Coastal Analysis

TLDR: To replicate tables in slides, run tab_model commands at the bottom (that is, after running all the models)

Read in data

```
library(readxl)
library(gee)
library(sjPlot)
library(sjmisc)
```

```
## Install package "strengejacke" from GitHub (`devtools::install_github("strengejacke/strengejacke")`)
```

```
library(sjlabelled)

# Read in dataset with coastal coding. Read in summary sheet (sheet
# 13)
coastal <- read_excel("FIPS-based datasets_05232021.xlsx", sheet = 13)
```

```
## New names:
## * `` -> ...12
## * `` -> ...22
## * `` -> ...25
## * `` -> ...39
```

```
# summary(coastal)

# Read in PM25 and humidity data from our 2020 study, created with:
# confounding = data.frame(fips =
# aggregate_pm_census_cdc_test_beds$fips, q_popdensity =
# aggregate_pm_census_cdc_test_beds$q_popdensity, poverty.old =
# aggregate_pm_census_cdc_test_beds$poverty, median_house_value =
# aggregate_pm_census_cdc_test_beds$median_house_value,
# median_household_income =
# aggregate_pm_census_cdc_test_beds$median_household_income,
# owner_occupied = aggregate_pm_census_cdc_test_beds$owner_occupied,
# blk_pct = aggregate_pm_census_cdc_test_beds$blk_pct, hispanic_pct =
# aggregate_pm_census_cdc_test_beds$hispanic_pct, white_pct =
# aggregate_pm_census_cdc_test_beds$white_pct, native_pct =
# aggregate_pm_census_cdc_test_beds$native_pct, asian_pct =
# aggregate_pm_census_cdc_test_beds$asian_pct, no_grad =
# aggregate_pm_census_cdc_test_beds$no_grad, date_since_social =
# aggregate_pm_census_cdc_test_beds$date_since_social, date_since =
```

```
# aggregate_pm_census_cdc_test_beds$date_since, beds =
# aggregate_pm_census_cdc_test_beds$beds, population.old =
# aggregate_pm_census_cdc_test_beds$population, obese =
# aggregate_pm_census_cdc_test_beds$obese, smoke =
# aggregate_pm_census_cdc_test_beds$smoke, mean_summer_temp =
# aggregate_pm_census_cdc_test_beds$mean_summer_temp,
# mean_winter_temp =
# aggregate_pm_census_cdc_test_beds$mean_winter_temp, mean_pm25 =
# aggregate_pm_census_cdc_test_beds$mean_pm25, mean_summer_rm =
# aggregate_pm_census_cdc_test_beds$mean_summer_rm, mean_winter_rm =
# aggregate_pm_census_cdc_test_beds$mean_winter_rm) save(confounding,
# file = 'confounding.Rda')
load("confounding.Rda")
```

Create smaller datasets from previous datasets, dataclean, merge region dataset with summary dataset, finally merge with PM25 dataset.

```
coastal.new = data.frame(coastal$`FIPS as Text`, coastal$state, coastal$cases,
    coastal$deaths, coastal$`Country REGION`, coastal$`Coastal Distance`,
    coastal$`Population 2019 Estimate`, coastal$`Population Density`, coastal$`All Ages in Poverty (%)`
    coastal$`Under 18s in Poverty`, coastal$`Median Income`, coastal$`percent adult obesity`,
    coastal$`diff/total`, coastal$`Politcal alignment 2020 election`, coastal$`median age 2019`,
    coastal$Humid)
colnames(coastal.new) = c("fips", "state", "cases", "deaths", "region",
    "coastal.distance", "population2019", "popdensity", "poverty", "under18poverty",
    "median_income", "pct_obesity", "voter_margin_2020", "party", "median_age",
    "humidity")

# change NAs in coastal.distance to level 4, and save as factor with
# reference level 4.
coastal.new$coastal.distance[is.na(coastal.new$coastal.distance)] <- 4
coastal.new$coastal.distance = as.factor(coastal.new$coastal.distance)
coastal.new <- within(coastal.new, coastal.distance <- relevel(coastal.distance,
    ref = 4))

# change NAs in coastal region to Inland, and save as factor with
# reference level Inland
coastal.new$region[is.na(coastal.new$region)] <- "Inland"
coastal.new$region[coastal.new$region == "0"] <- "Inland"
coastal.new$region[coastal.new$coastal.distance != 1] <- "Inland"
coastal.new$region = tolower(coastal.new$region)
coastal.new$region = as.factor(coastal.new$region)
coastal.new <- within(coastal.new, region <- relevel(region, ref = "inland"))

# Merge with confounding dataset
coastal.new = merge(coastal.new, confounding, by = "fips")
names(coastal.new)[names(coastal.new) == "poverty.x"] <- "poverty"
summary(coastal.new)
```

```
##      fips               state                cases              deaths
##  Length:3100        Length:3100        Min.   :      1   Min.   :    0.0
```

```
##  Class :character   Class :character   1st Qu.:   1024   1st Qu.:   18.0
##  Mode  :character   Mode  :character   Median :   2445   Median :   47.0
##                                        Mean   :   9384   Mean   :  165.4
##                                        3rd Qu.:   6124   3rd Qu.:  109.0
##                                        Max.   :1219237   Max.   :23101.0
##
##            region     coastal.distance population2019       popdensity
##  inland        :2800   4:2426           Min.   :     169   Min.   :    0.10
##  atlantic      : 124   1: 300           1st Qu.:   11093   1st Qu.:   17.60
##  gulf of mexico:  56   2: 202           Median :   25884   Median :   45.55
##  pacific       :  40   3: 172           Mean   :  102342   Mean   :  208.15
##  michigan      :  33                    3rd Qu.:   67644   3rd Qu.:  114.12
##  superior      :  14                    Max.   :10039107   Max.   :17179.10
##  (Other)       :  33
##     poverty       under18poverty   median_income     pct_obesity
##  Min.   :0.0270   Min.   :0.0240   Min.   : 24732   Min.   :13.6
##  1st Qu.:0.1050   1st Qu.:0.1370   1st Qu.: 46177   1st Qu.:29.4
##  Median :0.1340   Median :0.1870   Median : 53216   Median :32.4
##  Mean   :0.1448   Mean   :0.2001   Mean   : 55538   Mean   :32.1
##  3rd Qu.:0.1750   3rd Qu.:0.2500   3rd Qu.: 61736   3rd Qu.:35.1
##  Max.   :0.4770   Max.   :0.6340   Max.   :151806   Max.   :49.5
##
##  voter_margin_2020    party             median_age      humidity
##  Min.   :-0.8675   Length:3100        Min.   :22.30   Length:3100
##  1st Qu.: 0.1362   Class :character   1st Qu.:38.20   Class :character
##  Median : 0.3849   Mode  :character   Median :41.40   Mode  :character
##  Mean   : 0.3189                      Mean   :41.48
##  3rd Qu.: 0.5663                      3rd Qu.:44.52
##  Max.   : 0.9309                      Max.   :67.40
##
##   q_popdensity   poverty.y      median_house_value median_household_income
##  Min.   :1     Min.   :0.0181   Min.   : 19800     Min.   : 18972
##  1st Qu.:1     1st Qu.:0.1178   1st Qu.: 88075     1st Qu.: 39650
##  Median :1     Median :0.1568   Median :114150     Median : 46212
##  Mean   :1     Mean   :0.1644   Mean   :135060     Mean   : 47760
##  3rd Qu.:1     3rd Qu.:0.1992   3rd Qu.:157525     3rd Qu.: 53508
##  Max.   :1     Max.   :0.5395   Max.   :966600     Max.   :125672
##
##  owner_occupied      blk_pct          hispanic_pct     date_since_social
##  Min.   :0.2632   Min.   :0.000000   Min.   :0.00000   Min.   :  0.0
##  1st Qu.:0.6750   1st Qu.:0.006274   1st Qu.:0.01932   1st Qu.:  0.0
##  Median :0.7257   Median :0.022637   Median :0.03800   Median :434.0
##  Mean   :0.7134   Mean   :0.090870   Mean   :0.08949   Mean   :310.7
##  3rd Qu.:0.7669   3rd Qu.:0.103510   3rd Qu.:0.09049   3rd Qu.:440.0
##  Max.   :0.9309   Max.   :0.861849   Max.   :0.98959   Max.   :446.0
##
##    date_since         beds          population.old         obese
##  Min.   :  0.0   Min.   :    0.00   Min.   :      76   Min.   :0.1240
##  1st Qu.:157.0   1st Qu.:   20.75   1st Qu.:   11128   1st Qu.:0.2930
##  Median :166.0   Median :   50.00   Median :   25824   Median :0.3310
##  Mean   :156.8   Mean   :  329.19   Mean   :   99194   Mean   :0.3288
##  3rd Qu.:170.0   3rd Qu.:  193.25   3rd Qu.:   67356   3rd Qu.:0.3650
##  Max.   :170.0   Max.   :30147.00   Max.   :10057155   Max.   :0.5770
##
```

```
##      smoke          mean_summer_temp mean_winter_temp   mean_pm25
##  Min.   :0.05909   Min.   :290.5    Min.   :264.7    Min.   : 1.959
##  1st Qu.:0.14941   1st Qu.:300.8    1st Qu.:275.1    1st Qu.: 6.152
##  Median :0.16967   Median :303.3    Median :280.2    Median : 8.360
##  Mean   :0.17459   Mean   :303.1    Mean   :280.4    Mean   : 7.853
##  3rd Qu.:0.19719   3rd Qu.:305.8    3rd Qu.:285.5    3rd Qu.: 9.537
##  Max.   :0.41491   Max.   :313.9    Max.   :298.3    Max.   :12.729
##
##  mean_summer_rm  mean_winter_rm    white_pct         native_pct
##  Min.   :31.64   Min.   :58.16   Min.   :0.04641   Min.   :0.000000
##  1st Qu.:88.09   1st Qu.:85.11   1st Qu.:0.77715   1st Qu.:0.001582
##  Median :91.33   Median :88.03   Median :0.90163   Median :0.003399
##  Mean   :89.02   Mean   :87.50   Mean   :0.83818   Mean   :0.016467
##  3rd Qu.:94.82   3rd Qu.:90.75   3rd Qu.:0.95471   3rd Qu.:0.007701
##  Max.   :99.78   Max.   :97.67   Max.   :1.00000   Max.   :0.930379
##
##    asian_pct           no_grad
##  Min.   :0.000000   Min.   :0.05598
##  1st Qu.:0.002541   1st Qu.:0.16722
##  Median :0.005605   Median :0.20287
##  Mean   :0.011937   Mean   :0.21454
##  3rd Qu.:0.011992   3rd Qu.:0.25323
##  Max.   :0.343781   Max.   :0.54537
##
```

Create indicator for being a coast (degree 1)

```
# Indicator Coastal or NonCoastal
coastal.new$indicatorcoast = ifelse(coastal.new$coastal.distance == "1",
    "Coastal", "NonCoastal")

# Model cases
model.indicator.cases = gee(cases ~ factor(indicatorcoast) + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.new,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27

## running glm to get initial regression estimate

##                       (Intercept) factor(indicatorcoast)NonCoastal
##                      -1.539180916                      -0.063349824
##                 scale(popdensity)                   scale(poverty)
##                      -0.002228131                      -0.027518554
##         scale(log(median_income))                scale(pct_obesity)
##                      -0.086074054                      -0.030807163
##          scale(voter_margin_2020)                 scale(median_age)
##                       0.112018417                      -0.106228379
##           factor(party)Republican                         mean_pm25
##                      -0.016285392                       0.035212102
##                    mean_summer_rm                    mean_winter_rm
##                      -0.001684755                      -0.010277980
```

```
summary(model.indicator.cases)$coefficients
```

```
##                                    Estimate   Naive S.E.     Naive z
## (Intercept)                     -1.539180916 0.0596364202 -25.8094116
## factor(indicatorcoast)NonCoastal -0.063349824 0.0105135820  -6.0255224
## scale(popdensity)                -0.002228131 0.0023539519  -0.9465492
## scale(poverty)                   -0.027518554 0.0125523359  -2.1923054
## scale(log(median_income))        -0.086074054 0.0105492422  -8.1592642
## scale(pct_obesity)               -0.030807163 0.0062432987  -4.9344368
## scale(voter_margin_2020)          0.112018417 0.0083762230  13.3733804
## scale(median_age)                -0.106228379 0.0063584903 -16.7065409
## factor(party)Republican          -0.016285392 0.0154987849  -1.0507528
## mean_pm25                         0.035212102 0.0028394059  12.4012219
## mean_summer_rm                   -0.001684755 0.0005509548  -3.0578832
## mean_winter_rm                   -0.010277980 0.0008735142 -11.7662426
##                                  Robust S.E.   Robust z
## (Intercept)                     0.257817265 -5.9700459
## factor(indicatorcoast)NonCoastal 0.035530659 -1.7829622
## scale(popdensity)                0.005582572 -0.3991227
## scale(poverty)                   0.046210038 -0.5955103
## scale(log(median_income))        0.052042445 -1.6539203
```

```
## scale(pct_obesity)               0.032538653 -0.9467867
## scale(voter_margin_2020)         0.029267170  3.8274427
## scale(median_age)                0.016369592 -6.4893722
## factor(party)Republican          0.047857949 -0.3402860
## mean_pm25                        0.011278602  3.1220272
## mean_summer_rm                   0.002083177 -0.8087433
## mean_winter_rm                   0.004616915 -2.2261577
```

```
# Model deaths
model.indicator.deaths = gee(deaths ~ factor(indicatorcoast) + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.new,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                      (Intercept) factor(indicatorcoast)NonCoastal
##                     -4.816913778                     -0.067556274
##                scale(popdensity)                    scale(poverty)
##                      0.012062196                      0.198449213
##        scale(log(median_income))                scale(pct_obesity)
##                     -0.002085592                      0.024619499
##         scale(voter_margin_2020)                 scale(median_age)
##                      0.101637642                      0.129991106
##          factor(party)Republican                        mean_pm25
##                     -0.089474878                      0.042400136
##                    mean_summer_rm                    mean_winter_rm
##                      0.001133713                     -0.020862196
```

```
summary(model.indicator.deaths)$coefficients
```

```
##                                    Estimate   Naive S.E.      Naive z
## (Intercept)                     -4.816913778 0.0974146091 -49.4475502
## factor(indicatorcoast)NonCoastal -0.067556274 0.0169887220  -3.9765366
## scale(popdensity)                 0.012062196 0.0034588568   3.4873361
## scale(poverty)                    0.198449213 0.0194043531  10.2270461
## scale(log(median_income))        -0.002085592 0.0168314117  -0.1239107
## scale(pct_obesity)                0.024619499 0.0099887696   2.4647179
## scale(voter_margin_2020)          0.101637642 0.0134309667   7.5674107
## scale(median_age)                 0.129991106 0.0101278249  12.8350467
## factor(party)Republican          -0.089474878 0.0254711063  -3.5127991
## mean_pm25                         0.042400136 0.0046918590   9.0369588
## mean_summer_rm                    0.001133713 0.0009371976   1.2096836
## mean_winter_rm                   -0.020862196 0.0014678680 -14.2125831
##                                  Robust S.E.     Robust z
## (Intercept)                     0.335990155 -14.33647298
## factor(indicatorcoast)NonCoastal 0.031208510  -2.16467476
## scale(popdensity)                0.011039285   1.09266098
## scale(poverty)                   0.060380000   3.28667131
## scale(log(median_income))        0.062588732  -0.03332216
```

```
## scale(pct_obesity)               0.024631660   0.99950627
## scale(voter_margin_2020)         0.030367323   3.34694106
## scale(median_age)                0.027402072   4.74384231
## factor(party)Republican          0.042629373  -2.09890203
## mean_pm25                        0.019349492   2.19127900
## mean_summer_rm                   0.004782270   0.23706578
## mean_winter_rm                   0.007643095  -2.72954798
```

```
############ Repeat above, - humidity ##############

# Model cases
model.indicator.cases.nohumidity = gee(cases ~ factor(indicatorcoast) +
    offset(log(population2019)) + scale(popdensity) + scale(poverty) +
    scale(log(median_income)) + scale(pct_obesity) + scale(voter_margin_2020) +
    scale(median_age) + factor(party) + mean_pm25, family = poisson(link = "log"),
    data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##                      (Intercept) factor(indicatorcoast)NonCoastal
##                    -2.5277287703                    -0.0263656026
##                scale(popdensity)                   scale(poverty)
##                     0.0006959856                    0.0018851573
##        scale(log(median_income))                scale(pct_obesity)
##                    -0.0669430868                    -0.0572479051
##         scale(voter_margin_2020)                 scale(median_age)
##                     0.1230363195                    -0.1202846203
##          factor(party)Republican                        mean_pm25
##                    -0.0554930093                     0.0289778033
```

```
summary(model.indicator.cases.nohumidity)$coefficients
```

```
##                                    Estimate  Naive S.E.     Naive z
## (Intercept)                     -2.5277287703 0.028105198 -89.9381223
## factor(indicatorcoast)NonCoastal -0.0263656026 0.010853681  -2.4291854
## scale(popdensity)                 0.0006959856 0.002438615   0.2854020
## scale(poverty)                    0.0018851573 0.012912811   0.1459912
## scale(log(median_income))        -0.0669430868 0.010902972  -6.1398937
## scale(pct_obesity)               -0.0572479051 0.006401774  -8.9425065
## scale(voter_margin_2020)          0.1230363195 0.008772570  14.0251168
## scale(median_age)                -0.1202846203 0.006490014 -18.5338009
## factor(party)Republican          -0.0554930093 0.016188488  -3.4279303
## mean_pm25                         0.0289778033 0.002498154  11.5996852
##                                  Robust S.E.     Robust z
## (Intercept)                     0.148897532 -16.97629734
## factor(indicatorcoast)NonCoastal 0.040891621  -0.64476785
## scale(popdensity)                0.008640851   0.08054596
## scale(poverty)                   0.044824606   0.04205630
## scale(log(median_income))        0.052738189  -1.26934747
## scale(pct_obesity)               0.027585460  -2.07529275
## scale(voter_margin_2020)         0.030168144   4.07835228
```

```
## scale(median_age)                0.020903915  -5.75416725
## factor(party)Republican          0.033836593  -1.64002946
## mean_pm25                        0.014857847   1.95033665
```

```
# Model deaths
model.indicator.deaths.nohumidity = gee(deaths ~ factor(indicatorcoast) +
    offset(log(population2019)) + scale(popdensity) + scale(poverty) +
    scale(log(median_income)) + scale(pct_obesity) + scale(voter_margin_2020) +
    scale(median_age) + factor(party) + mean_pm25, family = poisson(link = "log"),
    data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                      (Intercept) factor(indicatorcoast)NonCoastal
##                      -6.52632362                      -0.01221231
##                scale(popdensity)                    scale(poverty)
##                       0.01567935                       0.24620870
##        scale(log(median_income))                scale(pct_obesity)
##                       0.03044379                       -0.01372684
##         scale(voter_margin_2020)                scale(median_age)
##                       0.11438834                       0.11371985
##          factor(party)Republican                         mean_pm25
##                      -0.14037140                       0.04215293
```

```
summary(model.indicator.deaths.nohumidity)$coefficients
```

```
##                                    Estimate  Naive S.E.      Naive z
## (Intercept)                      -6.52632362 0.046436264 -140.5436852
## factor(indicatorcoast)NonCoastal -0.01221231 0.017584593   -0.6944893
## scale(popdensity)                 0.01567935 0.003586530    4.3717322
## scale(poverty)                    0.24620870 0.019946354   12.3435441
## scale(log(median_income))         0.03044379 0.017410225    1.7486157
## scale(pct_obesity)               -0.01372684 0.010281954   -1.3350416
## scale(voter_margin_2020)          0.11438834 0.014162572    8.0768051
## scale(median_age)                 0.11371985 0.010384154   10.9512877
## factor(party)Republican          -0.14037140 0.026760096   -5.2455493
## mean_pm25                         0.04215293 0.004131639   10.2024704
##                                  Robust S.E.    Robust z
## (Intercept)                       0.22133643 -29.4859893
## factor(indicatorcoast)NonCoastal  0.04210152  -0.2900681
## scale(popdensity)                 0.01444359   1.0855576
## scale(poverty)                    0.05990987   4.1096516
## scale(log(median_income))         0.07531244   0.4042333
## scale(pct_obesity)                0.03134830  -0.4378814
## scale(voter_margin_2020)          0.03070833   3.7249935
## scale(median_age)                 0.03366831   3.3776530
## factor(party)Republican           0.04789463  -2.9308378
## mean_pm25                         0.02317297   1.8190556
```

Analysis by region

```
model.byregion.cases = gee(cases ~ region + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.new,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27

## running glm to get initial regression estimate

##               (Intercept)            regionatlantic                 regionerie
##              -1.688596979               0.204215671              -0.108356810
##     regiongreat salt lake      regiongulf of mexico               regionhuron
##               0.132565314              -0.043255529              -0.027030250
##            regionmichigan             regionontario             regionpacific
##               0.136491225              -0.127998621              -0.031779732
##            regionsuperior         scale(popdensity)            scale(poverty)
##               0.189020378              -0.007523609              -0.005643804
## scale(log(median_income))        scale(pct_obesity)  scale(voter_margin_2020)
##              -0.079744360              -0.040674317               0.108992803
##         scale(median_age)   factor(party)Republican                 mean_pm25
##              -0.109290739              -0.005730366               0.039942888
##            mean_summer_rm            mean_winter_rm
##              -0.002883539              -0.008642672
```

```
summary(model.byregion.cases)$coefficients
```

```
##                               Estimate   Naive S.E.     Naive z Robust S.E.
## (Intercept)               -1.688596979 0.0569905400 -29.6294258 0.274405880
## regionatlantic             0.204215671 0.0143892070  14.1922811 0.074237620
## regionerie                -0.108356810 0.0337973622  -3.2060730 0.066970699
## regiongreat salt lake      0.132565314 0.0535843278   2.4739568 0.074841729
## regiongulf of mexico      -0.043255529 0.0198768903  -2.1761719 0.042365107
## regionhuron               -0.027030250 0.1066409131  -0.2534698 0.050589334
## regionmichigan             0.136491225 0.0244595887   5.5802747 0.058853051
## regionontario             -0.127998621 0.0755540171  -1.6941339 0.042765958
## regionpacific             -0.031779732 0.0167978746  -1.8918900 0.085117999
## regionsuperior             0.189020378 0.1140577459   1.6572340 0.076303153
## scale(popdensity)         -0.007523609 0.0022833390  -3.2950030 0.004752741
## scale(poverty)            -0.005643804 0.0120976619  -0.4665202 0.044880995
## scale(log(median_income)) -0.079744360 0.0101711729  -7.8402325 0.046471802
## scale(pct_obesity)        -0.040674317 0.0061153075  -6.6512301 0.031164976
## scale(voter_margin_2020)   0.108992803 0.0081307940  13.4049397 0.024204307
## scale(median_age)         -0.109290739 0.0061271714 -17.8370625 0.014190845
## factor(party)Republican   -0.005730366 0.0148262127  -0.3865023 0.039452688
## mean_pm25                  0.039942888 0.0028397963  14.0654060 0.009740551
## mean_summer_rm            -0.002883539 0.0005871782  -4.9108410 0.001969371
## mean_winter_rm            -0.008642672 0.0008968655  -9.6365313 0.005163852
##                             Robust z
```

```
## (Intercept)               -6.1536472
## regionatlantic             2.7508381
## regionerie                -1.6179734
## regiongreat salt lake      1.7712754
## regiongulf of mexico      -1.0210178
## regionhuron               -0.5343073
## regionmichigan             2.3191869
## regionontario             -2.9930025
## regionpacific             -0.3733609
## regionsuperior             2.4772289
## scale(popdensity)         -1.5830043
## scale(poverty)            -0.1257504
## scale(log(median_income)) -1.7159731
## scale(pct_obesity)        -1.3051291
## scale(voter_margin_2020)   4.5030333
## scale(median_age)         -7.7014960
## factor(party)Republican   -0.1452465
## mean_pm25                  4.1006807
## mean_summer_rm            -1.4641925
## mean_winter_rm            -1.6736870
```

```
model.byregion.deaths = gee(deaths ~ region + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.new,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##               (Intercept)           regionatlantic                regionerie
##              -5.010724600              0.222892186              0.041660140
##     regiongreat salt lake      regiongulf of mexico               regionhuron
##              -0.600953792             -0.006739778              0.309363488
##            regionmichigan            regionontario            regionpacific
##               0.113333494             -0.127037900             -0.080022647
##            regionsuperior        scale(popdensity)           scale(poverty)
##               0.144067048              0.006698679              0.218769882
## scale(log(median_income))       scale(pct_obesity) scale(voter_margin_2020)
##               0.006159058              0.007762584              0.102217615
##         scale(median_age)   factor(party)Republican                mean_pm25
##               0.119525317             -0.073145536              0.050680476
##            mean_summer_rm           mean_winter_rm
##              -0.001760438             -0.017492354
```

```
summary(model.byregion.deaths)$coefficients
```

```
##                              Estimate  Naive S.E.     Naive z Robust S.E.
## (Intercept)               -5.010724600 0.095768741 -52.3210870 0.329535568
## regionatlantic             0.222892186 0.023390756   9.5290716 0.068120762
## regionerie                 0.041660140 0.048407530   0.8606128 0.075662685
## regiongreat salt lake     -0.600953792 0.152751891  -3.9341823 0.159531503
```

```
## regiongulf of mexico      -0.006739778 0.032609406  -0.2066820 0.052697418
## regionhuron                0.309363489 0.141701739   2.1832018 0.058291494
## regionmichigan             0.113333494 0.040654566   2.7877187 0.067708615
## regionontario             -0.127037900 0.127089249  -0.9995960 0.057253363
## regionpacific             -0.080022647 0.028721481  -2.7861602 0.099046829
## regionsuperior             0.144067048 0.195370869   0.7374029 0.114092929
## scale(popdensity)          0.006698679 0.003458165   1.9370617 0.009910443
## scale(poverty)             0.218769881 0.019257693  11.3601293 0.058880799
## scale(log(median_income))  0.006159058 0.016701316   0.3687768 0.061330486
## scale(pct_obesity)         0.007762584 0.010141833   0.7654025 0.024499782
## scale(voter_margin_2020)   0.102217615 0.013380483   7.6393070 0.031690419
## scale(median_age)          0.119525317 0.010019748  11.9289744 0.028693646
## factor(party)Republican   -0.073145536 0.025000109  -2.9258087 0.041152296
## mean_pm25                  0.050680476 0.004858210  10.4319229 0.017619827
## mean_summer_rm            -0.001760438 0.001015523  -1.7335289 0.004790069
## mean_winter_rm            -0.017492354 0.001551305 -11.2758931 0.007877458
##                              Robust z
## (Intercept)               -15.2054136
## regionatlantic              3.2720155
## regionerie                  0.5506035
## regiongreat salt lake      -3.7669914
## regiongulf of mexico       -0.1278958
## regionhuron                 5.3071806
## regionmichigan              1.6738416
## regionontario              -2.2188723
## regionpacific              -0.8079274
## regionsuperior              1.2627167
## scale(popdensity)           0.6759213
## scale(poverty)              3.7154707
## scale(log(median_income))   0.1004241
## scale(pct_obesity)          0.3168430
## scale(voter_margin_2020)    3.2255053
## scale(median_age)           4.1655673
## factor(party)Republican    -1.7774351
## mean_pm25                   2.8763322
## mean_summer_rm             -0.3675183
## mean_winter_rm             -2.2205582
```

```
#### Repeat above, - humidity ###############

model.byregion.cases.nohumidity = gee(cases ~ region + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25,
    family = poisson(link = "log"), data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##               (Intercept)            regionatlantic                regionerie
##               -2.57369106                0.16264955               -0.13332726
##     regiongreat salt lake      regiongulf of mexico               regionhuron
##                0.19090444               -0.14180237               -0.08198547
##            regionmichigan             regionontario             regionpacific
```

```
##                0.11038854               -0.19432775               -0.02325864
##            regionsuperior         scale(popdensity)            scale(poverty)
##                0.06747165               -0.00359108                0.01758539
## scale(log(median_income))        scale(pct_obesity)  scale(voter_margin_2020)
##               -0.06627520               -0.06331005                0.12301459
##         scale(median_age)   factor(party)Republican                 mean_pm25
##               -0.12512998               -0.04798863                0.03084745
```

```
summary(model.byregion.cases.nohumidity)$coefficients
```

```
##                               Estimate  Naive S.E.     Naive z Robust S.E.
## (Intercept)                -2.57369106 0.026321422 -97.7793323 0.143822210
## regionatlantic              0.16264955 0.014549037  11.1794031 0.061241436
## regionerie                 -0.13332726 0.035643087  -3.7406204 0.063062538
## regiongreat salt lake       0.19090444 0.053856679   3.5446754 0.031958003
## regiongulf of mexico       -0.14180237 0.020493038  -6.9195387 0.046304561
## regionhuron                -0.08198547 0.113146625  -0.7245949 0.042588477
## regionmichigan              0.11038854 0.025286819   4.3654577 0.054197518
## regionontario              -0.19432775 0.080128750  -2.4251938 0.041402347
## regionpacific              -0.02325864 0.017832898  -1.3042546 0.105222239
## regionsuperior              0.06747165 0.120863905   0.5582448 0.077235530
## scale(popdensity)          -0.00359108 0.002374425  -1.5124000 0.007136096
## scale(poverty)              0.01758539 0.012609581   1.3946055 0.046322531
## scale(log(median_income)) -0.06627520 0.010661599  -6.2162531 0.050840161
## scale(pct_obesity)         -0.06331005 0.006314503 -10.0261333 0.028822474
## scale(voter_margin_2020)    0.12301459 0.008566576  14.3598327 0.023633829
## scale(median_age)          -0.12512998 0.006374749 -19.6290036 0.018642596
## factor(party)Republican    -0.04798863 0.015608439  -3.0745310 0.029268918
## mean_pm25                   0.03084745 0.002443926  12.6220908 0.014184089
##                               Robust z
## (Intercept)                -17.8949486
## regionatlantic               2.6558741
## regionerie                  -2.1142070
## regiongreat salt lake        5.9736037
## regiongulf of mexico        -3.0623845
## regionhuron                 -1.9250623
## regionmichigan               2.0367822
## regionontario               -4.6936409
## regionpacific               -0.2210430
## regionsuperior               0.8735831
## scale(popdensity)           -0.5032275
## scale(poverty)               0.3796293
## scale(log(median_income))   -1.3035993
## scale(pct_obesity)          -2.1965516
## scale(voter_margin_2020)     5.2050217
## scale(median_age)           -6.7120469
## factor(party)Republican     -1.6395765
## mean_pm25                    2.1747926
```

```
model.byregion.deaths.nohumidity = gee(deaths ~ region + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25,
    family = poisson(link = "log"), data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##               (Intercept)            regionatlantic                regionerie
##               -6.55525139                0.17793505               -0.01724918
##     regiongreat salt lake      regiongulf of mexico                regionhuron
##               -0.59601442                -0.15909509                0.20395184
##            regionmichigan             regionontario             regionpacific
##                0.04481734                -0.23198628               -0.06033017
##            regionsuperior         scale(popdensity)            scale(poverty)
##               -0.03746627                0.01244111                0.25159682
## scale(log(median_income))        scale(pct_obesity)  scale(voter_margin_2020)
##                0.02636318                -0.02405789                0.11815459
##         scale(median_age)   factor(party)Republican                 mean_pm25
##                0.09670178                -0.12963447                0.04282456
```

```
summary(model.byregion.deaths.nohumidity)$coefficients
```

```
##                              Estimate  Naive S.E.      Naive z Robust S.E.
## (Intercept)               -6.55525139 0.044177198 -148.3854056  0.23728373
## regionatlantic             0.17793505 0.023456028    7.5858988  0.08798933
## regionerie                -0.01724918 0.050669649   -0.3404244  0.07669580
## regiongreat salt lake     -0.59601442 0.158525455   -3.7597395  0.06512395
## regiongulf of mexico      -0.15909509 0.033490982   -4.7503858  0.04724166
## regionhuron                0.20395184 0.149776495    1.3617079  0.05697602
## regionmichigan             0.04481734 0.041686010    1.0751171  0.07342439
## regionontario             -0.23198628 0.134332126   -1.7269605  0.06152517
## regionpacific             -0.06033017 0.030406994   -1.9840886  0.13293317
## regionsuperior            -0.03746627 0.206338766   -0.1815765  0.11848553
## scale(popdensity)          0.01244111 0.003543749    3.5107197  0.01305516
## scale(poverty)             0.25159682 0.019893668   12.6470808  0.06116511
## scale(log(median_income))  0.02636318 0.017373795    1.5174103  0.07695828
## scale(pct_obesity)        -0.02405789 0.010368814   -2.3202163  0.03341496
## scale(voter_margin_2020)   0.11815459 0.014066124    8.3999398  0.02977091
## scale(median_age)          0.09670178 0.010371716    9.3236046  0.03244031
## factor(party)Republican   -0.12963447 0.026263440   -4.9359286  0.04457407
## mean_pm25                  0.04282456 0.004129515   10.3703614  0.02324873
##                              Robust z
## (Intercept)               -27.6262150
## regionatlantic              2.0222343
## regionerie                 -0.2249039
## regiongreat salt lake      -9.1520011
## regiongulf of mexico       -3.3676859
## regionhuron                 3.5796082
## regionmichigan              0.6103877
## regionontario              -3.7705916
## regionpacific              -0.4538383
## regionsuperior             -0.3162096
## scale(popdensity)           0.9529648
## scale(poverty)              4.1134044
## scale(log(median_income))   0.3425645
## scale(pct_obesity)         -0.7199736
## scale(voter_margin_2020)    3.9687938
```

```
## scale(median_age)           2.9809140
## factor(party)Republican    -2.9082933
## mean_pm25                   1.8420174
```

By region, splitting into Urban and Rural

```
coastal.new$area = ifelse(coastal.new$popdensity >= 1500, "Urban", "Rural")
summary(as.factor(coastal.new$area))
```

```
## Rural Urban
##  3014    86
```

```
coastal.new$regionru = paste(as.character(coastal.new$region), coastal.new$area)
coastal.new$regionru[coastal.new$regionru == "inland Rural"] = "inland"
coastal.new$regionru[coastal.new$regionru == "inland Urban"] = "inland"
coastal.new$regionru = as.factor(coastal.new$regionru)
coastal.new <- within(coastal.new, regionru <- relevel(regionru, ref = "inland"))
summary(coastal.new$regionru)
```

```
##                inland        atlantic Rural        atlantic Urban
##                  2800                   105                    19
##            erie Rural            erie Urban great salt lake Rural
##                    10                     2                     3
##  gulf of mexico Rural  gulf of mexico Urban           huron Rural
##                    53                     3                    12
##        michigan Rural        michigan Urban         ontario Rural
##                    30                     3                     6
##         pacific Rural         pacific Urban        superior Rural
##                    35                     5                    14
```

```
model.byregionru.cases = gee(cases ~ regionru + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.new,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27

## running glm to get initial regression estimate

##                   (Intercept)        regionruatlantic Rural
##                  -1.733534725                   0.170139104
##        regionruatlantic Urban            regionruerie Rural
##                   0.272566689                  -0.053146583
##            regionruerie Urban regionrugreat salt lake Rural
##                  -0.155451912                   0.129765168
##  regionrugulf of mexico Rural  regionrugulf of mexico Urban
##                   0.023878507                  -0.162089950
##           regionruhuron Rural        regionrumichigan Rural
##                  -0.041222180                   0.132600033
##        regionrumichigan Urban         regionruontario Rural
##                   0.167079749                  -0.152458896
##         regionrupacific Rural         regionrupacific Urban
##                  -0.205226291                   0.102232281
```

```
##        regionrusuperior Rural             scale(popdensity)
##                     0.134793749                 -0.010894458
##                scale(poverty)    scale(log(median_income))
##                    -0.012272895                 -0.079999056
##             scale(pct_obesity)     scale(voter_margin_2020)
##                    -0.032508992                  0.109426415
##              scale(median_age)      factor(party)Republican
##                    -0.113262811                 -0.033038960
##                       mean_pm25               mean_summer_rm
##                     0.031790008                 -0.002437536
##                  mean_winter_rm
##                    -0.007513832
```

```
summary(model.byregionru.cases)$coefficients
```

```
##                                    Estimate   Naive S.E.     Naive z Robust S.E.
## (Intercept)                    -1.733534725 0.0564480965 -30.7102424 0.279993550
## regionruatlantic Rural          0.170139104 0.0163050730  10.4347343 0.091987332
## regionruatlantic Urban          0.272566689 0.0226521478  12.0327084 0.104857941
## regionruerie Rural             -0.053146583 0.0453627395  -1.1715911 0.039011979
## regionruerie Urban             -0.155451912 0.0463509848  -3.3537996 0.084689500
## regionrugreat salt lake Rural   0.129765168 0.0522962816   2.4813460 0.074582290
## regionrugulf of mexico Rural    0.023878507 0.0235771577   1.0127814 0.037968689
## regionrugulf of mexico Urban   -0.162089950 0.0318099308  -5.0955769 0.045064273
## regionruhuron Rural            -0.041222180 0.1040565945  -0.3961515 0.048942362
## regionrumichigan Rural          0.132600033 0.0400649457   3.3096272 0.109695993
## regionrumichigan Urban          0.167079749 0.0292235495   5.7172983 0.059996624
## regionruontario Rural          -0.152458896 0.0737289434  -2.0678297 0.040419679
## regionrupacific Rural          -0.205226291 0.0245103365  -8.3730507 0.138994480
## regionrupacific Urban           0.102232281 0.0206969393   4.9394879 0.036980078
## regionrusuperior Rural          0.134793749 0.1113725068   1.2102964 0.071894978
## scale(popdensity)              -0.010894458 0.0023909913  -4.5564605 0.006171302
## scale(poverty)                 -0.012272895 0.0118636304  -1.0344974 0.042432028
## scale(log(median_income))      -0.079999056 0.0100799302  -7.9364693 0.040110107
## scale(pct_obesity)             -0.032508992 0.0061016134  -5.3279338 0.027262420
## scale(voter_margin_2020)        0.109426415 0.0079374117  13.7861584 0.022904223
## scale(median_age)              -0.113262811 0.0060101297 -18.8453190 0.014994658
## factor(party)Republican        -0.033038960 0.0146964200  -2.2480958 0.037656599
## mean_pm25                       0.031790008 0.0029145460  10.9073620 0.009877254
## mean_summer_rm                 -0.002437536 0.0005783202  -4.2148547 0.002060133
## mean_winter_rm                 -0.007513832 0.0008901843  -8.4407600 0.005173484
##                                  Robust z
## (Intercept)                    -6.1913381
## regionruatlantic Rural          1.8495928
## regionruatlantic Urban          2.5993900
## regionruerie Rural             -1.3623144
## regionruerie Urban             -1.8355512
## regionrugreat salt lake Rural   1.7398925
## regionrugulf of mexico Rural    0.6289000
## regionrugulf of mexico Urban   -3.5968615
## regionruhuron Rural            -0.8422597
## regionrumichigan Rural          1.2087956
## regionrumichigan Urban          2.7848192
## regionruontario Rural          -3.7718978
```

```
## regionrupacific Rural         -1.4765068
## regionrupacific Urban          2.7645232
## regionrusuperior Rural         1.8748702
## scale(popdensity)             -1.7653419
## scale(poverty)                -0.2892366
## scale(log(median_income))     -1.9944862
## scale(pct_obesity)            -1.1924471
## scale(voter_margin_2020)       4.7775651
## scale(median_age)             -7.5535443
## factor(party)Republican       -0.8773750
## mean_pm25                      3.2185065
## mean_summer_rm                -1.1831934
## mean_winter_rm                -1.4523737
```

```
model.byregionru.deaths = gee(deaths ~ regionru + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.new,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                   (Intercept)        regionruatlantic Rural
##                  -5.116174369                   0.120947248
##        regionruatlantic Urban            regionruerie Rural
##                   0.416176040                   0.003893615
##           regionruerie Urban regionrugreat salt lake Rural
##                   0.079966653                  -0.604281740
##  regionrugulf of mexico Rural  regionrugulf of mexico Urban
##                   0.068027947                  -0.169230030
##           regionruhuron Rural        regionrumichigan Rural
##                   0.270956806                   0.060102893
##        regionrumichigan Urban         regionruontario Rural
##                   0.189949127                  -0.167570437
##         regionrupacific Rural         regionrupacific Urban
##                  -0.350387316                   0.109709879
##        regionrusuperior Rural             scale(popdensity)
##                   0.048101281                  -0.001521227
##                scale(poverty)     scale(log(median_income))
##                   0.200465035                  -0.006069958
##            scale(pct_obesity)      scale(voter_margin_2020)
##                   0.014802788                   0.102529618
##             scale(median_age)       factor(party)Republican
##                   0.115075634                  -0.114635698
##                     mean_pm25                mean_summer_rm
##                   0.038824847                  -0.001163866
##                mean_winter_rm
##                  -0.015221065
```

```
summary(model.byregionru.deaths)$coefficients
```

```
##                                 Estimate   Naive S.E.      Naive z
```

```
## (Intercept)                   -5.116174369 0.0951115741 -53.79129112
## regionruatlantic Rural         0.120947249 0.0271455143   4.45551509
## regionruatlantic Urban         0.416176040 0.0349339051  11.91324128
## regionruerie Rural             0.003893615 0.0698870794   0.05571295
## regionruerie Urban             0.079966653 0.0616723876   1.29663624
## regionrugreat salt lake Rural -0.604281740 0.1487233413  -4.06312644
## regionrugulf of mexico Rural   0.068027948 0.0379779132   1.79125028
## regionrugulf of mexico Urban  -0.169230029 0.0538295989  -3.14380996
## regionruhuron Rural            0.270956806 0.1380255727   1.96309134
## regionrumichigan Rural         0.060102893 0.0703534831   0.85429875
## regionrumichigan Urban         0.189949127 0.0472109905   4.02340906
## regionruontario Rural         -0.167570437 0.1237653091  -1.35393705
## regionrupacific Rural         -0.350387316 0.0456582253  -7.67413349
## regionrupacific Urban          0.109709879 0.0340267916   3.22422050
## regionrusuperior Rural         0.048101282 0.1903743718   0.25266679
## scale(popdensity)             -0.001521227 0.0036295288  -0.41912531
## scale(poverty)                 0.200465035 0.0188315014  10.64519663
## scale(log(median_income))     -0.006069958 0.0165137678  -0.36756954
## scale(pct_obesity)             0.014802787 0.0101126552   1.46378841
## scale(voter_margin_2020)       0.102529618 0.0130285948   7.86958379
## scale(median_age)              0.115075634 0.0098021927  11.73978492
## factor(party)Republican       -0.114635698 0.0247722987  -4.62757611
## mean_pm25                      0.038824847 0.0049806894   7.79507488
## mean_summer_rm                -0.001163866 0.0009989164  -1.16512845
## mean_winter_rm                -0.015221065 0.0015404868  -9.88068572
##                               Robust S.E.     Robust z
## (Intercept)                   0.348311210 -14.68851481
## regionruatlantic Rural        0.063222720   1.91303456
## regionruatlantic Urban        0.113622223   3.66280493
## regionruerie Rural            0.068202395   0.05708913
## regionruerie Urban            0.109766597   0.72851536
## regionrugreat salt lake Rural 0.155172845  -3.89424927
## regionrugulf of mexico Rural  0.092832868   0.73280023
## regionrugulf of mexico Urban  0.090413234  -1.87173960
## regionruhuron Rural           0.059491246   4.55456601
## regionrumichigan Rural        0.059687153   1.00696532
## regionrumichigan Urban        0.093432351   2.03301239
## regionruontario Rural         0.054132452  -3.09556341
## regionrupacific Rural         0.125746420  -2.78645957
## regionrupacific Urban         0.084363798   1.30043789
## regionrusuperior Rural        0.112079210   0.42917221
## scale(popdensity)             0.009946328  -0.15294362
## scale(poverty)                0.054920949   3.65006501
## scale(log(median_income))     0.057148397  -0.10621397
## scale(pct_obesity)            0.023370361   0.63340004
## scale(voter_margin_2020)      0.032487584   3.15596318
## scale(median_age)             0.032562061   3.53404028
## factor(party)Republican       0.043421757  -2.64005203
## mean_pm25                     0.017794293   2.18187069
## mean_summer_rm                0.004883593  -0.23832164
## mean_winter_rm                0.007947677  -1.91515897
```

```
model.byregionru.cases.nohumidity = gee(cases ~ regionru + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
```

```
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25,
    family = poisson(link = "log"), data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                   (Intercept)        regionruatlantic Rural
##                   -2.469395382                   0.113593065
##        regionruatlantic Urban            regionruerie Rural
##                    0.296284409                  -0.085569563
##            regionruerie Urban regionrugreat salt lake Rural
##                   -0.159611137                   0.177901599
##  regionrugulf of mexico Rural  regionrugulf of mexico Urban
##                   -0.056230951                  -0.238673862
##           regionruhuron Rural        regionrumichigan Rural
##                   -0.096595552                   0.094910100
##        regionrumichigan Urban         regionruontario Rural
##                    0.173260778                  -0.216138661
##         regionrupacific Rural         regionrupacific Urban
##                   -0.262479208                   0.174531428
##        regionrusuperior Rural             scale(popdensity)
##                    0.011759752                  -0.010952735
##                scale(poverty)     scale(log(median_income))
##                    0.001328331                  -0.072381845
##            scale(pct_obesity)      scale(voter_margin_2020)
##                   -0.047892107                   0.118822396
##             scale(median_age)       factor(party)Republican
##                   -0.126449400                  -0.074314297
##                      mean_pm25
##                    0.021313480
```

```
summary(model.byregionru.cases.nohumidity)$coefficients
```

```
##                                 Estimate  Naive S.E.     Naive z Robust S.E.
## (Intercept)                  -2.469395382 0.026021092 -94.8997601  0.11992347
## regionruatlantic Rural        0.113593065 0.016341104   6.9513705  0.07135056
## regionruatlantic Urban        0.296284409 0.022877891  12.9506869  0.11698561
## regionruerie Rural           -0.085569563 0.047050961  -1.8186571  0.03652486
## regionruerie Urban           -0.159611137 0.047949804  -3.3287130  0.08270693
## regionrugreat salt lake Rural 0.177901599 0.051467427   3.4565862  0.02914999
## regionrugulf of mexico Rural -0.056230951 0.024073918  -2.3357624  0.02206322
## regionrugulf of mexico Urban -0.238673862 0.032705373  -7.2976958  0.04295127
## regionruhuron Rural          -0.096595552 0.108103148  -0.8935498  0.03872954
## regionrumichigan Rural        0.094910100 0.041483814   2.2878827  0.12057892
## regionrumichigan Urban        0.173260778 0.029695530   5.8345743  0.04614607
## regionruontario Rural        -0.216138661 0.076550955  -2.8234613  0.03730012
## regionrupacific Rural        -0.262479208 0.025259962 -10.3911166  0.15208850
## regionrupacific Urban         0.174531428 0.021167941   8.2450830  0.03830799
## regionrusuperior Rural        0.011759752 0.115503963   0.1018125  0.07060074
## scale(popdensity)            -0.010952735 0.002458778  -4.4545445  0.00926321
## scale(poverty)                0.001328331 0.012164374   0.1091984  0.04273280
## scale(log(median_income))    -0.072381845 0.010377690  -6.9747553  0.04271274
```

```
## scale(pct_obesity)            -0.047892107 0.006222851  -7.6961674  0.02320282
## scale(voter_margin_2020)       0.118822396 0.008195459  14.4985650  0.02180123
## scale(median_age)             -0.126449400 0.006120126 -20.6612412  0.01876220
## factor(party)Republican       -0.074314297 0.015095170  -4.9230512  0.02920429
## mean_pm25                      0.021313480 0.002449322   8.7017876  0.01186660
##                                   Robust z
## (Intercept)                   -20.59142690
## regionruatlantic Rural          1.59204170
## regionruatlantic Urban          2.53265683
## regionruerie Rural             -2.34277591
## regionruerie Urban             -1.92984000
## regionrugreat salt lake Rural   6.10297310
## regionrugulf of mexico Rural   -2.54862874
## regionrugulf of mexico Urban   -5.55685216
## regionruhuron Rural            -2.49410551
## regionrumichigan Rural          0.78712018
## regionrumichigan Urban          3.75461586
## regionruontario Rural          -5.79458380
## regionrupacific Rural          -1.72583210
## regionrupacific Urban           4.55600630
## regionrusuperior Rural          0.16656698
## scale(popdensity)              -1.18239087
## scale(poverty)                  0.03108457
## scale(log(median_income))      -1.69461967
## scale(pct_obesity)             -2.06406432
## scale(voter_margin_2020)        5.45026136
## scale(median_age)              -6.73958153
## factor(party)Republican        -2.54463676
## mean_pm25                       1.79608946
```

```
model.byregionru.deaths.nohumidity = gee(deaths ~ regionru + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25,
    family = poisson(link = "log"), data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##                   (Intercept)        regionruatlantic Rural
##                  -6.391521544                   0.046869406
##        regionruatlantic Urban            regionruerie Rural
##                   0.475780226                  -0.061602493
##           regionruerie Urban regionrugreat salt lake Rural
##                   0.049166912                  -0.609905934
##  regionrugulf of mexico Rural  regionrugulf of mexico Urban
##                  -0.057500717                  -0.282285016
##           regionruhuron Rural        regionrumichigan Rural
##                   0.166492782                  -0.015784678
##        regionrumichigan Urban         regionruontario Rural
##                   0.167470698                  -0.266238507
##         regionrupacific Rural         regionrupacific Urban
##                  -0.442210483                   0.223350850
##        regionrusuperior Rural             scale(popdensity)
```

```
##                  -0.133129929                  -0.001257640
##                scale(poverty)     scale(log(median_income))
##                   0.217480467                   0.002357260
##            scale(pct_obesity)      scale(voter_margin_2020)
##                  -0.006692977                   0.112052781
##             scale(median_age)       factor(party)Republican
##                   0.097380308                  -0.169861748
##                     mean_pm25
##                   0.028739584
```

```
summary(model.byregionru.deaths.nohumidity)$coefficients
```

```
##                                    Estimate  Naive S.E.      Naive z Robust S.E.
## (Intercept)                    -6.391521545 0.043627859 -146.5009226  0.20142626
## regionruatlantic Rural          0.046869406 0.027120491    1.7281916  0.06524722
## regionruatlantic Urban          0.475780227 0.034891409   13.6360279  0.13148619
## regionruerie Rural             -0.061602493 0.072180434   -0.8534514  0.06537690
## regionruerie Urban              0.049166912 0.063348817    0.7761299  0.11064600
## regionrugreat salt lake Rural -0.609905933 0.151135681   -4.0354860  0.06178095
## regionrugulf of mexico Rural  -0.057500716 0.038584862   -1.4902403  0.09315697
## regionrugulf of mexico Urban  -0.282285016 0.055170408   -5.1166019  0.07883638
## regionruhuron Rural             0.166492782 0.142827293    1.1656930  0.05359757
## regionrumichigan Rural         -0.015784678 0.072562171   -0.2175332  0.06520613
## regionrumichigan Urban          0.167470698 0.047646530    3.5148561  0.10566097
## regionruontario Rural          -0.266238507 0.128068267   -2.0788796  0.05575313
## regionrupacific Rural          -0.442210483 0.046965206   -9.4157042  0.15577119
## regionrupacific Urban           0.223350850 0.034711280    6.4345323  0.08894265
## regionrusuperior Rural         -0.133129928 0.196775676   -0.6765568  0.10892125
## scale(popdensity)              -0.001257640 0.003685882   -0.3412047  0.01366765
## scale(poverty)                  0.217480467 0.019163291   11.3488055  0.05705784
## scale(log(median_income))       0.002357260 0.016898974    0.1394913  0.06724088
## scale(pct_obesity)             -0.006692977 0.010227196   -0.6544294  0.02409307
## scale(voter_margin_2020)        0.112052781 0.013414333    8.3532130  0.03012613
## scale(median_age)               0.097380308 0.009927665    9.8089841  0.03556135
## factor(party)Republican        -0.169861748 0.025402307   -6.6868631  0.04440686
## mean_pm25                       0.028739584 0.004128948    6.9605102  0.01955551
##                                    Robust z
## (Intercept)                    -31.73132249
## regionruatlantic Rural           0.71833571
## regionruatlantic Urban           3.61848048
## regionruerie Rural              -0.94226702
## regionruerie Urban               0.44436231
## regionrugreat salt lake Rural  -9.87207048
## regionrugulf of mexico Rural   -0.61724543
## regionrugulf of mexico Urban   -3.58064399
## regionruhuron Rural              3.10634917
## regionrumichigan Rural          -0.24207355
## regionrumichigan Urban           1.58498168
## regionruontario Rural           -4.77531011
## regionrupacific Rural           -2.83884638
## regionrupacific Urban            2.51117837
## regionrusuperior Rural          -1.22225854
## scale(popdensity)               -0.09201581
## scale(poverty)                   3.81157879
```

```
## scale(log(median_income))       0.03505695
## scale(pct_obesity)             -0.27779674
## scale(voter_margin_2020)        3.71945530
## scale(median_age)               2.73837485
## factor(party)Republican        -3.82512380
## mean_pm25                       1.46964100
```

Comparing 1st vs 2nd vs 3rd degree Coastal

```
# Subset coastal counties only
coastal.only = coastal.new[coastal.new$coastal.distance != 4, ]
nrow(coastal.only)
```

```
## [1] 674
```

```
nrow(na.omit(coastal.only))  #check nas
```

```
## [1] 636
```

```
coastal.only$coastal.distance = factor(coastal.only$coastal.distance)  #drops level 4
summary(coastal.only)
```

```
##      fips              state               cases             deaths
##  Length:674         Length:674         Min.   :     36   Min.   :    0.0
##  Class :character   Class :character   1st Qu.:   1899   1st Qu.:   36.0
##  Mode  :character   Mode  :character   Median :   4696   Median :   84.0
##                                        Mean   :  20660   Mean   :  376.3
##                                        3rd Qu.:  16346   3rd Qu.:  272.5
##                                        Max.   :1219237   Max.   :23101.0
##
##             region    coastal.distance population2019       popdensity
##  inland        :374   1:300            Min.   :     404   Min.   :    0.30
##  atlantic      :124   2:202            1st Qu.:   25248   1st Qu.:   39.62
##  gulf of mexico: 56   3:172            Median :   62987   Median :   99.15
##  pacific       : 40                    Mean   :  235470   Mean   :  457.59
##  michigan      : 33                    3rd Qu.:  208981   3rd Qu.:  339.38
##  superior      : 14                    Max.   :10039107   Max.   :17179.10
##  (Other)       : 33
##     poverty       under18poverty   median_income     pct_obesity
##  Min.   :0.0350   Min.   :0.0350   Min.   : 30998   Min.   :15.20
##  1st Qu.:0.0940   1st Qu.:0.1260   1st Qu.: 49410   1st Qu.:28.50
##  Median :0.1270   Median :0.1840   Median : 56748   Median :31.40
##  Mean   :0.1341   Mean   :0.1897   Mean   : 61179   Mean   :31.14
##  3rd Qu.:0.1660   3rd Qu.:0.2410   3rd Qu.: 68682   3rd Qu.:34.40
##  Max.   :0.3250   Max.   :0.4890   Max.   :137849   Max.   :44.40
##
##  voter_margin_2020     party             median_age      humidity
##  Min.   :-0.80526   Length:674         Min.   :24.80   Length:674
##  1st Qu.:-0.09234   Class :character   1st Qu.:37.90   Class :character
##  Median : 0.15212   Mode  :character   Median :41.35   Mode  :character
##  Mean   : 0.11991                      Mean   :41.85
##  3rd Qu.: 0.32801                      3rd Qu.:45.27
##  Max.   : 0.82867                      Max.   :67.40
##
##   q_popdensity   poverty.y       median_house_value median_household_income
##  Min.   :1     Min.   :0.02693   Min.   : 48400     Min.   : 24000
##  1st Qu.:1     1st Qu.:0.11423   1st Qu.:104725     1st Qu.: 42158
##  Median :1     Median :0.15227   Median :150450     Median : 49177
```

```
##  Mean   :1     Mean   :0.15604   Mean   :180388     Mean   : 52264
##  3rd Qu.:1     3rd Qu.:0.18702   3rd Qu.:217975     3rd Qu.: 57604
##  Max.   :1     Max.   :0.37642   Max.   :966600     Max.   :115244
##
##  owner_occupied      blk_pct         hispanic_pct      date_since_social
##  Min.   :0.3078   Min.   :0.00000   Min.   :0.001731   Min.   :  0.0
##  1st Qu.:0.6560   1st Qu.:0.01084   1st Qu.:0.026059   1st Qu.:431.0
##  Median :0.7147   Median :0.06126   Median :0.056348   Median :438.0
##  Mean   :0.7055   Mean   :0.11843   Mean   :0.110651   Mean   :397.1
##  3rd Qu.:0.7679   3rd Qu.:0.17099   3rd Qu.:0.118732   3rd Qu.:441.0
##  Max.   :0.9019   Max.   :0.76813   Max.   :0.989589   Max.   :446.0
##
##    date_since         beds          population.old         obese
##  Min.   :  0.0   Min.   :    0.0   Min.   :     558   Min.   :0.1460
##  1st Qu.:164.0   1st Qu.:   25.0   1st Qu.:   25260   1st Qu.:0.2870
##  Median :170.0   Median :  134.5   Median :   61694   Median :0.3240
##  Mean   :163.6   Mean   :  709.5   Mean   :  229086   Mean   :0.3213
##  3rd Qu.:170.0   3rd Qu.:  560.2   3rd Qu.:  200351   3rd Qu.:0.3590
##  Max.   :170.0   Max.   :30147.0   Max.   :10057155   Max.   :0.5230
##
##      smoke         mean_summer_temp mean_winter_temp   mean_pm25
##  Min.   :0.05909   Min.   :292.6    Min.   :265.9    Min.   : 2.717
##  1st Qu.:0.14390   1st Qu.:299.1    1st Qu.:274.0    1st Qu.: 6.338
##  Median :0.16384   Median :301.8    Median :280.6    Median : 8.469
##  Mean   :0.16399   Mean   :302.1    Mean   :281.3    Mean   : 7.893
##  3rd Qu.:0.18661   3rd Qu.:305.5    3rd Qu.:289.2    3rd Qu.: 9.371
##  Max.   :0.33580   Max.   :313.8    Max.   :298.3    Max.   :12.334
##
##  mean_summer_rm  mean_winter_rm    white_pct         native_pct
##  Min.   :40.76   Min.   :62.11   Min.   :0.09558   Min.   :0.000000
##  1st Qu.:89.65   1st Qu.:85.15   1st Qu.:0.70704   1st Qu.:0.002118
##  Median :92.78   Median :89.75   Median :0.83260   Median :0.003968
##  Mean   :90.95   Mean   :88.69   Mean   :0.79651   Mean   :0.011127
##  3rd Qu.:96.83   3rd Qu.:92.58   3rd Qu.:0.92431   3rd Qu.:0.007322
##  Max.   :99.78   Max.   :97.67   Max.   :0.98972   Max.   :0.855059
##
##    asian_pct          no_grad       indicatorcoast         area
##  Min.   :0.00000   Min.   :0.1020   Length:674         Length:674
##  1st Qu.:0.00480   1st Qu.:0.1633   Class :character   Class :character
##  Median :0.01042   Median :0.1918   Mode  :character   Mode  :character
##  Mean   :0.02216   Mean   :0.2053
##  3rd Qu.:0.02335   3rd Qu.:0.2372
##  Max.   :0.34378   Max.   :0.5454
##
##                  regionru
##  inland              :374
##  atlantic Rural      :105
##  gulf of mexico Rural: 53
##  pacific Rural       : 35
##  michigan Rural      : 30
##  atlantic Urban      : 19
##  (Other)             : 58
```

```r
# Model cases
model.initial.cases = gee(cases ~ coastal.distance + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.only,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27

## running glm to get initial regression estimate

##               (Intercept)         coastal.distance2         coastal.distance3
##              -1.597849570              -0.006831130              -0.052687564
##         scale(popdensity)            scale(poverty) scale(log(median_income))
##              -0.004160461              -0.020643848              -0.122516361
##        scale(pct_obesity)  scale(voter_margin_2020)         scale(median_age)
##              -0.091723849               0.117514404              -0.069315640
##   factor(party)Republican                 mean_pm25            mean_summer_rm
##              -0.026073926               0.050880753              -0.001384356
##            mean_winter_rm
##              -0.012797151
```

```r
summary(model.initial.cases)$coefficients
```

```
##                               Estimate  Naive S.E.     Naive z Robust S.E.
## (Intercept)               -1.597849570 0.146405307 -10.9138774 0.299036072
## coastal.distance2         -0.006831130 0.025932859  -0.2634160 0.028248618
## coastal.distance3         -0.052687564 0.034381462  -1.5324411 0.039478312
## scale(popdensity)         -0.004160461 0.008122541  -0.5122117 0.011734619
## scale(poverty)            -0.020643848 0.030570607  -0.6752842 0.069130245
## scale(log(median_income)) -0.122516361 0.028533082  -4.2938355 0.084945077
## scale(pct_obesity)        -0.091723849 0.014928053  -6.1443947 0.051911706
## scale(voter_margin_2020)   0.117514404 0.020087827   5.8500307 0.047429533
## scale(median_age)         -0.069315640 0.017865804  -3.8797941 0.032636748
## factor(party)Republican   -0.026073926 0.037000743  -0.7046866 0.082188461
## mean_pm25                  0.050880753 0.006846732   7.4313928 0.017927148
## mean_summer_rm            -0.001384356 0.001283815  -1.0783146 0.003186362
## mean_winter_rm            -0.012797151 0.001929554  -6.6321803 0.004835806
##                             Robust z
## (Intercept)               -5.3433339
## coastal.distance2         -0.2418217
## coastal.distance3         -1.3345951
## scale(popdensity)         -0.3545459
## scale(poverty)            -0.2986225
## scale(log(median_income)) -1.4423009
## scale(pct_obesity)        -1.7669203
## scale(voter_margin_2020)   2.4776631
## scale(median_age)         -2.1238525
## factor(party)Republican   -0.3172456
## mean_pm25                  2.8381957
## mean_summer_rm            -0.4344630
## mean_winter_rm            -2.6463325
```

```r
# Model deaths
model.initial.deaths = gee(deaths ~ coastal.distance + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25 +
    mean_summer_rm + mean_winter_rm, family = poisson(link = "log"), data = coastal.only,
    id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##               (Intercept)         coastal.distance2         coastal.distance3
##              -5.212192182               0.086454400               0.066194187
##         scale(popdensity)            scale(poverty) scale(log(median_income))
##               0.010520519               0.217726126               0.018070364
##        scale(pct_obesity)  scale(voter_margin_2020)         scale(median_age)
##              -0.016660883               0.062220236               0.190298559
##   factor(party)Republican                 mean_pm25            mean_summer_rm
##              -0.082366443               0.074815247               0.006357866
##            mean_winter_rm
##              -0.026837688
```

```r
summary(model.initial.deaths)$coefficients
```

```
##                                Estimate  Naive S.E.     Naive z Robust S.E.
## (Intercept)                -5.212192182 0.206333208 -25.2610437 0.374365953
## coastal.distance2           0.086454400 0.035850269   2.4115412 0.051926963
## coastal.distance3           0.066194187 0.047433875   1.3955045 0.064277866
## scale(popdensity)           0.010520519 0.010313949   1.0200282 0.022938314
## scale(poverty)              0.217726126 0.040977749   5.3132768 0.094003664
## scale(log(median_income))   0.018070364 0.039054710   0.4626936 0.078896092
## scale(pct_obesity)         -0.016660883 0.020358895  -0.8183589 0.037055088
## scale(voter_margin_2020)    0.062220236 0.027210734   2.2866063 0.048132318
## scale(median_age)           0.190298559 0.024290431   7.8343014 0.022143582
## factor(party)Republican    -0.082366443 0.051543069  -1.5980120 0.063807959
## mean_pm25                   0.074815248 0.009605103   7.7891142 0.023049458
## mean_summer_rm              0.006357866 0.001905080   3.3373219 0.004918870
## mean_winter_rm             -0.026837688 0.002773013  -9.6781704 0.007754542
##                                Robust z
## (Intercept)                -13.9227196
## coastal.distance2            1.6649231
## coastal.distance3            1.0298131
## scale(popdensity)            0.4586439
## scale(poverty)               2.3161451
## scale(log(median_income))    0.2290400
## scale(pct_obesity)          -0.4496247
## scale(voter_margin_2020)     1.2926914
## scale(median_age)            8.5938471
## factor(party)Republican     -1.2908491
## mean_pm25                    3.2458572
## mean_summer_rm               1.2925460
## mean_winter_rm              -3.4608992
```

```
##### Repeat above, - humidity ###### Model cases
model.initial.cases.nohumidity = gee(cases ~ coastal.distance + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25,
    family = poisson(link = "log"), data = coastal.only, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##               (Intercept)         coastal.distance2         coastal.distance3
##             -2.9702526710              0.0003152536             -0.0033867427
##         scale(popdensity)            scale(poverty) scale(log(median_income))
##             -0.0098893337              0.0019116678             -0.0964438865
##        scale(pct_obesity)  scale(voter_margin_2020)         scale(median_age)
##             -0.1315778859              0.0976526723             -0.1100270831
##   factor(party)Republican                 mean_pm25
##             -0.0127519414              0.0601696977
```

```
summary(model.initial.cases.nohumidity)$coefficients
```

```
##                               Estimate  Naive S.E.      Naive z Robust S.E.
## (Intercept)               -2.9702526710 0.067746367 -43.84371888  0.21481827
## coastal.distance2          0.0003152536 0.027423227   0.01149586  0.04585919
## coastal.distance3         -0.0033867427 0.035497804  -0.09540711  0.05654169
## scale(popdensity)         -0.0098893337 0.008576404  -1.15308628  0.01999667
## scale(poverty)             0.0019116678 0.031872139   0.05997927  0.08874663
## scale(log(median_income)) -0.0964438865 0.029671707  -3.25036533  0.10610851
## scale(pct_obesity)        -0.1315778859 0.015307367  -8.59572297  0.02849082
## scale(voter_margin_2020)   0.0976526723 0.021172066   4.61233552  0.06101117
## scale(median_age)         -0.1100270831 0.017400638  -6.32316373  0.04597389
## factor(party)Republican   -0.0127519414 0.039260917  -0.32479989  0.07432528
## mean_pm25                  0.0601696977 0.006499028   9.25826161  0.02046223
##                               Robust z
## (Intercept)               -13.826815719
## coastal.distance2           0.006874382
## coastal.distance3          -0.059898151
## scale(popdensity)          -0.494549117
## scale(poverty)              0.021540737
## scale(log(median_income))  -0.908917510
## scale(pct_obesity)         -4.618255290
## scale(voter_margin_2020)    1.600570380
## scale(median_age)          -2.393251476
## factor(party)Republican    -0.171569372
## mean_pm25                   2.940525028
```

```
# Model deaths
model.initial.deaths.nohumidity = gee(deaths ~ coastal.distance + offset(log(population2019)) +
    scale(popdensity) + scale(poverty) + scale(log(median_income)) + scale(pct_obesity) +
    scale(voter_margin_2020) + scale(median_age) + factor(party) + mean_pm25,
    family = poisson(link = "log"), data = coastal.only, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##               (Intercept)         coastal.distance2         coastal.distance3
##             -7.270084241               0.073984550               0.089801376
##         scale(popdensity)            scale(poverty) scale(log(median_income))
##               0.001520705               0.279667961               0.086807996
##        scale(pct_obesity)  scale(voter_margin_2020)         scale(median_age)
##             -0.053282240               0.042709432               0.175395994
##   factor(party)Republican                 mean_pm25
##             -0.072869688               0.103936577
```

```
summary(model.initial.deaths.nohumidity)$coefficients
```

```
##                               Estimate  Naive S.E.     Naive z Robust S.E.
## (Intercept)               -7.270084241 0.098172637 -74.0540792  0.25252352
## coastal.distance2          0.073984550 0.039062967   1.8939819  0.05517380
## coastal.distance3          0.089801376 0.050653543   1.7728548  0.05689974
## scale(popdensity)          0.001520705 0.011223474   0.1354932  0.03258369
## scale(poverty)             0.279667961 0.043856076   6.3769491  0.10926278
## scale(log(median_income))  0.086807996 0.041632648   2.0850943  0.13350163
## scale(pct_obesity)        -0.053282240 0.021460562  -2.4827980  0.04097083
## scale(voter_margin_2020)   0.042709432 0.029472397   1.4491333  0.06040924
## scale(median_age)          0.175395994 0.024790619   7.0750955  0.04837195
## factor(party)Republican   -0.072869688 0.056298683  -1.2943409  0.07546056
## mean_pm25                  0.103936577 0.009443543  11.0060999  0.02457496
##                               Robust z
## (Intercept)               -28.78973112
## coastal.distance2           1.34093625
## coastal.distance3           1.57823878
## scale(popdensity)           0.04667073
## scale(poverty)              2.55959038
## scale(log(median_income))   0.65023920
## scale(pct_obesity)         -1.30049214
## scale(voter_margin_2020)    0.70700164
## scale(median_age)           3.62598580
## factor(party)Republican    -0.96566589
## mean_pm25                   4.22936841
```

Same Analysis with Our Additional Confounders

```
model.indicator.cases.addconfounders = gee(cases ~  factor(indicatorcoast) + offset(log(population2019))
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              + scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27

## running glm to get initial regression estimate

##                       (Intercept) factor(indicatorcoast)NonCoastal
##                       -2.302402658                     -0.069504060
##                 scale(popdensity)                   scale(poverty)
##                       -0.008832819                     -0.063811430
##         scale(log(median_income))                scale(pct_obesity)
##                       -0.094911900                     -0.042286906
##          scale(voter_margin_2020)                 scale(median_age)
##                        0.194934466                     -0.036894381
##           factor(party)Republican   scale(log(median_house_value))
##                       -0.013310933                      0.106647846
##             scale(owner_occupied)                    scale(blk_pct)
##                       -0.014009764                      0.109220361
##               scale(hispanic_pct)                 scale(native_pct)
##                        0.135786251                      0.085714802
##                  scale(asian_pct)          scale(date_since_social)
##                       -0.011112374                      0.007090302
##                 scale(date_since)       scale(beds/population.old)
##                        0.014151799                      0.055854467
##                       scale(smoke)                  scale(mean_pm25)
##                        0.023866374                      0.064981495
##             scale(mean_summer_rm)             scale(mean_winter_rm)
##                        0.011577434                     -0.019715123
##           scale(mean_summer_temp)           scale(mean_winter_temp)
##                        0.118162896                     -0.175593137
##                     scale(no_grad)
##                        0.006501428
```

```
model.indicator.deaths.addconfounders = gee(deaths ~  factor(indicatorcoast) + offset(log(population2019
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
```

```
                            + scale(mean_summer_rm) + scale(mean_winter_rm)
                            + scale(mean_summer_temp) + scale(mean_winter_temp)
                            + scale(no_grad), family = poisson(link = "log"),
                            data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                      (Intercept) factor(indicatorcoast)NonCoastal
##                     -6.184006847                     -0.096186287
##                scale(popdensity)                   scale(poverty)
##                      0.007993644                      0.151267379
##        scale(log(median_income))               scale(pct_obesity)
##                     -0.014854501                     -0.009360570
##         scale(voter_margin_2020)                scale(median_age)
##                      0.192994725                      0.208845963
##          factor(party)Republican   scale(log(median_house_value))
##                     -0.081471033                      0.014468953
##            scale(owner_occupied)                   scale(blk_pct)
##                      0.011986153                      0.103604443
##              scale(hispanic_pct)                scale(native_pct)
##                      0.173475720                      0.106424778
##                 scale(asian_pct)         scale(date_since_social)
##                      0.012180315                      0.054948242
##                scale(date_since)       scale(beds/population.old)
##                      0.117282630                      0.091727421
##                     scale(smoke)                 scale(mean_pm25)
##                     -0.025552491                      0.054160270
##            scale(mean_summer_rm)            scale(mean_winter_rm)
##                      0.088472919                     -0.095358841
##          scale(mean_summer_temp)          scale(mean_winter_temp)
##                      0.144905259                     -0.263530015
##                   scale(no_grad)
##                      0.053221430
```

```
model.byregion.cases.addconfounders = gee(cases ~  region + offset(log(population2019)) + scale(popdens
                            + scale(log(median_house_value)) + scale(owner_occupied)
                            + scale(blk_pct) + scale(hispanic_pct)
                            + scale(native_pct) + scale(asian_pct)
                            + scale(date_since_social) + scale(date_since)
                            + scale(beds/population.old) + scale(smoke)
                            + scale(mean_pm25)
                            + scale(mean_summer_rm) + scale(mean_winter_rm)
                            + scale(mean_summer_temp) + scale(mean_winter_temp)
                            + scale(no_grad), family = poisson(link = "log"),
                            data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)                 regionatlantic
##                    -2.374765310                     0.149013830
```

```
##                     regionerie          regiongreat salt lake
##                   -0.067036227                    0.357558071
##           regiongulf of mexico                    regionhuron
##                   -0.061452467                   -0.065551675
##                 regionmichigan                  regionontario
##                    0.051681713                   -0.053899857
##                  regionpacific                 regionsuperior
##                    0.139133967                    0.167917980
##              scale(popdensity)                scale(poverty)
##                   -0.009727614                   -0.051153910
##      scale(log(median_income))             scale(pct_obesity)
##                   -0.064092010                   -0.046162593
##       scale(voter_margin_2020)              scale(median_age)
##                    0.188190266                   -0.027506014
##        factor(party)Republican scale(log(median_house_value))
##                   -0.004790468                    0.060650497
##          scale(owner_occupied)                 scale(blk_pct)
##                   -0.023911796                    0.102881147
##            scale(hispanic_pct)              scale(native_pct)
##                    0.139176136                    0.084174538
##               scale(asian_pct)       scale(date_since_social)
##                   -0.010316187                    0.013127435
##              scale(date_since)     scale(beds/population.old)
##                    0.022399632                    0.054402686
##                   scale(smoke)               scale(mean_pm25)
##                    0.026987076                    0.067804566
##          scale(mean_summer_rm)          scale(mean_winter_rm)
##                    0.013425534                   -0.017080529
##        scale(mean_summer_temp)        scale(mean_winter_temp)
##                    0.126573913                   -0.178031991
##                 scale(no_grad)
##                    0.002631069
```

```
model.byregion.deaths.addconfounders = gee(deaths ~  region + offset(log(population2019)) + scale(popde
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              + scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)                 regionatlantic
##                   -6.287729610                    0.213706074
##                     regionerie          regiongreat salt lake
##                    0.034829155                   -0.284593354
##           regiongulf of mexico                    regionhuron
```

```
##                   0.050532621                   0.126354364
##                regionmichigan                 regionontario
##                  -0.054655122                  -0.138768471
##                 regionpacific                regionsuperior
##                   0.147811373                  -0.018808994
##             scale(popdensity)                scale(poverty)
##                   0.008197899                   0.149938300
##     scale(log(median_income))             scale(pct_obesity)
##                  -0.012353314                  -0.012229267
##      scale(voter_margin_2020)              scale(median_age)
##                   0.180749191                   0.202219615
##       factor(party)Republican scale(log(median_house_value))
##                  -0.071785865                  -0.019282891
##         scale(owner_occupied)                 scale(blk_pct)
##                   0.014628310                   0.098550996
##           scale(hispanic_pct)              scale(native_pct)
##                   0.166190476                   0.104266550
##              scale(asian_pct)       scale(date_since_social)
##                   0.011252482                   0.050603179
##             scale(date_since)     scale(beds/population.old)
##                   0.121647134                   0.090912497
##                  scale(smoke)                scale(mean_pm25)
##                  -0.037867379                   0.075243253
##         scale(mean_summer_rm)          scale(mean_winter_rm)
##                   0.060735460                  -0.080113465
##       scale(mean_summer_temp)        scale(mean_winter_temp)
##                   0.141132961                  -0.262573905
##                scale(no_grad)
##                   0.054425583
```

```
# - humidity
model.indicator.cases.addconfounders.nohumidity = gee(cases ~  factor(indicatorcoast) + offset(log(popul
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                      (Intercept) factor(indicatorcoast)NonCoastal
##                     -2.302104616                     -0.066311826
##                 scale(popdensity)                   scale(poverty)
##                     -0.008055646                     -0.062169722
##         scale(log(median_income))               scale(pct_obesity)
##                     -0.100897818                     -0.042405787
##          scale(voter_margin_2020)                scale(median_age)
```

```
##                      0.196210410                      -0.032586382
##          factor(party)Republican   scale(log(median_house_value))
##                     -0.017230073                       0.125450339
##            scale(owner_occupied)                    scale(blk_pct)
##                     -0.013603282                       0.111359285
##              scale(hispanic_pct)                 scale(native_pct)
##                      0.133832242                       0.085404902
##                  scale(asian_pct)          scale(date_since_social)
##                     -0.011477525                       0.006488465
##                scale(date_since)        scale(beds/population.old)
##                      0.013692978                       0.055422940
##                     scale(smoke)                  scale(mean_pm25)
##                      0.024722978                       0.068891253
##          scale(mean_summer_temp)           scale(mean_winter_temp)
##                      0.134939629                      -0.183872560
##                    scale(no_grad)
##                      0.011315743
```

```
model.indicator.deaths.addconfounders.nohumidity = gee(deaths ~  factor(indicatorcoast) + offset(log(pop
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),  data = coastal.new, id
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                      (Intercept) factor(indicatorcoast)NonCoastal
##                     -6.183652550                      -0.081324319
##                scale(popdensity)                   scale(poverty)
##                      0.011478571                       0.158611634
##        scale(log(median_income))                scale(pct_obesity)
##                     -0.032714548                       -0.010131835
##         scale(voter_margin_2020)                 scale(median_age)
##                      0.200082394                       0.225069962
##          factor(party)Republican   scale(log(median_house_value))
##                     -0.094245603                       0.088728860
##            scale(owner_occupied)                    scale(blk_pct)
##                      0.020920125                       0.122843318
##              scale(hispanic_pct)                 scale(native_pct)
##                      0.160191657                       0.103320340
##                  scale(asian_pct)          scale(date_since_social)
##                      0.007495283                       0.038495925
##                scale(date_since)        scale(beds/population.old)
##                      0.108139865                       0.092261491
##                     scale(smoke)                  scale(mean_pm25)
##                     -0.018574668                       0.090596550
##          scale(mean_summer_temp)           scale(mean_winter_temp)
```

```
##                       0.185052500                      -0.272352728
##                   scale(no_grad)
##                       0.072771185
```

```
model.byregion.cases.addconfounders.nohumidity = gee(cases ~  region + offset(log(population2019)) + sca
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),  data = coastal.new, id
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)                  regionatlantic
##                    -2.372201125                       0.153719460
##                      regionerie           regiongreat salt lake
##                    -0.068157687                       0.307109221
##            regiongulf of mexico                      regionhuron
##                    -0.069106404                      -0.069298061
##                   regionmichigan                    regionontario
##                       0.038021729                      -0.045984260
##                   regionpacific                  regionsuperior
##                       0.155286567                       0.175554338
##               scale(popdensity)                  scale(poverty)
##                    -0.008585718                      -0.049555540
##      scale(log(median_income))              scale(pct_obesity)
##                    -0.067110932                      -0.047038785
##       scale(voter_margin_2020)               scale(median_age)
##                       0.188921474                      -0.024978515
##        factor(party)Republican scale(log(median_house_value))
##                    -0.007622520                       0.071722630
##          scale(owner_occupied)                  scale(blk_pct)
##                    -0.021815340                       0.105749894
##            scale(hispanic_pct)                scale(native_pct)
##                       0.137146390                       0.083526080
##                 scale(asian_pct)        scale(date_since_social)
##                    -0.011738658                       0.011005026
##               scale(date_since)     scale(beds/population.old)
##                       0.022951825                       0.054373679
##                    scale(smoke)                 scale(mean_pm25)
##                       0.027327859                       0.073602392
##         scale(mean_summer_temp)          scale(mean_winter_temp)
##                       0.139623075                      -0.184240248
##                    scale(no_grad)
##                       0.005380304
```

```r
model.byregion.deaths.addconfounders.nohumidity = gee(deaths ~  region + offset(log(population2019)) + s
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),  data = coastal.new, id
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##                     (Intercept)                 regionatlantic
##                    -6.273003677                    0.238420699
##                      regionerie          regiongreat salt lake
##                     0.029438922                   -0.515122334
##           regiongulf of mexico                     regionhuron
##                     0.012525088                    0.102355347
##                  regionmichigan                  regionontario
##                    -0.124437943                   -0.105886540
##                  regionpacific                 regionsuperior
##                     0.220972213                    0.005865737
##              scale(popdensity)                scale(poverty)
##                     0.013639356                    0.156244149
##      scale(log(median_income))             scale(pct_obesity)
##                    -0.028672891                   -0.016166147
##       scale(voter_margin_2020)              scale(median_age)
##                     0.184319107                    0.213318636
##        factor(party)Republican scale(log(median_house_value))
##                    -0.083288076                    0.033990869
##          scale(owner_occupied)                 scale(blk_pct)
##                     0.023148821                    0.110087297
##            scale(hispanic_pct)               scale(native_pct)
##                     0.155030693                    0.102288228
##               scale(asian_pct)       scale(date_since_social)
##                     0.005141215                    0.042289608
##              scale(date_since)     scale(beds/population.old)
##                     0.122736010                    0.091092496
##                    scale(smoke)                scale(mean_pm25)
##                    -0.039022729                    0.099716352
##        scale(mean_summer_temp)         scale(mean_winter_temp)
##                     0.204288672                   -0.295772701
##                  scale(no_grad)
##                     0.071878346
```

```r
# Analysis by region, rural/urban split
model.byregionru.cases.addconfounders = gee(cases ~  regionru + offset(log(population2019)) + scale(popo
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
```

```
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              + scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),  data = coastal.new, id
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)         regionruatlantic Rural
##                    -2.341027914                    0.128319087
##         regionruatlantic Urban             regionruerie Rural
##                     0.224400595                   -0.002115066
##             regionruerie Urban  regionrugreat salt lake Rural
##                    -0.141029022                    0.335196399
##   regionrugulf of mexico Rural   regionrugulf of mexico Urban
##                     0.029560505                   -0.214801027
##             regionruhuron Rural         regionrumichigan Rural
##                    -0.071245745                    0.077053312
##         regionrumichigan Urban          regionruontario Rural
##                     0.074949488                   -0.078421682
##          regionrupacific Rural          regionrupacific Urban
##                     0.026996037                    0.337268891
##         regionrusuperior Rural              scale(popdensity)
##                     0.120866266                   -0.010771147
##                scale(poverty)      scale(log(median_income))
##                    -0.045309466                   -0.039358095
##             scale(pct_obesity)       scale(voter_margin_2020)
##                    -0.048554497                    0.188179242
##              scale(median_age)        factor(party)Republican
##                    -0.029000573                   -0.038950806
## scale(log(median_house_value))          scale(owner_occupied)
##                     0.041567453                   -0.025339523
##                  scale(blk_pct)            scale(hispanic_pct)
##                     0.107505868                    0.130342756
##               scale(native_pct)               scale(asian_pct)
##                     0.078053394                   -0.016365693
##       scale(date_since_social)              scale(date_since)
##                     0.012519549                    0.029052002
##     scale(beds/population.old)                   scale(smoke)
##                     0.048579938                    0.028606622
##                scale(mean_pm25)          scale(mean_summer_rm)
##                     0.046947856                    0.014469828
##           scale(mean_winter_rm)        scale(mean_summer_temp)
##                    -0.007411340                    0.144160525
##         scale(mean_winter_temp)                 scale(no_grad)
##                    -0.186962011                    0.007052773
```

```
model.byregionru.deaths.addconfounders = gee(deaths ~  regionru + offset(log(population2019)) + scale(p
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
```

```
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              + scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)         regionruatlantic Rural
##                    -6.240574996                    0.165552531
##          regionruatlantic Urban             regionruerie Rural
##                     0.332922650                    0.020527319
##              regionruerie Urban  regionrugreat salt lake Rural
##                     0.041957845                   -0.314984664
##   regionrugulf of mexico Rural   regionrugulf of mexico Urban
##                     0.175990801                   -0.191953424
##            regionruhuron Rural         regionrumichigan Rural
##                     0.116733698                   -0.069871385
##          regionrumichigan Urban          regionruontario Rural
##                     0.002016635                   -0.167325773
##           regionrupacific Rural          regionrupacific Urban
##                    -0.021041610                    0.366729016
##          regionrusuperior Rural              scale(popdensity)
##                    -0.079659468                    0.006092088
##                  scale(poverty)      scale(log(median_income))
##                     0.147419551                    0.006041146
##              scale(pct_obesity)       scale(voter_margin_2020)
##                    -0.015445561                    0.182368506
##               scale(median_age)        factor(party)Republican
##                     0.199210917                   -0.117400439
## scale(log(median_house_value))          scale(owner_occupied)
##                    -0.037697856                    0.012813586
##                  scale(blk_pct)            scale(hispanic_pct)
##                     0.102236532                    0.155181714
##               scale(native_pct)               scale(asian_pct)
##                     0.098201465                    0.004851435
##       scale(date_since_social)              scale(date_since)
##                     0.046425999                    0.131515586
##     scale(beds/population.old)                   scale(smoke)
##                     0.084106136                   -0.035526992
##                scale(mean_pm25)          scale(mean_summer_rm)
##                     0.049895483                    0.063041711
##           scale(mean_winter_rm)        scale(mean_summer_temp)
##                    -0.068466272                    0.160512610
##         scale(mean_winter_temp)                 scale(no_grad)
##                    -0.269457533                    0.058052134
```

```
model.byregionru.cases.addconfounders.nohumidity = gee(cases ~  regionru + offset(log(population2019)) +
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
```

```
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##                     (Intercept)          regionruatlantic Rural
##                     -2.342410617                     0.132064816
##          regionruatlantic Urban              regionruerie Rural
##                     0.236185029                    -0.006180829
##              regionruerie Urban  regionrugreat salt lake Rural
##                     -0.153228563                     0.283542574
##    regionrugulf of mexico Rural   regionrugulf of mexico Urban
##                     0.026244675                    -0.214022631
##             regionruhuron Rural         regionrumichigan Rural
##                     -0.070732035                     0.074184028
##          regionrumichigan Urban          regionruontario Rural
##                     0.066607131                    -0.074363541
##           regionrupacific Rural          regionrupacific Urban
##                     0.027256174                     0.338024749
##          regionrusuperior Rural              scale(popdensity)
##                     0.135316755                    -0.010906236
##                  scale(poverty)      scale(log(median_income))
##                     -0.044939390                    -0.037964426
##              scale(pct_obesity)       scale(voter_margin_2020)
##                     -0.048687928                     0.187486426
##               scale(median_age)        factor(party)Republican
##                     -0.028494036                    -0.038389430
## scale(log(median_house_value))          scale(owner_occupied)
##                     0.041342194                    -0.023157042
##                   scale(blk_pct)            scale(hispanic_pct)
##                     0.110454479                     0.128828752
##               scale(native_pct)               scale(asian_pct)
##                     0.077076512                    -0.017333765
##        scale(date_since_social)              scale(date_since)
##                     0.007876817                     0.028168949
##     scale(beds/population.old)                   scale(smoke)
##                     0.048873857                     0.030085660
##                scale(mean_pm25)        scale(mean_summer_temp)
##                     0.055135396                     0.138100486
##         scale(mean_winter_temp)                 scale(no_grad)
##                     -0.179768134                    0.006197466
```

```
model.byregionru.deaths.addconfounders.nohumidity = gee(deaths ~  regionru + offset(log(population2019))
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
```

```
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.new, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate

##                     (Intercept)         regionruatlantic Rural
##                   -6.2264804637                   0.1681129315
##          regionruatlantic Urban             regionruerie Rural
##                    0.4052252166                   0.0184029415
##              regionruerie Urban  regionrugreat salt lake Rural
##                    0.0169561156                  -0.5495347920
##    regionrugulf of mexico Rural   regionrugulf of mexico Urban
##                    0.1309280142                  -0.2107553588
##             regionruhuron Rural         regionrumichigan Rural
##                    0.0973001101                  -0.0990743557
##          regionrumichigan Urban          regionruontario Rural
##                   -0.0521082283                  -0.1446212867
##           regionrupacific Rural          regionrupacific Urban
##                   -0.0010929220                   0.4540735981
##          regionrusuperior Rural              scale(popdensity)
##                   -0.0525178672                   0.0085812975
##                  scale(poverty)      scale(log(median_income))
##                    0.1522219477                  -0.0001508913
##              scale(pct_obesity)       scale(voter_margin_2020)
##                   -0.0177701181                   0.1812027080
##               scale(median_age)        factor(party)Republican
##                    0.2070779065                  -0.1283399673
## scale(log(median_house_value))          scale(owner_occupied)
##                   -0.0040239666                   0.0221238035
##                  scale(blk_pct)            scale(hispanic_pct)
##                    0.1135446585                   0.1436459269
##               scale(native_pct)              scale(asian_pct)
##                    0.0939247232                  -0.0023271259
##       scale(date_since_social)              scale(date_since)
##                    0.0347747252                   0.1307465812
##     scale(beds/population.old)                    scale(smoke)
##                    0.0835038573                  -0.0333945072
##                scale(mean_pm25)        scale(mean_summer_temp)
##                    0.0745333572                   0.1959668053
##        scale(mean_winter_temp)                scale(no_grad)
##                   -0.2781405627                   0.0682754822
```

```
# Comparing 1st vs 2nd vs 3rd degree coastal counties
model.initial.cases.addconfounders = gee(cases ~  coastal.distance + offset(log(population2019)) + scal
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
```

```
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              + scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.only, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)              coastal.distance2
##                   -2.4957113010                  -0.0292073433
##               coastal.distance3              scale(popdensity)
##                   -0.0789204543                  -0.0093446927
##                  scale(poverty)      scale(log(median_income))
##                   -0.0913822076                  -0.1031328001
##              scale(pct_obesity)       scale(voter_margin_2020)
##                   -0.1050516246                   0.2294212879
##               scale(median_age)        factor(party)Republican
##                   -0.0310320679                   0.0079936095
## scale(log(median_house_value))          scale(owner_occupied)
##                    0.1132756880                   0.0070093515
##                  scale(blk_pct)            scale(hispanic_pct)
##                    0.1913028658                   0.2003274077
##               scale(native_pct)               scale(asian_pct)
##                    0.0368911084                  -0.0284748808
##       scale(date_since_social)              scale(date_since)
##                    0.0336962947                   0.0328958638
##     scale(beds/population.old)                    scale(smoke)
##                    0.0791172791                   0.0216553208
##                scale(mean_pm25)          scale(mean_summer_rm)
##                    0.0488937602                  -0.0007662729
##           scale(mean_winter_rm)        scale(mean_summer_temp)
##                   -0.0271642476                   0.0634036977
##         scale(mean_winter_temp)                 scale(no_grad)
##                   -0.1951416041                   0.0156158743
```

```
model.initial.deaths.addconfounders = gee(deaths ~  coastal.distance + offset(log(population2019)) + sca
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              + scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad), family = poisson(link = "log"),
                              data = coastal.only, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)              coastal.distance2
##                    -6.458570837                    0.011345574
##              coastal.distance3              scale(popdensity)
##                     0.006232884                    0.001239119
##                  scale(poverty)      scale(log(median_income))
##                     0.128577777                   -0.009231115
##             scale(pct_obesity)       scale(voter_margin_2020)
##                    -0.059508906                    0.091786449
##              scale(median_age)        factor(party)Republican
##                     0.257315864                   -0.038120342
## scale(log(median_house_value))          scale(owner_occupied)
##                     0.076310491                    0.010521447
##                  scale(blk_pct)            scale(hispanic_pct)
##                     0.015649361                    0.145437961
##              scale(native_pct)               scale(asian_pct)
##                    -0.134163399                    0.011689045
##       scale(date_since_social)              scale(date_since)
##                     0.040674115                    0.170519586
##     scale(beds/population.old)                   scale(smoke)
##                     0.082241817                    0.064744832
##                scale(mean_pm25)          scale(mean_summer_rm)
##                     0.047768099                    0.156323944
##           scale(mean_winter_rm)        scale(mean_summer_temp)
##                    -0.140167390                    0.166352788
##         scale(mean_winter_temp)                 scale(no_grad)
##                    -0.353015491                    0.166171435
```

```
model.initial.cases.nohumidity.addconfounders = gee(cases ~  coastal.distance + offset(log(population20
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad),  data = coastal.only, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)              coastal.distance2
##                     36790.95471                   -9646.55848
##              coastal.distance3              scale(popdensity)
##                    -11544.85023                    3497.51543
##                  scale(poverty)      scale(log(median_income))
##                     -9521.46801                  -13867.11558
##             scale(pct_obesity)       scale(voter_margin_2020)
##                     -9395.30879                   13594.03179
##              scale(median_age)        factor(party)Republican
##                       -69.39831                  -15399.58308
## scale(log(median_house_value))          scale(owner_occupied)
##                      2034.94051                   -5405.23481
```

```
##                  scale(blk_pct)            scale(hispanic_pct)
##                     10477.02726                    18966.99120
##              scale(native_pct)               scale(asian_pct)
##                      3488.75689                    12774.42366
##       scale(date_since_social)              scale(date_since)
##                      7144.70603                     3467.35466
##     scale(beds/population.old)                   scale(smoke)
##                       994.32172                    -7491.59229
##               scale(mean_pm25)        scale(mean_summer_temp)
##                      8952.52386                    -2184.67172
##        scale(mean_winter_temp)                scale(no_grad)
##                     -6799.00291                     -294.52113
```

```
model.initial.deaths.nohumidity.addconfounders = gee(deaths ~  coastal.distance + offset(log(population
                              + scale(log(median_house_value)) + scale(owner_occupied)
                              + scale(blk_pct) + scale(hispanic_pct)
                              + scale(native_pct) + scale(asian_pct)
                              + scale(date_since_social) + scale(date_since)
                              + scale(beds/population.old) + scale(smoke)
                              + scale(mean_pm25)
                              #+ scale(mean_summer_rm) + scale(mean_winter_rm)
                              + scale(mean_summer_temp) + scale(mean_winter_temp)
                              + scale(no_grad),  data = coastal.only, id = as.factor(state))
```

```
## Beginning Cgee S-function, @(#) geeformula.q 4.13 98/01/27
## running glm to get initial regression estimate
```

```
##                     (Intercept)              coastal.distance2
##                       635.39444                     -159.62199
##              coastal.distance3              scale(popdensity)
##                      -202.78016                      105.33472
##                  scale(poverty)      scale(log(median_income))
##                      -106.88712                     -224.50276
##              scale(pct_obesity)       scale(voter_margin_2020)
##                      -160.03317                      188.15740
##              scale(median_age)        factor(party)Republican
##                        48.02748                     -255.07220
## scale(log(median_house_value))          scale(owner_occupied)
##                        46.04244                      -89.63372
##                  scale(blk_pct)            scale(hispanic_pct)
##                       123.87673                      296.31321
##              scale(native_pct)               scale(asian_pct)
##                        47.38038                      212.30267
##       scale(date_since_social)              scale(date_since)
##                        99.76446                       48.12677
##     scale(beds/population.old)                   scale(smoke)
##                        23.20402                     -126.29635
##               scale(mean_pm25)        scale(mean_summer_temp)
##                       237.63441                      -74.11170
##        scale(mean_winter_temp)                scale(no_grad)
##                      -134.73885                       43.25731
```

Print tables

```
# Run each line individually not all at once
tab_model(model.indicator.cases, digits = 3)
tab_model(model.indicator.deaths, digits = 3)
tab_model(model.indicator.cases.nohumidity, digits = 3)
tab_model(model.indicator.deaths.nohumidity, digits = 3)

tab_model(model.byregion.cases, digits = 3)
tab_model(model.byregion.deaths, digits = 3)
tab_model(model.byregion.cases.nohumidity, digits = 3)
tab_model(model.byregion.deaths.nohumidity, digits = 3)

tab_model(model.byregionru.cases, digits = 3)
tab_model(model.byregionru.deaths, digits = 3)
tab_model(model.byregionru.cases.nohumidity, digits = 3)
tab_model(model.byregionru.deaths.nohumidity, digits = 3)

tab_model(model.initial.cases, digits = 3)
tab_model(model.initial.deaths, digits = 3)
tab_model(model.initial.cases.nohumidity, digits = 3)
tab_model(model.initial.deaths.nohumidity, digits = 3)
```

Printing tablesL Confounders added

```
# Run each line individually not all at once
tab_model(model.indicator.cases.addconfounders, digits = 3)
tab_model(model.indicator.cases.addconfounders.nohumidity, digits = 3)
tab_model(model.indicator.deaths.addconfounders, digits = 3)
tab_model(model.indicator.deaths.addconfounders.nohumidity, digits = 3)

tab_model(model.byregion.cases.addconfounders, digits = 3)
tab_model(model.byregion.cases.addconfounders.nohumidity, digits = 3)
tab_model(model.byregion.deaths.addconfounders, digits = 3)
tab_model(model.byregion.deaths.addconfounders.nohumidity, digits = 3)

tab_model(model.byregionru.cases.addconfounders, digits = 3)
tab_model(model.byregionru.cases.addconfounders.nohumidity, digits = 3)
tab_model(model.byregionru.deaths.addconfounders, digits = 3)
tab_model(model.byregionru.deaths.addconfounders.nohumidity, digits = 3)

tab_model(model.initial.cases, digits = 3)
tab_model(model.initial.deaths, digits = 3)
tab_model(model.initial.cases.nohumidity, digits = 3)
tab_model(model.initial.deaths.nohumidity, digits = 3)
```