SEM Preliminary

Ryan Larson - UMN

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```
ols <- lm(total_ff_log~black+hispanic+asian+nativeam+other.race+
          male+log(age)+priors+trial_flag+felony+gross.mis+drug+alcohol.dui+hunt.fish+other.o
          min_perc+repubvote+lecperc, data = monsanc.short)
summary(ols)
```

```
##
## Call:
## lm(formula = total_ff_log ~ black + hispanic + asian + nativeam +
##     other.race + male + log(age) + priors + trial_flag + felony +
##     gross.mis + drug + alcohol.dui + hunt.fish + other.offense +
##     min_perc + repubvote + lecperc, data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.0602 -0.3034  0.2999  0.7897  3.6809
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     5.3704365  0.0216120 248.493  < 2e-16 ***
## black          -0.2922685  0.0036512 -80.047  < 2e-16 ***
## hispanic        0.0923581  0.0051090  18.077  < 2e-16 ***
## asian           0.1334524  0.0077527  17.214  < 2e-16 ***
## nativeam       -0.1545409  0.0063464 -24.351  < 2e-16 ***
## other.race     -0.0777876  0.0101045  -7.698 1.38e-14 ***
## male            0.0228813  0.0030645   7.466 8.24e-14 ***
## log(age)       -0.0392370  0.0041473  -9.461  < 2e-16 ***
## priors         -0.0146779  0.0001583 -92.694  < 2e-16 ***
## trial_flagTRUE -0.6582206  0.1306944  -5.036 4.75e-07 ***
## felony         -0.5328676  0.0054587 -97.617  < 2e-16 ***
## gross.mis       0.0359677  0.0049332   7.291 3.08e-13 ***
## drug            0.2687882  0.0084612  31.767  < 2e-16 ***
## alcohol.dui     0.5413503  0.0067232  80.520  < 2e-16 ***
## hunt.fish      -0.0591106  0.0151796  -3.894 9.86e-05 ***
## other.offense   0.2963025  0.0059754  49.587  < 2e-16 ***
## min_perc       -0.0231018  0.0003112 -74.244  < 2e-16 ***
## repubvote      -0.0033053  0.0002209 -14.961  < 2e-16 ***
## lecperc         0.0187737  0.0004520  41.532  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.472 on 1172480 degrees of freedom
```

```
##   (421612 observations deleted due to missingness)
## Multiple R-squared:  0.06215,    Adjusted R-squared:  0.06214
## F-statistic:  4317 on 18 and 1172480 DF,  p-value: < 2.2e-16
```

```
#Multivariate Regression - when all predictors are identical across models
  #equivalent to separate OLS, but more efficient and takes into account error covariance

mv <- lm(cbind(total_ff_log, conf_days)~black+hispanic+asian+nativeam+other.race+
         male+log(age)+priors+trial_flag+felony+gross.mis+drug+alcohol.dui+hunt.fish+other.o
         min_perc+repubvote+lecperc, data = monsanc.short)
summary(mv)
```

```
## Response total_ff_log :
##
## Call:
## lm(formula = total_ff_log ~ black + hispanic + asian + nativeam +
##     other.race + male + log(age) + priors + trial_flag + felony +
##     gross.mis + drug + alcohol.dui + hunt.fish + other.offense +
##     min_perc + repubvote + lecperc, data = monsanc.short)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -6.0602 -0.3034  0.2999  0.7897  3.6809
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     5.3704365  0.0216120 248.493  < 2e-16 ***
## black          -0.2922685  0.0036512 -80.047  < 2e-16 ***
## hispanic        0.0923581  0.0051090  18.077  < 2e-16 ***
## asian           0.1334524  0.0077527  17.214  < 2e-16 ***
## nativeam       -0.1545409  0.0063464 -24.351  < 2e-16 ***
## other.race     -0.0777876  0.0101045  -7.698 1.38e-14 ***
## male            0.0228813  0.0030645   7.466 8.24e-14 ***
## log(age)       -0.0392370  0.0041473  -9.461  < 2e-16 ***
## priors         -0.0146779  0.0001583 -92.694  < 2e-16 ***
## trial_flagTRUE -0.6582206  0.1306944  -5.036 4.75e-07 ***
## felony         -0.5328676  0.0054587 -97.617  < 2e-16 ***
## gross.mis       0.0359677  0.0049332   7.291 3.08e-13 ***
## drug            0.2687882  0.0084612  31.767  < 2e-16 ***
## alcohol.dui     0.5413503  0.0067232  80.520  < 2e-16 ***
## hunt.fish      -0.0591106  0.0151796  -3.894 9.86e-05 ***
## other.offense   0.2963025  0.0059754  49.587  < 2e-16 ***
## min_perc       -0.0231018  0.0003112 -74.244  < 2e-16 ***
## repubvote      -0.0033053  0.0002209 -14.961  < 2e-16 ***
## lecperc         0.0187737  0.0004520  41.532  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 1.472 on 1172480 degrees of freedom
##   (421612 observations deleted due to missingness)
## Multiple R-squared:  0.06215,    Adjusted R-squared:  0.06214
## F-statistic:  4317 on 18 and 1172480 DF,  p-value: < 2.2e-16
##
##
## Response conf_days :
##
## Call:
## lm(formula = conf_days ~ black + hispanic + asian + nativeam +
##     other.race + male + log(age) + priors + trial_flag + felony +
##     gross.mis + drug + alcohol.dui + hunt.fish + other.offense +
##     min_perc + repubvote + lecperc, data = monsanc.short)
##
## Residuals:
##    Min     1Q Median     3Q    Max
##  -2054    -28     -4     19  43555
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)     16.82469    5.01708   3.353 0.000798 ***
## black           16.27695    0.84760  19.203  < 2e-16 ***
## hispanic        13.12751    1.18602  11.068  < 2e-16 ***
## asian           -1.24325    1.79974  -0.691 0.489694
## nativeam        21.08305    1.47327  14.310  < 2e-16 ***
## other.race       4.16471    2.34569   1.775 0.075820 .
## male            18.48199    0.71141  25.979  < 2e-16 ***
## log(age)        21.36834    0.96277  22.195  < 2e-16 ***
## priors           1.16302    0.03676  31.639  < 2e-16 ***
## trial_flagTRUE 1512.84424   30.33985  49.863  < 2e-16 ***
## felony         376.24576    1.26721 296.908  < 2e-16 ***
## gross.mis      165.36252    1.14520 144.396  < 2e-16 ***
## drug          -164.44345    1.96420 -83.720  < 2e-16 ***
## alcohol.dui    -84.64800    1.56075 -54.236  < 2e-16 ***
## hunt.fish     -137.51131    3.52383 -39.023  < 2e-16 ***
## other.offense -136.03719    1.38715 -98.070  < 2e-16 ***
## min_perc         0.37021    0.07223   5.125 2.97e-07 ***
## repubvote       -0.28268    0.05129  -5.512 3.56e-08 ***
## lecperc          2.10431    0.10494  20.053  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 341.8 on 1172480 degrees of freedom
##   (421612 observations deleted due to missingness)
## Multiple R-squared:  0.1421, Adjusted R-squared:  0.1421
## F-statistic: 1.079e+04 on 18 and 1172480 DF,  p-value: < 2.2e-16
```

```
#SUR: seemingly unrelated regression
  #same as OLS when covariance matrix is diagonal, or predictors same across equations
sur <- systemfit(list(total_ff_log~black+hispanic+asian+nativeam+other.race+
        male+log(age)+priors+felony+gross.mis+drug+alcohol.dui+hunt.fish+other.offense+
        min_perc+repubvote+lecperc,
                  conf_days~black+hispanic+asian+nativeam+other.race+
        male+log(age)+priors+trial_flag+felony+gross.mis+drug+alcohol.dui+hunt.fish+other.o
        min_perc+repubvote+lecperc), data=monsanc.short)
```

Warning in systemfit(list(total_ff_log ~ black + hispanic + asian + nativeam + :
the estimation of systems of equations with unequal numbers of observations has
not been thoroughly tested yet

```
summary(sur)
```

Warning in nObsEq[i] * nObsEq[j]: NAs produced by integer overflow

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```
##
## systemfit results
## method: OLS
##
##             N        DF        SSR detRCov    OLS-R2 McElroy-R2
## system 2348181 2348144 1.36959e+11  253088 0.142137         NA
##
##           N       DF        SSR       MSE     RMSE       R2   Adj R2
## eq1 1175682 1175664 2.54293e+06 2.16297e+00   1.4707 0.061905 0.061891
## eq2 1172499 1172480 1.36957e+11 1.16810e+05 341.7741 0.142138 0.142125
##
## The covariance matrix of the residuals
##          eq1        eq2
## eq1    2.16758    -10.3021
## eq2 -10.30213 116809.5027
##
## The correlations of the residuals
##          eq1        eq2
## eq1  1.0000000 -0.0204739
## eq2 -0.0204739  1.0000000
##
##
## OLS estimates for 'eq1' (equation 1)
## Model Formula: total_ff_log ~ black + hispanic + asian + nativeam + other.race +
##     male + log(age) + priors + felony + gross.mis + drug + alcohol.dui +
##     hunt.fish + other.offense + min_perc + repubvote + lecperc
```

```
##
##                  Estimate   Std. Error   t value   Pr(>|t|)
## (Intercept)     5.360841323 0.021568657 248.54776 < 2.22e-16 ***
## black          -0.292068650 0.003649986 -80.01912 < 2.22e-16 ***
## hispanic        0.093024719 0.005105180  18.22163 < 2.22e-16 ***
## asian           0.133929943 0.007748417  17.28481 < 2.22e-16 ***
## nativeam       -0.153750688 0.006343984 -24.23567 < 2.22e-16 ***
## other.race     -0.077246106 0.010097165  -7.65028 1.9984e-14 ***
## male            0.022781426 0.003060803   7.44296 9.8588e-14 ***
## log(age)       -0.037580216 0.004141226  -9.07466 < 2.22e-16 ***
## priors         -0.014654746 0.000158302 -92.57446 < 2.22e-16 ***
## felony         -0.531899427 0.005457336 -97.46504 < 2.22e-16 ***
## gross.mis       0.039374694 0.004927577   7.99068 1.3323e-15 ***
## drug            0.269422531 0.008460828  31.84352 < 2.22e-16 ***
## alcohol.dui     0.536916909 0.006714238  79.96691 < 2.22e-16 ***
## hunt.fish      -0.057224133 0.015178632  -3.77005 0.00016323 ***
## other.offense  0.296680489 0.005974795  49.65534 < 2.22e-16 ***
## min_perc       -0.022939219 0.000310650 -73.84266 < 2.22e-16 ***
## repubvote      -0.003288091 0.000220592 -14.90574 < 2.22e-16 ***
## lecperc         0.018756237 0.000451398  41.55141 < 2.22e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.470705 on 1175664 degrees of freedom
## Number of observations: 1175682 Degrees of Freedom: 1175664
## SSR: 2542929.777133 MSE: 2.162973 Root MSE: 1.470705
## Multiple R-Squared: 0.061905 Adjusted R-Squared: 0.061891
##
##
## OLS estimates for 'eq2' (equation 2)
## Model Formula: conf_days ~ black + hispanic + asian + nativeam + other.race +
##      male + log(age) + priors + trial_flag + felony + gross.mis +
##      drug + alcohol.dui + hunt.fish + other.offense + min_perc +
##      repubvote + lecperc
##
##                  Estimate   Std. Error   t value   Pr(>|t|)
## (Intercept)     16.8246890   5.0170823   3.35348 0.00079804 ***
## black           16.2769478   0.8476040  19.20348 < 2.22e-16 ***
## hispanic        13.1275054   1.1860240  11.06850 < 2.22e-16 ***
## asian           -1.2432510   1.7997369  -0.69080 0.48969390
## nativeam        21.0830454   1.4732736  14.31034 < 2.22e-16 ***
## other.race       4.1647099   2.3456913   1.77547 0.07582020 .
## male            18.4819912   0.7114118  25.97931 < 2.22e-16 ***
## log(age)        21.3683389   0.9627743  22.19455 < 2.22e-16 ***
## priors           1.1630214   0.0367594  31.63874 < 2.22e-16 ***
## trial_flagTRUE 1512.8442359  30.3398499  49.86327 < 2.22e-16 ***
## felony         376.2457613   1.2672127 296.90813 < 2.22e-16 ***
## gross.mis      165.3625232   1.1451998 144.39623 < 2.22e-16 ***
```

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```
## drug            -164.4434455    1.9642035 -83.72017 < 2.22e-16 ***
## alcohol.dui       -84.6480011    1.5607487 -54.23551 < 2.22e-16 ***
## hunt.fish        -137.5113082    3.5238328 -39.02322 < 2.22e-16 ***
## other.offense    -136.0371921    1.3871460 -98.06985 < 2.22e-16 ***
## min_perc            0.3702135    0.0722338   5.12521 2.9725e-07 ***
## repubvote          -0.2826838    0.0512882  -5.51168 3.5551e-08 ***
## lecperc             2.1043099    0.1049364  20.05319 < 2.22e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 341.774052 on 1172480 degrees of freedom
## Number of observations: 1172499 Degrees of Freedom: 1172480
## SSR: 136956805781.059 MSE: 116809.502747 Root MSE: 341.774052
## Multiple R-Squared: 0.142138 Adjusted R-Squared: 0.142125
```

```r
#structural equation model
  #2SLS - uses pedicted value of conf days in LFO equation

tsls <- tsls(total_ff_log~black+hispanic+asian+nativeam+other.race+
        male+log(age)+felony+gross.mis+mis+conf_days+drug+alcohol.dui+hunt.fish+other.offens
        min_perc+repubvote+lecperc,
        ~black+hispanic+asian+nativeam+other.race+
        male+log(age)+priors+trial_flag+felony+gross.mis+drug+alcohol.dui+hunt.fish+other.o
        min_perc+repubvote+lecperc, data = monsanc.short)

summary(tsls)
```

```
##
##  2SLS Estimates
##
## Model Formula: total_ff_log ~ black + hispanic + asian + nativeam + other.race +
##     male + log(age) + felony + gross.mis + mis + conf_days +
##     drug + alcohol.dui + hunt.fish + other.offense + min_perc +
##     repubvote + lecperc
##
## Instruments: ~black + hispanic + asian + nativeam + other.race + male + log(age) +
##     priors + trial_flag + felony + gross.mis + drug + alcohol.dui +
##     hunt.fish + other.offense + min_perc + repubvote + lecperc
##
## Residuals:
##      Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
##  -7.17625   -0.41095    0.22736   -0.02605    0.73720  172.25733
##
##                    Estimate    Std. Error   t value   Pr(>|t|)
## (Intercept)     5.368573e+00  6.661791e+03   0.00081    0.99936
## black          -2.624520e-01  5.245271e-03 -50.03594 < 2.22e-16 ***
## hispanic        1.564641e-01  6.949783e-03  22.51352 < 2.22e-16 ***
## asian           1.441376e-01  1.040981e-02  13.84633 < 2.22e-16 ***
```

```
## nativeam      -8.580593e-02  8.796868e-03  -9.75415 < 2.22e-16 ***
## other.race    -6.497227e-02  1.357507e-02  -4.78614 1.7004e-06 ***
## male           7.692293e-02  4.570885e-03  16.82889 < 2.22e-16 ***
## log(age)       2.617034e-02  6.018036e-03   4.34865 1.3699e-05 ***
## felony         1.073856e+00  6.661791e+03   0.00016    0.99987
## gross.mis      7.901704e-01  6.661791e+03   0.00012    0.99991
## mis            1.341775e-01  6.661791e+03   0.00002    0.99998
## conf_days     -3.937220e-03  9.786825e-05 -40.22980 < 2.22e-16 ***
## drug          -3.935105e-01  1.961199e-02 -20.06479 < 2.22e-16 ***
## alcohol.dui    2.221237e-01  1.238796e-02  17.93061 < 2.22e-16 ***
## hunt.fish     -5.934936e-01  2.449197e-02 -24.23217 < 2.22e-16 ***
## other.offense -2.557564e-01  1.543255e-02 -16.57253 < 2.22e-16 ***
## min_perc      -2.258251e-02  4.202684e-04 -53.73353 < 2.22e-16 ***
## repubvote     -4.477170e-03  2.979261e-04 -15.02779 < 2.22e-16 ***
## lecperc        2.681043e-02  6.407069e-04  41.84508 < 2.22e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.976972 on 1172480 degrees of freedom
```