

Sensitivity Analysis: Flood Factor Groupings

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```

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  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      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/sensitivity_analysis/fhs_model_df_ff_grouped.rds"))

var_names <- c("Intercept", "flood_ff_group1", "flood_ff_group2", "flood_ff_group3",
               "EP_UNINSUR", "pollute_conc_pc1", "pollute_conc_pc2",
               "pollute_conc_pc3", "tmmx", "rmax", "Data_Value_CSMOKING")

names_ff_grouped_strat <- c(paste("strat0", var_names, sep = ":"),
                           paste("strat1", var_names, sep = ":"))

```

Helper Functions

Function for post-processing the inference

```

# extract the flood risk PC coefficients
# pc_idx is the vector of indices of the flood risk PC coefficients, after splitting data frame by strat
beta_data_frames_extract <- function(beta_inference_df, pc_idx) {

  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)]

  beta_pcs_strat0 <- beta_inference_df_strat0[pc_idx, ]

```

```

beta_pcs_strat1 <- beta_inference_df_strat1[pc_idx, ]

beta_pcs_strat0 <- mutate(beta_pcs_strat0, var_idx = factor(1:nrow(beta_pcs_strat0)))
beta_pcs_strat1 <- mutate(beta_pcs_strat1, var_idx = factor(1:nrow(beta_pcs_strat1)))

return(list(beta_pcs_strat0 = beta_pcs_strat0, beta_pcs_strat1 = beta_pcs_strat1))
}

```

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/sensitivity_analysis/ff_grouped/all_census_tract_CHD.RData"))

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

colnames(beta_samples_matrix) <- names_ff_grouped_strat

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

beta_inference

```

	50%	2.5%	97.5%
## strat0:Intercept	6.23243	6.21298	6.25191
## strat0:flood_ff_group1	0.01407	-0.00782	0.03585
## strat0:flood_ff_group2	0.01823	-0.00077	0.03706
## strat0:flood_ff_group3	0.08804	0.07019	0.10586
## strat0:EP_UNINSUR	-0.01044	-0.03871	0.01806
## strat0:pollute_conc_pc1	-0.44536	-0.50037	-0.38884
## strat0:pollute_conc_pc2	-0.50906	-0.58969	-0.42809
## strat0:pollute_conc_pc3	-0.20659	-0.28198	-0.12932
## strat0:tmx	-0.00061	-0.12178	0.12021
## strat0:rmax	0.14099	0.04885	0.23051
## strat0:Data_Value_CSMOKING	0.38124	0.35020	0.41219
## strat1:Intercept	6.86954	6.85271	6.88619
## strat1:flood_ff_group1	0.00488	-0.01267	0.02231
## strat1:flood_ff_group2	0.01922	0.00378	0.03465
## strat1:flood_ff_group3	0.06069	0.04108	0.08031
## strat1:EP_UNINSUR	-0.13900	-0.15783	-0.12044
## strat1:pollute_conc_pc1	-0.28413	-0.34123	-0.22545
## strat1:pollute_conc_pc2	-0.40869	-0.48847	-0.32956
## strat1:pollute_conc_pc3	-0.27477	-0.35068	-0.19704
## strat1:tmx	0.08883	-0.03322	0.21065
## strat1:rmax	0.13936	0.04691	0.22889
## strat1:Data_Value_CSMOKING	0.85763	0.83422	0.88101

```
saveRDS(beta_inference, file = here("modeling_files/sensitivity_analysis/ff_grouped/beta_inference_files/"))
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
## [1] "strat0:Intercept"      "strat0:flood_ff_group3"
## [3] "strat0:pollute_conc_pc1" "strat0:pollute_conc_pc2"
## [5] "strat0:pollute_conc_pc3" "strat0:rmax"
## [7] "strat0:Data_Value_CSMOKING" "strat1:Intercept"
## [9] "strat1:flood_ff_group2" "strat1:flood_ff_group3"
## [11] "strat1:EP_UNINSUR"      "strat1:pollute_conc_pc1"
## [13] "strat1:pollute_conc_pc2" "strat1:pollute_conc_pc3"
## [15] "strat1: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 <- factor(c(rep("Low SV", (nrow(beta_inference_df)/2)),
                                   rep("High SV", (nrow(beta_inference_df)/2))), levels = c("Low SV", "High SV"))
```

Splitting up the beta coefficients for each strata

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

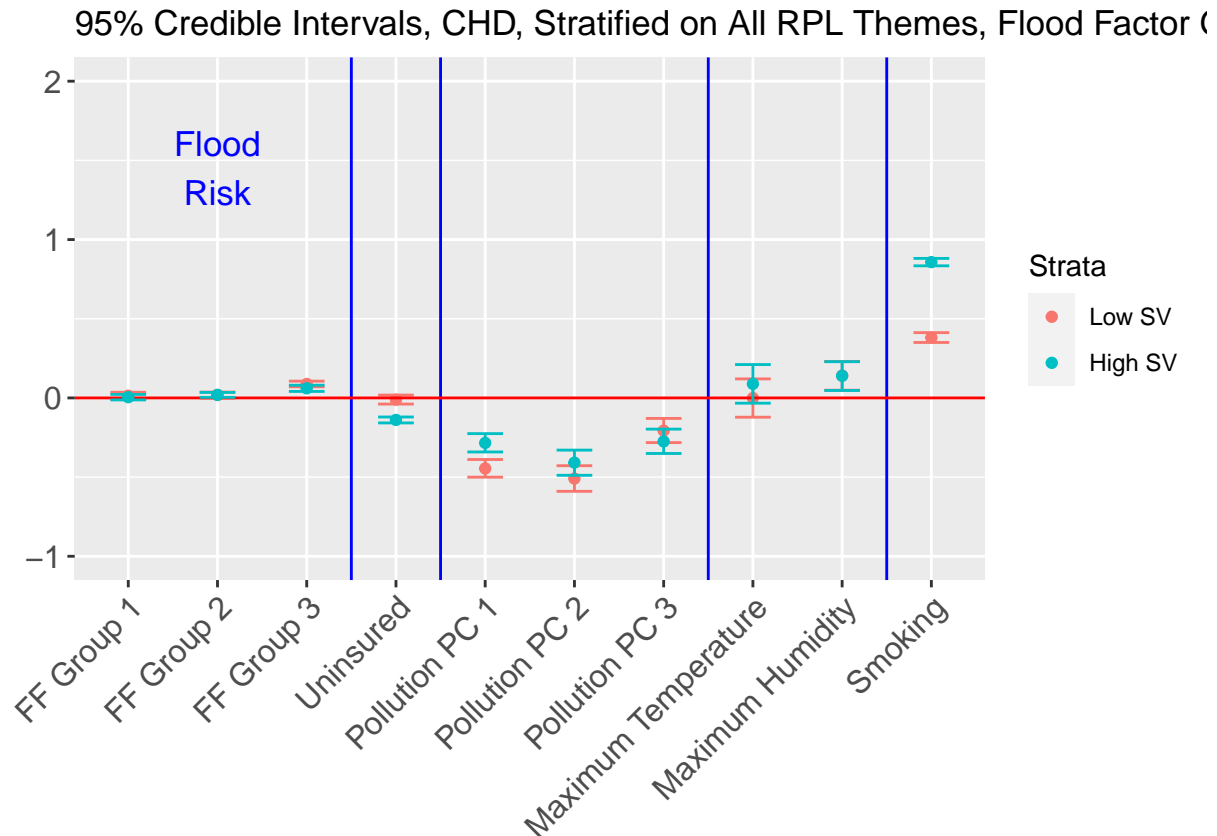
```
beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

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.title.y = element_blank(),
        axis.text=element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(3.5, 4.5, 7.5, 9.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 2, y = 1.45, label = "Flood\nRisk",
          col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3", "Uninsured",
                              "Pollution PC 1", "Pollution PC 2", "Pollution PC 3",
                              "Maximum Temperature", "Maximum Humidity",
                              "Smoking")) + ggtitle("95% Credible Intervals, CHD, Stratified on All RPL")
p <- p +
  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 = 0.4), col = "#00BFC4")
```

```
scale_color_manual(name = "Strata",
  values = c("#F8766D", "#00BFC4"),
  drop = FALSE)
```

p

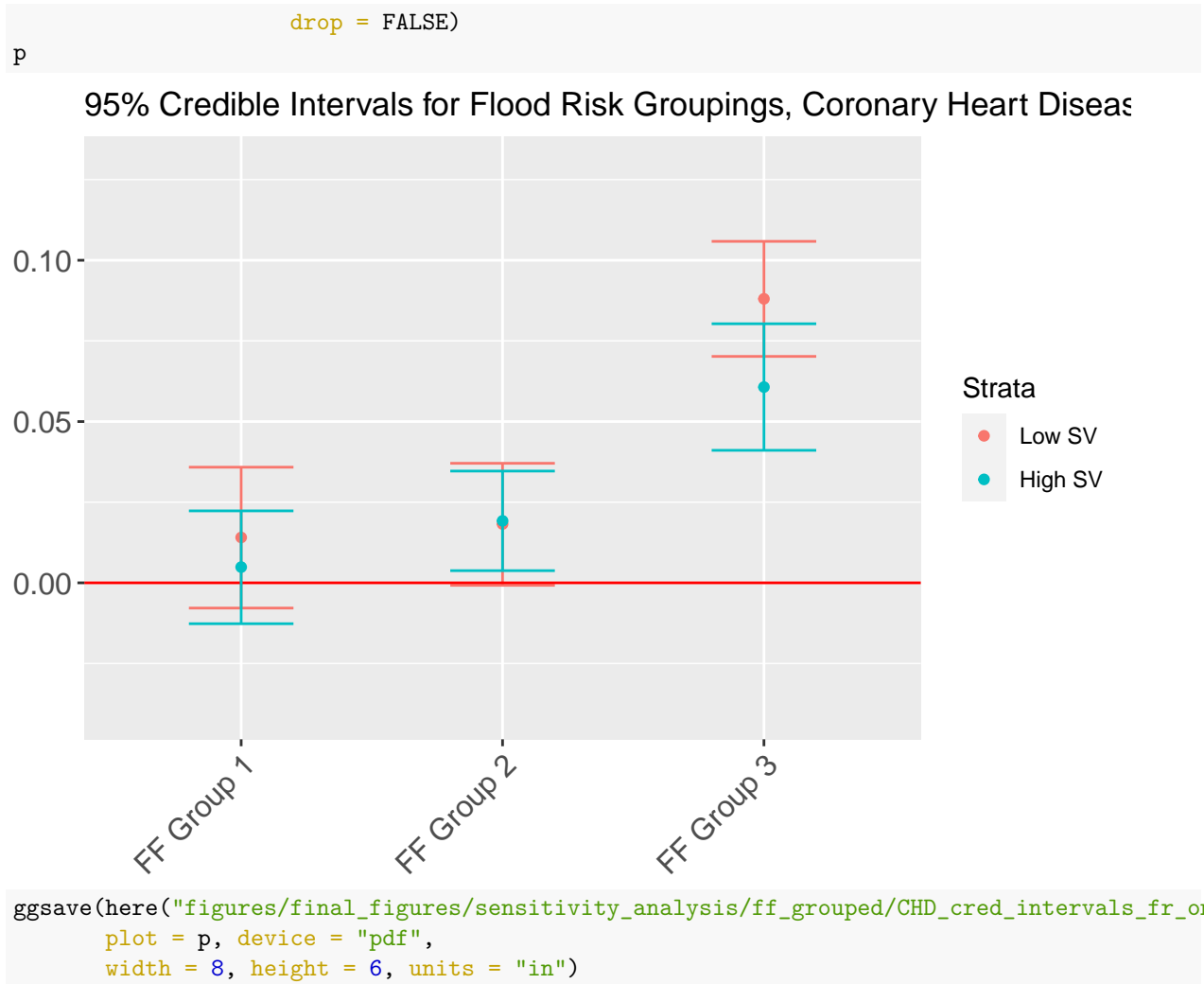


```
ggsave(here("figures/final_figures/sensitivity_analysis/ff_grouped/CHD_CI_rpls.pdf"),
  plot = p, device = "pdf",
  width = 8, height = 6, units = "in")
```

```
pc_extract_idx <- 2:4
```

```
beta_CHD_pcs <- beta_data_frames_extract(beta_inference_df, pc_extract_idx)
```

```
p <- ggplot(beta_CHD_pcs$beta_pcs_strat0, aes(x = var_idx, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-0.04, 0.13)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis.title.y = element_text(size=12),
    plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_hline(yintercept = 0, col = "red") +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3"), 6) + ggtitle("95% Credible Intervals, CHD, Stratified on All RPL Themes, Flood Factor (")
  geom_point(data = beta_CHD_pcs$beta_pcs_strat1, col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_CHD_pcs$beta_pcs_strat1, aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#00BFC4") +
  scale_color_manual(name = "Strata",
    values = c("#F8766D", "#00BFC4"),
```



CAR model results, High Blood Pressure Stratified on RPL_THEMES

```
load(here("modeling_files/sensitivity_analysis/ff_grouped/all_census_tract_BPHIGH.RData"))

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

colnames(beta_samples_matrix) <- names_ff_grouped_strat

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

beta_inference
```

	50%	2.5%	97.5%
## strat0:Intercept	31.05190	30.99444	31.10923
## strat0:flood_ff_group1	-0.01803	-0.08435	0.04823
## strat0:flood_ff_group2	0.01329	-0.04422	0.07048
## strat0:flood_ff_group3	0.20867	0.15438	0.26284
## strat0:EP_UNINSUR	-0.09963	-0.18484	-0.01406

```
## strat0:pollute_conc_pc1      -1.66675 -1.83825 -1.49119
## strat0:pollute_conc_pc2      -2.39616 -2.64341 -2.14154
## strat0:pollute_conc_pc3       0.37656  0.14324  0.62196
## strat0:tmmx                  -0.03531 -0.40350  0.34643
## strat0:rmax                   0.19324 -0.10026  0.47757
## strat0:Data_Value_CSMOKING    0.73863  0.64527  0.83213
## strat1:Intercept              32.84111 32.79177 32.88981
## strat1:flood_ff_group1        0.00855 -0.04487  0.06165
## strat1:flood_ff_group2        0.03385 -0.01288  0.08071
## strat1:flood_ff_group3       -0.02314 -0.08271  0.03620
## strat1:EP_UNINSUR             -0.47514 -0.53158 -0.41884
## strat1:pollute_conc_pc1       -0.74064 -0.91870 -0.55859
## strat1:pollute_conc_pc2       -2.22077 -2.46508 -1.97155
## strat1:pollute_conc_pc3       -0.17637 -0.41242  0.07120
## strat1:tmmx                   0.49442  0.12109  0.88122
## strat1:rmax                   0.28215 -0.01326  0.56640
## strat1:Data_Value_CSMOKING    2.12807  2.05691  2.19935
```

```
saveRDS(beta_inference, file = here("modeling_files/sensitivity_analysis/ff_grouped/beta_inference_files"))
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
## [1] "strat0:Intercept"          "strat0:flood_ff_group3"
## [3] "strat0:EP_UNINSUR"         "strat0:pollute_conc_pc1"
## [5] "strat0:pollute_conc_pc2"   "strat0:pollute_conc_pc3"
## [7] "strat0:Data_Value_CSMOKING" "strat1:Intercept"
## [9] "strat1:EP_UNINSUR"         "strat1:pollute_conc_pc1"
## [11] "strat1:pollute_conc_pc2"   "strat1:tmmx"
## [13] "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 <- factor(c(rep("Low SV", (nrow(beta_inference_df)/2)),
                                   rep("High SV", (nrow(beta_inference_df)/2))), levels = c("Low SV", "High SV"))
```

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),]
```

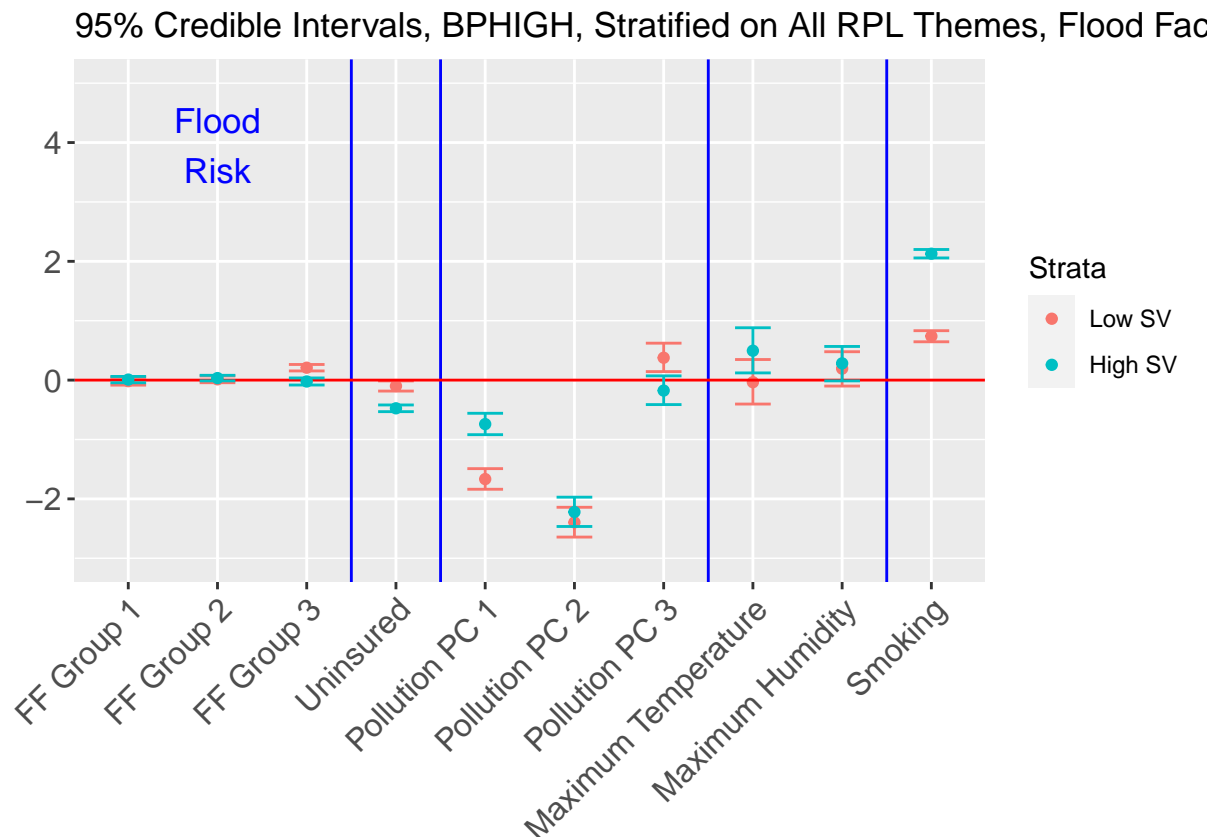
Note: The intercept for both strata is not included.

```

p <- ggplot(beta_inference_df_strat0[-1, ], aes(x = var_name, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-3, 5)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis.title.y = element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(3.5, 4.5, 7.5, 9.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 2, y = 3.95, label = "Flood\nRisk",
         col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3", "Uninsured",
                             "Pollution PC 1", "Pollution PC 2", "Pollution PC 3",
                             "Maximum Temperature", "Maximum Humidity",
                             "Smoking")) + ggtitle("95% Credible Intervals, BPHIGH, Stratified on All RPL Themes, Flood Fac")
p <- p +
  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 = 0.4), col = "#00BFC4") +
  scale_color_manual(name = "Strata",
                    values = c("#F8766D", "#00BFC4"),
                    drop = FALSE)

```

p



```

ggsave(here("figures/final_figures/sensitivity_analysis/ff_grouped/BPHIGH_CI_rpls.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")

```



```

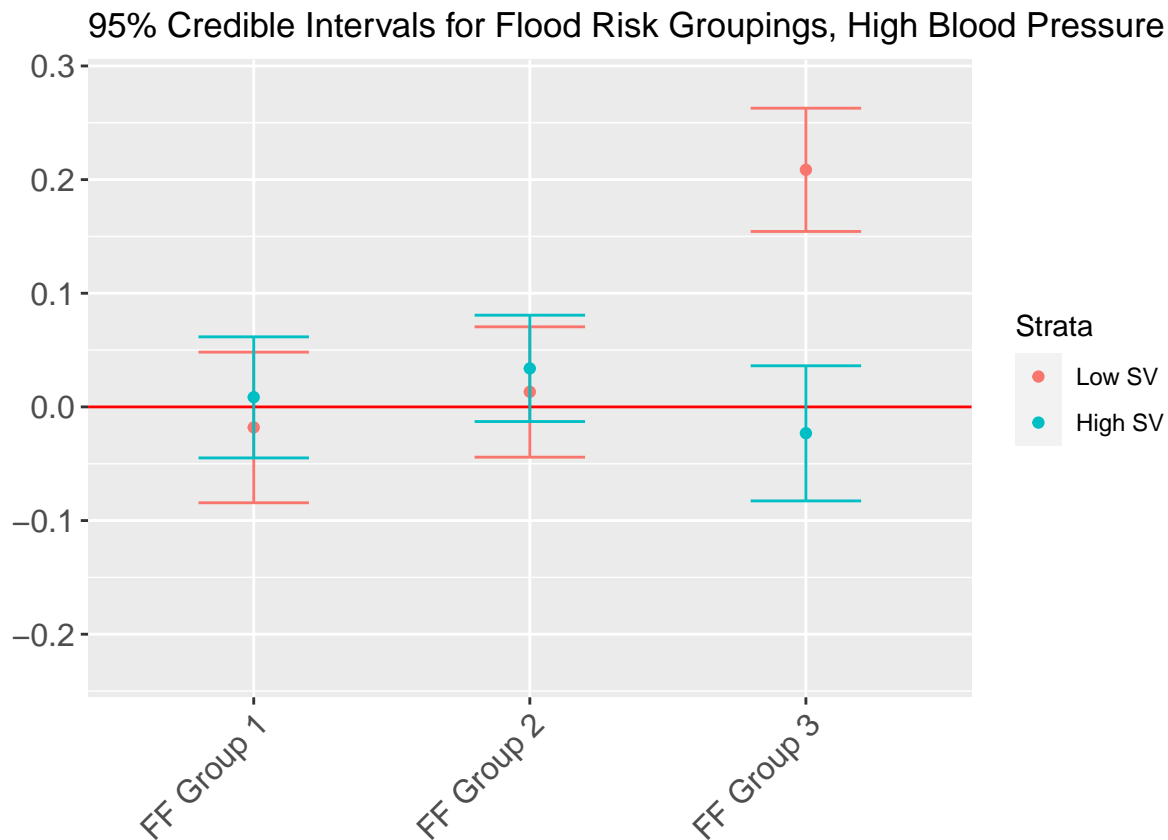
pc_extract_idx <- 2:4

beta_BPHIGH_pcs <- beta_data_frames_extract(beta_inference_df, pc_extract_idx)

p <- ggplot(beta_BPHIGH_pcs$beta_pcs_strat0, aes(x = var_idx, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-0.23, 0.28)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis.title.y = element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_hline(yintercept = 0, col = "red") +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3"), 6) + ggtitle("95% Credible Intervals for Flood Risk Groupings, High Blood Pressure")
  geom_point(data = beta_BPHIGH_pcs$beta_pcs_strat1, col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_BPHIGH_pcs$beta_pcs_strat1, aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#00BFC4") +
  scale_color_manual(name = "Strata",
                    values = c("#F8766D", "#00BFC4"),
                    drop = FALSE)

```

p



```

ggsave(here("figures/final_figures/sensitivity_analysis/ff_grouped/BPHIGH_cred_intervals_fr_only.pdf"),
       plot = p, device = "pdf",
       width = 8, height = 6, units = "in")

```

CAR model results, Asthma Stratified on RPL_THEMES

```
load(here("modeling_files/sensitivity_analysis/ff_grouped/all_census_tract_CASTHMA.RData"))

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

colnames(beta_samples_matrix) <- names_ff_grouped_strat

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

beta_inference
```

##	50%	2.5%	97.5%
## strat0:Intercept	9.76095	9.75423	9.76770
## strat0:flood_ff_group1	-0.02519	-0.03306	-0.01736
## strat0:flood_ff_group2	0.00145	-0.00539	0.00825
## strat0:flood_ff_group3	-0.00239	-0.00883	0.00405
## strat0:EP_UNINSUR	-0.02874	-0.03881	-0.01864
## strat0:pollute_conc_pc1	0.12192	0.10144	0.14282
## strat0:pollute_conc_pc2	-0.17891	-0.20813	-0.14853
## strat0:pollute_conc_pc3	-0.04918	-0.07685	-0.01945
## strat0:tmmx	-0.00275	-0.04600	0.04327
## strat0:rmax	-0.08532	-0.12032	-0.05156
## strat0:Data_Value_CSMOKING	1.12509	1.11403	1.13615
## strat1:Intercept	9.94379	9.93804	9.94947
## strat1:flood_ff_group1	-0.00499	-0.01134	0.00132
## strat1:flood_ff_group2	0.00200	-0.00354	0.00756
## strat1:flood_ff_group3	-0.02300	-0.03007	-0.01599
## strat1:EP_UNINSUR	-0.08558	-0.09225	-0.07890
## strat1:pollute_conc_pc1	0.19612	0.17499	0.21787
## strat1:pollute_conc_pc2	-0.16418	-0.19330	-0.13449
## strat1:pollute_conc_pc3	-0.10285	-0.13069	-0.07291
## strat1:tmmx	0.04393	0.00036	0.09082
## strat1:rmax	-0.12043	-0.15573	-0.08667
## strat1:Data_Value_CSMOKING	1.31047	1.30207	1.31894

```
saveRDS(beta_inference, file = here("modeling_files/sensitivity_analysis/ff_grouped/beta_inference_files"))
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

## [1] "strat0:Intercept"	"strat0:flood_ff_group1"
## [3] "strat0:EP_UNINSUR"	"strat0:pollute_conc_pc1"
## [5] "strat0:pollute_conc_pc2"	"strat0:pollute_conc_pc3"
## [7] "strat0:rmax"	"strat0:Data_Value_CSMOKING"
## [9] "strat1:Intercept"	"strat1:flood_ff_group3"
## [11] "strat1:EP_UNINSUR"	"strat1:pollute_conc_pc1"
## [13] "strat1:pollute_conc_pc2"	"strat1:pollute_conc_pc3"
## [15] "strat1:tmmx"	"strat1:rmax"
## [17] "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 <- factor(c(rep("Low SV", (nrow(beta_inference_df)/2)),
                                   rep("High SV", (nrow(beta_inference_df)/2))), levels = c("Low SV",
```

Splitting up the beta coefficients for each strata

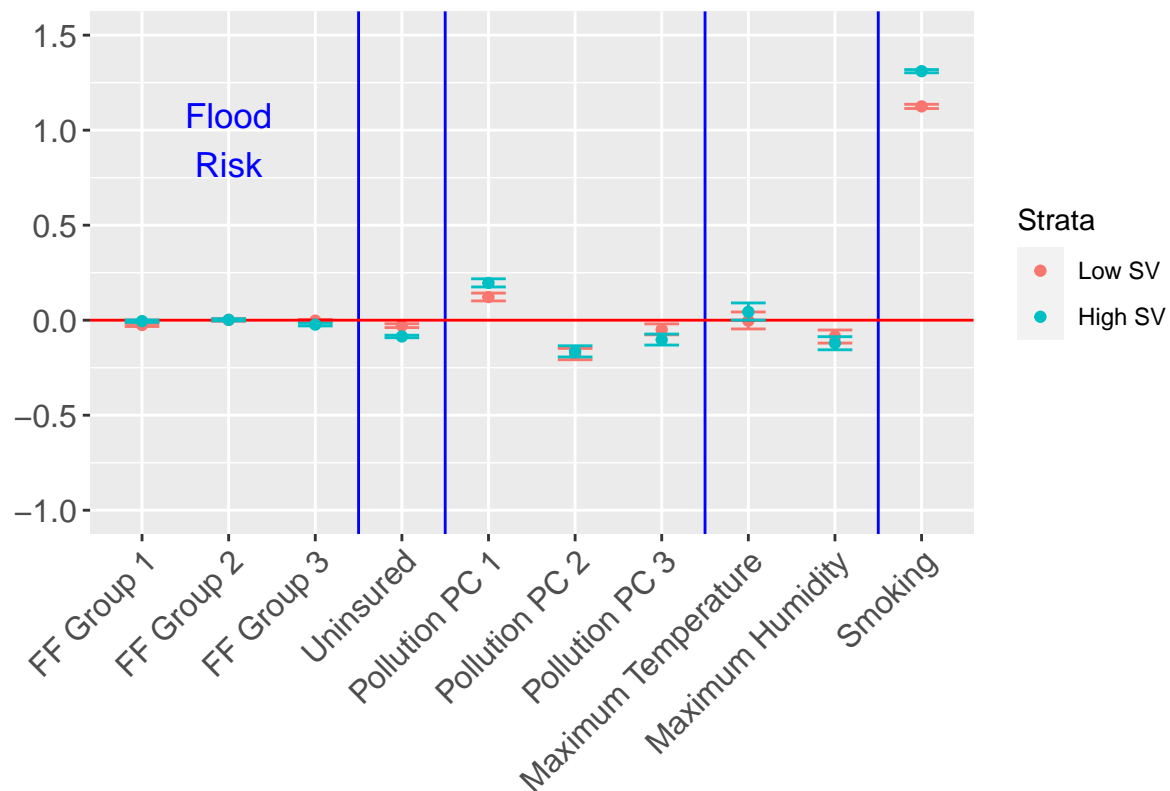
```
beta_inference_df_strat0 <- beta_inference_df[1:(nrow(beta_inference_df)/2),]
beta_inference_df_strat1 <- beta_inference_df[(nrow(beta_inference_df)/2 + 1):nrow(beta_inference_df),]
```

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, 1.5)) +
  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, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(3.5, 4.5, 7.5, 9.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 2, y = 0.95, label = "Flood\nRisk",
          col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3", "Uninsured",
                             "Pollution PC 1", "Pollution PC 2", "Pollution PC 3",
                             "Maximum Temperature", "Maximum Humidity",
                             "Smoking")) + ggtitle("95% Credible Intervals, CASTHMA, Stratified on All
  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

95% Credible Intervals, CASTHMA, Stratified on All RPL Themes, Flood



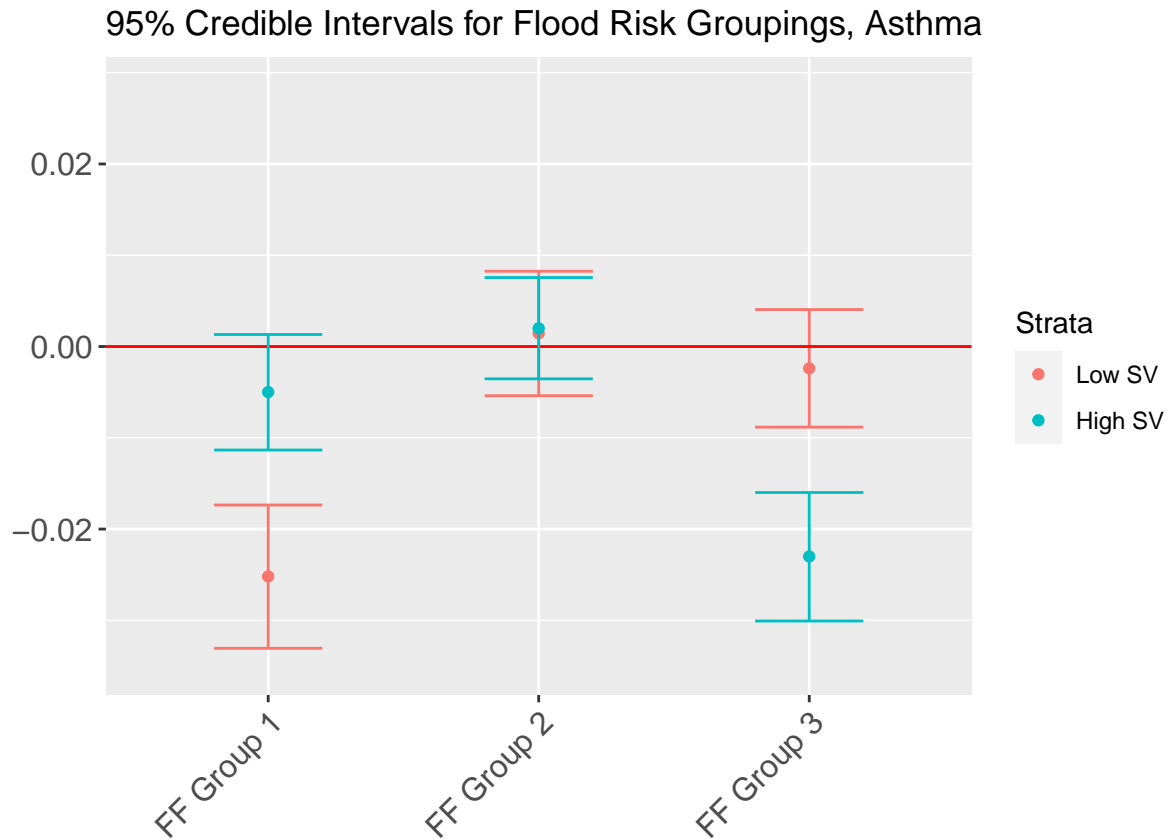
```
ggsave(here("figures/final_figures/sensitivity_analysis/ff_grouped/CASTHMA_CI_rpls.pdf"),
  plot = p, device = "pdf",
  width = 8, height = 6, units = "in")
```

```
pc_extract_idx <- 2:4
```

```
beta_CASTHMA_pcs <- beta_data_frames_extract(beta_inference_df, pc_extract_idx)
```

```
p <- ggplot(beta_CASTHMA_pcs$beta_pcs_strat0, aes(x = var_idx, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-0.035, 0.0285)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis.title.y = element_text(size=12),
    plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_hline(yintercept = 0, col = "red") +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3"), 6) + ggtitle("95% Credible Intervals, CASTHMA, Stratified on All RPL Themes, Flood")
  geom_point(data = beta_CASTHMA_pcs$beta_pcs_strat1, col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_CASTHMA_pcs$beta_pcs_strat1, aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#00BFC4") +
  scale_color_manual(name = "Strata",
    values = c("#F8766D", "#00BFC4"),
    drop = FALSE)
```

p



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

CAR model results, Poor Mental Health Stratified on RPL_THEMES

```
load(here("modeling_files/sensitivity_analysis/ff_grouped/all_census_tract_MHLTH.RData"))

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

colnames(beta_samples_matrix) <- names_ff_grouped_strat

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

beta_inference
```

##	50%	2.5%	97.5%
## strat0:Intercept	14.15665	14.14412	14.16921
## strat0:flood_ff_group1	-0.03445	-0.04925	-0.01971
## strat0:flood_ff_group2	0.01115	-0.00176	0.02397
## strat0:flood_ff_group3	-0.00953	-0.02160	0.00255
## strat0:EP_UNINSUR	0.01660	-0.00228	0.03552
## strat0:pollute_conc_pc1	0.63611	0.59754	0.67546
## strat0:pollute_conc_pc2	0.36459	0.30962	0.42152
## strat0:pollute_conc_pc3	-0.50878	-0.56017	-0.45241
## strat0:tmx	0.03138	-0.04920	0.11907

```
## strat0:rmax -0.09012 -0.15538 -0.02700
## strat0:Data_Value_CSMOKING 3.32658 3.30587 3.34740
## strat1:Intercept 14.34677 14.33603 14.35735
## strat1:flood_ff_group1 0.00661 -0.00534 0.01848
## strat1:flood_ff_group2 0.00410 -0.00631 0.01457
## strat1:flood_ff_group3 -0.01257 -0.02586 0.00057
## strat1:EP_UNINSUR 0.04707 0.03457 0.05962
## strat1:pollute_conc_pc1 0.68425 0.64453 0.72515
## strat1:pollute_conc_pc2 0.38458 0.32977 0.44015
## strat1:pollute_conc_pc3 -0.48958 -0.54141 -0.43260
## strat1:tmmx 0.07988 -0.00084 0.16941
## strat1:rmax -0.09826 -0.16434 -0.03545
## strat1:Data_Value_CSMOKING 3.28702 3.27128 3.30301
```

```
saveRDS(beta_inference, file = here("modeling_files/sensitivity_analysis/ff_grouped/beta_inference_files"))
```

List of significant beta coefficients:

```
row.names(beta_inference)[sign(beta_inference[, 2]) == sign(beta_inference[, 3])]
```

```
## [1] "strat0:Intercept" "strat0:flood_ff_group1"
## [3] "strat0:pollute_conc_pc1" "strat0:pollute_conc_pc2"
## [5] "strat0:pollute_conc_pc3" "strat0:rmax"
## [7] "strat0:Data_Value_CSMOKING" "strat1:Intercept"
## [9] "strat1:EP_UNINSUR" "strat1:pollute_conc_pc1"
## [11] "strat1:pollute_conc_pc2" "strat1:pollute_conc_pc3"
## [13] "strat1: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 <- factor(c(rep("Low SV", (nrow(beta_inference_df)/2)),
                                   rep("High SV", (nrow(beta_inference_df)/2))), levels = c("Low SV", "High SV"))
```

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(-1.5, 4)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis.title.y = element_text(size=12),
```

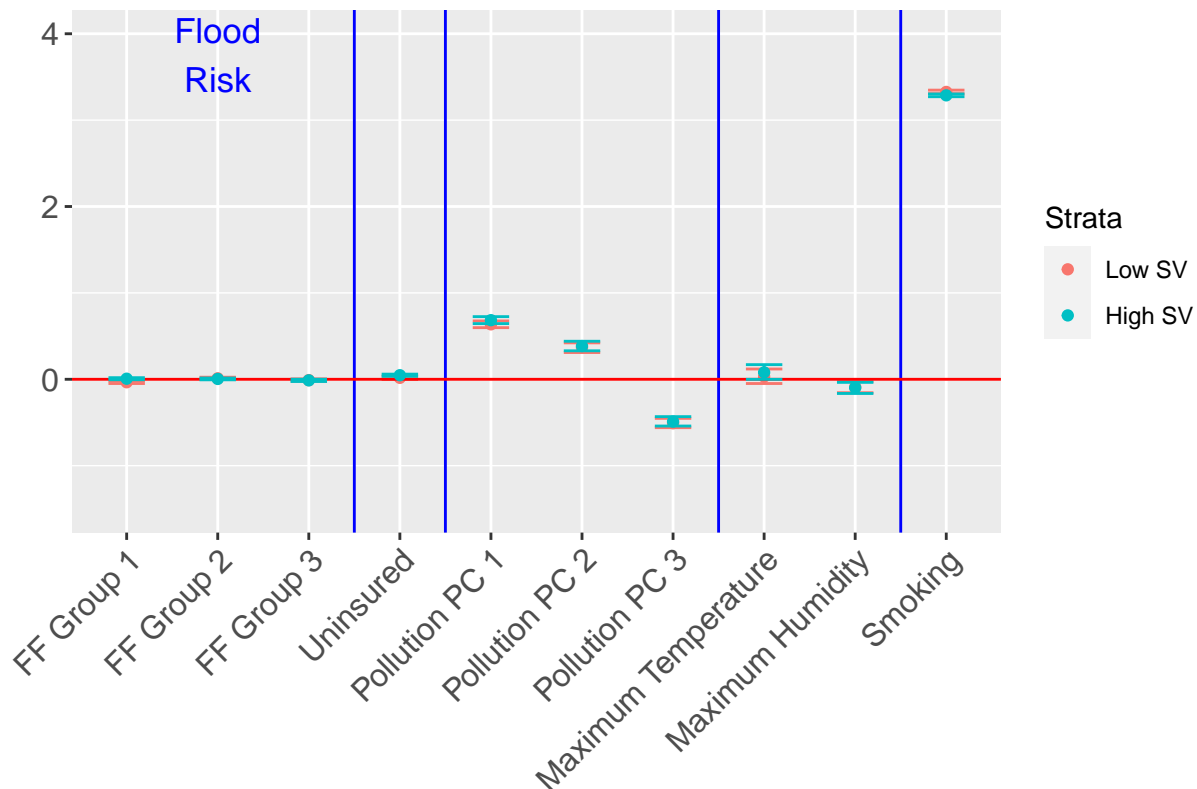
```

    plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_vline(xintercept = c(3.5, 4.5, 7.5, 9.5), col = "blue") +
  geom_hline(yintercept = 0, col = "red") +
  annotate(geom = "text", x = 2, y = 3.75, label = "Flood\nRisk",
    col = "blue", size = 4.5) +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3", "Uninsured",
    "Pollution PC 1", "Pollution PC 2", "Pollution PC 3",
    "Maximum Temperature", "Maximum Humidity",
    "Smoking")) + ggtitle("95% Credible Intervals, CASTHMA, Stratified on All
  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

95% Credible Intervals, CASTHMA, Stratified on All RPL Themes, Flood Fa



```

ggsave(here("figures/final_figures/sensitivity_analysis/ff_grouped/MHLTH_CI_rpls.pdf"),
  plot = p, device = "pdf",
  width = 8, height = 6, units = "in")

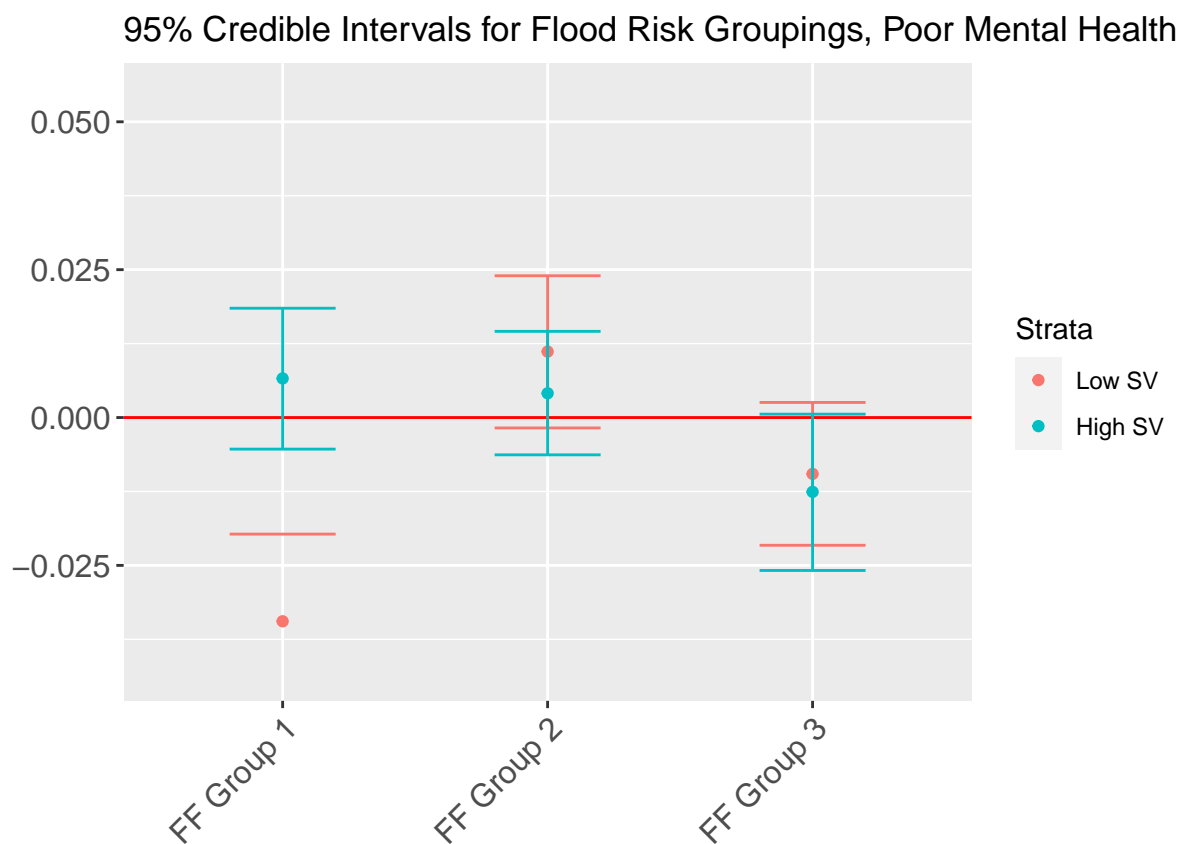
```

```
pc_extract_idx <- 2:4
```

```
beta_MHLTH_pcs <- beta_data_frames_extract(beta_inference_df, pc_extract_idx)
```

```
p <- ggplot(beta_MHLTH_pcs$beta_pcs_strat0, aes(x = var_idx, y = post_median, color = strat)) +
  geom_point() +
  ylim(c(-0.043, 0.055)) +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1), axis.title.x = element_blank(), axis.title.y = element_text(size=12),
        plot.margin = margin(5.5, 5.5, 5.5, 25)) +
  geom_errorbar(aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#F8766D") +
  geom_hline(yintercept = 0, col = "red") +
  scale_x_discrete(labels = c("FF Group 1", "FF Group 2", "FF Group 3"), 6) + ggtitle("95% Credible Intervals for Flood Risk Groupings, Poor Mental Health")
  geom_point(data = beta_MHLTH_pcs$beta_pcs_strat1, col = "#00BFC4") + # strat 1
  geom_errorbar(data = beta_MHLTH_pcs$beta_pcs_strat1, aes(ymin = post_2.5, ymax = post_97.5, width = 0.4), col = "#00BFC4") +
  scale_color_manual(name = "Strata",
                    values = c("#F8766D", "#00BFC4"),
                    drop = FALSE)
```

p



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