

Coastal Analysis

Read in data

```
library("readxl")
library("lme4")
```

```
## Loading required package: Matrix
```

```
#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 data from our 2020 study, created with: PM25 = data.frame(fips = aggregate_pm_census_cdc_  
#save(PM25, file = 'PM25.Rda')  
load('PM25.Rda')
```

Create smaller dataset from previous dataset, dataclean, merge with PM25 dataset.

```
coastal.new = data.frame(coastal$`FIPS as Text`, coastal$state, coastal$cases, coastal$deaths, coastal$  
colnames(coastal.new) = c('fips', 'state', 'cases', 'deaths', 'region', 'coastal.distance', 'population')  
  
#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 'region' to 'Inland', convert all characters to lowercase  
coastal.new$region[is.na(coastal.new$region)] <- 'Inland'  
coastal.new$region = tolower(coastal.new$region)  
  
#Merge with PM25 dataset  
coastal.new = merge(coastal.new, PM25, by = 'fips')  
summary(coastal.new)
```

```

##      fips              state      cases      deaths
## Length:3088      Length:3088      Min.   :      1      Min.   :      0.0
## Class :character      Class :character      1st Qu.:    1025      1st Qu.:    18.0
## Mode  :character      Mode  :character      Median :    2456      Median :    47.0
##                                         Mean  :    9416      Mean   :   165.9
##                                         3rd Qu.:    6160      3rd Qu.:   110.0
##                                         Max.   :1219237      Max.   :23101.0
##      region      coastal.distance      population2019      popdensity
## Length:3088      4:2417      Min.   :    169      Min.   :      0.1
## Class :character      1: 300      1st Qu.:   11137      1st Qu.:    17.5
## Mode  :character      2: 200      Median :    26163      Median :    45.3
##                                         Mean  :   102696      Mean   :   202.6
##                                         3rd Qu.:    68022      3rd Qu.:   112.7
##                                         Max.   :10039107      Max.   :17179.1
##      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.: 46212      1st Qu.:29.4
## Median :0.1340      Median :0.1870      Median : 53242      Median :32.4
## Mean   :0.1447      Mean   :0.1999      Mean   : 55573      Mean   :32.1
## 3rd Qu.:0.1750      3rd Qu.:0.2490      3rd Qu.: 61767      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:3088      Min.   :23.4      Length:3088
## 1st Qu.:  0.1375      Class :character      1st Qu.:38.2      Class :character
## Median :  0.3859      Mode  :character      Median :41.4      Mode  :character
## Mean   :  0.3203                                         Mean   :41.5
## 3rd Qu.:  0.5666                                         3rd Qu.:44.6
## Max.   :  0.9309                                         Max.   :67.4
##      mean_pm25
## Min.   :  2.060
## 1st Qu.:  6.335
## Median :  8.789
## Mean   :  8.398
## 3rd Qu.:10.483
## Max.   :15.786

```

PRELIMINARY ANALYSIS on only coastal counties

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

```
## [1] 671
```

```
nrow(na.omit(coastal.only))
```

```
## [1] 633
```

```
# Model cases
```

```
model.initial.cases = glmer(cases ~ (1|state) + coastal.distance + offset(log(population2019)) + scale(
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable:
## - Rescale variables?
```

```
summary(model.initial.cases)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## cases ~ (1 | state) + 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) + factor(humidity) + mean_pm25
## Data: coastal.only
##
##      AIC      BIC    logLik deviance df.resid
## 489510.4 489572.7 -244741.2  489482.4      619
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -137.952  -12.341   -1.138    9.761   302.294
##
## Random effects:
##  Groups Name      Variance Std.Dev.
##  state  (Intercept) 0.04082  0.202
## Number of obs: 633, groups:  state, 29
##
## Fixed effects:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   -2.8945199  0.0905050  -31.982 < 2e-16 ***
## coastal.distance2 -0.0083465  0.0007805  -10.694 < 2e-16 ***
## coastal.distance3  0.0032707  0.0010161   3.219 0.00129 **
## scale(popdensity) -0.0157230  0.0002362  -66.553 < 2e-16 ***
## scale(poverty)    0.0453624  0.0009874   45.939 < 2e-16 ***
## scale(log(median_income)) -0.0333711  0.0009787  -34.098 < 2e-16 ***
```

```
## scale(pct_obesity)          -0.0667857  0.0005562 -120.075 < 2e-16 ***
## scale(voter_margin_2020)    0.0539723  0.0006596   81.828 < 2e-16 ***
## scale(median_age)          -0.1103005  0.0005729 -192.535 < 2e-16 ***
## factor(party)Republican     -0.0055143  0.0010650   -5.178 2.25e-07 ***
## factor(humidity)Marine      -0.3254818  0.0018670 -174.337 < 2e-16 ***
## factor(humidity)Moist       0.1085565  0.0994371    1.092 0.27496
## mean_pm25                   0.0326665  0.0002082  156.909 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Correlation matrix not shown by default, as p = 13 > 12.
## Use print(x, correlation=TRUE) or
##     vcov(x)           if you need it
```

```
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

```
# Model deaths
```

```
model.initial.deaths = glmer(deaths ~ (1|state) + coastal.distance + offset(log(population2019)) + scale
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

```
summary(model.initial.deaths)
```

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## deaths ~ (1 | state) + 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) + factor(humidity) + mean_pm25
## Data: coastal.only
##
##      AIC      BIC   logLik deviance df.resid
## 19261.6 19323.9 -9616.8  19233.6      619
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -21.5020  -2.6453  -0.4458   2.1176  25.4407
##
## Random effects:
##   Groups Name            Variance Std.Dev.
##   state  (Intercept) 0.09803   0.3131
## Number of obs: 633, groups: state, 29
##
## Fixed effects:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -7.497281   0.146351 -51.228 < 2e-16 ***
```

```

## coastal.distance2      0.042181  0.005735   7.355 1.90e-13 ***
## coastal.distance3      0.023638  0.007407   3.191 0.00142 **
## scale(popdensity)     -0.019259  0.001658 -11.616 < 2e-16 ***
## scale(poverty)        0.217943  0.007131  30.563 < 2e-16 ***
## scale(log(median_income)) -0.021899  0.007304  -2.998 0.00271 **
## scale(pct_obesity)     -0.030917  0.004250  -7.275 3.46e-13 ***
## scale(voter_margin_2020) 0.023010  0.004848   4.746 2.07e-06 ***
## scale(median_age)      0.129801  0.004205  30.868 < 2e-16 ***
## factor(party)Republican 0.018457  0.007942   2.324 0.02012 *
## factor(humidity)Marine  -0.223662  0.015466 -14.462 < 2e-16 ***
## factor(humidity)Moist   0.280738  0.158825   1.768 0.07713 .
## mean_pm25              0.085450  0.001641  52.064 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

##
## Correlation matrix not shown by default, as p = 13 > 12.
## Use print(x, correlation=TRUE) or
##     vcov(x)         if you need it

## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?

```

Redo: Create indicator for being a coast (levels 1,2,3) instead.

```
# Indicator Coastal or NonCoastal
coastal.new$indicatorcoast = ifelse(coastal.new$coastal.distance == '4', 'Noncoastal', 'Coastal')

# Model cases
model.indicator.cases = glmer(cases ~ (1|state) + factor(indicatorcoast) + offset(log(population2019))
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable:
## - Rescale variables?
```

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

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## cases ~ (1 | state) + 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) + factor(humidity) + mean_pm25
## Data: coastal.new
##
##           AIC          BIC      logLik deviance df.resid
## 965452.9 965530.9 -482713.5 965426.9      2973
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -147.77   -6.66   -0.44    6.57   351.65
##
## Random effects:
##  Groups Name            Variance Std.Dev.
##  state  (Intercept) 0.07194  0.2682
## Number of obs: 2986, groups: state, 49
##
## Fixed effects:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -2.4439948  0.0383566  -63.718 < 2e-16 ***
## factor(indicatorcoast)Noncoastal  0.0017808  0.0006072   2.933  0.00336 **
## scale(popdensity)      -0.0014500  0.0001089  -13.310 < 2e-16 ***
## scale(poverty)         0.0156984  0.0006444   24.359 < 2e-16 ***
## scale(log(median_income)) -0.0332435  0.0005610  -59.253 < 2e-16 ***
## scale(pct_obesity)     -0.0133383  0.0003348  -39.842 < 2e-16 ***
## scale(voter_margin_2020)  0.0830422  0.0004115  201.787 < 2e-16 ***
## scale(median_age)      -0.0824599  0.0003313 -248.867 < 2e-16 ***
## factor(party)Republican -0.0222363  0.0007204  -30.866 < 2e-16 ***
## factor(humidity)Marine  -0.2696846  0.0015653 -172.285 < 2e-16 ***
## factor(humidity)Moist   -0.3756649  0.0016911 -222.147 < 2e-16 ***
## mean_pm25             0.0428397  0.0001566  273.594 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Correlation of Fixed Effects:
##          (Intr) fct(N scl(pp) scl(pv) s(( )) scl(p_) s(__20 scl(m_)
## fctr(ndct)N   -0.017
## scl(ppdnst)   0.011  0.045
## scal(pvrty)   0.000  0.103 -0.158
## scl(lg(m_))   0.002  0.100 -0.081  0.869
## scl(pct_bs)   0.003  0.030  0.140  0.081  0.344
## scl(__2020)   0.007  0.021  0.252  0.152  0.118 -0.153
## scal(mdn_g)   0.004  0.063 -0.042  0.306  0.266  0.157 -0.173
## fctr(prty)R   -0.018 -0.051 -0.110  0.001 -0.024 -0.077 -0.662 -0.082
## fctr(hmdty)Mr -0.014  0.077 -0.101 -0.094 -0.194 -0.079  0.168 -0.112
## fctr(hmdty)Ms -0.030  0.117  0.007  0.036 -0.002 -0.021  0.014 -0.082
## mean_pm25     -0.031  0.083 -0.282 -0.026 -0.086 -0.035  0.155  0.062
##          fct(R fctr(hmdty)Mr fctr(hmdty)Ms
## fctr(ndct)N
## scl(ppdnst)
## scal(pvrty)
## scl(lg(m_))
## scl(pct_bs)
## scl(__2020)
## scal(mdn_g)
## fctr(prty)R
## fctr(hmdty)Mr -0.022
## fctr(hmdty)Ms  0.010 -0.015
## mean_pm25      0.055  0.395      -0.142
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

Model deaths

```
model.indicator.deaths = glmer(deaths ~ (1|state) + factor(indicatorcoast) + offset(log(population2019))
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

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

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## deaths ~ (1 | state) + 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) + factor(humidity) + mean_pm25
## Data: coastal.new
##
##          AIC          BIC    logLik deviance df.resid
## 56181.9 56259.9 -28077.9 56155.9      2973
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -25.4192  -1.8723  -0.1705   1.8628  28.5901
```

```

##
## Random effects:
## Groups Name      Variance Std.Dev.
## state (Intercept) 0.2004   0.4476
## Number of obs: 2986, groups: state, 49
##
## Fixed effects:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -6.4523015   0.0655875  -98.377 < 2e-16 ***
## factor(indicatorcoast)Noncoastal -0.0390305   0.0045180   -8.639 < 2e-16 ***
## scale(popdensity)    0.0003630   0.0007515    0.483  0.6291
## scale(poverty)       0.1428398   0.0046432   30.763 < 2e-16 ***
## scale(log(median_income)) -0.0837035   0.0041728  -20.059 < 2e-16 ***
## scale(pct_obesity)    0.0062326   0.0025400    2.454  0.0141 *
## scale(voter_margin_2020) 0.0926075   0.0030716   30.150 < 2e-16 ***
## scale(median_age)     0.1103580   0.0024355   45.312 < 2e-16 ***
## factor(party)Republican -0.0290072   0.0054692   -5.304 1.13e-07 ***
## factor(humidity)Marine -0.1816042   0.0128505  -14.132 < 2e-16 ***
## factor(humidity)Moist  -0.6519452   0.0119237  -54.676 < 2e-16 ***
## mean_pm25           0.0792389   0.0011936   66.386 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr) fct(N scl(pp) scl(pv) s((_)) scl(p_) s(__20 scl(m_)
## fctr(ndct)N   -0.073
## scl(ppdnst)   0.050  0.044
## scal(pvrty)  -0.003  0.105 -0.171
## scl(lg(m_))   0.009  0.109 -0.069  0.863
## scl(pct_bs)   0.016  0.026  0.183  0.055  0.336
## scl(__2020)   0.034 -0.001  0.264  0.149  0.106 -0.136
## scal(mdn_g)   0.009  0.076  0.005  0.294  0.276  0.181 -0.164
## fctr(prty)R   -0.080 -0.046 -0.141  0.009 -0.010 -0.084 -0.663 -0.105
## fctr(hmdty)Mr -0.058  0.057 -0.090 -0.084 -0.182 -0.075  0.155 -0.100
## fctr(hmdty)Ms -0.123  0.135 -0.004  0.031 -0.011 -0.035 -0.006 -0.082
## mean_pm25     -0.137  0.064 -0.257 -0.027 -0.097 -0.038  0.162  0.080
##      fct(R fctr(hmdty)Mr fctr(hmdty)Ms
## fctr(ndct)N
## scl(ppdnst)
## scal(pvrty)
## scl(lg(m_))
## scl(pct_bs)
## scl(__2020)
## scal(mdn_g)
## fctr(prty)R
## fctr(hmdty)Mr -0.014
## fctr(hmdty)Ms  0.019 -0.021
## mean_pm25      0.052  0.379      -0.152
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?

```


Repeat above, - humidity

```
# Model cases
```

```
model.initial.cases.nohumidity = glmer(cases ~ (1|state) + coastal.distance + offset(log(population2019)
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable:
## - Rescale variables?
```

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

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## cases ~ (1 | state) + 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
## Data: coastal.only
##
##           AIC          BIC      logLik  deviance  df.resid
## 527346.4   527400.5 -263661.2   527322.4         659
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -134.073  -12.358   -0.726    9.286   307.251
##
## Random effects:
##   Groups Name            Variance Std.Dev.
##   state  (Intercept) 0.05554  0.2357
## Number of obs: 671, groups: state, 30
##
## Fixed effects:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -2.9758995  0.0430803  -69.08  <2e-16 ***
## coastal.distance2    0.0126640  0.0007663   16.53  <2e-16 ***
## coastal.distance3    0.0220155  0.0010005   22.00  <2e-16 ***
## scale(popdensity)   -0.0181007  0.0002334  -77.57  <2e-16 ***
## scale(poverty)       0.0239593  0.0009704   24.69  <2e-16 ***
## scale(log(median_income)) -0.0812242  0.0009311  -87.23  <2e-16 ***
## scale(pct_obesity)  -0.0810283  0.0005513 -146.97  <2e-16 ***
## scale(voter_margin_2020)  0.0828887  0.0006381  129.91  <2e-16 ***
## scale(median_age)   -0.1150409  0.0005626 -204.47  <2e-16 ***
## factor(party)Republican -0.0225069  0.0010564  -21.30  <2e-16 ***
## mean_pm25           0.0510268  0.0001765  289.11  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) cstl.2 cstl.3 scl(pp) scl(pv) s(( )) scl(p_) s(__20 scl(m_)
## cstl.dstnc2 -0.011
## cstl.dstnc3 -0.013  0.361
```

```
## scl(ppdnst) 0.008 0.197 0.156
## scal(pvrty) 0.007 -0.104 -0.131 -0.206
## scl(lg(m_)) 0.002 -0.154 -0.081 -0.157 0.844
## scl(pct_bs) -0.001 -0.130 -0.110 0.107 0.070 0.392
## scl(__2020) 0.016 -0.170 -0.237 0.237 0.280 0.202 -0.113
## scal(mdn_g) 0.003 0.232 0.118 0.017 0.304 0.198 0.140 -0.051
## fctr(prty)R -0.019 0.042 0.092 -0.124 -0.055 -0.044 -0.099 -0.624 -0.188
## mean_pm25 -0.040 0.116 0.128 -0.224 -0.088 -0.010 0.088 -0.070 0.103
##          fct()R
## cst1.dstnc2
## cst1.dstnc3
## scl(ppdnst)
## scal(pvrty)
## scl(lg(m_))
## scl(pct_bs)
## scl(__2020)
## scal(mdn_g)
## fctr(prty)R
## mean_pm25 0.086
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

Model deaths

```
model.initial.deaths.nohumidity = glmer(deaths ~ (1|state) + coastal.distance + offset(log(population20
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

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

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## deaths ~ (1 | state) + 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
## Data: coastal.only
##
##          AIC          BIC    logLik deviance df.resid
## 20037.7    20091.8 -10006.8   20013.7      659
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -21.9505  -2.7575  -0.4996   2.0563  25.8188
##
## Random effects:
## Groups Name             Variance Std.Dev.
## state (Intercept) 0.1185    0.3442
## Number of obs: 671, groups: state, 30
##
```

```
## Fixed effects:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -7.367694   0.064917 -113.493 < 2e-16 ***
## coastal.distance2  0.057546   0.005621  10.239 < 2e-16 ***
## coastal.distance3  0.036126   0.007306   4.945 7.63e-07 ***
## scale(popdensity) -0.020616   0.001644 -12.543 < 2e-16 ***
## scale(poverty)     0.202320   0.007016  28.838 < 2e-16 ***
## scale(log(median_income)) -0.056214   0.006948  -8.091 5.93e-16 ***
## scale(pct_obesity) -0.043184   0.004192 -10.303 < 2e-16 ***
## scale(voter_margin_2020) 0.039597   0.004702   8.422 < 2e-16 ***
## scale(median_age)    0.128092   0.004131  31.010 < 2e-16 ***
## factor(party)Republican 0.009171   0.007901   1.161  0.246
## mean_pm25         0.096793   0.001379  70.176 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##      (Intr) cstl.2 cstl.3 scl(pp) scl(pv) s((_)) scl(p_) s(_20 scl(m_)
## cstl.dstnc2 -0.056
## cstl.dstnc3 -0.062  0.348
## scl(ppdnst)  0.042  0.209  0.171
## scl(pvrtty)  0.033 -0.113 -0.131 -0.211
## scl(lg(m_))  0.012 -0.164 -0.081 -0.133  0.840
## scl(pct_bs) -0.003 -0.107 -0.097  0.150  0.071  0.411
## scl(_2020)  0.070 -0.154 -0.214  0.239  0.248  0.160 -0.129
## scl(mdn_g)  0.006  0.201  0.119  0.061  0.310  0.229  0.179 -0.074
## fctr(prty)R -0.092  0.050  0.079 -0.147 -0.042 -0.033 -0.106 -0.615 -0.203
## mean_pm25   -0.206  0.126  0.118 -0.199 -0.091 -0.034  0.072 -0.022  0.102
##      fct()R
## cstl.dstnc2
## cstl.dstnc3
## scl(ppdnst)
## scl(pvrtty)
## scl(lg(m_))
## scl(pct_bs)
## scl(_2020)
## scl(mdn_g)
## fctr(prty)R
## mean_pm25    0.064
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

Model cases

```
model.indicator.cases.nohumidity = glmer(cases ~ (1|state) + factor(indicatorcoast) + offset(log(popula
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?
```

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

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
```

```

## Family: poisson ( log )
## Formula:
## cases ~ (1 | state) + 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
## Data: coastal.new
##
##           AIC          BIC      logLik deviance df.resid
## 1057204.6 1057270.9 -528591.3 1057182.6      3077
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -151.69   -6.54    -0.35     6.59   348.90
##
## Random effects:
## Groups Name          Variance Std.Dev.
## state (Intercept) 0.06138  0.2478
## Number of obs: 3088, groups: state, 49
##
## Fixed effects:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -2.7931663   0.0354172  -78.86  <2e-16 ***
## factor(indicatorcoast)Noncoastal  0.0229925   0.0005957   38.60  <2e-16 ***
## scale(popdensity)    -0.0032662   0.0001072  -30.46  <2e-16 ***
## scale(poverty)        0.0095969   0.0006379   15.04  <2e-16 ***
## scale(log(median_income)) -0.0535472   0.0005471  -97.87  <2e-16 ***
## scale(pct_obesity)   -0.0198709   0.0003324  -59.78  <2e-16 ***
## scale(voter_margin_2020)  0.0962538   0.0004038  238.36  <2e-16 ***
## scale(median_age)    -0.0928609   0.0003254 -285.36  <2e-16 ***
## factor(party)Republican -0.0249967   0.0007164  -34.89  <2e-16 ***
## mean_pm25           0.0487717   0.0001402  347.85  <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) fct()N scl(pp) scl(pv) s((_) scl(p_) s(__20 scl(m_) fct()R
## fctr(ndct)N -0.012
## scl(ppdnst)  0.010  0.053
## scal(pvrty) -0.001  0.110 -0.171
## scl(lg(m_)) -0.001  0.117 -0.107  0.872
## scl(pct_bs)  0.001  0.038  0.127  0.073  0.334
## scl(__2020)  0.011  0.004  0.277  0.174  0.162 -0.144
## scal(mdn_g) -0.001  0.088 -0.060  0.303  0.250  0.143 -0.158
## fctr(prty)R -0.019 -0.052 -0.113 -0.002 -0.032 -0.079 -0.667 -0.082
## mean_pm25   -0.035  0.062 -0.264  0.020 -0.009 -0.008  0.090  0.123  0.075
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
## - Rescale variables?

```

```
# Model deaths
```

```
model.indicator.deaths.nohumidity = glmer(deaths ~ (1|state) + factor(indicatorcoast) + offset(log(popu
```

```
## Warning in checkConv(attr(opt, "derivs"), opt$par, ctrl = control$checkConv, : Model is nearly unider
```

```
## - Rescale variables?
```

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

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
## Approximation) [glmerMod]
## Family: poisson ( log )
## Formula:
## deaths ~ (1 | state) + 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
## Data: coastal.new
##
##      AIC      BIC   logLik deviance df.resid
## 60292.6 60359.0 -30135.3 60270.6      3077
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -31.1304  -1.8940  -0.1535   1.9171  30.4553
##
## Random effects:
## Groups Name      Variance Std.Dev.
## state (Intercept) 0.1422   0.377
## Number of obs: 3088, groups: state, 49
##
## Fixed effects:
##
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      -6.9578465   0.0550405  -126.413 < 2e-16 ***
## factor(indicatorcoast)Noncoastal -0.0085454   0.0044110   -1.937  0.0527 .
## scale(popdensity) -0.0004735   0.0007431   -0.637  0.5240
## scale(poverty)     0.1428341   0.0046043   31.022 < 2e-16 ***
## scale(log(median_income)) -0.0979063   0.0040880  -23.950 < 2e-16 ***
## scale(pct_obesity) -0.0001420   0.0025195   -0.056  0.9550
## scale(voter_margin_2020)  0.1008441   0.0030286   33.297 < 2e-16 ***
## scale(median_age)    0.0990921   0.0024002   41.284 < 2e-16 ***
## factor(party)Republican -0.0295320   0.0054381   -5.431 5.62e-08 ***
## mean_pm25          0.0774046   0.0010779   71.809 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) fct(N scl(pp) scl(pv) s(( )) scl(p_) s(__20 scl(m_) fct())R
## fctr(ndct)N -0.059
## scl(ppdnst)  0.052  0.049
## scl(pvrty) -0.005  0.111 -0.179
## scl(lg(m_)) -0.003  0.123 -0.089  0.867
## scl(pct_bs)  0.009  0.033  0.171  0.051  0.328
## scl(__2020)  0.053 -0.011  0.289  0.168  0.146 -0.126
## scl(mdn_g) -0.012  0.096 -0.012  0.292  0.260  0.166 -0.154
## fctr(prty)R -0.094 -0.050 -0.144  0.005 -0.017 -0.086 -0.668 -0.104
## mean_pm25   -0.171  0.054 -0.246  0.013 -0.032 -0.018  0.101  0.135  0.068
## optimizer (Nelder_Mead) convergence code: 0 (OK)
## Model is nearly unidentifiable: very large eigenvalue
```

- Rescale variables?

Summary of output

[1] "-0.0083 (-0.0099, -0.0068)"

[1] "0.0033 (0.0013, 0.0053)"

[1] "0.042 (0.031, 0.053)"

[1] "0.024 (0.0091, 0.038)"

[1] "0.013 (0.011, 0.014)"

[1] "0.022 (0.02, 0.024)"

[1] "0.058 (0.047, 0.069)"

[1] "0.036 (0.022, 0.05)"

[1] "0.0018 (0.00059, 0.003)"

[1] "-0.039 (-0.048, -0.03)"

[1] "0.023 (0.022, 0.024)"

[1] "-0.0085 (-0.017, 1e-04)"

Humidity Included

| Coastal Distance | Case Model Coefficients (CI) | Death Model Coefficients (CI) |
|------------------|------------------------------|-------------------------------|
| 1 (Reference) | 0 | 0 |
| 2 | -0.0083 (-0.0099, -0.0068) | 0.042 (0.031, 0.053) |
| 3 | 0.0033 (0.0013, 0.0053) | 0.024 (0.0091, 0.038) |

Humidity Excluded

| Coastal Distance | Case Model Coefficients (CI) | Death Model Coefficients (CI) |
|------------------|------------------------------|-------------------------------|
| 1 (Reference) | 0 | 0 |
| 2 | 0.013 (0.011, 0.014) | 0.058 (0.047, 0.069) |
| 3 | 0.022 (0.02, 0.024) | 0.036 (0.022, 0.05) |

Humidity Included

| Binary Variable | Case Model Coefficients (CI) | Death Model Coefficients (CI) |
|---------------------|------------------------------|-------------------------------|
| Coastal (Reference) | 0 | 0 |
| Noncoastal | 0.0018 (0.00059, 0.003) | -0.039 (-0.048, -0.03) |

Humidity Excluded

| Binary Variable | Case Model Coefficients (CI) | Death Model Coefficients (CI) |
|---------------------|------------------------------|-------------------------------|
| Coastal (Reference) | 0 | 0 |
| Noncoastal | 0.023 (0.022, 0.024) | -0.0085 (-0.017, 1e-04) |