Stratified Analysis

Alvin Sheng

Contents


```
library(here)
```

```
## Warning in readLines(f, n): line 1 appears to contain an embedded nul
```

```
## Warning in readLines(f, n): incomplete final line found on '/Volumes/
## ALVINDRIVE2/flood-risk-health-effects/._flood-risk-health-effects.Rproj'
```

```
## here() starts at /Volumes/ALVINDRIVE2/flood-risk-health-effects
```

```
library(coda)
library(CARBayes)
```

```
## Loading required package: MASS
```

```
## Loading required package: Rcpp
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
library(ggplot2)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
## v purrr   0.3.4
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## x dplyr::select() masks MASS::select()
```

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

CHD Stratified Analysis

CAR model results, Coronary Heart Disease Stratified on Poverty

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_poverty.RData"))
```

Beta samples

```
beta_samples <- mcmc.list(chain1$samples$beta, chain2$samples$beta,
                          chain3$samples$beta)
```

```
effectiveSize(beta_samples)
```

```
##       var1       var2       var3       var4       var5       var6       var7
## 68447.2046 36382.4841 37761.1319 53281.5366 68914.2531 78405.5864 87890.6361
##       var8       var9      var10      var11      var12      var13      var14
## 41973.9980 61353.3136 50147.4980 60253.3373 74957.3127 89787.3447 35155.2520
##      var15      var16      var17      var18      var19      var20      var21
## 63037.1789 62136.1468 70022.6252 73724.5058 32342.7837 88478.5492 57534.7711
##      var22      var23      var24      var25      var26      var27      var28
## 10909.7609  6229.8757   323.8625  4500.4463  2003.7053  2883.0879   996.6574
##      var29      var30      var31      var32      var33      var34      var35
##   161.4431   672.4907  1167.2441 28855.9245 78428.6550 39030.9892 34364.0083
##      var36      var37      var38      var39      var40      var41      var42
## 52293.7785 66509.7765 69269.6952 76671.2019 56050.2334 50185.4620 50495.6724
##      var43      var44      var45      var46      var47      var48      var49
## 60423.8387 60221.4781 80050.1425 28753.4787 41256.5990 55529.6434 37611.9176
##      var50      var51      var52      var53      var54      var55      var56
## 63008.8724 35946.8002 79938.2627 47002.3867  8686.7542  6769.6085   325.5017
##      var57      var58      var59      var60      var61      var62      var63
##  3937.8319  2135.7717  2707.4575  1039.3790   163.8511   680.0737  1232.0642
##      var64
## 28006.0742
```

Examining sigma2, nu2, rho

```
sigma2_samples <- mcmc.list(chain1$samples$sigma2, chain2$samples$sigma2,
                            chain3$samples$sigma2)

nu2_samples <- mcmc.list(chain1$samples$nu2, chain2$samples$nu2,
                         chain3$samples$nu2)
```

```
effectiveSize(sigma2_samples)
```

```
##     var1
## 6808.768
```

```
effectiveSize(nu2_samples)
```

```
##     var1
## 9364.658
```

Examining a sample of the 3108 phi parameters

```
phi_samples <- mcmc.list(chain1$samples$phi, chain2$samples$phi, chain3$samples$phi)
```

```
set.seed(1157, kind = "Mersenne-Twister", normal.kind = "Inversion", sample.kind = "Rejection")

phi_subset_idx <- sample(1:ncol(phi_samples[[1]]), size = 10)

phi_samples_subset <- phi_samples[, phi_subset_idx]
```

```
effectiveSize(phi_samples_subset)
```

```
##      var1      var2      var3      var4      var5      var6      var7      var8
## 37202.660  4572.161  6806.516 20135.793 93307.470 39089.413 33554.743 40535.330
##      var9     var10
## 70212.189  4821.368
```

Inference

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

colnames(beta_samples_matrix) <- var_names
```

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

```
##                               50%     2.5%    97.5%
## strat0                    6.43057  6.41684  6.44428
## strat0:flood_risk_pc1    -0.01479 -0.02603 -0.00362
## strat0:flood_risk_pc2     0.00961 -0.00341  0.02245
## strat0:flood_risk_pc3    -0.00201 -0.01169  0.00766
## strat0:flood_risk_pc4     0.00792 -0.00135  0.01719
## strat0:flood_risk_pc5     0.00190 -0.00692  0.01075
## strat0:EP_UNEMP           0.05020  0.03500  0.06527
## strat0:EP_PCI            -0.04941 -0.06333 -0.03545
## strat0:EP_NOHSDP          0.23345  0.20579  0.26097
## strat0:EP_AGE65           1.23105  1.21750  1.24458
## strat0:EP_AGE17           0.15970  0.14417  0.17523
## strat0:EP_DISABL          0.22445  0.20776  0.24128
## strat0:EP_SNGPNT          0.01504 -0.00063  0.03067
## strat0:EP_MINRTY         -0.17432 -0.19679 -0.15201
## strat0:EP_LIMENG         -0.02997 -0.05533 -0.00480
## strat0:EP_MUNIT          -0.05975 -0.07265 -0.04682
## strat0:EP_MOBILE          0.07762  0.06456  0.09065
## strat0:EP_CROWD           0.01336 -0.00717  0.03394
## strat0:EP_NOVEH           0.08992  0.06770  0.11209
## strat0:EP_GROUPQ         -0.09386 -0.10680 -0.08081
## strat0:EP_UNINSUR         0.13585  0.11884  0.15277
## strat0:co                -0.11942 -0.15848 -0.07998
## strat0:no2                0.01534 -0.03633  0.06636
## strat0:o3                -0.14595 -0.21856 -0.07619
```

```
## strat0:pm10                -0.19961 -0.23314 -0.16712
## strat0:pm25                 0.43798  0.39060  0.48763
## strat0:so2                  0.05621  0.02290  0.09022
## strat0:summer_tmmx          0.13280  0.08339  0.18615
## strat0:winter_tmmx         -0.31593 -0.47846 -0.18847
## strat0:summer_rmax          0.00254 -0.06569  0.07049
## strat0:winter_rmax          0.05320  0.00389  0.10322
## strat0:Data_Value_CSMOKING  0.70817  0.67899  0.73708
## strat1                      6.74754  6.73568  6.75929
## strat1:flood_risk_pc1      -0.01268 -0.02315 -0.00227
## strat1:flood_risk_pc2       0.00658 -0.00523  0.01846
## strat1:flood_risk_pc3       0.00569 -0.00365  0.01504
## strat1:flood_risk_pc4      -0.00259 -0.01103  0.00583
## strat1:flood_risk_pc5       0.00154 -0.00691  0.00993
## strat1:EP_UNEMP             0.05283  0.04390  0.06177
## strat1:EP_PCI              -0.08201 -0.10645 -0.05750
## strat1:EP_NOHSDP            0.14347  0.12630  0.16066
## strat1:EP_AGE65             1.63400  1.61986  1.64827
## strat1:EP_AGE17             0.30099  0.28704  0.31510
## strat1:EP_DISABL            0.22420  0.21232  0.23611
## strat1:EP_SNGPNT           -0.05794 -0.06914 -0.04666
## strat1:EP_MINRTY            0.01348 -0.00424  0.03122
## strat1:EP_LIMENG           -0.04214 -0.05721 -0.02698
## strat1:EP_MUNIT            -0.00647 -0.01763  0.00469
## strat1:EP_MOBILE            0.05158  0.04197  0.06119
## strat1:EP_CROWD            -0.02294 -0.03467 -0.01119
## strat1:EP_NOVEH             0.19940  0.18479  0.21408
## strat1:EP_GROUPQ           -0.05314 -0.06171 -0.04457
## strat1:EP_UNINSUR           0.08819  0.07621  0.10005
## strat1:co                  -0.14840 -0.19083 -0.10638
## strat1:no2                 -0.02954 -0.08115  0.02160
## strat1:o3                  -0.15649 -0.22953 -0.08649
## strat1:pm10                -0.14592 -0.18058 -0.11255
## strat1:pm25                 0.45173  0.40449  0.50151
## strat1:so2                  0.01675 -0.01555  0.04973
## strat1:summer_tmmx          0.04595 -0.00426  0.09936
## strat1:winter_tmmx         -0.16618 -0.32870 -0.03905
## strat1:summer_rmax         -0.07471 -0.14382 -0.00705
## strat1:winter_rmax          0.04073 -0.00820  0.09070
## strat1:Data_Value_CSMOKING  1.03745  1.01707  1.05807
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:EP_UNEMP"           "strat0:EP_PCI"
##  [5] "strat0:EP_NOHSDP"          "strat0:EP_AGE65"
##  [7] "strat0:EP_AGE17"           "strat0:EP_DISABL"
##  [9] "strat0:EP_MINRTY"          "strat0:EP_LIMENG"
## [11] "strat0:EP_MUNIT"           "strat0:EP_MOBILE"
## [13] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
## [15] "strat0:EP_UNINSUR"         "strat0:co"
## [17] "strat0:o3"                 "strat0:pm10"
## [19] "strat0:pm25"               "strat0:so2"
```

```
## [21] "strat0:summer_tmmx"         "strat0:winter_tmmx"
## [23] "strat0:winter_rmax"         "strat0:Data_Value_CSMOKING"
## [25] "strat1"                     "strat1:flood_risk_pc1"
## [27] "strat1:EP_UNEMP"            "strat1:EP_PCI"
## [29] "strat1:EP_NOHSDP"           "strat1:EP_AGE65"
## [31] "strat1:EP_AGE17"            "strat1:EP_DISABL"
## [33] "strat1:EP_SNGPNT"           "strat1:EP_LIMENG"
## [35] "strat1:EP_MOBILE"           "strat1:EP_CROWD"
## [37] "strat1:EP_NOVEH"            "strat1:EP_GROUPQ"
## [39] "strat1:EP_UNINSUR"          "strat1:co"
## [41] "strat1:o3"                  "strat1:pm10"
## [43] "strat1:pm25"                "strat1:winter_tmmx"
## [45] "strat1:summer_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand

beta_inference_df <- as.data.frame(beta_inference)

beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))

beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)

beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))

beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

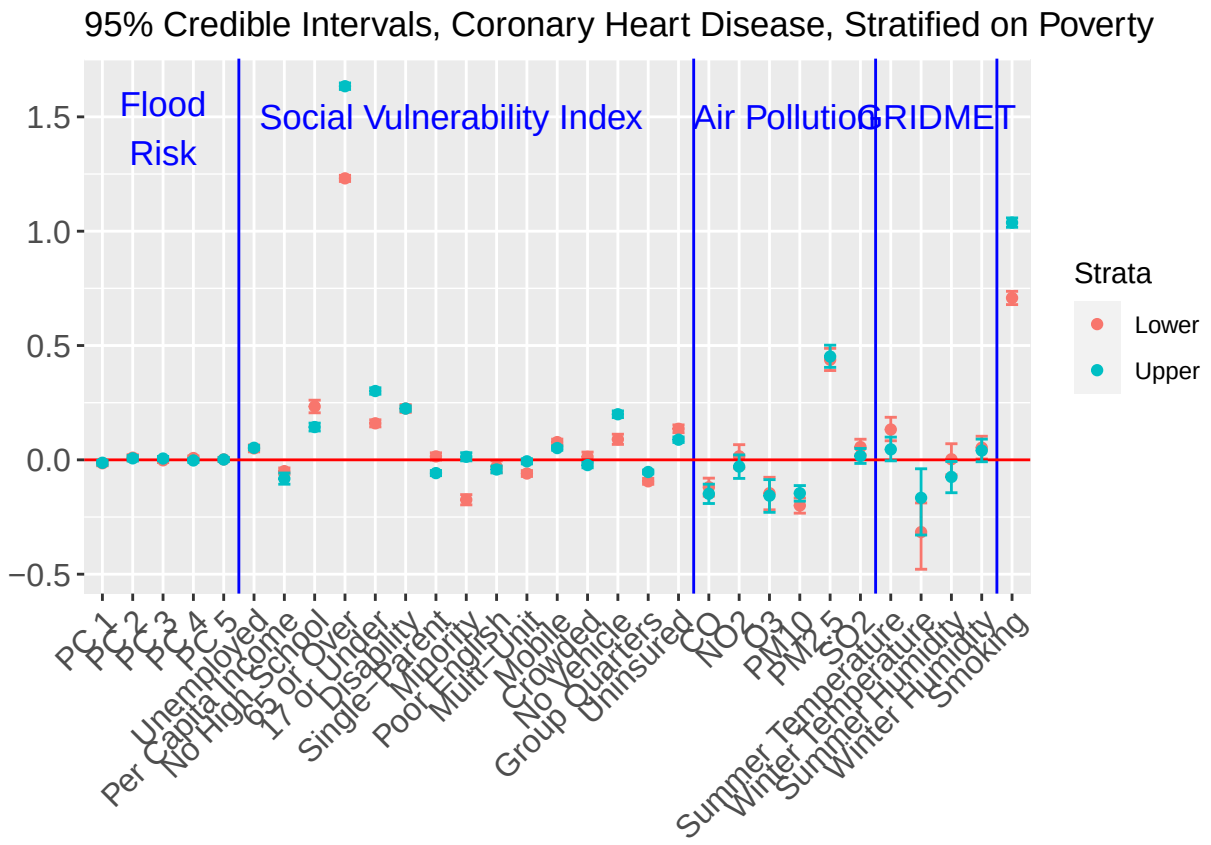
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
```

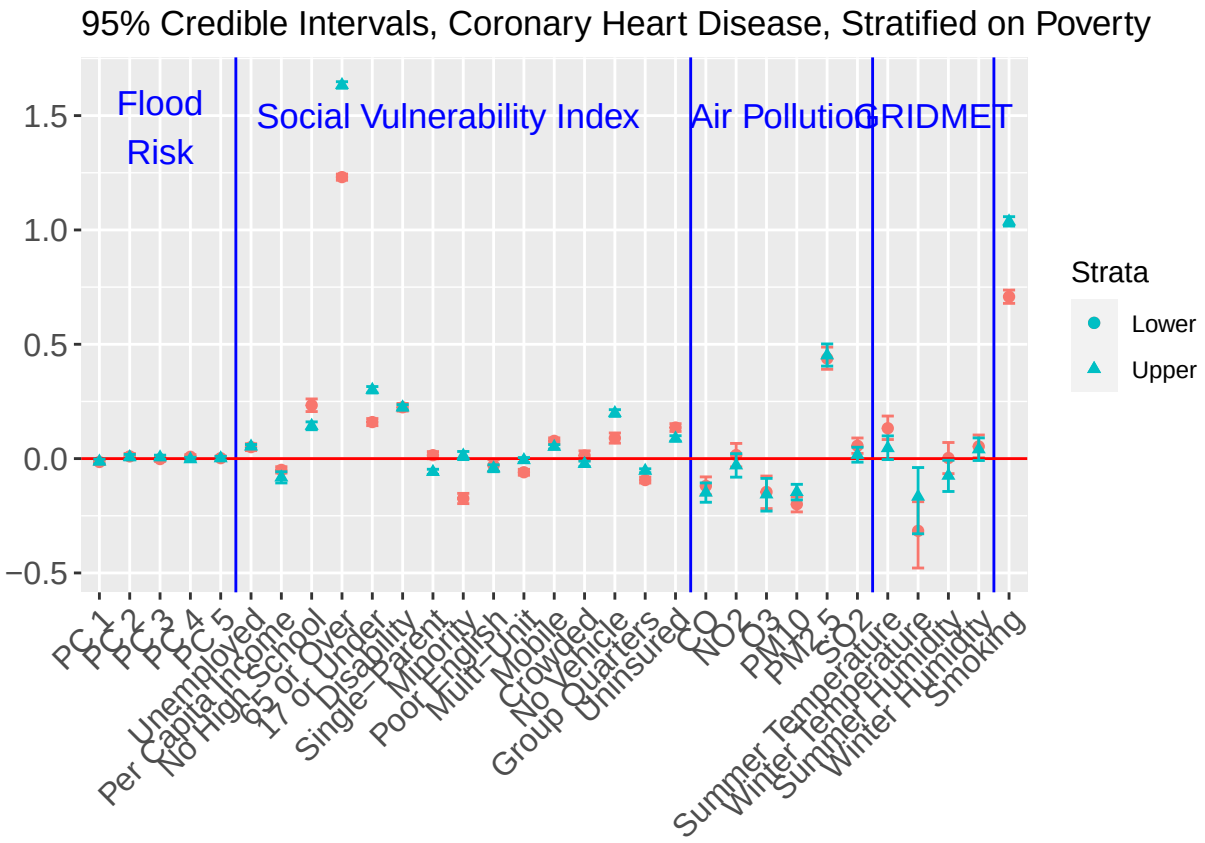
```
  annotate(geom = "text", x = 23.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_poverty.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

Below is my best attempt to use both color and shape to indicate the strata. The only problem is the legend.

```r
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat, shape = st
  geom_point() +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 20.5, 26.5, 30.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 23.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 28.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, Str
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_shape_manual(name = "Strata",
                     values = c(19, 17),
                     drop = FALSE) +
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```



CAR model results, Coronary Heart Disease Stratified on RPL_THEME1

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl1.RData"))
```

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

colnames(beta_samples_matrix) <- var_names
```

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

```
##                                50%     2.5%    97.5%
## strat0                     6.45402  6.43867  6.46944
## strat0:flood_risk_pc1     -0.01373 -0.02504 -0.00250
## strat0:flood_risk_pc2      0.01940  0.00628  0.03251
## strat0:flood_risk_pc3     -0.00281 -0.01244  0.00678
## strat0:flood_risk_pc4      0.01097  0.00171  0.02027
## strat0:flood_risk_pc5     -0.00040 -0.00931  0.00847
## strat0:EP_AGE65            1.25700  1.24396  1.27002
## strat0:EP_AGE17            0.19428  0.17933  0.20931
## strat0:EP_DISABL           0.23010  0.21400  0.24622
## strat0:EP_SNGPNT           0.00391 -0.01205  0.01993
## strat0:EP_MINRTY          -0.13127 -0.15406 -0.10848
## strat0:EP_LIMENG           0.05495  0.02828  0.08153
## strat0:EP_MUNIT           -0.05162 -0.06380 -0.03945
## strat0:EP_MOBILE           0.08315  0.06849  0.09783
## strat0:EP_CROWD            0.03774  0.01391  0.06135
```

```
## strat0:EP_NOVEH             0.11075  0.08929  0.13216
## strat0:EP_GROUPQ           -0.05570 -0.06636 -0.04511
## strat0:EP_UNINSUR           0.15819  0.14010  0.17630
## strat0:co                  -0.10803 -0.14862 -0.06744
## strat0:no2                  0.01240 -0.04062  0.06543
## strat0:o3                  -0.18017 -0.25288 -0.10678
## strat0:pm10                -0.22289 -0.25677 -0.18884
## strat0:pm25                 0.49051  0.44084  0.53994
## strat0:so2                  0.05745  0.02305  0.09116
## strat0:summer_tmmx          0.12253  0.07118  0.17360
## strat0:winter_tmmx         -0.31262 -0.43899 -0.17723
## strat0:summer_rmax         -0.00054 -0.06838  0.06803
## strat0:winter_rmax          0.05775  0.00683  0.10815
## strat0:Data_Value_CSMOKING  0.89818  0.87352  0.92311
## strat1                      6.68605  6.67465  6.69750
## strat1:flood_risk_pc1      -0.01704 -0.02776 -0.00619
## strat1:flood_risk_pc2       0.00178 -0.01015  0.01371
## strat1:flood_risk_pc3       0.00354 -0.00636  0.01337
## strat1:flood_risk_pc4      -0.00033 -0.00887  0.00824
## strat1:flood_risk_pc5       0.00002 -0.00852  0.00859
## strat1:EP_AGE65             1.70414  1.68925  1.71910
## strat1:EP_AGE17             0.28821  0.27392  0.30257
## strat1:EP_DISABL            0.24440  0.23236  0.25646
## strat1:EP_SNGPNT           -0.02580 -0.03688 -0.01474
## strat1:EP_MINRTY            0.06665  0.04966  0.08361
## strat1:EP_LIMENG            0.02108  0.00815  0.03399
## strat1:EP_MUNIT            -0.01386 -0.02566 -0.00205
## strat1:EP_MOBILE            0.05589  0.04646  0.06526
## strat1:EP_CROWD             0.00304 -0.00842  0.01452
## strat1:EP_NOVEH             0.21061  0.19575  0.22548
## strat1:EP_GROUPQ           -0.02986 -0.03868 -0.02099
## strat1:EP_UNINSUR           0.11241  0.10070  0.12410
## strat1:co                  -0.15616 -0.19852 -0.11415
## strat1:no2                 -0.02130 -0.07389  0.03080
## strat1:o3                  -0.17981 -0.25226 -0.10658
## strat1:pm10                -0.13845 -0.17356 -0.10333
## strat1:pm25                 0.49868  0.44917  0.54790
## strat1:so2                  0.02675 -0.00619  0.05901
## strat1:summer_tmmx          0.02545 -0.02723  0.07781
## strat1:winter_tmmx         -0.15659 -0.28254 -0.02076
## strat1:summer_rmax         -0.08239 -0.15016 -0.01307
## strat1:winter_rmax          0.06055  0.00976  0.11082
## strat1:Data_Value_CSMOKING  1.19512  1.17709  1.21304
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"     "strat0:flood_risk_pc4"
##  [5] "strat0:EP_AGE65"           "strat0:EP_AGE17"
##  [7] "strat0:EP_DISABL"          "strat0:EP_MINRTY"
##  [9] "strat0:EP_LIMENG"          "strat0:EP_MUNIT"
## [11] "strat0:EP_MOBILE"          "strat0:EP_CROWD"
## [13] "strat0:EP_NOVEH"           "strat0:EP_GROUPQ"
```

```
## [15] "strat0:EP_UNINSUR"          "strat0:co"
## [17] "strat0:o3"                  "strat0:pm10"
## [19] "strat0:pm25"                "strat0:so2"
## [21] "strat0:summer_tmmx"         "strat0:winter_tmmx"
## [23] "strat0:winter_rmax"         "strat0:Data_Value_CSMOKING"
## [25] "strat1"                     "strat1:flood_risk_pc1"
## [27] "strat1:EP_AGE65"            "strat1:EP_AGE17"
## [29] "strat1:EP_DISABL"           "strat1:EP_SNGPNT"
## [31] "strat1:EP_MINRTY"           "strat1:EP_LIMENG"
## [33] "strat1:EP_MUNIT"            "strat1:EP_MOBILE"
## [35] "strat1:EP_NOVEH"            "strat1:EP_GROUPQ"
## [37] "strat1:EP_UNINSUR"          "strat1:co"
## [39] "strat1:o3"                  "strat1:pm10"
## [41] "strat1:pm25"                "strat1:winter_tmmx"
## [43] "strat1:summer_rmax"         "strat1:winter_rmax"
## [45] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

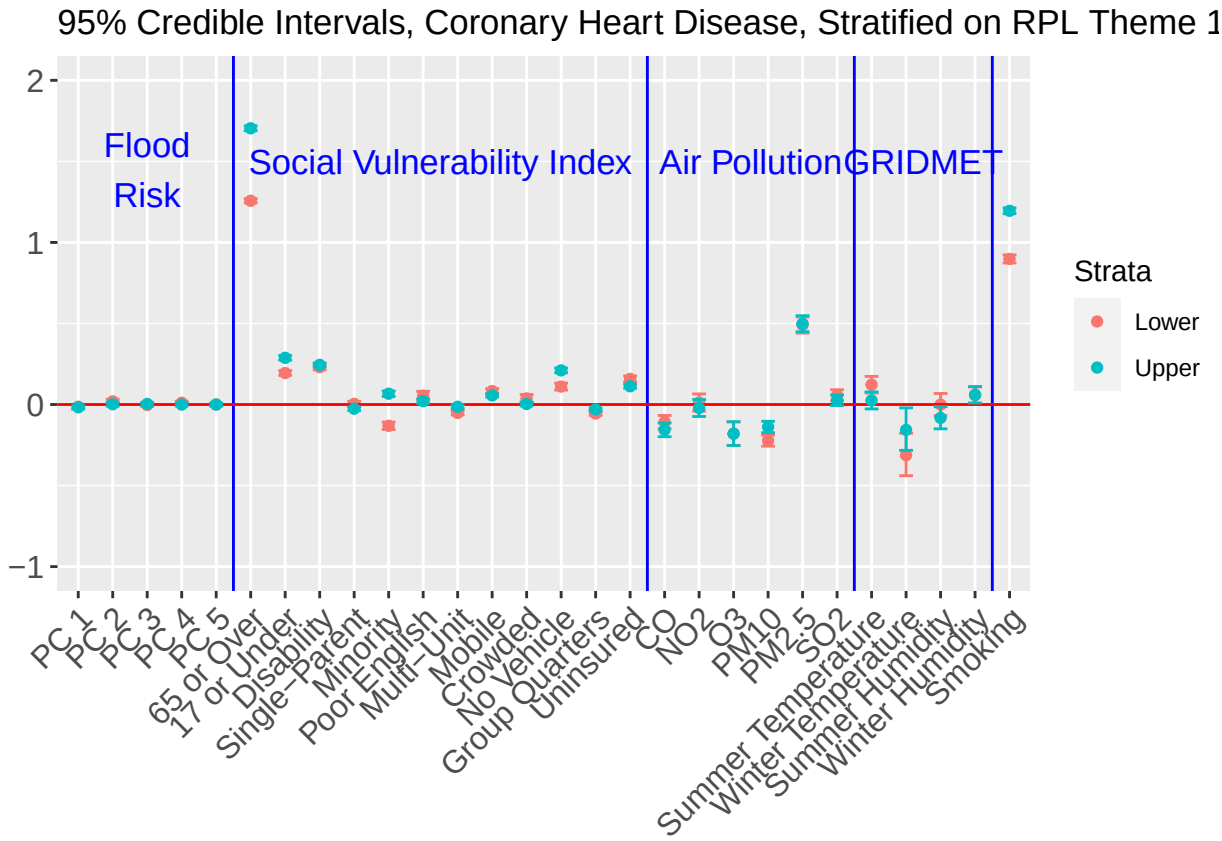
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 1.5, label = "Air Pollution",
```

```
            col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 1.5, label = "GRIDMET",
            col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent", "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)
p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl1.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEME2

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl2.RData"))
```

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

colnames(beta_samples_matrix) <- var_names

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

```
##                                50%     2.5%    97.5%
## strat0                     6.30423  6.28996  6.31858
## strat0:flood_risk_pc1     -0.06673 -0.08370 -0.04983
## strat0:flood_risk_pc2      0.03380  0.01456  0.05310
## strat0:flood_risk_pc3     -0.02927 -0.04362 -0.01490
## strat0:flood_risk_pc4      0.01555  0.00232  0.02886
## strat0:flood_risk_pc5     -0.01854 -0.03140 -0.00567
## strat0:EP_POV              0.17521  0.15077  0.19948
## strat0:EP_UNEMP            0.14020  0.12108  0.15921
## strat0:EP_PCI              0.05835  0.03835  0.07856
## strat0:EP_NOHSDP           0.84768  0.81526  0.88063
## strat0:EP_MINRTY          -0.69547 -0.72610 -0.66503
## strat0:EP_LIMENG          -0.02521 -0.05299  0.00254
## strat0:EP_MUNIT           -0.07892 -0.09462 -0.06322
## strat0:EP_MOBILE           0.26763  0.24778  0.28737
## strat0:EP_CROWD           -0.25308 -0.27413 -0.23196
## strat0:EP_NOVEH            0.50768  0.48130  0.53391
## strat0:EP_GROUPQ          -0.29208 -0.30253 -0.28167
## strat0:EP_UNINSUR         -0.06808 -0.08957 -0.04657
## strat0:co                 -0.26079 -0.32410 -0.19767
## strat0:no2                 0.00479 -0.08237  0.09049
## strat0:o3                  0.03266 -0.10392  0.16851
## strat0:pm10               -0.52101 -0.57945 -0.46236
## strat0:pm25                0.53864  0.45407  0.62318
## strat0:so2                -0.06112 -0.11984 -0.00350
## strat0:summer_tmmx        -0.00153 -0.09792  0.09139
## strat0:winter_tmmx        -0.25447 -0.48549  0.01561
## strat0:summer_rmax         0.00042 -0.12539  0.12497
## strat0:winter_rmax         0.01963 -0.07374  0.11369
## strat0:Data_Value_CSMOKING -0.04856 -0.08570 -0.01111
## strat1                     7.02421  7.00937  7.03925
## strat1:flood_risk_pc1     -0.05120 -0.06865 -0.03360
## strat1:flood_risk_pc2     -0.00071 -0.01997  0.01843
## strat1:flood_risk_pc3     -0.00739 -0.02342  0.00851
## strat1:flood_risk_pc4      0.01246 -0.00160  0.02677
## strat1:flood_risk_pc5     -0.01306 -0.02721  0.00109
## strat1:EP_POV              0.65182  0.62551  0.67798
## strat1:EP_UNEMP            0.07042  0.05548  0.08540
## strat1:EP_PCI             -0.03986 -0.07767 -0.00180
## strat1:EP_NOHSDP           0.60882  0.57970  0.63782
## strat1:EP_MINRTY          -0.54699 -0.57551 -0.51871
## strat1:EP_LIMENG          -0.17493 -0.20235 -0.14773
## strat1:EP_MUNIT            0.07210  0.04990  0.09420
## strat1:EP_MOBILE           0.20244  0.18781  0.21696
## strat1:EP_CROWD           -0.23715 -0.25767 -0.21643
## strat1:EP_NOVEH            0.54499  0.51862  0.57143
## strat1:EP_GROUPQ           0.12809  0.09979  0.15653
## strat1:EP_UNINSUR         -0.04980 -0.06976 -0.02978
```

```
## strat1:co                  -0.30915 -0.38079 -0.23805
## strat1:no2                 -0.19977 -0.29126 -0.10965
## strat1:o3                   0.06285 -0.07316  0.19868
## strat1:pm10                -0.45389 -0.51216 -0.39624
## strat1:pm25                 0.61054  0.52651  0.69397
## strat1:so2                 -0.03964 -0.09686  0.01733
## strat1:summer_tmmx          0.01070 -0.08642  0.10425
## strat1:winter_tmmx         -0.28525 -0.51747 -0.01566
## strat1:summer_rmax          0.02450 -0.10133  0.14917
## strat1:winter_rmax          0.03539 -0.05743  0.12851
## strat1:Data_Value_CSMOKING -0.21323 -0.24947 -0.17705
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"      "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"      "strat0:flood_risk_pc5"
##  [7] "strat0:EP_POV"              "strat0:EP_UNEMP"
##  [9] "strat0:EP_PCI"              "strat0:EP_NOHSDP"
## [11] "strat0:EP_MINRTY"           "strat0:EP_MUNIT"
## [13] "strat0:EP_MOBILE"           "strat0:EP_CROWD"
## [15] "strat0:EP_NOVEH"            "strat0:EP_GROUPQ"
## [17] "strat0:EP_UNINSUR"          "strat0:co"
## [19] "strat0:pm10"                "strat0:pm25"
## [21] "strat0:so2"                 "strat0:Data_Value_CSMOKING"
## [23] "strat1"                     "strat1:flood_risk_pc1"
## [25] "strat1:EP_POV"              "strat1:EP_UNEMP"
## [27] "strat1:EP_PCI"              "strat1:EP_NOHSDP"
## [29] "strat1:EP_MINRTY"           "strat1:EP_LIMENG"
## [31] "strat1:EP_MUNIT"            "strat1:EP_MOBILE"
## [33] "strat1:EP_CROWD"            "strat1:EP_NOVEH"
## [35] "strat1:EP_GROUPQ"           "strat1:EP_UNINSUR"
## [37] "strat1:co"                  "strat1:no2"
## [39] "strat1:pm10"                "strat1:pm25"
## [41] "strat1:winter_tmmx"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

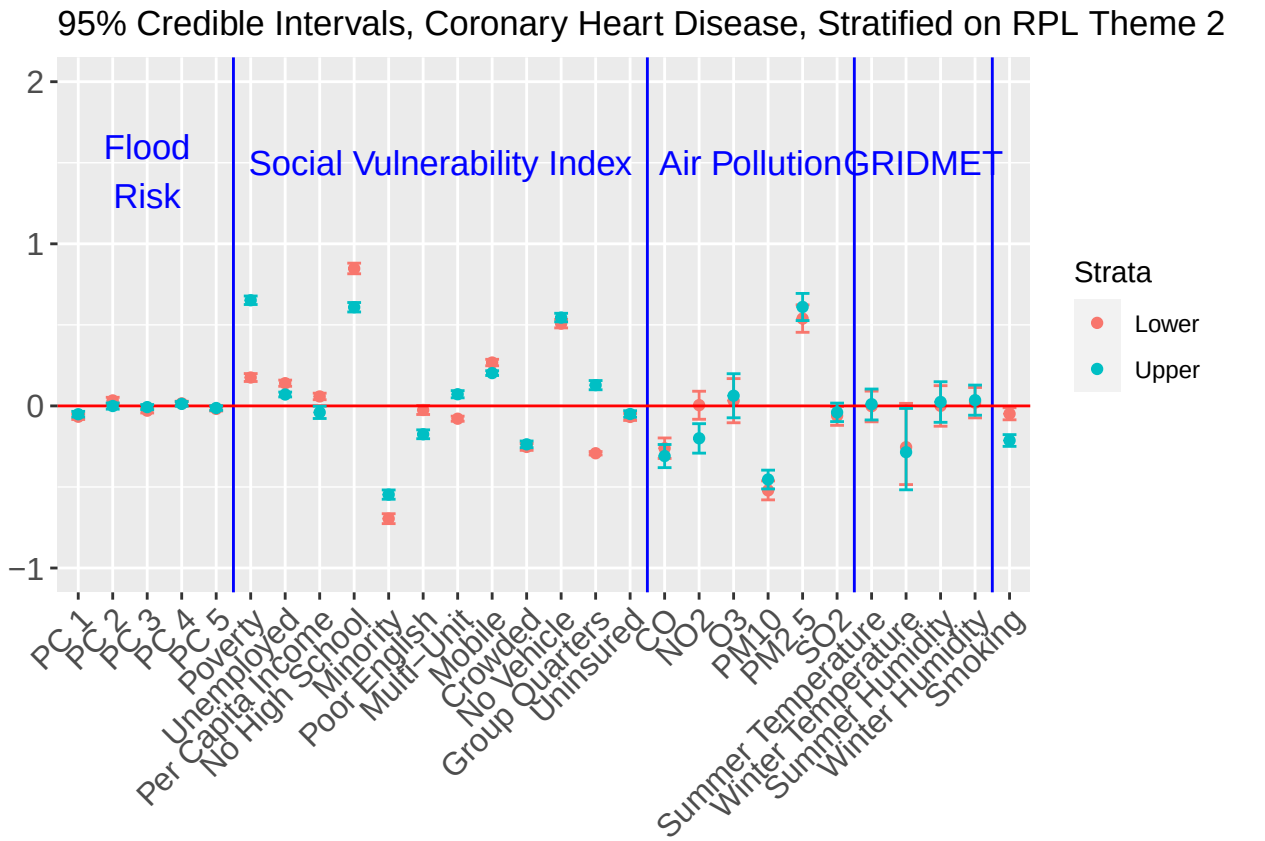
```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

Splitting up the beta coefficients for each strata

```r
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```r
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 17.5, 23.5, 27.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 20.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 25.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "Minority", "Poor English",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl2.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEME3

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl3.RData"))
```

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

colnames(beta_samples_matrix) <- var_names
```

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

```
##                                50%     2.5%    97.5%
## strat0                     6.76501  6.74767  6.78232
## strat0:flood_risk_pc1     -0.01483 -0.02636 -0.00329
## strat0:flood_risk_pc2      0.01941  0.00585  0.03304
## strat0:flood_risk_pc3      0.01204  0.00166  0.02237
## strat0:flood_risk_pc4      0.01696  0.00631  0.02751
## strat0:flood_risk_pc5      0.00355 -0.00677  0.01390
## strat0:EP_POV              0.31113  0.29337  0.32879
## strat0:EP_UNEMP            0.03773  0.02563  0.04977
```

```
## strat0:EP_PCI              -0.02874 -0.04289 -0.01464
## strat0:EP_NOHSDP            0.27300  0.24645  0.29950
## strat0:EP_AGE65             1.30345  1.29075  1.31612
## strat0:EP_AGE17             0.29597  0.28110  0.31068
## strat0:EP_DISABL            0.26693  0.25282  0.28102
## strat0:EP_SNGPNT           -0.01633 -0.03074 -0.00193
## strat0:EP_MUNIT            -0.05652 -0.07218 -0.04082
## strat0:EP_MOBILE            0.06397  0.05291  0.07506
## strat0:EP_CROWD            -0.00750 -0.03182  0.01660
## strat0:EP_NOVEH             0.13557  0.11469  0.15648
## strat0:EP_GROUPQ           -0.12827 -0.13845 -0.11820
## strat0:EP_UNINSUR           0.10768  0.09121  0.12411
## strat0:co                  -0.12087 -0.16222 -0.07935
## strat0:no2                 -0.04947 -0.10435  0.00505
## strat0:o3                  -0.15967 -0.23060 -0.07892
## strat0:pm10                -0.14755 -0.18179 -0.11344
## strat0:pm25                 0.39031  0.33941  0.44041
## strat0:so2                  0.04042  0.00561  0.07503
## strat0:summer_tmmx          0.07608  0.02380  0.12765
## strat0:winter_tmmx         -0.27667 -0.40808 -0.15117
## strat0:summer_rmax         -0.01973 -0.08950  0.04666
## strat0:winter_rmax          0.07179  0.01947  0.12320
## strat0:Data_Value_CSMOKING  0.69089  0.66326  0.71846
## strat1                      6.70294  6.69188  6.71406
## strat1:flood_risk_pc1      -0.02118 -0.03244 -0.00987
## strat1:flood_risk_pc2       0.00852 -0.00349  0.02045
## strat1:flood_risk_pc3      -0.00779 -0.01750  0.00194
## strat1:flood_risk_pc4      -0.00117 -0.00917  0.00686
## strat1:flood_risk_pc5       0.00156 -0.00624  0.00930
## strat1:EP_POV               0.32643  0.31130  0.34164
## strat1:EP_UNEMP             0.02950  0.01973  0.03931
## strat1:EP_PCI              -0.03701 -0.05396 -0.02003
## strat1:EP_NOHSDP            0.13020  0.11521  0.14521
## strat1:EP_AGE65             1.55164  1.53707  1.56633
## strat1:EP_AGE17             0.24312  0.22915  0.25720
## strat1:EP_DISABL            0.24637  0.23310  0.25961
## strat1:EP_SNGPNT           -0.06454 -0.07580 -0.05327
## strat1:EP_MUNIT            -0.06197 -0.07234 -0.05155
## strat1:EP_MOBILE            0.09291  0.08235  0.10348
## strat1:EP_CROWD            -0.02666 -0.03815 -0.01518
## strat1:EP_NOVEH             0.09375  0.07817  0.10935
## strat1:EP_GROUPQ           -0.06692 -0.07650 -0.05736
## strat1:EP_UNINSUR           0.08772  0.07555  0.09989
## strat1:co                  -0.12116 -0.16478 -0.07813
## strat1:no2                 -0.05278 -0.10570  0.00006
## strat1:o3                  -0.15822 -0.22952 -0.07679
## strat1:pm10                -0.16850 -0.20472 -0.13198
## strat1:pm25                 0.44519  0.39367  0.49574
## strat1:so2                  0.02409 -0.01298  0.06035
## strat1:summer_tmmx          0.04815 -0.00518  0.10083
## strat1:winter_tmmx         -0.21012 -0.34171 -0.08545
## strat1:summer_rmax         -0.07801 -0.14827 -0.01132
## strat1:winter_rmax          0.04087 -0.01191  0.09299
## strat1:Data_Value_CSMOKING  0.84659  0.82323  0.86998
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                      "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"       "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc4"       "strat0:EP_POV"
##  [7] "strat0:EP_UNEMP"             "strat0:EP_PCI"
##  [9] "strat0:EP_NOHSDP"            "strat0:EP_AGE65"
## [11] "strat0:EP_AGE17"             "strat0:EP_DISABL"
## [13] "strat0:EP_SNGPNT"            "strat0:EP_MUNIT"
## [15] "strat0:EP_MOBILE"            "strat0:EP_NOVEH"
## [17] "strat0:EP_GROUPQ"            "strat0:EP_UNINSUR"
## [19] "strat0:co"                   "strat0:o3"
## [21] "strat0:pm10"                 "strat0:pm25"
## [23] "strat0:so2"                  "strat0:summer_tmmx"
## [25] "strat0:winter_tmmx"          "strat0:winter_rmax"
## [27] "strat0:Data_Value_CSMOKING" "strat1"
## [29] "strat1:flood_risk_pc1"       "strat1:EP_POV"
## [31] "strat1:EP_UNEMP"             "strat1:EP_PCI"
## [33] "strat1:EP_NOHSDP"            "strat1:EP_AGE65"
## [35] "strat1:EP_AGE17"             "strat1:EP_DISABL"
## [37] "strat1:EP_SNGPNT"            "strat1:EP_MUNIT"
## [39] "strat1:EP_MOBILE"            "strat1:EP_CROWD"
## [41] "strat1:EP_NOVEH"             "strat1:EP_GROUPQ"
## [43] "strat1:EP_UNINSUR"           "strat1:co"
## [45] "strat1:o3"                   "strat1:pm10"
## [47] "strat1:pm25"                 "strat1:winter_tmmx"
## [49] "strat1:summer_rmax"          "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

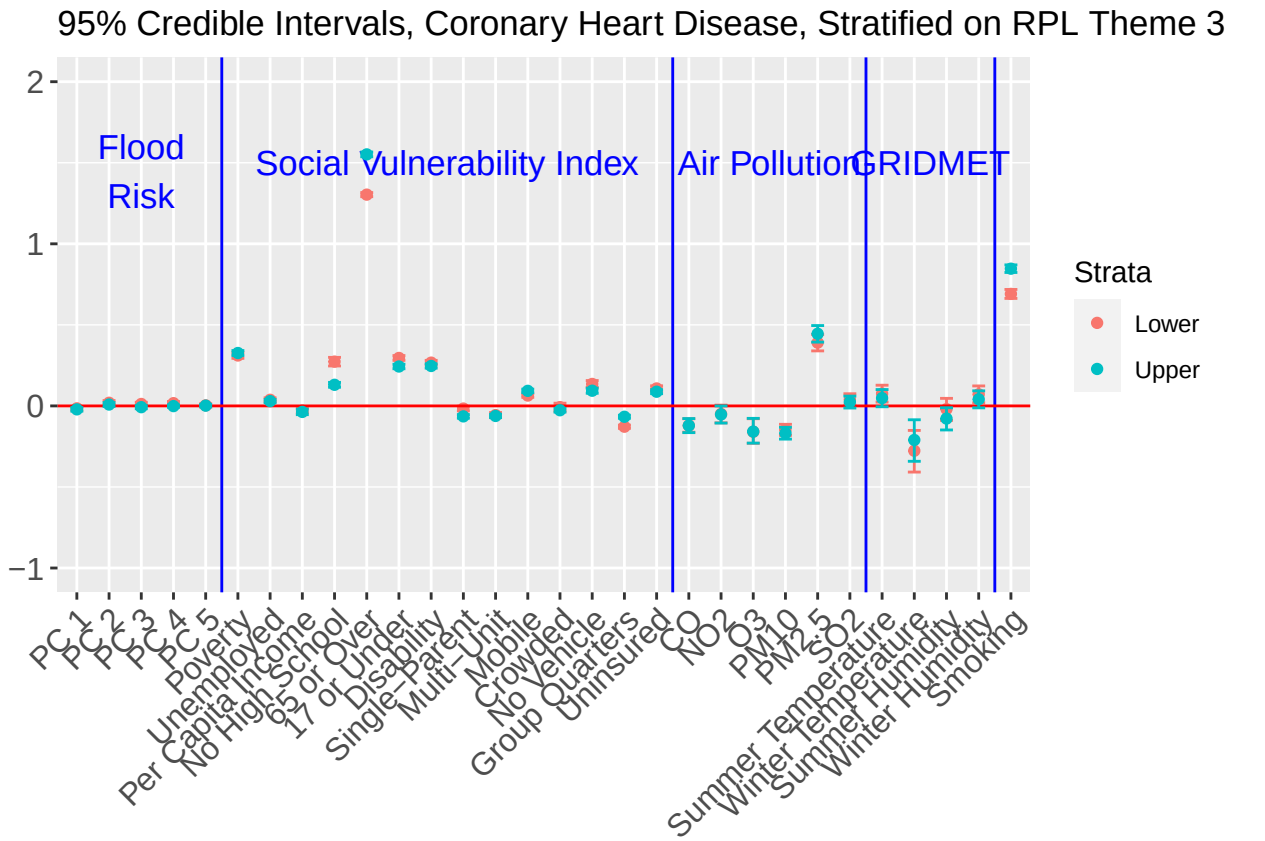
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
```

```
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 19.5, 25.5, 29.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 12.5, y = 1.5, label = "Social Vulnerability Index",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 22.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 27.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Multi-Unit", "Mobile", "Crowded",
                              "No Vehicle", "Group Quarters", "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hum
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, Str
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl3.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEME4

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpl4.RData"))
```

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

colnames(beta_samples_matrix) <- var_names
```

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

```
##                              50%     2.5%    97.5%
## strat0                   6.63735  6.62864  6.64598
## strat0:flood_risk_pc1   -0.00364 -0.01457  0.00737
## strat0:flood_risk_pc2    0.02375  0.01129  0.03624
## strat0:flood_risk_pc3    0.00200 -0.00753  0.01157
## strat0:flood_risk_pc4    0.00945  0.00023  0.01875
## strat0:flood_risk_pc5    0.00102 -0.00800  0.01002
## strat0:EP_POV            0.35369  0.33530  0.37222
## strat0:EP_UNEMP          0.02864  0.01693  0.04041
```

```
## strat0:EP_PCI               0.00055 -0.01324  0.01443
## strat0:EP_NOHSDP            0.25463  0.23257  0.27695
## strat0:EP_AGE65             1.31732  1.30509  1.32956
## strat0:EP_AGE17             0.28532  0.27281  0.29780
## strat0:EP_DISABL            0.24523  0.23103  0.25938
## strat0:EP_SNGPNT           -0.05462 -0.06811 -0.04103
## strat0:EP_MINRTY           -0.11497 -0.13396 -0.09593
## strat0:EP_LIMENG           -0.10944 -0.13225 -0.08678
## strat0:EP_UNINSUR           0.15000  0.13483  0.16519
## strat0:co                  -0.14266 -0.18588 -0.09948
## strat0:no2                 -0.01346 -0.06727  0.04026
## strat0:o3                  -0.18840 -0.25888 -0.11536
## strat0:pm10                -0.18489 -0.21851 -0.15140
## strat0:pm25                 0.39730  0.34927  0.44605
## strat0:so2                  0.04539  0.01126  0.07893
## strat0:summer_tmmx          0.11469  0.06126  0.16597
## strat0:winter_tmmx         -0.27003 -0.39622 -0.11920
## strat0:summer_rmax         -0.03065 -0.09464  0.03626
## strat0:winter_rmax          0.06184  0.01007  0.11092
## strat0:Data_Value_CSMOKING  0.76785  0.74208  0.79377
## strat1                      6.69248  6.68424  6.70077
## strat1:flood_risk_pc1      -0.01305 -0.02363 -0.00250
## strat1:flood_risk_pc2      -0.00001 -0.01185  0.01190
## strat1:flood_risk_pc3       0.00253 -0.00697  0.01204
## strat1:flood_risk_pc4       0.00372 -0.00465  0.01210
## strat1:flood_risk_pc5       0.00187 -0.00655  0.01020
## strat1:EP_POV               0.27532  0.26177  0.28878
## strat1:EP_UNEMP             0.02950  0.01933  0.03962
## strat1:EP_PCI              -0.02088 -0.03821 -0.00346
## strat1:EP_NOHSDP            0.12811  0.11050  0.14567
## strat1:EP_AGE65             1.58104  1.56781  1.59430
## strat1:EP_AGE17             0.36873  0.35667  0.38077
## strat1:EP_DISABL            0.29361  0.28102  0.30624
## strat1:EP_SNGPNT           -0.08524 -0.09724 -0.07322
## strat1:EP_MINRTY           -0.00064 -0.01896  0.01768
## strat1:EP_LIMENG           -0.03896 -0.05410 -0.02382
## strat1:EP_UNINSUR           0.10881  0.09672  0.12092
## strat1:co                  -0.13901 -0.17730 -0.10084
## strat1:no2                 -0.06750 -0.11743 -0.01767
## strat1:o3                  -0.20967 -0.28003 -0.13643
## strat1:pm10                -0.13527 -0.16996 -0.10129
## strat1:pm25                 0.40482  0.35736  0.45303
## strat1:so2                  0.04802  0.01488  0.08091
## strat1:summer_tmmx          0.08015  0.02752  0.13014
## strat1:winter_tmmx         -0.20823 -0.33365 -0.05768
## strat1:summer_rmax         -0.06400 -0.12763  0.00301
## strat1:winter_rmax          0.05103 -0.00009  0.09987
## strat1:Data_Value_CSMOKING  0.92192  0.89936  0.94454
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                    "strat0:flood_risk_pc2"
##  [3] "strat0:flood_risk_pc4"     "strat0:EP_POV"
```

```
##  [5] "strat0:EP_UNEMP"            "strat0:EP_NOHSDP"
##  [7] "strat0:EP_AGE65"            "strat0:EP_AGE17"
##  [9] "strat0:EP_DISABL"           "strat0:EP_SNGPNT"
## [11] "strat0:EP_MINRTY"           "strat0:EP_LIMENG"
## [13] "strat0:EP_UNINSUR"          "strat0:co"
## [15] "strat0:o3"                  "strat0:pm10"
## [17] "strat0:pm25"                "strat0:so2"
## [19] "strat0:summer_tmmx"         "strat0:winter_tmmx"
## [21] "strat0:winter_rmax"         "strat0:Data_Value_CSMOKING"
## [23] "strat1"                     "strat1:flood_risk_pc1"
## [25] "strat1:EP_POV"              "strat1:EP_UNEMP"
## [27] "strat1:EP_PCI"              "strat1:EP_NOHSDP"
## [29] "strat1:EP_AGE65"            "strat1:EP_AGE17"
## [31] "strat1:EP_DISABL"           "strat1:EP_SNGPNT"
## [33] "strat1:EP_LIMENG"           "strat1:EP_UNINSUR"
## [35] "strat1:co"                  "strat1:no2"
## [37] "strat1:o3"                  "strat1:pm10"
## [39] "strat1:pm25"                "strat1:so2"
## [41] "strat1:summer_tmmx"         "strat1:winter_tmmx"
## [43] "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

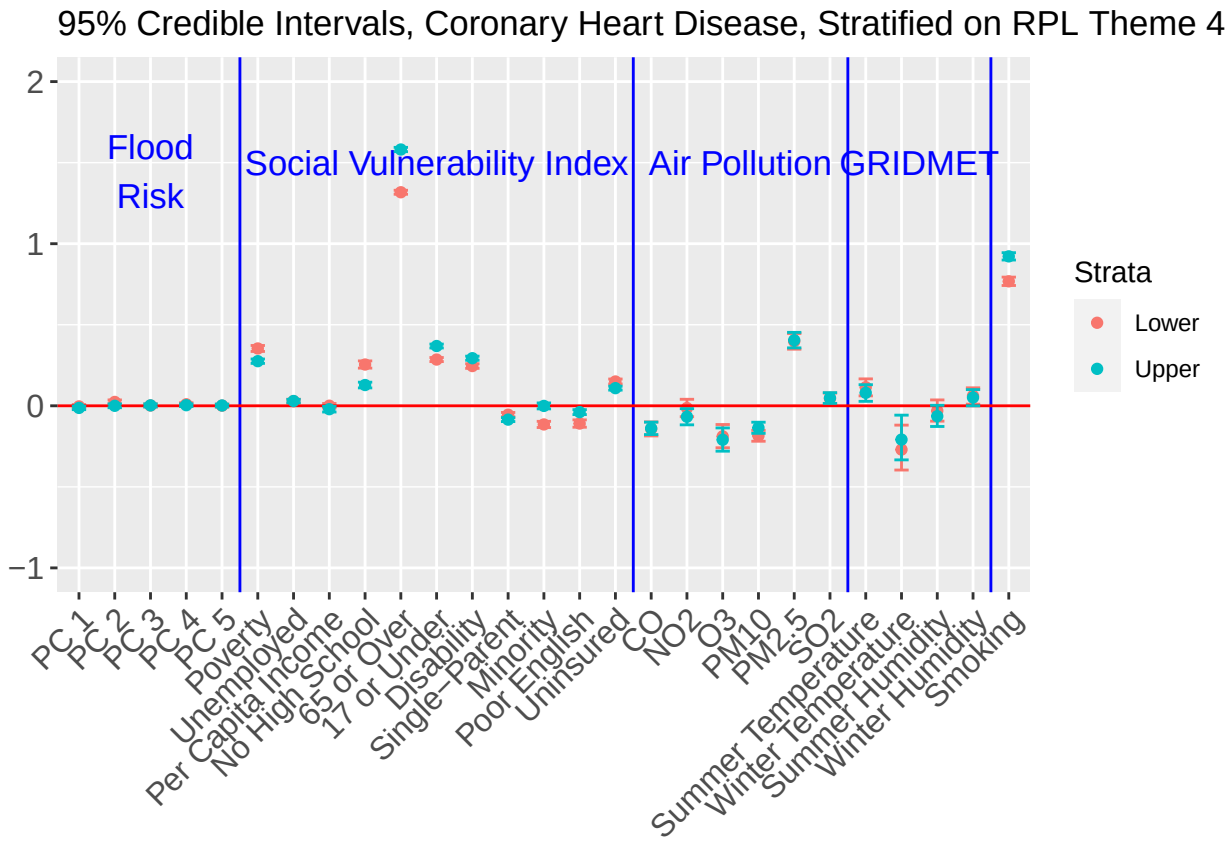
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 16.5, 22.5, 26.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
```

```
          col = "blue", size = 4.5) +
  annotate(geom = "text", x = 11, y = 1.5, label = "Social Vulnerability Index",
          col = "blue", size = 4.5) +
  annotate(geom = "text", x = 19.5, y = 1.5, label = "Air Pollution",
          col = "blue", size = 4.5) +
  annotate(geom = "text", x = 24.5, y = 1.5, label = "GRIDMET",
          col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Poverty", "Unemployed", "Per Capita Income", "No High School",
                              "65 or Over", "17 or Under", "Disability",
                              "Single-Parent",
                              "Minority", "Poor English",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpl4.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```

CAR model results, Coronary Heart Disease Stratified on RPL_THEMES

Inference is based on 3 markov chains, each of which has been run for 110000 samples, the first 10000 of which has been removed for burn-in. The remaining 100000 samples are thinned by 2, resulting in 150000 samples for inference across the 3 Markov chains.

```
load(here("modeling_files/stratified_analysis/model_stratif_rpls.RData"))
```

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

colnames(beta_samples_matrix) <- var_names
```

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

```
##                                50%     2.5%    97.5%
## strat0                     6.22923  6.20960  6.24873
## strat0:flood_risk_pc1     -0.09529 -0.11554 -0.07482
## strat0:flood_risk_pc2      0.02648  0.00304  0.04975
## strat0:flood_risk_pc3     -0.03070 -0.04791 -0.01340
## strat0:flood_risk_pc4      0.01623 -0.00086  0.03324
## strat0:flood_risk_pc5     -0.03153 -0.04782 -0.01522
## strat0:EP_UNINSUR         -0.00946 -0.03789  0.01914
## strat0:co                 -0.31590 -0.39066 -0.24136
## strat0:no2                -0.34359 -0.44004 -0.24469
## strat0:o3                 -0.41323 -0.57595 -0.26473
## strat0:pm10               -0.69297 -0.76084 -0.62591
## strat0:pm25                0.81704  0.72026  0.91460
## strat0:so2                 0.02995 -0.03554  0.09841
## strat0:summer_tmmx         0.08278 -0.03023  0.20197
## strat0:winter_tmmx        -0.46540 -0.80970 -0.12863
## strat0:summer_rmax        -0.02028 -0.15795  0.12244
## strat0:winter_rmax         0.12838  0.02425  0.23107
## strat0:Data_Value_CSMOKING 0.36589  0.33407  0.39785
## strat1                     6.86194  6.84507  6.87874
## strat1:flood_risk_pc1     -0.06508 -0.08469 -0.04536
## strat1:flood_risk_pc2      0.03272  0.01137  0.05412
## strat1:flood_risk_pc3     -0.02048 -0.03820 -0.00300
## strat1:flood_risk_pc4      0.01250 -0.00257  0.02757
## strat1:flood_risk_pc5     -0.00153 -0.01654  0.01355
## strat1:EP_UNINSUR         -0.13812 -0.15672 -0.11934
## strat1:co                 -0.49377 -0.57383 -0.41376
## strat1:no2                -0.04214 -0.14042  0.05686
## strat1:o3                 -0.52150 -0.68436 -0.37188
## strat1:pm10               -0.62719 -0.69743 -0.55768
## strat1:pm25                0.82231  0.72475  0.91947
## strat1:so2                 0.03199 -0.03275  0.09900
## strat1:summer_tmmx         0.00419 -0.10952  0.12432
## strat1:winter_tmmx        -0.25761 -0.59916  0.07707
## strat1:summer_rmax        -0.07899 -0.21757  0.06513
## strat1:winter_rmax         0.10485  0.00059  0.20788
## strat1:Data_Value_CSMOKING 0.86591  0.84219  0.88957
```

List of significant beta coefficients:

```
colnames(beta_samples_matrix)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
##  [1] "strat0"                     "strat0:flood_risk_pc1"
##  [3] "strat0:flood_risk_pc2"      "strat0:flood_risk_pc3"
##  [5] "strat0:flood_risk_pc5"      "strat0:co"
##  [7] "strat0:no2"                 "strat0:o3"
##  [9] "strat0:pm10"                "strat0:pm25"
## [11] "strat0:winter_tmmx"         "strat0:winter_rmax"
## [13] "strat0:Data_Value_CSMOKING" "strat1"
## [15] "strat1:flood_risk_pc1"      "strat1:flood_risk_pc2"
## [17] "strat1:flood_risk_pc3"      "strat1:EP_UNINSUR"
## [19] "strat1:co"                  "strat1:o3"
## [21] "strat1:pm10"                "strat1:pm25"
## [23] "strat1:winter_rmax"         "strat1:Data_Value_CSMOKING"
```

Credible Interval plots for the coefficients, in ggplot

```
# first, process the beta_inference matrix in a form ggplot can understand
beta_inference_df <- as.data.frame(beta_inference)
beta_inference_df <- mutate(beta_inference_df, var_name = row.names(beta_inference_df))
beta_inference_df <- rename(beta_inference_df,
                            post_median = `50%`,
                            post_2.5 = `2.5%`,
                            post_97.5 = `97.5%`)
beta_inference_df$var_name <- substring(beta_inference_df$var_name, first = 8)
beta_inference_df$var_name <- factor(beta_inference_df$var_name,
                                     levels = unique(beta_inference_df$var_name))
beta_inference_df$strat <- as.factor(c(rep("Lower", (nrow(beta_inference_df)/2)),
                                       rep("Upper", (nrow(beta_inference_df)/2))))
```

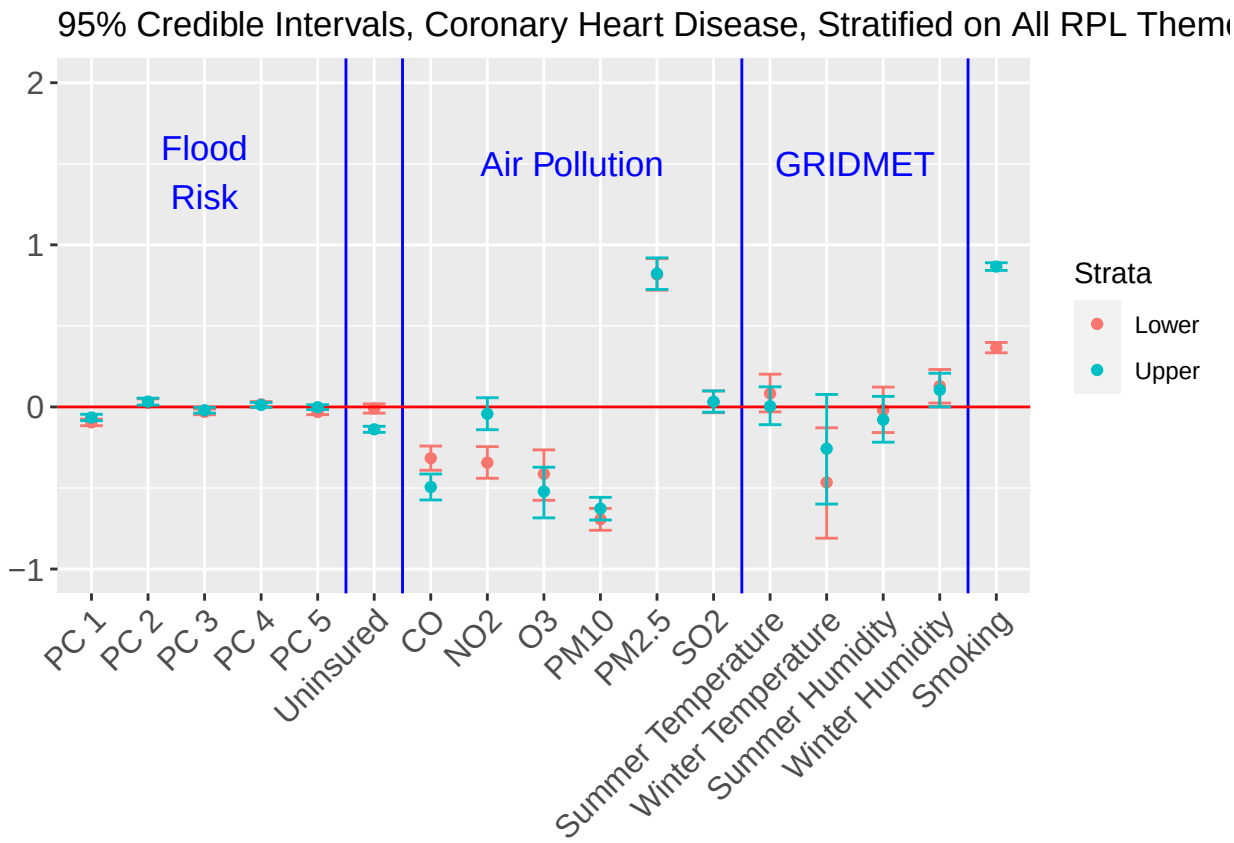
Splitting up the beta coefficients for each strata

```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]

beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

Note: The intercept for both strata is not included.

```
p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-1, 2)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 10)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(5.5, 6.5, 12.5, 16.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 3, y = 1.45, label = "Flood\nRisk",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 9.5, y = 1.5, label = "Air Pollution",
           col = "blue", size = 4.5) +
  annotate(geom = "text", x = 14.5, y = 1.5, label = "GRIDMET",
           col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5",
                              "Uninsured",
                              "CO", "NO2", "O3", "PM10", "PM2.5", "SO2",
```

```
                              "Summer Temperature", "Winter Temperature", "Summer Humidity", "Winter Hu
                              "Smoking")) + ggtitle("95% Credible Intervals, Coronary Heart Disease, St
  geom_point(data = beta_inference_df_strat1[-1, ], col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_inference_df_strat1[-1, ], aes(ymin = post_2.5, ymax = post_97.5, width = 0
  scale_color_manual(name = "Strata",
                     values = c("#F8766D", "#00BFC4"),
                     drop = FALSE)

p
```




```
ggsave(here("figures/final_figures/stratified_analysis/CHD_CI_rpls.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")
```