423 1.15e-13 ***
## as.factor(sentence_year)2016          0.470564   0.106662   4.412 1.03e-05 ***
## as.factor(sentence_year)2017          0.321234   0.134450   2.389 0.016884 *
## conf_minus_stayed_ts_log:presum_pris  0.892606   0.056875  15.694  < 2e-16 ***
## black:presum_pris                     0.183260   0.078486   2.335 0.019548 *
## hispanic:presum_pris                  0.253643   0.141002   1.799 0.072043 .
## asian:presum_pris                     0.021555   0.230892   0.093 0.925620
## nativeam:presum_pris                 -0.829317   0.134515  -6.165 7.05e-10 ***
## other.race:presum_pris                0.447790   0.296786   1.509 0.131352
##
## Diagnostic tests:
##                      df1    df2 statistic  p-value
## Weak instruments       4 192104   2304.60  < 2e-16 ***
## Wu-Hausman             1 192105   1959.61  < 2e-16 ***
## Sargan                 3     NA     53.52 1.42e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.881 on 192106 degrees of freedom
## Multiple R-Squared: -0.4622, Adjusted R-squared: -0.4625
## Wald test:  1372 on 48 and 192106 DF,  p-value: < 2.2e-16
```

```
car::linearHypothesis(iv.prob.int2, "conf_minus_stayed_ts_log + conf_minus_stayed_ts_log:presu
```

```
##
## Linear hypothesis test:
## conf_minus_stayed_ts_log  + conf_minus_stayed_ts_log:presum_pris = 0
##
## Model 1: restricted model
## Model 2: prob_days_log ~ conf_minus_stayed_ts_log + black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     presum_pris + conf_minus_stayed_ts_log * presum_pris + black *
##     presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | black + hispanic + asian + nativeam +
##     other.race + race.miss + male + log(age) + priors + pubdef +
```

```
##     perc_credit + perc_stayed + trial_flag + felony_flag + gm_flag +
##     violent_flag + drug_flag + alcohol_flag + presum_pris + filed_district +
##     as.factor(sentence_year) + cap_ratio + conf_minus_stayed_ts_log:presum_pris +
##     black:presum_pris + hispanic:presum_pris + asian:presum_pris +
##     nativeam:presum_pris + other.race:presum_pris + gm_flag:cap_ratio +
##     felony_flag:cap_ratio
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1 192107
## 2 192106  1 2158.5  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
car::linearHypothesis(iv.prob.int2, "black + black:presum_pris = 0")
```

```
##
## Linear hypothesis test:
## black  + black:presum_pris = 0
##
## Model 1: restricted model
## Model 2: prob_days_log ~ conf_minus_stayed_ts_log + black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     presum_pris + conf_minus_stayed_ts_log * presum_pris + black *
##     presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | black + hispanic + asian + nativeam +
##     other.race + race.miss + male + log(age) + priors + pubdef +
##     perc_credit + perc_stayed + trial_flag + felony_flag + gm_flag +
##     violent_flag + drug_flag + alcohol_flag + presum_pris + filed_district +
##     as.factor(sentence_year) + cap_ratio + conf_minus_stayed_ts_log:presum_pris +
##     black:presum_pris + hispanic:presum_pris + asian:presum_pris +
##     nativeam:presum_pris + other.race:presum_pris + gm_flag:cap_ratio +
##     felony_flag:cap_ratio
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1 192107
## 2 192106  1 1.0544     0.3045
```

```
car::linearHypothesis(iv.prob.int2, "black  = 0")
```

```
##
## Linear hypothesis test:
## black = 0
##
## Model 1: restricted model
## Model 2: prob_days_log ~ conf_minus_stayed_ts_log + black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
```

```
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     presum_pris + conf_minus_stayed_ts_log * presum_pris + black *
##     presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | black + hispanic + asian + nativeam +
##     other.race + race.miss + male + log(age) + priors + pubdef +
##     perc_credit + perc_stayed + trial_flag + felony_flag + gm_flag +
##     violent_flag + drug_flag + alcohol_flag + presum_pris + filed_district +
##     as.factor(sentence_year) + cap_ratio + conf_minus_stayed_ts_log:presum_pris +
##     black:presum_pris + hispanic:presum_pris + asian:presum_pris +
##     nativeam:presum_pris + other.race:presum_pris + gm_flag:cap_ratio +
##     felony_flag:cap_ratio
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1 192107
## 2 192106  1 13.703  0.0002142 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
car::linearHypothesis(iv.prob.int2, "nativeam + nativeam:presum_pris = 0")
```

```
##
## Linear hypothesis test:
## nativeam  + nativeam:presum_pris = 0
##
## Model 1: restricted model
## Model 2: prob_days_log ~ conf_minus_stayed_ts_log + black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     presum_pris + conf_minus_stayed_ts_log * presum_pris + black *
##     presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | black + hispanic + asian + nativeam +
##     other.race + race.miss + male + log(age) + priors + pubdef +
##     perc_credit + perc_stayed + trial_flag + felony_flag + gm_flag +
##     violent_flag + drug_flag + alcohol_flag + presum_pris + filed_district +
##     as.factor(sentence_year) + cap_ratio + conf_minus_stayed_ts_log:presum_pris +
##     black:presum_pris + hispanic:presum_pris + asian:presum_pris +
##     nativeam:presum_pris + other.race:presum_pris + gm_flag:cap_ratio +
##     felony_flag:cap_ratio
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1 192107
## 2 192106  1 9.5698   0.001978 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
car::linearHypothesis(iv.prob.int2, "nativeam = 0")
```

```
##
## Linear hypothesis test:
## nativeam = 0
##
## Model 1: restricted model
## Model 2: prob_days_log ~ conf_minus_stayed_ts_log + black + hispanic +
##     asian + nativeam + other.race + race.miss + male + log(age) +
##     priors + pubdef + perc_credit + perc_stayed + trial_flag +
##     felony_flag + gm_flag + violent_flag + drug_flag + alcohol_flag +
##     presum_pris + conf_minus_stayed_ts_log * presum_pris + black *
##     presum_pris + hispanic * presum_pris + asian * presum_pris +
##     nativeam * presum_pris + other.race * presum_pris + filed_district +
##     as.factor(sentence_year) | black + hispanic + asian + nativeam +
##     other.race + race.miss + male + log(age) + priors + pubdef +
##     perc_credit + perc_stayed + trial_flag + felony_flag + gm_flag +
##     violent_flag + drug_flag + alcohol_flag + presum_pris + filed_district +
##     as.factor(sentence_year) + cap_ratio + conf_minus_stayed_ts_log:presum_pris +
##     black:presum_pris + hispanic:presum_pris + asian:presum_pris +
##     nativeam:presum_pris + other.race:presum_pris + gm_flag:cap_ratio +
##     felony_flag:cap_ratio
##
##   Res.Df Df Chisq Pr(>Chisq)
## 1 192107
## 2 192106  1    94  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#exogeneity checks
ppcor::pcor.test(y = monsanc.short$cap_ratio_lead[!is.na(monsanc.short$cap_ratio_lead)],
                 x = monsanc.short$total_ff_log[!is.na(monsanc.short$cap_ratio_lead)],
                 z = monsanc.short$cap_ratio[!is.na(monsanc.short$cap_ratio_lead)],
                 method = "pearson")
```

```
##      estimate       p.value statistic      n gp  Method
## 1 -0.05857807 1.785028e-144 -25.61592 190574  1 pearson
```

```
ppcor::pcor.test(y = monsanc.short$cap_ratio_lead[!is.na(monsanc.short$cap_ratio_lead)],
                 x = monsanc.short$prob_days_log[!is.na(monsanc.short$cap_ratio_lead)],
                 z = monsanc.short$cap_ratio[!is.na(monsanc.short$cap_ratio_lead)],
                 method = "pearson")
```

```
##      estimate       p.value statistic      n gp  Method
## 1 -0.06670763 7.592092e-187 -29.18585 190574  1 pearson
```

Table 3: IV 2SLS Models of Punishment, Minnesota 2004-2017

	Punishment Outcome			
	log(LFO) Coef(SE)	log(Probation) Coef(SE)	log(LFO) Coef(SE)	log(Probation) Coef(SE)
log(Incarceration)	−0.267*** (0.051)	−2.259*** (0.108)	−0.144*** (0.036)	−2.008*** (0.069)
Black	−0.598*** (0.016)	0.071* (0.033)	−0.745*** (0.015)	−0.106*** (0.029)
Hispanic	−0.197*** (0.022)	0.018 (0.047)	−0.250*** (0.021)	−0.129** (0.041)
Asian	−0.093** (0.033)	−0.096 (0.072)	−0.111** (0.034)	−0.095 (0.066)
Native American	−0.528*** (0.027)	0.509*** (0.057)	−0.621*** (0.023)	0.438*** (0.045)
Other Race	−0.258*** (0.042)	−0.244** (0.090)	−0.286*** (0.043)	−0.262** (0.083)
Missing Race	−0.141*** (0.024)	−0.668*** (0.051)	−0.108*** (0.022)	−0.624*** (0.042)
Male	0.176*** (0.037)	0.990*** (0.080)	0.069** (0.022)	0.695*** (0.043)
log(Age)	0.030 (0.023)	0.320*** (0.049)	−0.036* (0.015)	0.084** (0.030)
Prior Convictions	−0.030*** (0.004)	0.109*** (0.008)	−0.041*** (0.002)	0.076*** (0.004)
Public Defender	−0.653*** (0.022)	0.855*** (0.047)	−0.698*** (0.016)	0.727*** (0.031)
Percent Credit	−0.006*** (0.002)	−0.056*** (0.003)	−0.002 (0.001)	−0.043*** (0.002)
Percent Stayed	0.005*** (0.001)	−0.024*** (0.002)	0.008*** (0.001)	−0.015*** (0.001)
Trial	1.068*** (0.264)	3.966*** (0.564)	0.455 (0.235)	2.049*** (0.459)
Felony	0.294*** (0.018)	1.445*** (0.038)	0.200*** (0.025)	0.948*** (0.049)
Gross Misdemeanor	0.272*** (0.056)	−1.419*** (0.119)	0.411*** (0.039)	−1.138*** (0.076)
Violent	0.101*** (0.024)	1.162*** (0.052)	0.013 (0.015)	0.868*** (0.029)
Drug	0.212*** (0.019)	0.424*** (0.042)	0.244*** (0.017)	0.489*** (0.033)
Alcohol/DUI	0.796*** (0.050)	3.646*** (0.107)	0.641*** (0.030)	3.253*** (0.058)
Presumptive Prison (PP)			−0.904*** (0.083)	−3.307*** (0.161)
log(Incarceration) X PP			0.148*** (0.029)	0.893*** (0.057)
Black X PP			0.965*** (0.040)	0.183* (0.078)
Hispanic X PP			0.337*** (0.072)	0.254 (0.141)
Asian X PP			0.426*** (0.118)	0.022 (0.231)
Native American X PP			0.542*** (0.069)	−0.829*** (0.135)
Other Race X PP			0.591*** (0.152)	0.448 (0.297)
Constant	6.270*** (0.108)	6.653*** (0.232)	6.165*** (0.111)	6.831*** (0.216)
District FE	*Yes*	*Yes*	*Yes*	*Yes*
Sentence Year FE	*Yes*	*Yes*	*Yes*	*Yes*
IV F(Incar.)	132.89***	132.89***	2304.596***	2304.596***
IV Wu-Hausman	20.92***	955.64***	7.40***	1959.61***
Observations	192,155	192,155	192,155	192,155

Note: *p<0.05; **p<0.01; ***p<0.001

All tests are two-tailed.

IV: County-Level Jail Capacity Ratio interacted with felony and gross misdemeanor indicators.

Figure 2: Coefficient Plot

```
conf_coef_mv <- broom::tidy(conf_model) %>%
  filter(str_detect(term, pattern = "black|hispanic|asian|nativeam|other.race")) %>%
  relabel_predictors(c(
    black = "Black",
    hispanic = "Hispanic",
    asian = "Asian",
    nativeam = "Native American",
    other.race = "Other Race"
  )) %>%
  mutate(model = "MV",
         punishment = "Incarceration")

prob_coef_mv <- broom::tidy(prob_model) %>%
  filter(str_detect(term, pattern = "black|hispanic|asian|nativeam|other.race")) %>%
  relabel_predictors(c(
    black = "Black",
    hispanic = "Hispanic",
    asian = "Asian",
    nativeam = "Native American",
    other.race = "Other Race"
  )) %>%
  mutate(model = "MV",
         punishment = "Probation")

lfo_coef_mv <- broom::tidy(lfo_model) %>%
  filter(str_detect(term, pattern = "black|hispanic|asian|nativeam|other.race")) %>%
  relabel_predictors(c(
    black = "Black",
    hispanic = "Hispanic",
    asian = "Asian",
    nativeam = "Native American",
    other.race = "Other Race"
  )) %>%
  mutate(model = "MV",
         punishment = "LFO")

prob_coef_iv <- broom::tidy(iv.prob.int) %>%
  filter(str_detect(term, pattern = "black|hispanic|asian|nativeam|other.race")) %>%
  relabel_predictors(c(
    black = "Black",
    hispanic = "Hispanic",
    asian = "Asian",
    nativeam = "Native American",
    other.race = "Other Race"
  )) %>%
```

```
  mutate(model = "IV",
         punishment = "Probation")

lfo_coef_iv <- broom::tidy(iv.ff.int) %>%
  filter(str_detect(term, pattern = "black|hispanic|asian|nativeam|other.race")) %>%
  relabel_predictors(c(
    black = "Black",
    hispanic = "Hispanic",
    asian = "Asian",
    nativeam = "Native American",
    other.race = "Other Race"
  )) %>%
  mutate(model = "IV",
         punishment = "LFO")

mv_coef <- rbind(conf_coef_mv,
                 prob_coef_mv,
                 lfo_coef_mv,
                 prob_coef_iv,
                 lfo_coef_iv) %>%
  mutate(model = factor(model, levels = c("MV", "IV")))%>%
  drop_na(punishment)

dwplot(mv_coef,
       vline = geom_vline(
        xintercept = 0,
        colour = "grey60",
        linetype = 2),
        dot_args = list(aes(shape = model)),
    whisker_args = list(aes(linetype = model))) +
  theme_classic()+
  #theme(text=element_text(family="Times New Roman"))+
facet_wrap(~punishment)+
  labs(x = "Coefficient Estimate",
       y = "",
       title = "Figure 2: Coefficient Plots for MV and IV Punishment Models",
       subtitle = "MV = Multivariate, IV = Instrumental Variable",
       caption = "Dotted line represents the referent group - White defendants.") +
  guides(shape = guide_legend("Model"),
         colour = guide_legend("Model"))+
    scale_colour_manual(
        values = c("black", "orange"),
        name = "Model",
        breaks = c("MV", "IV"),
        labels = c("MV", "IV")) +
    scale_shape_manual(
      values = c(1,2),
```

```
        name = "Model",
        breaks = c("MV", "IV"),
        labels = c("MV", "IV"))
```

```
## Warning: Using the ‘size‘ aesthetic with geom_segment was deprecated in ggplot2 3.4.0.
## i Please use the ‘linewidth‘ aesthetic instead.
## i The deprecated feature was likely used in the dotwhisker package.
##   Please report the issue at <https://github.com/fsolt/dotwhisker/issues>.
## This warning is displayed once per session.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```

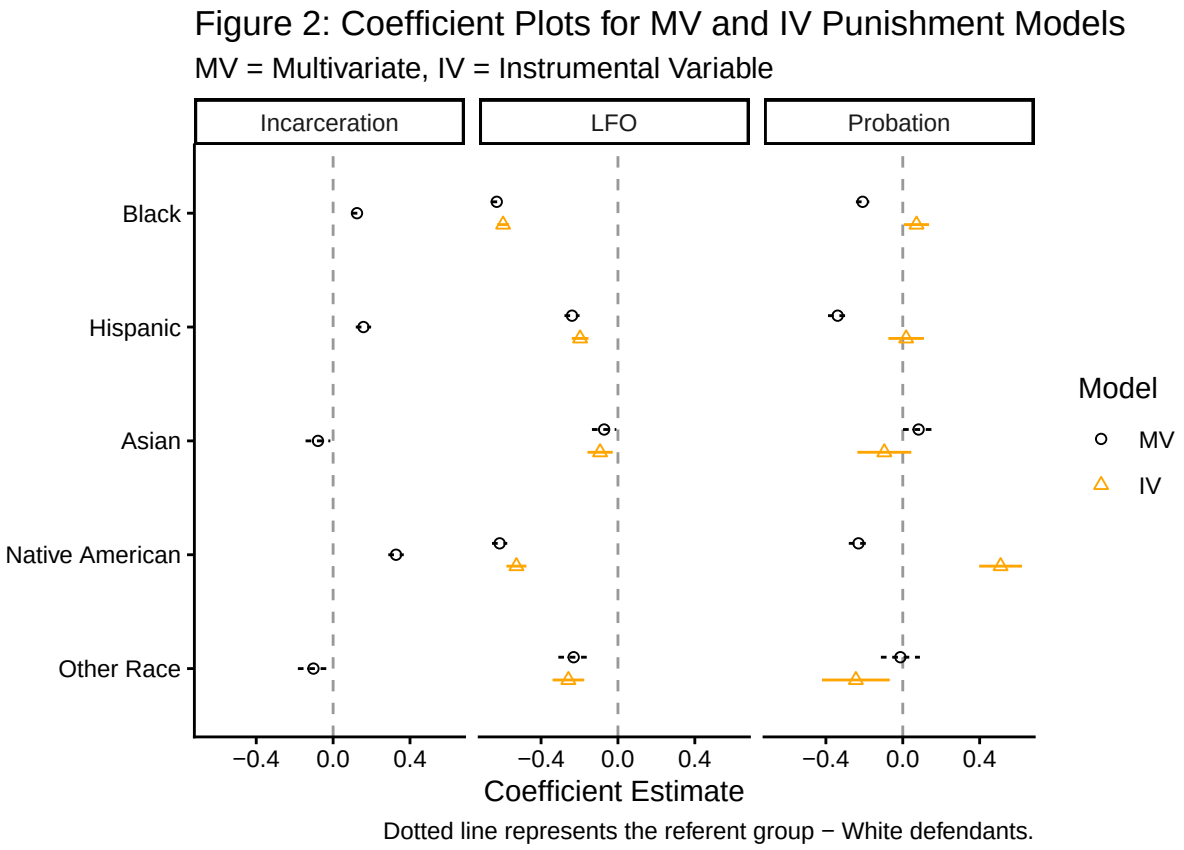


Figure #3: Interaction Plots

```
library(ggeffects)


conf_preds <- ggpredict(iv.ff.int2,
                  terms = c("conf_minus_stayed_ts_log[all]", "presum_pris[0,1]"),
                  na.omit = TRUE)

black_preds <- ggpredict(iv.ff.int2,
                  terms = c("black", "presum_pris[0,1]"),
```

```
                    na.omit = TRUE) %>%
                mutate(race = "Black")

hispanic_preds <- ggpredict(iv.ff.int2,
                    terms = c("hispanic", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
                mutate(race = "Hispanic")

asian_preds <- ggpredict(iv.ff.int2,
                    terms = c("asian", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
                mutate(race = "Asian")

na_preds <- ggpredict(iv.ff.int2,
                    terms = c("nativeam", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
                mutate(race = "Native American")

other_preds <- ggpredict(iv.ff.int2,
                    terms = c("other.race", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
                mutate(race = "Other")

race_preds <- black_preds %>%
  bind_rows(hispanic_preds) %>%
  bind_rows(asian_preds) %>%
  bind_rows(na_preds) %>%
  bind_rows(other_preds) %>%
  filter(!is.na(race))

conf_plot_lfo <- ggplot(conf_preds, aes(x = x, y = predicted, fill = group,
                                        color = group))+
  geom_line()+
  geom_ribbon(aes(ymin = conf.low, ymax = conf.high), alpha = 0.2) +
  scale_fill_brewer(palette = "Dark2")+
  scale_color_brewer(palette = "Dark2")+
  labs(
    title = "Figure 3: LFO Interaction Plots of Incarceration and Focal Race Effects by Presum
    x = "log(Incarceration)",
    y = "Predicted log(LFO)",
    subtitle = "Confinement Interaction Plot",
    color = "Presumptive Prison",
    fill = "Presumptive Prison"
  ) +
  guides(fill = "none", color = "none")+
  theme_minimal()
```

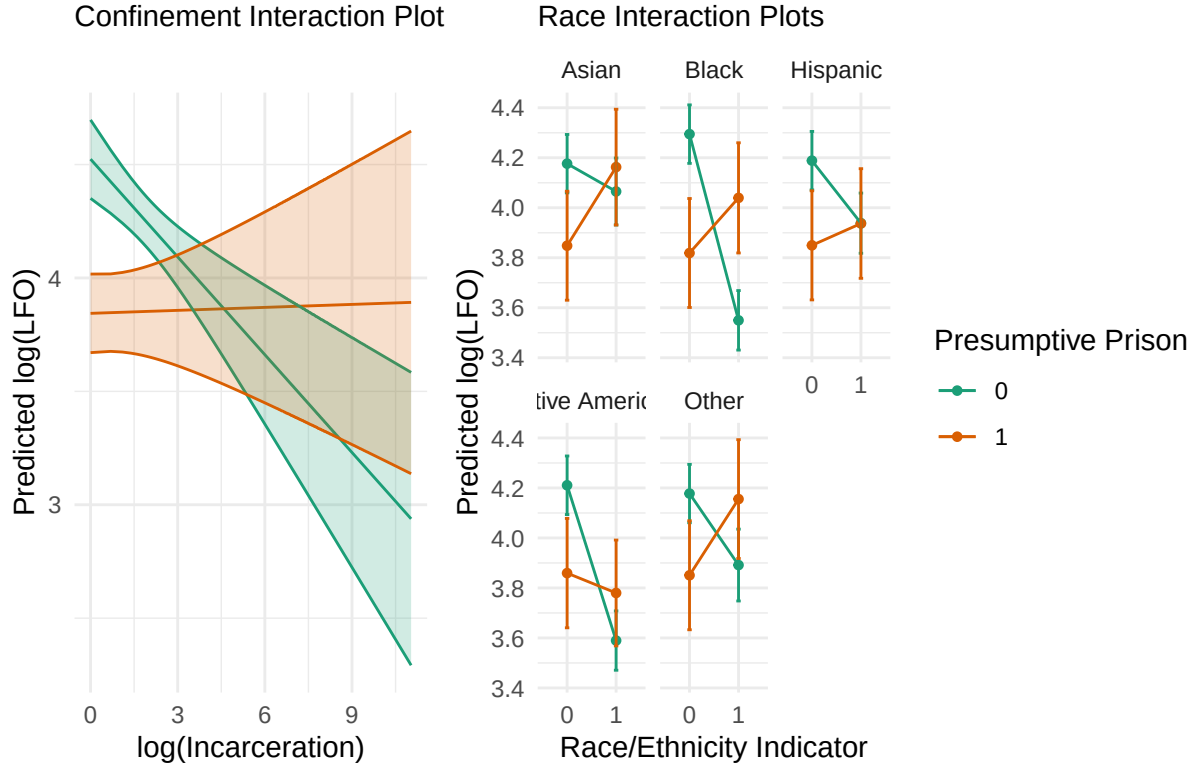
```
race_plot_lfo <- ggplot(race_preds, aes(x = as.factor(x), y = predicted, color = group)) +
  geom_point(size = 1.2) +
  geom_line(aes(group = group), size = .5)+
  geom_errorbar(aes(ymin = conf.low, ymax = conf.high), width = 0.09) +
  facet_wrap(~race)+
  scale_color_brewer(palette = "Dark2")+
  labs(
    x = "Race/Ethnicity Indicator",
    y = "Predicted log(LFO)",
    subtitle = "Race Interaction Plots",
    color = "Presumptive Prison"
  ) +
  theme_minimal()

library(cowplot)
```

```
##
## Attaching package: 'cowplot'
```

```
## The following object is masked from 'package:ggeffects':
##
##     get_title
```

```
conf_plot_lfo+race_plot_lfo
```

Figure 3: LFO Interaction Plots of Incarceration and Focal Race Effects by F



```r
conf_preds <- ggpredict(iv.prob.int2,
                    terms = c("conf_minus_stayed_ts_log[all]", "presum_pris[0,1]"),
                    na.omit = TRUE)

black_preds <- ggpredict(iv.prob.int2,
                    terms = c("black", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
               mutate(race = "Black")

hispanic_preds <- ggpredict(iv.prob.int2,
                    terms = c("hispanic", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
               mutate(race = "Hispanic")

asian_preds <- ggpredict(iv.prob.int2,
                    terms = c("asian", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
               mutate(race = "Asian")

na_preds <- ggpredict(iv.prob.int2,
                    terms = c("nativeam", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
               mutate(race = "Native American")

other_preds <- ggpredict(iv.prob.int2,
                    terms = c("other.race", "presum_pris[0,1]"),
                    na.omit = TRUE) %>%
               mutate(race = "Other")

race_preds <- black_preds %>%
  bind_rows(hispanic_preds) %>%
  bind_rows(asian_preds) %>%
  bind_rows(na_preds) %>%
  bind_rows(other_preds) %>%
  filter(!is.na(race))

conf_plot_prob <- ggplot(conf_preds, aes(x = x, y = predicted, fill = group,
                                         color = group))+
  geom_line()+
  geom_ribbon(aes(ymin = conf.low, ymax = conf.high), alpha = 0.2) +
  scale_fill_brewer(palette = "Dark2")+
  scale_color_brewer(palette = "Dark2")+
  labs(
    title = "Figure 4: Probation Interaction Plots of Incarceration and Focal Race Effects by I
    x = "log(Incarceration)",
    y = "Predicted log(Probation)",
    subtitle = "Confinement Interaction Plot",
```

```
    color = "Presumptive Prison",
    fill = "Presumptive Prison"
  ) +
  guides(fill = "none", color = "none")+
  theme_minimal()

race_plot_prob <- ggplot(race_preds, aes(x = as.factor(x), y = predicted, color = group)) +
  geom_point(size = 1.2) +
  geom_line(aes(group = group), size = .5)+
  geom_errorbar(aes(ymin = conf.low, ymax = conf.high), width = 0.09) +
  facet_wrap(~race)+
  scale_color_brewer(palette = "Dark2")+
  labs(
    x = "Race/Ethnicity Indicator",
    y = "Predicted log(Probation)",
    subtitle = "Race Interaction Plots",
    color = "Presumptive Prison"
  ) +
  theme_minimal()

conf_plot_prob+race_plot_prob
```

Figure 4: Probation Interaction Plots of Incarceration and Focal Race Effec

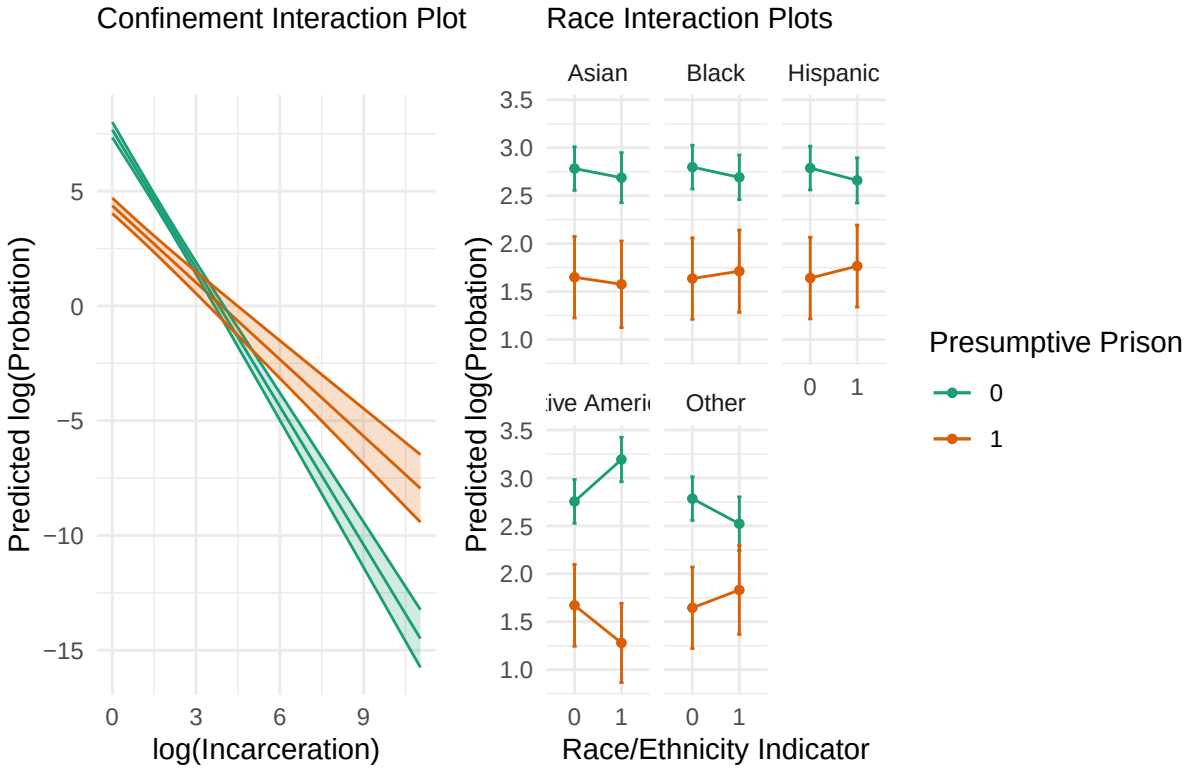


Table 4: IV 2SLS Models of Punishment, Minnesota 2004-2017

	Punishment Outcome	
	log(LFO) Coef(SE)	log(Probation) Coef(SE)
log(Incarceration)	-0.267^{***} (0.051)	2.295^{*} (0.916)
Black	-0.598^{***} (0.016)	-0.494^{***} (0.121)
Hispanic	-0.197^{***} (0.022)	-0.701^{***} (0.157)
Asian	-0.093^{**} (0.033)	0.263^{*} (0.122)
Native American	-0.528^{***} (0.027)	-0.981^{**} (0.306)
Other Race	-0.258^{***} (0.042)	0.223 (0.155)
Missing Race	-0.141^{***} (0.024)	0.763^{**} (0.293)
Male	0.176^{***} (0.037)	-2.198^{***} (0.642)
log(Age)	0.030 (0.023)	-1.225^{***} (0.314)
Prior Convictions	-0.030^{***} (0.004)	-0.207^{**} (0.064)
Public Defender	-0.653^{***} (0.022)	-0.894^{*} (0.353)
Percent Credit	-0.006^{***} (0.002)	0.078^{**} (0.027)
Percent Stayed	0.005^{***} (0.001)	0.063^{***} (0.018)
Trial	1.068^{***} (0.264)	-5.900^{**} (2.108)
Felony	0.294^{***} (0.018)	0.860^{***} (0.127)
Gross Misdemeanor	0.272^{***} (0.056)	3.380^{***} (0.967)
Violent	0.101^{***} (0.024)	-0.614 (0.360)
Drug	0.212^{***} (0.019)	1.389^{***} (0.200)
Alcohol/DUI	0.796^{***} (0.050)	-0.706 (0.877)
Constant	6.270^{***} (0.108)	-1.506 (1.651)
District FE	*Yes*	*Yes*
Sentence Year FE	*Yes*	*Yes*
IV F(Incar.)	10.58^{**}	10.58^{**}
IV Wu-Hausman	136.08^{***}	57.62^{***}
Observations	192,155	192,155

Note: *p<0.05; **p<0.01; ***p<0.001

All tests are two-tailed. IV: County-Level Jail Capacity Ratio

Appendix

First Stage Model

```
library(cowplot)
library(car)

fs <-  lm(conf_minus_stayed_ts_log ~
                        cap_ratio +
                        black + hispanic + asian + nativeam + other.race +
                        race.miss +
                        male + log(age) +
                        priors + pubdef + perc_credit +
                        perc_stayed +
                        trial_flag +
                        felony_flag +
                        gm_flag +
                        violent_flag + drug_flag + alcohol_flag +
                        filed_district +
                        as.factor(sentence_year),
          data = monsanc.short)


fs_fel <- lm(conf_minus_stayed_ts_log ~
                        cap_ratio +
                        black + hispanic + asian + nativeam + other.race +
                        race.miss +
                        male + log(age) +
                        priors + pubdef + perc_credit +
                        perc_stayed +
                        trial_flag +
                        felony_flag +
                        gm_flag +
                        violent_flag + drug_flag + alcohol_flag +
                        filed_district +
                        as.factor(sentence_year),
          data = monsanc.short[monsanc.short$felony_flag==1,])

fs_gm <- lm(conf_minus_stayed_ts_log ~
                        cap_ratio +
                        black + hispanic + asian + nativeam + other.race +
                        race.miss +
                        male + log(age) +
                        priors + pubdef + perc_credit +
                        perc_stayed +
                        trial_flag +
                        felony_flag +
                        gm_flag +
```

```
                        violent_flag + drug_flag + alcohol_flag +
                        filed_district +
                        as.factor(sentence_year),
         data = monsanc.short[monsanc.short$gm_flag==1,])

av_data <- function(model, var){
  X <- model.matrix(model)
  y <- model.response(model.frame(model))
  preds <- colnames(X)[-1]  # drop intercept
  other <- setdiff(preds, var)
  r_y <- resid(lm(y ~ X[, other, drop=FALSE]))
  r_x <- resid(lm(X[, var] ~ X[, other, drop=FALSE]))
  data.frame(x = r_x, y = r_y)
}

av_ovr <- av_data(fs, "cap_ratio")
av_fel <- av_data(fs_fel, "cap_ratio")
av_gm <- av_data(fs_gm, "cap_ratio")


p1 <- ggplot(data = av_ovr, aes(x = x, y = y))+
  geom_point(alpha = .01)+
  geom_smooth(method = "lm")+
  labs(title = "Figure A1: First Stage Partial Relationships between Jail-Capacity Ratio and In
       x = "",
       y = "log(Incarceration Length)|Covariates",
       subtitle = "Full Sample")+
  theme_minimal()

p2 <- ggplot(data = av_fel, aes(x = x, y = y))+
  geom_point(alpha = .01)+
  geom_smooth(method = "lm")+
  labs(title = "",
       x = "County-Level Jail Capacity Ratio|Covariates",
       y = "",
       subtitle = "Felony")+
  theme_minimal()

p3 <- ggplot(data = av_gm, aes(x = x, y = y))+
  geom_point(alpha = .01)+
  geom_smooth(method = "lm")+
  labs(title = "",
       x = "",
       y = "",
       subtitle = "Gross Misdemeanor")+
  theme_minimal()
```

```
p1+p2+p3
```

```
## `geom_smooth()` using formula = 'y ~ x'
## `geom_smooth()` using formula = 'y ~ x'
## `geom_smooth()` using formula = 'y ~ x'
```

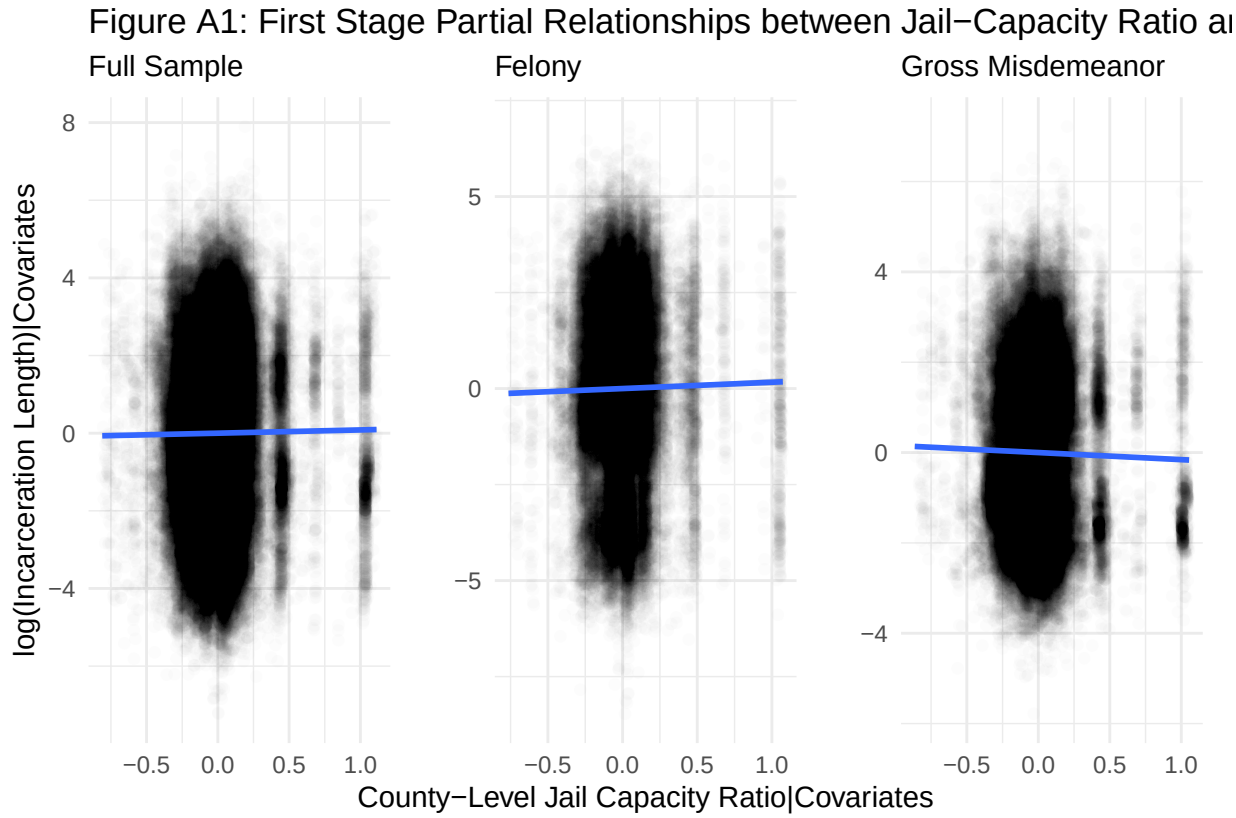


Table A1: First-Stage OLS Models of Incarceration Length, Minnesota 2004-2017

	Dependent variable:		
	log(Incarceration)		
	Full Sample	Felony	Gross Misdemeanor
County-Level Jail Capacity Ratio	0.083^{**} (0.026)	0.165^{***} (0.047)	-0.157^{***} (0.028)
Black	0.122^{***} (0.014)	0.456^{***} (0.025)	-0.142^{***} (0.016)
Hispanic	0.156^{***} (0.020)	0.499^{***} (0.039)	0.002 (0.022)
Asian	-0.079^{*} (0.033)	0.021 (0.061)	-0.034 (0.037)
Native American	0.328^{***} (0.021)	0.459^{***} (0.036)	0.218^{***} (0.023)
Other Race	-0.103^{*} (0.041)	-0.030 (0.075)	-0.154^{***} (0.046)
Missing Race	-0.314^{***} (0.018)	-0.128^{***} (0.038)	-0.370^{***} (0.018)
Male	0.700^{***} (0.011)	1.018^{***} (0.022)	0.413^{***} (0.012)
log(Age)	0.339^{***} (0.015)	0.594^{***} (0.028)	0.200^{***} (0.016)
Prior Convictions	0.069^{***} (0.001)	0.088^{***} (0.002)	0.048^{***} (0.001)
Public Defender	0.384^{***} (0.010)	0.404^{***} (0.021)	0.259^{***} (0.011)
Percent Credit	-0.030^{***} (0.0002)	-0.035^{***} (0.0002)	-0.019^{***} (0.0002)
Percent Stayed	-0.019^{***} (0.0001)	-0.035^{***} (0.0003)	-0.010^{***} (0.0002)
Trial	2.161^{***} (0.237)	1.884^{***} (0.295)	1.315^{**} (0.432)
Felony	0.133^{***} (0.016)		1.101^{***} (0.019)
Gross Misdemeanor	-1.049^{***} (0.016)	0.166^{***} (0.026)	
Violent	0.389^{***} (0.014)	0.721^{***} (0.021)	0.115^{***} (0.016)
Drug	-0.211^{***} (0.016)	-0.148^{***} (0.021)	0.054^{*} (0.024)
Alcohol/DUI	0.954^{***} (0.012)	1.011^{***} (0.034)	0.959^{***} (0.012)
Constant	1.716^{***} (0.063)	0.647^{***} (0.132)	0.829^{***} (0.068)
District FE	*Yes*	*Yes*	*Yes*
Sentence Year FE	*Yes*	*Yes*	*Yes*
Observations	192,155	67,289	118,713
F Statistic	$2{,}317.223^{***}$ (df = 41; 192113)	$1{,}056.395^{***}$ (df = 40; 67248)	717.908^{***} (df = 40; 118672)

Note: *p<0.05; **p<0.01; ***p<0.001
All tests are two-tailed.

IV Models w/ presumptive prison control

```
#LFO
iv.ff <- ivreg(total_ff_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
                 male+log(age)+
                  priors+pubdef+perc_credit+
                 perc_stayed+
                 trial_flag+
                 felony_flag+
                 presum_pris+
                 gm_flag+
                 violent_flag+drug_flag+alcohol_flag+
                 filed_district+
                 as.factor(sentence_year)|
               .-conf_minus_stayed_ts_log+cap_ratio,
           data = monsanc.short)

summary(iv.ff, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = total_ff_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + presum_pris + gm_flag + violent_flag +
##     drug_flag + alcohol_flag + filed_district + as.factor(sentence_year) |
##     . - conf_minus_stayed_ts_log + cap_ratio, data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -35.389  -6.031   0.404   5.912  29.829
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  16.57684    3.57938   4.631 3.64e-06 ***
## conf_minus_stayed_ts_log     -4.08920    1.35170  -3.025 0.002485 **
## black                        -0.69184    0.05836 -11.855  < 2e-16 ***
## hispanic                      0.04991    0.12277   0.407 0.684364
## asian                        -0.49832    0.18929  -2.633 0.008476 **
## nativeam                      0.36482    0.33273   1.096 0.272881
## other.race                   -0.67035    0.21493  -3.119 0.001815 **
## race.miss                    -1.49049    0.47879  -3.113 0.001852 **
## male                          2.20881    0.73372   3.010 0.002609 **
## log(age)                      0.49162    0.18941   2.596 0.009446 **
## priors                        0.15022    0.06578   2.284 0.022399 *
## pubdef                        0.64107    0.46303   1.385 0.166202
```

```
## perc_credit                    -0.10002    0.03357  -2.979 0.002889 **
## perc_stayed                    -0.05207    0.02039  -2.554 0.010647 *
## trial_flag                      4.86521    1.70059   2.861 0.004225 **
## felony_flag                    -1.83852    0.70222  -2.618 0.008842 **
## presum_pris                    14.13054    4.70180   3.005 0.002653 **
## gm_flag                        -3.41634    1.31283  -2.602 0.009261 **
## violent_flag                    0.80113    0.26937   2.974 0.002939 **
## drug_flag                      -0.11071    0.13870  -0.798 0.424751
## alcohol_flag                    3.74221    1.05776   3.538 0.000403 ***
## filed_district02                4.18418    1.75685   2.382 0.017237 *
## filed_district03               -0.29390    0.20571  -1.429 0.153090
## filed_district04                1.24904    1.01445   1.231 0.218232
## filed_district05                1.74327    0.68173   2.557 0.010554 *
## filed_district06                0.04744    0.22007   0.216 0.829340
## filed_district07                4.83447    1.74400   2.772 0.005571 **
## filed_district08                3.31186    1.26613   2.616 0.008904 **
## filed_district09                3.40850    1.29524   2.632 0.008500 **
## filed_district10                2.57654    1.22753   2.099 0.035822 *
## as.factor(sentence_year)2005 -1.09160    0.25473  -4.285 1.83e-05 ***
## as.factor(sentence_year)2006 -2.35866    0.62565  -3.770 0.000163 ***
## as.factor(sentence_year)2007 -3.16612    0.88556  -3.575 0.000350 ***
## as.factor(sentence_year)2008 -4.14670    1.20801  -3.433 0.000598 ***
## as.factor(sentence_year)2009 -4.31315    1.28447  -3.358 0.000785 ***
## as.factor(sentence_year)2010 -4.55408    1.51175  -3.012 0.002592 **
## as.factor(sentence_year)2011 -4.55928    1.47564  -3.090 0.002004 **
## as.factor(sentence_year)2012 -4.74011    1.53896  -3.080 0.002070 **
## as.factor(sentence_year)2013 -4.31022    1.44071  -2.992 0.002774 **
## as.factor(sentence_year)2014 -4.64656    1.60599  -2.893 0.003813 **
## as.factor(sentence_year)2015 -4.50429    1.58943  -2.834 0.004599 **
## as.factor(sentence_year)2016 -4.94684    1.73263  -2.855 0.004303 **
## as.factor(sentence_year)2017 -4.37752    1.55342  -2.818 0.004833 **
##
## Diagnostic tests:
##                     df1    df2 statistic p-value
## Weak instruments      1 192112     9.588 0.00196 **
## Wu-Hausman            1 192111   136.040 < 2e-16 ***
## Sargan                0     NA        NA      NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.742 on 192112 degrees of freedom
## Multiple R-Squared: -10.39,  Adjusted R-squared: -10.39
## Wald test: 100.1 on 42 and 192112 DF,  p-value: < 2.2e-16
```

```
#Probation
iv.prob <- ivreg(prob_days_log~conf_minus_stayed_ts_log+
                 black+hispanic+asian+nativeam+other.race+
                 race.miss+
```

```
                male+log(age)+
                priors+pubdef+perc_credit+
                perc_stayed+
                trial_flag+
                felony_flag+
                   presum_pris+
                  gm_flag+
                violent_flag+drug_flag+alcohol_flag+
                filed_district+
                as.factor(sentence_year)|
             .-conf_minus_stayed_ts_log+cap_ratio,
          data = monsanc.short)

summary(iv.prob, diagnostics=T)
```

```
##
## Call:
## ivreg(formula = prob_days_log ~ conf_minus_stayed_ts_log + black +
##     hispanic + asian + nativeam + other.race + race.miss + male +
##     log(age) + priors + pubdef + perc_credit + perc_stayed +
##     trial_flag + felony_flag + presum_pris + gm_flag + violent_flag +
##     drug_flag + alcohol_flag + filed_district + as.factor(sentence_year) |
##     . - conf_minus_stayed_ts_log + cap_ratio, data = monsanc.short)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -28.45275  -4.03326  -0.07398   4.43463  30.03382
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   -5.96560    2.84973  -2.093 0.036315 *
## conf_minus_stayed_ts_log       2.82259    1.07616   2.623 0.008721 **
## black                          0.01866    0.04646   0.402 0.687999
## hispanic                      -0.42210    0.09775  -4.318 1.57e-05 ***
## asian                          0.41047    0.15071   2.724 0.006457 **
## nativeam                      -0.79041    0.26490  -2.984 0.002848 **
## other.race                     0.29793    0.17112   1.741 0.081672 .
## race.miss                      1.07877    0.38119   2.830 0.004655 **
## male                          -1.91433    0.58415  -3.277 0.001049 **
## log(age)                      -0.55571    0.15080  -3.685 0.000229 ***
## priors                        -0.15766    0.05237  -3.010 0.002609 **
## pubdef                        -0.91985    0.36864  -2.495 0.012587 *
## perc_credit                    0.07425    0.02673   2.778 0.005468 **
## perc_stayed                    0.05634    0.01623   3.472 0.000518 ***
## trial_flag                    -2.48580    1.35392  -1.836 0.066359 .
## felony_flag                    3.45886    0.55908   6.187 6.15e-10 ***
## presum_pris                  -14.35990    3.74335  -3.836 0.000125 ***
```

```
## gm_flag                          3.59108    1.04521   3.436 0.000591 ***
## violent_flag                    -0.01655    0.21446  -0.077 0.938470
## drug_flag                        1.00592    0.11043   9.109  < 2e-16 ***
## alcohol_flag                    -0.49214    0.84214  -0.584 0.558957
## filed_district02                -4.70994    1.39872  -3.367 0.000759 ***
## filed_district03                -0.59878    0.16377  -3.656 0.000256 ***
## filed_district04                -3.79499    0.80766  -4.699 2.62e-06 ***
## filed_district05                -1.60695    0.54276  -2.961 0.003070 **
## filed_district06                -0.85851    0.17521  -4.900 9.59e-07 ***
## filed_district07                -4.04410    1.38848  -2.913 0.003585 **
## filed_district08                -2.68104    1.00803  -2.660 0.007822 **
## filed_district09                -2.91904    1.03121  -2.831 0.004645 **
## filed_district10                -2.59887    0.97730  -2.659 0.007832 **
## as.factor(sentence_year)2005     1.39336    0.20281   6.870 6.42e-12 ***
## as.factor(sentence_year)2006     2.66781    0.49812   5.356 8.53e-08 ***
## as.factor(sentence_year)2007     3.93586    0.70504   5.582 2.37e-08 ***
## as.factor(sentence_year)2008     5.29103    0.96176   5.501 3.77e-08 ***
## as.factor(sentence_year)2009     5.24273    1.02263   5.127 2.95e-07 ***
## as.factor(sentence_year)2010     5.48873    1.20358   4.560 5.11e-06 ***
## as.factor(sentence_year)2011     6.19305    1.17483   5.271 1.36e-07 ***
## as.factor(sentence_year)2012     6.33985    1.22524   5.174 2.29e-07 ***
## as.factor(sentence_year)2013     6.16948    1.14702   5.379 7.51e-08 ***
## as.factor(sentence_year)2014     6.50856    1.27861   5.090 3.58e-07 ***
## as.factor(sentence_year)2015     6.40090    1.26543   5.058 4.23e-07 ***
## as.factor(sentence_year)2016     6.64871    1.37944   4.820 1.44e-06 ***
## as.factor(sentence_year)2017     5.79493    1.23675   4.686 2.79e-06 ***
##
## Diagnostic tests:
##                     df1    df2 statistic  p-value
## Weak instruments      1 192112     9.588  0.00196 **
## Wu-Hausman            1 192111    62.658 2.47e-15 ***
## Sargan                0     NA        NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.164 on 192112 degrees of freedom
## Multiple R-Squared: -2.687,  Adjusted R-squared: -2.688
## Wald test: 601.1 on 42 and 192112 DF,  p-value: < 2.2e-16
```

Table A2: IV 2SLS Models of Punishment w/ Presumptive Prison Control, Minnesota 2004-2017

	Punishment Outcome	
	log(LFO) Coef(SE)	log(Probation) Coef(SE)
log(Incarceration)	-4.089^{**} (1.352)	2.823^{**} (1.076)
Black	-0.692^{***} (0.058)	0.019 (0.046)
Hispanic	0.050 (0.123)	-0.422^{***} (0.098)
Asian	-0.498^{**} (0.189)	0.410^{**} (0.151)
Native American	0.365 (0.333)	-0.790^{**} (0.265)
Other Race	-0.670^{**} (0.215)	0.298 (0.171)
Missing Race	-1.490^{**} (0.479)	1.079^{**} (0.381)
Male	2.209^{**} (0.734)	-1.914^{**} (0.584)
log(Age)	0.492^{**} (0.189)	-0.556^{***} (0.151)
Prior Convictions	0.150^{*} (0.066)	-0.158^{**} (0.052)
Public Defender	0.641 (0.463)	-0.920^{*} (0.369)
Percent Credit	-0.100^{**} (0.034)	0.074^{**} (0.027)
Percent Stayed	-0.052^{*} (0.020)	0.056^{***} (0.016)
Trial	4.865^{**} (1.701)	-2.486 (1.354)
Felony	-1.839^{**} (0.702)	3.459^{***} (0.559)
Gross Misdemeanor	14.131^{**} (4.702)	-14.360^{***} (3.743)
Violent	-3.416^{**} (1.313)	3.591^{***} (1.045)
Drug	0.801^{**} (0.269)	-0.017 (0.214)
Alcohol/DUI	-0.111 (0.139)	1.006^{***} (0.110)
alcohol_flag	3.742^{***} (1.058)	-0.492 (0.842)
Constant	16.577^{***} (3.579)	-5.966^{*} (2.850)
District FE	Yes	Yes
Sentence Year FE	Yes	Yes
IV F(Incar.)	5.56^{*}	5.56^{*}
IV Wu-Hausman	109.82^{***}	65.26^{***}
Observations	192,155	192,155

Note: *p<0.05; **p<0.01; ***p<0.001

All tests are two-tailed. IV: County-Level Jail Capacity Ratio