CAR model Divide and Conquer

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```
library(here)
```

```
## here() starts at /Users/Alvin/Documents/NCSU_Fall_2021/NIH_SIP/flood-risk-health-effects
```

```
library(coda)

i_am("reports/CARmodel_div_and_conq.Rmd")
```

```
## here() starts at /Users/Alvin/Documents/NCSU_Fall_2021/NIH_SIP/flood-risk-health-effects
```

```
fhs_model_df <- readRDS("intermediary_data/fhs_model_df_all_census_tract_pc.rds")
```

Northeastern States

```
load(here("modeling_files/census_tract_ne.RData"))
```

```
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     20263.728      2445.153     20534.472      2224.815    -10266.616
## loglikelihood
##     -7686.710
```

```
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 19924.3841  8535.6954  9071.2043 11427.1045  8029.4220 14610.1586 17568.6452
##       var8       var9      var10      var11      var12      var13      var14
##  8652.2035 13626.6973  9238.1350  8885.6968 15943.1623 15366.9421  9738.7846
##      var15      var16      var17      var18      var19      var20      var21
## 10220.6180 13039.4927 13102.5838 15121.0921  6358.8205 13514.5528 12997.3493
##      var22      var23      var24      var25      var26      var27      var28
##  3050.2743  2828.6815   418.0523  3482.7534  2079.2610  1826.8789  1558.1103
##      var29      var30      var31      var32
##  1057.8724  1033.6833   895.6165 10035.7393
```

```
effectiveSize(chain1$samples$sigma2)
```

```
##    var1
## 1410.95
```

```
effectiveSize(chain1$samples$nu2)
```

```
##     var1
```

```
## 2085.748
```

```r
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 1254.369
```

```r
effectiveSize(chain1$samples$phi)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 13756.1936 13044.6198 16972.8671 10164.5781 11030.2728 16980.1265  9560.3049
##       var8       var9      var10      var11      var12      var13      var14
## 10709.2288 12243.9540 12145.2421 14000.3339   999.7428  1192.8601  1354.6731
##      var15      var16      var17      var18      var19      var20      var21
##  8944.9707 11021.8827  8262.8568  5172.2263  6918.4772  9308.8818  1139.6445
##      var22      var23      var24      var25      var26      var27      var28
##  4234.3473  2583.5385  3553.7232  2438.2262  6119.9726  4116.1276  5565.6320
##      var29      var30      var31      var32      var33      var34      var35
##  4906.8550  4687.7549  1852.7072  4011.7508  2672.3774  3555.2658  8029.6526
##      var36      var37      var38      var39      var40      var41      var42
## 15321.4269  9552.3741 14796.3681 16407.6342  5608.5177  3499.1347  2769.7553
##      var43      var44      var45      var46      var47      var48      var49
##  4833.5839  2514.2668  3728.4475  3909.6211  9688.1139  7000.0017 10346.1414
##      var50      var51      var52      var53      var54      var55      var56
##  2993.9606  2272.6064  2160.7036  6026.3203  2341.4114  3216.5961  6106.1595
##      var57      var58      var59      var60      var61      var62      var63
##  4955.0938  4020.6189  4431.6094  4810.7403 14865.5928  2864.0834  4165.4858
##      var64      var65      var66      var67      var68      var69      var70
##  5180.8471  1387.8007  4911.3380  4883.9575  3917.4117  3456.2748  2416.3616
##      var71      var72      var73      var74      var75      var76      var77
##  3049.7511  2622.3360  5569.8064  3433.4215  3930.9120  3108.7956  3054.8138
##      var78      var79      var80      var81      var82      var83      var84
##  5721.1961  4585.5651  4072.4071  4577.0800  5486.5151  3582.6231  2936.1222
##      var85      var86      var87      var88      var89      var90      var91
##  4851.7337  4940.7762  4106.7174  4049.2013  7934.8211 17965.1962  8775.7826
##      var92      var93      var94      var95      var96      var97      var98
##  8658.6893  7723.0877  4775.8742  2862.2045  2425.4532  4849.4131  2710.6152
##      var99     var100     var101     var102     var103     var104     var105
##  2718.1862  5661.7373  3213.9545  4669.4233  3819.6525  4795.9477 12603.1777
##     var106     var107     var108     var109     var110     var111     var112
##  3377.7652  2522.4021  4336.6083  5426.9996  3499.2013  7114.8710  4296.5112
##     var113     var114     var115     var116     var117     var118     var119
##  8280.6468  5486.5525  4008.7955  4403.8025  9914.0974 11466.8616 11330.5087
##     var120     var121     var122     var123     var124     var125     var126
## 14571.5895  9441.3677  1550.7551  3416.0813  4474.1458  3668.0125  5652.8653
##     var127     var128     var129     var130     var131     var132     var133
## 11916.2764 18328.8498  2705.9182 16496.6247 14263.7495  7866.4797  9623.8015
##     var134     var135     var136     var137     var138     var139     var140
##  9584.1839 11681.8573 18334.2377 15220.6859 17890.3190   826.1982  2379.6860
```

```r
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                          50%     2.5%    97.5%
## Intercept            6.12709  6.11575  6.13833
## flood_risk_pc1       0.01442 -0.00782  0.03661
## flood_risk_pc2       0.02424 -0.00288  0.05138
## flood_risk_pc3       0.01720 -0.00166  0.03613
## flood_risk_pc4       0.01499 -0.00860  0.03859
## EP_POV               0.35438  0.32330  0.38578
## EP_UNEMP             0.00530 -0.01355  0.02407
## EP_PCI              -0.04145 -0.06982 -0.01256
## EP_NOHSDP            0.19670  0.15870  0.23450
## EP_AGE65             1.16461  1.14214  1.18699
## EP_AGE17             0.27808  0.25321  0.30309
## EP_DISABL            0.31838  0.29529  0.34142
## EP_SNGPNT           -0.05387 -0.07763 -0.03052
## EP_MINRTY           -0.10093 -0.13882 -0.06316
## EP_LIMENG           -0.02634 -0.05991  0.00707
## EP_MUNIT             0.02436 -0.00149  0.05021
## EP_MOBILE           -0.00116 -0.01922  0.01713
## EP_CROWD            -0.07262 -0.09807 -0.04707
## EP_NOVEH            -0.00729 -0.05292  0.03840
## EP_GROUPQ           -0.06476 -0.08295 -0.04645
## EP_UNINSUR           0.07287  0.05020  0.09563
## co                  -0.23321 -0.35862 -0.10977
## no2                  0.11274 -0.03391  0.25814
## o3                   0.01312 -0.09095  0.11292
## pm10                -0.04860 -0.15684  0.06058
## pm25                 0.12708  0.01596  0.23896
## so2                 -0.06295 -0.14553  0.01743
## summer_tmmx          0.02665 -0.06762  0.12025
## winter_tmmx         -0.01000 -0.16829  0.14961
## summer_rmax          0.08294 -0.03194  0.19772
## winter_rmax         -0.12354 -0.27814  0.03346
## Data_Value_CSMOKING  0.61749  0.57572  0.65933
```

```
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9895314 0.9718360 0.9977547
```

Mid-Atlantic States

```
load(here("modeling_files/census_tract_at.RData"))
```

```
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     24319.953      3536.872     24491.573      2989.081    -12466.259
## loglikelihood
##     -8623.105
```

```
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 20000.0000  6470.7926  4861.1368  7365.5957  4223.9027 13430.9642 15916.2398
##       var8       var9      var10      var11      var12      var13      var14
## 11073.8512 13729.5763 13430.2927 15479.8024 14895.3516 17804.6061  6762.5185
##      var15      var16      var17      var18      var19      var20      var21
## 13216.3158 10982.3267 12725.6436 16856.1118 12321.0871 17424.0864 15817.5517
##      var22      var23      var24      var25      var26      var27      var28
##  3136.5209  2155.1850   536.7094  4039.7285  3007.4259  1378.7529   662.5022
##      var29      var30      var31      var32
##   270.7723   797.4361   498.6294  8893.3681
```

```r
effectiveSize(chain1$samples$sigma2)
```

```
##     var1
## 2023.887
```

```r
effectiveSize(chain1$samples$nu2)
```

```
##     var1
## 2700.438
```

```r
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 2438.818
```

```r
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                      50%     2.5%    97.5%
## Intercept        7.06914  7.05815  7.08021
## flood_risk_pc1  -0.05987 -0.09066 -0.02839
## flood_risk_pc2  -0.06704 -0.10264 -0.03139
## flood_risk_pc3  -0.01970 -0.04660  0.00726
## flood_risk_pc4   0.01082 -0.01995  0.04102
## EP_POV           0.26633  0.23317  0.29935
## EP_UNEMP         0.02195  0.00068  0.04346
## EP_PCI           0.00051 -0.03128  0.03194
## EP_NOHSDP        0.14201  0.10893  0.17507
## EP_AGE65         1.22004  1.19640  1.24354
## EP_AGE17         0.28273  0.25748  0.30801
## EP_DISABL        0.28377  0.25629  0.31168
## EP_SNGPNT       -0.08177 -0.10615 -0.05742
## EP_MINRTY       -0.04553 -0.08173 -0.00959
## EP_LIMENG       -0.01604 -0.04051  0.00802
## EP_MUNIT        -0.00496 -0.02576  0.01566
## EP_MOBILE        0.03530  0.01175  0.05905
## EP_CROWD        -0.04348 -0.06250 -0.02438
## EP_NOVEH         0.15090  0.11984  0.18204
## EP_GROUPQ       -0.08937 -0.10777 -0.07096
## EP_UNINSUR       0.05308  0.03175  0.07424
## co              -0.19300 -0.25950 -0.12530
## no2             -0.08226 -0.17170  0.00841
## o3              -0.14730 -0.21768 -0.07635
```

```
## pm10                -0.18240 -0.23133 -0.13316
## pm25                 0.38587  0.31850  0.45356
## so2                  0.04348 -0.01364  0.09983
## summer_tmmx         -0.05873 -0.18548  0.06961
## winter_tmmx          0.11325 -0.11147  0.33677
## summer_rmax          0.03729 -0.05560  0.13323
## winter_rmax          0.06663 -0.05800  0.18817
## Data_Value_CSMOKING  0.93036  0.87480  0.98623
```

```
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9950900 0.9858950 0.9993056
```

Midwest States

```
load(here("modeling_files/census_tract_mw.RData"))
```

```
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     20268.523      3855.849     20344.496      3150.409    -10600.234
## loglikelihood
##     -6278.413
```

```
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 14176.9331  7292.1336  7115.7703  9916.6604  9735.8663 12312.9084 15673.9349
##       var8       var9      var10      var11      var12      var13      var14
##  9380.4631 15293.8336  9498.6610 14259.8238 12487.5672 15243.5654  8393.6201
##      var15      var16      var17      var18      var19      var20      var21
## 13387.1733 12432.0260 13214.3195 16995.9056 12648.2632 15889.5749 15117.8928
##      var22      var23      var24      var25      var26      var27      var28
##  3147.3217  2952.3668   402.5297  2357.2708  2232.4225  1844.9766  1132.9651
##      var29      var30      var31      var32
##   294.6823  1236.6201  1495.6788 10935.3041
```

```
effectiveSize(chain1$samples$sigma2)
```

```
##     var1
## 2150.872
```

```
effectiveSize(chain1$samples$nu2)
```

```
##     var1
## 2621.567
```

```
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 493.0444
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)
```

```r
colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                          50%     2.5%    97.5%
## Intercept            6.92090  6.91106  6.93078
## flood_risk_pc1      -0.04159 -0.06743 -0.01594
## flood_risk_pc2       0.00419 -0.02579  0.03423
## flood_risk_pc3      -0.01666 -0.04183  0.00875
## flood_risk_pc4      -0.00108 -0.02275  0.02060
## EP_POV               0.24808  0.21748  0.27870
## EP_UNEMP             0.04559  0.02368  0.06750
## EP_PCI               0.00769 -0.02098  0.03659
## EP_NOHSDP            0.12279  0.09112  0.15429
## EP_AGE65             1.16537  1.14330  1.18752
## EP_AGE17             0.26675  0.24297  0.29056
## EP_DISABL            0.25795  0.23394  0.28140
## EP_SNGPNT           -0.03318 -0.05617 -0.00993
## EP_MINRTY           -0.02717 -0.06209  0.00846
## EP_LIMENG           -0.07040 -0.09641 -0.04453
## EP_MUNIT            -0.00478 -0.02528  0.01596
## EP_MOBILE            0.01178 -0.00518  0.02883
## EP_CROWD             0.00054 -0.01818  0.01917
## EP_NOVEH             0.06258  0.03453  0.09098
## EP_GROUPQ           -0.09286 -0.10918 -0.07640
## EP_UNINSUR           0.06305  0.04225  0.08412
## co                  -0.17681 -0.25575 -0.09808
## no2                 -0.09224 -0.20232  0.01825
## o3                  -0.26177 -0.37457 -0.15367
## pm10                -0.03123 -0.07419  0.01177
## pm25                 0.30588  0.21817  0.39578
## so2                 -0.06273 -0.11634 -0.00750
## summer_tmmx         -0.16854 -0.34081  0.00498
## winter_tmmx          0.32625  0.00238  0.58523
## summer_rmax         -0.03860 -0.14646  0.06632
## winter_rmax          0.08265 -0.01865  0.18714
## Data_Value_CSMOKING  0.86130  0.81483  0.90777
```

```r
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9919207 0.9757573 0.9991344
```

Southwest States

```r
load(here("modeling_files/census_tract_sw.RData"))
```

```r
chain1$modelfit
```

```
##          DIC          p.d         WAIC          p.w         LMPL
##    23839.303     4700.027    23815.862     3672.685   -12592.330
```

```
## loglikelihood
##     -7219.624
```

```r
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 19458.3285  3719.2246  3251.5426  3594.2936  2847.1635  8319.8851 16316.8251
##       var8       var9      var10      var11      var12      var13      var14
##  9640.6262 12812.8202 11466.9809 13581.5541 13026.9593 17569.0420  7203.3411
##      var15      var16      var17      var18      var19      var20      var21
## 12512.8841  8553.8761 11585.6582 16242.2790 14951.0498 16559.8161 12296.5420
##      var22      var23      var24      var25      var26      var27      var28
##   908.4464  1607.0303   450.5388   618.6898   349.3116  1550.8689   298.9448
##      var29      var30      var31      var32
##   183.2675   334.3156   877.3514  5059.8192
```

```r
effectiveSize(chain1$samples$sigma2)
```

```
##     var1
## 2585.363
```

```r
effectiveSize(chain1$samples$nu2)
```

```
##     var1
## 3046.342
```

```r
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 395.9194
```

```r
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                          50%     2.5%    97.5%
## Intercept            6.62008  6.60955  6.63069
## flood_risk_pc1      -0.04533 -0.08296 -0.00793
## flood_risk_pc2      -0.00901 -0.04416  0.02561
## flood_risk_pc3       0.00382 -0.02333  0.03097
## flood_risk_pc4      -0.02698 -0.06323  0.00919
## EP_POV               0.31153  0.27918  0.34365
## EP_UNEMP             0.01195 -0.00715  0.03083
## EP_PCI               0.04189  0.01169  0.07232
## EP_NOHSDP            0.22215  0.17680  0.26722
## EP_AGE65             1.38854  1.36124  1.41578
## EP_AGE17             0.24124  0.21157  0.27127
## EP_DISABL            0.27902  0.25322  0.30526
## EP_SNGPNT           -0.06114 -0.08427 -0.03806
## EP_MINRTY            0.00824 -0.03122  0.04799
## EP_LIMENG           -0.12963 -0.16813 -0.09147
## EP_MUNIT            -0.17679 -0.19961 -0.15397
## EP_MOBILE            0.08057  0.05945  0.10212
## EP_CROWD            -0.00297 -0.02680  0.02131
## EP_NOVEH             0.12896  0.10407  0.15369
## EP_GROUPQ           -0.11021 -0.12860 -0.09174
```

```
## EP_UNINSUR            0.15501  0.12411  0.18597
## co                   -0.17488 -0.27404 -0.07671
## no2                   0.09555 -0.00637  0.19702
## o3                   -0.11709 -0.29883  0.06070
## pm10                 -0.31363 -0.39787 -0.23076
## pm25                  0.60818  0.47431  0.74209
## so2                   0.01872 -0.02719  0.06417
## summer_tmmx          -0.02803 -0.18946  0.13179
## winter_tmmx           0.08777 -0.23156  0.41071
## summer_rmax          -0.23597 -0.50141  0.02994
## winter_rmax           0.18816  0.04239  0.33389
## Data_Value_CSMOKING  0.82317  0.77449  0.87221
```

```
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9979082 0.9923275 0.9997867
```

Northwestern States

```
load(here("modeling_files/census_tract_nw.RData"))
```

```
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     12028.694      2001.797     12078.916      1684.783     -6210.617
## loglikelihood
##     -4012.550
```

```
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 18825.1158  9591.9041  7419.2680  7216.2317 12545.4062 14925.5301 17805.5153
##       var8       var9      var10      var11      var12      var13      var14
## 10221.4026 14434.5808  9510.5994 15793.8560 15394.3300 18806.5701 11598.3921
##      var15      var16      var17      var18      var19      var20      var21
## 15782.5361 16755.1206 15173.5167 17916.6595 16412.0755 18495.5968 14362.5457
##      var22      var23      var24      var25      var26      var27      var28
##  2110.1385  3119.4027   371.0572  2857.1338  1360.9157  3847.2042   653.8790
##      var29      var30      var31      var32
##   164.2047   438.9211   545.6021  8381.5970
```

```
effectiveSize(chain1$samples$sigma2)
```

```
##    var1
## 2026.07
```

```
effectiveSize(chain1$samples$nu2)
```

```
##    var1
## 3169.02
```

```
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 1112.344
```

```r
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                          50%     2.5%    97.5%
## Intercept            6.33337  6.32156  6.34535
## flood_risk_pc1      -0.06598 -0.09288 -0.03913
## flood_risk_pc2       0.03138  0.00576  0.05704
## flood_risk_pc3      -0.00310 -0.02636  0.01974
## flood_risk_pc4       0.00351 -0.01633  0.02365
## EP_POV               0.21646  0.18652  0.24636
## EP_UNEMP             0.00958 -0.01123  0.03013
## EP_PCI              -0.00281 -0.03289  0.02737
## EP_NOHSDP            0.15270  0.11573  0.18989
## EP_AGE65             1.20545  1.17783  1.23289
## EP_AGE17             0.23770  0.20946  0.26597
## EP_DISABL            0.17838  0.15192  0.20507
## EP_SNGPNT           -0.01771 -0.04017  0.00463
## EP_MINRTY           -0.09313 -0.13142 -0.05446
## EP_LIMENG           -0.04617 -0.07806 -0.01454
## EP_MUNIT            -0.02372 -0.04931  0.00144
## EP_MOBILE            0.03112  0.01075  0.05133
## EP_CROWD            -0.01493 -0.03835  0.00852
## EP_NOVEH             0.10488  0.07759  0.13212
## EP_GROUPQ           -0.09078 -0.10954 -0.07211
## EP_UNINSUR           0.10857  0.08268  0.13453
## co                  -0.04961 -0.12618  0.02626
## no2                 -0.13642 -0.21609 -0.05694
## o3                  -0.06644 -0.19040  0.06008
## pm10                 0.02407 -0.04215  0.08984
## pm25                 0.15187  0.06599  0.23963
## so2                  0.05630  0.01624  0.09585
## summer_tmmx          0.04616 -0.02380  0.11765
## winter_tmmx         -0.01752 -0.17190  0.12389
## summer_rmax         -0.09303 -0.16645 -0.01634
## winter_rmax          0.15648  0.08792  0.22203
## Data_Value_CSMOKING  0.64881  0.60285  0.69509
```

```r
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9952555 0.9847260 0.9994229
```

Western States

```r
load(here("modeling_files/census_tract_we.RData"))
```

```r
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     15536.571      2467.467     15594.869      2077.491     -7955.639
## loglikelihood
##     -5300.818
```

```r
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 18998.1341  9450.0029  8229.1184  8372.5161 11151.0083 14516.4035 16067.8040
##       var8       var9      var10      var11      var12      var13      var14
##  9463.6244 12505.7610 13317.1628 15352.8296 16011.8244 18552.3248  7253.4042
##      var15      var16      var17      var18      var19      var20      var21
## 11739.8301 14125.2766 16320.1392 16085.0651 10767.9217 16028.7149 13761.3158
##      var22      var23      var24      var25      var26      var27      var28
##  2556.3826  3086.1602  1072.7372  2131.7513  1455.9886  3498.9501  1530.2806
##      var29      var30      var31      var32
##   993.4636  1528.7578  1702.5361 11522.8421
```

```r
effectiveSize(chain1$samples$sigma2)
```

```
##    var1
## 2020.54
```

```r
effectiveSize(chain1$samples$nu2)
```

```
##     var1
## 3038.306
```

```r
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 2105.624
```

```r
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                         50%     2.5%    97.5%
## Intercept           5.40034  5.38958  5.41119
## flood_risk_pc1      0.00088 -0.02542  0.02742
## flood_risk_pc2     -0.00144 -0.03057  0.02790
## flood_risk_pc3      0.00140 -0.02375  0.02684
## flood_risk_pc4      0.01201 -0.00686  0.03054
## EP_POV              0.18700  0.15779  0.21578
## EP_UNEMP            0.04353  0.02607  0.06102
## EP_PCI             -0.00405 -0.03512  0.02715
## EP_NOHSDP           0.11813  0.06804  0.16818
## EP_AGE65            1.22944  1.20393  1.25517
## EP_AGE17            0.19874  0.17215  0.22538
## EP_DISABL           0.18389  0.16120  0.20641
## EP_SNGPNT          -0.05427 -0.07614 -0.03250
## EP_MINRTY          -0.14764 -0.18816 -0.10729
## EP_LIMENG           0.06976  0.03041  0.10915
```

```
## EP_MUNIT            -0.08970 -0.11140 -0.06787
## EP_MOBILE            0.15665  0.14108  0.17224
## EP_CROWD            -0.07092 -0.10128 -0.04035
## EP_NOVEH             0.12326  0.09728  0.14899
## EP_GROUPQ           -0.04436 -0.06146 -0.02695
## EP_UNINSUR           0.01385 -0.01156  0.03929
## co                  -0.07682 -0.18570  0.03074
## no2                  0.17995  0.05811  0.30261
## o3                  -0.09422 -0.17329 -0.01738
## pm10                -0.19213 -0.29270 -0.09236
## pm25                 0.19409  0.07397  0.31798
## so2                  0.01808 -0.01037  0.04671
## summer_tmmx          0.08730  0.00245  0.17466
## winter_tmmx         -0.02349 -0.11210  0.06033
## summer_rmax         -0.05002 -0.16687  0.07073
## winter_rmax         -0.06270 -0.15991  0.03359
## Data_Value_CSMOKING  0.78128  0.73144  0.83070
```

```
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9798239 0.9508365 0.9951700
```

Southeastern States

```
load(here("modeling_files/census_tract_se.RData"))
```

```
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     30518.317      4023.033     30638.228      3366.575    -15662.320
## loglikelihood
##    -11236.125
```

```
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 15062.7239  4395.0905  7177.9832  8619.2360  8747.2531 14278.0698 18080.5768
##       var8       var9      var10      var11      var12      var13      var14
## 12772.7833 14096.1353 11031.4717 15942.4904 15486.6603 17786.6498  9488.8069
##      var15      var16      var17      var18      var19      var20      var21
##  9063.3433 13091.1081 11363.6806 17884.9077 17246.6775 17847.7761 14820.8373
##      var22      var23      var24      var25      var26      var27      var28
##  8544.0316  3031.4741   468.6427  2859.6661  1929.9408  2970.7981   837.9440
##      var29      var30      var31      var32
##   264.7875  1382.4547  1076.7992  8950.6229
```

```
effectiveSize(chain1$samples$sigma2)
```

```
##     var1
## 1970.914
```

```r
effectiveSize(chain1$samples$nu2)
```

```
##     var1
## 2410.862
```

```r
effectiveSize(chain1$samples$rho)
```

```
##     var1
## 273.8822
```

```r
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                         50%     2.5%    97.5%
## Intercept           7.57506  7.56292  7.58720
## flood_risk_pc1     -0.07685 -0.11381 -0.03976
## flood_risk_pc2      0.00148 -0.04262  0.04600
## flood_risk_pc3     -0.01576 -0.04791  0.01618
## flood_risk_pc4      0.02411 -0.00281  0.05125
## EP_POV              0.41380  0.38120  0.44569
## EP_UNEMP            0.03331  0.01305  0.05354
## EP_PCI             -0.16224 -0.19147 -0.13332
## EP_NOHSDP           0.17732  0.14017  0.21435
## EP_AGE65            1.85470  1.82231  1.88648
## EP_AGE17            0.33094  0.30039  0.36132
## EP_DISABL           0.26235  0.23540  0.28879
## EP_SNGPNT          -0.09773 -0.12339 -0.07238
## EP_MINRTY          -0.04679 -0.08346 -0.01048
## EP_LIMENG           0.01758 -0.01652  0.05056
## EP_MUNIT           -0.09203 -0.11501 -0.06919
## EP_MOBILE           0.14733  0.12288  0.17183
## EP_CROWD           -0.03986 -0.06168 -0.01840
## EP_NOVEH            0.12359  0.09811  0.14907
## EP_GROUPQ          -0.15419 -0.17317 -0.13503
## EP_UNINSUR          0.09136  0.06490  0.11765
## co                  0.01661 -0.02480  0.05824
## no2                -0.00356 -0.07008  0.06326
## o3                 -0.67024 -0.96910 -0.37854
## pm10               -0.18217 -0.23049 -0.13404
## pm25                0.59173  0.47157  0.71171
## so2                 0.05219 -0.00344  0.10740
## summer_tmmx        -0.00317 -0.09907  0.09354
## winter_tmmx        -0.23757 -0.60410  0.10492
## summer_rmax         0.00252 -0.09461  0.10071
## winter_rmax         0.01407 -0.09360  0.12297
## Data_Value_CSMOKING  0.59400  0.54048  0.64771
```

```r
rho_samples <- c(chain1$samples$rho, chain2$samples$rho, chain3$samples$rho)

quantile(rho_samples, c(0.5, 0.025, 0.975))
```

```
##       50%      2.5%     97.5%
## 0.9969215 0.9891482 0.9996960
```

Intrinsic CAR model

```
load(here("modeling_files/all_census_tract_intrinsic.RData"))
```

```
chain1$modelfit
```

```
##           DIC           p.d          WAIC           p.w          LMPL
##     150302.84      24758.98     150672.45      20140.25     -77614.81
## loglikelihood
##     -50392.45
```

```
effectiveSize(chain1$samples$beta)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 20000.0000  4606.0442  4542.8112  5596.5697  4427.2349 11122.8548 16044.1043
##       var8       var9      var10      var11      var12      var13      var14
##  8704.1411  9937.2164  9320.7221 12172.0610 12930.1821 14837.7390  7417.0104
##      var15      var16      var17      var18      var19      var20      var21
## 10709.4891 12512.0997  7727.0971 13706.0932  8179.4938 16918.8629 11397.8977
##      var22      var23      var24      var25      var26      var27      var28
##  2593.8152  1364.6111   104.8081  1145.9917   639.9753   906.1866   334.9774
##      var29      var30      var31      var32
##    65.5292   244.2531   417.8313  5036.3883
```

```
effectiveSize(chain1$samples$sigma2)
```

```
##     var1
## 2567.243
```

```
effectiveSize(chain1$samples$nu2)
```

```
##     var1
## 3443.284
```

```
beta_samples_matrix <- rbind(chain1$samples$beta, chain2$samples$beta, chain3$samples$beta)

colnames(beta_samples_matrix) <- c("Intercept", names(fhs_model_df[, 14:(ncol(fhs_model_df) - 1)]))

(beta_inference <- round(t(apply(beta_samples_matrix, 2, quantile, c(0.5, 0.025, 0.975))),5))
```

```
##                         50%     2.5%    97.5%
## Intercept           6.66082  6.65654  6.66508
## flood_risk_pc1     -0.03794 -0.04935 -0.02671
## flood_risk_pc2      0.00309 -0.00979  0.01595
## flood_risk_pc3     -0.00006 -0.00949  0.00915
## flood_risk_pc4      0.00796 -0.00206  0.01802
## EP_POV              0.31388  0.30161  0.32602
## EP_UNEMP            0.02995  0.02198  0.03795
## EP_PCI             -0.03636 -0.04830 -0.02442
## EP_NOHSDP           0.19419  0.17873  0.20987
## EP_AGE65            1.38018  1.37007  1.39023
## EP_AGE17            0.27892  0.26839  0.28953
## EP_DISABL           0.27029  0.26031  0.28030
## EP_SNGPNT          -0.06528 -0.07436 -0.05609
## EP_MINRTY          -0.03909 -0.05446 -0.02379
## EP_LIMENG          -0.06151 -0.07530 -0.04758
## EP_MUNIT           -0.05714 -0.06613 -0.04814
```

```
## EP_MOBILE            0.08001  0.07173  0.08819
## EP_CROWD            -0.04626 -0.05673 -0.03577
## EP_NOVEH             0.12708  0.11348  0.14052
## EP_GROUPQ           -0.09404 -0.10105 -0.08707
## EP_UNINSUR           0.10427  0.09380  0.11473
## co                  -0.14584 -0.18211 -0.10880
## no2                 -0.06298 -0.11022 -0.01513
## o3                  -0.13043 -0.20639 -0.05347
## pm10                -0.16507 -0.19724 -0.13240
## pm25                 0.46427  0.41576  0.51223
## so2                  0.03235  0.00033  0.06444
## summer_tmmx          0.06919  0.01613  0.12219
## winter_tmmx         -0.22820 -0.36848 -0.09261
## summer_rmax         -0.04796 -0.11669  0.02057
## winter_rmax          0.04813 -0.00119  0.10015
## Data_Value_CSMOKING  0.78514  0.76504  0.80543
```