

R Notebook

```
library("nlme")
library("mgcv")
```

```
## This is mgcv 1.8-38. For overview type 'help("mgcv-package")'.
```

```
library("lattice")
library("tidyverse")
```

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

```
## v ggplot2 3.3.5    v purrr  0.3.4
## v tibble  3.1.4    v dplyr  1.0.7
## v tidyr   1.1.3    v stringr 1.4.0
## v readr   2.0.1    v forcats 0.5.1
```

```
## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::collapse() masks nlme::collapse()
## x dplyr::filter()   masks stats::filter()
## x dplyr::lag()      masks stats::lag()
```

```
library("stringr")
library("plot3D")
```

```
setwd('C:/Users/danie/OneDrive/Documents/stats501/STATS501_project/data')
knn_dat = read_delim('violenceKNN.csv', delim = ",")
```

IMPUTE USING KNN

```
## New names:
## * ' ' -> ...1
```

```
## Rows: 122 Columns: 10
```

```
## -- Column specification -----
## Delimiter: ","
## chr (1): sitename
## dbl (9): ...1, year, violenceScore, AllAgesInPovertyPercent, UnderAge18InPov...
```

```
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
#econ_dat$`Median Household Income in Dollars` = substring(econ_dat$`Median Household Income in Dollars`
#econ_dat$`Median Household Income in Dollars` = str_replace_all(econ_dat$`Median Household Income in D
#as.double(econ_dat$`Median Household Income in Dollars`)
```

```
#setwd('C:/Users/danie/OneDrive/Documents/stats501/STATS501_project/data')
#write.csv(econ_dat, 'violenceKNN.csv')
```

```
## Group by County
```

```
# Use all age poverty percent
```

```
mod_all_reml_knn = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
mod_all_ml_knn = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
# Use under 18 poverty percent
```

```
mod_und_reml_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + Un
```

```
mod_und_ml_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
summary(mod_all_reml_knn)
```

```
## Linear mixed-effects model fit by REML
```

```
## Data: knn_dat
```

```
## AIC BIC logLik
```

```
## 840.0582 864.7626 -411.0291
```

```
##
```

```
## Random effects:
```

```
## Formula: ~1 | sitename
```

```
## (Intercept) Residual
```

```
## StdDev: 4.13187 5.282829
```

```
##
```

```
## Fixed effects: violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
## Value Std.Error DF t-value p-value
```

```
## (Intercept) 2011.5486 600.9998 102 3.347004 0.0011
```

```
## AllAgesInPovertyPercent -0.0904 0.2747 102 -0.329155 0.7427
```

```
## MedianHouseholdIncomeInDollars 0.0000 0.0001 102 0.010102 0.9920
```

```
## UnemploymentRate 0.6024 0.3570 102 1.687261 0.0946
```

```
## Population 0.0000 0.0000 102 -0.453880 0.6509
```

```
## SNAP -0.0151 0.0667 102 -0.225854 0.8218
```

```
## year -0.9806 0.3031 102 -3.235735 0.0016
```

```
## Correlation:
```

```
## (Intr) AlAIPP MdHIID UnmplR Popltn SNAP
```

```
## AllAgesInPovertyPercent 0.307
```

```
## MedianHouseholdIncomeInDollars 0.299 0.643
```

```
## UnemploymentRate -0.695 -0.223 0.136
```

```
## Population 0.091 0.041 0.048 -0.073
```

```
## SNAP 0.824 -0.027 -0.189 -0.771 0.040
```

```
## year -1.000 -0.314 -0.306 0.693 -0.093 -0.822
```

```
##
```

```
## Standardized Within-Group Residuals:
```

```
## Min Q1 Med Q3 Max
```

```
## -2.3097613 -0.6086369 -0.1088058 0.7059423 3.4413454
```

```
##
```

```
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_all_ml_knn)
```

```
## Linear mixed-effects model fit by maximum likelihood
## Data: knn_dat
##      AIC      BIC    logLik
## 788.3369 813.5731 -385.1684
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      3.02715 5.261189
##
## Fixed effects:  violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
##
##              Value Std.Error DF   t-value p-value
## (Intercept)    1846.8788  592.0293 102   3.1195735  0.0024
## AllAgesInPovertyPercent      0.0005   0.2444 102   0.0019052  0.9985
## MedianHouseholdIncomeInDollars  0.0000   0.0001 102  -0.2559827  0.7985
## UnemploymentRate      0.6181   0.3615 102   1.7098122  0.0903
## Population      0.0000   0.0000 102  -0.4966403  0.6205
## SNAP      -0.0278   0.0673 102  -0.4129826  0.6805
## year      -0.8982   0.2984 102  -3.0103398  0.0033
## Correlation:
##              (Intr)  AlAIPP  MdHIID  UnmplR  Popltn  SNAP
## AllAgesInPovertyPercent      0.305
## MedianHouseholdIncomeInDollars  0.234  0.654
## UnemploymentRate      -0.705 -0.218  0.166
## Population      0.095  0.055  0.046 -0.093
## SNAP      0.834 -0.015 -0.226 -0.774  0.051
## year      -1.000 -0.312 -0.241  0.704 -0.097 -0.833
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.3263532 -0.6676802 -0.1231870  0.7163254  3.5870696
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_und_reml_knn)
```

```
## Linear mixed-effects model fit by REML
## Data: knn_dat
##      AIC      BIC    logLik
## 840.9459 865.6503 -411.4729
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      3.826259 5.319247
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + U
```

```
##
```

	Value	Std.Error	DF	t-value	p-value
## (Intercept)	2039.9555	598.5202	102	3.408332	0.0009
## UnderAge18InPovertyPercent	0.0307	0.1766	102	0.173808	0.8624
## MedianHouseholdIncomeInDollars	0.0000	0.0001	102	0.201372	0.8408
## UnemploymentRate	0.5728	0.3585	102	1.597873	0.1132
## Population	0.0000	0.0000	102	-0.452252	0.6520
## SNAP	-0.0188	0.0669	102	-0.281438	0.7789
## year	-0.9960	0.3018	102	-3.300784	0.0013

```
## Correlation:
```

	(Intr)	UA18IP	MdHIID	UnmplR	Popltn	SNAP
## UnderAge18InPovertyPercent	0.306					
## MedianHouseholdIncomeInDollars	0.282	0.648				
## UnemploymentRate	-0.698	-0.223	0.142			
## Population	0.080	0.005	0.022	-0.069		
## SNAP	0.839	0.015	-0.174	-0.781	0.044	
## year	-1.000	-0.313	-0.289	0.696	-0.081	-0.837

```
##
```

Standardized Within-Group Residuals:

	Min	Q1	Med	Q3	Max
##	-2.2870412	-0.6243049	-0.1038836	0.6993627	3.4601582

```
##
```

Number of Observations: 122

Number of Groups: 14

```
summary(mod_und_ml_knn)
```

```
## Linear mixed-effects model fit by maximum likelihood
## Data: knn_dat
## AIC BIC logLik
## 788.1197 813.3559 -385.0599
##
```

Random effects:

```
## Formula: ~1 | sitename
## (Intercept) Residual
## StdDev: 2.841833 5.286479
##
```

Fixed effects: violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars +

	Value	Std.Error	DF	t-value	p-value
## (Intercept)	1887.6019	588.9177	102	3.205205	0.0018
## UnderAge18InPovertyPercent	0.0779	0.1598	102	0.487560	0.6269
## MedianHouseholdIncomeInDollars	0.0000	0.0001	102	-0.036383	0.9710
## UnemploymentRate	0.5903	0.3622	102	1.629734	0.1062
## Population	0.0000	0.0000	102	-0.506688	0.6135
## SNAP	-0.0298	0.0673	102	-0.442158	0.6593
## year	-0.9196	0.2967	102	-3.099006	0.0025

```
## Correlation:
```

	(Intr)	UA18IP	MdHIID	UnmplR	Popltn	SNAP
## UnderAge18InPovertyPercent	0.301					
## MedianHouseholdIncomeInDollars	0.218	0.657				
## UnemploymentRate	-0.708	-0.218	0.171			
## Population	0.084	0.016	0.018	-0.089		
## SNAP	0.847	0.018	-0.214	-0.781	0.055	
## year	-1.000	-0.308	-0.225	0.706	-0.085	-0.845

```
##
```

```

## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.3103166 -0.6335080 -0.1205531  0.6787459  3.5906562
##
## Number of Observations: 122
## Number of Groups: 14

# Dropping each predictor
mod_und_reml_pov_knn = lme(violenceScore ~ MedianHouseholdIncomeInDollars + UnemploymentRate + Population, data = data, random = ~ 1 | sitename)
mod_und_reml_med_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population, data = data, random = ~ 1 | sitename)
mod_und_reml_unemp_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars, data = data, random = ~ 1 | sitename)
mod_und_reml_pop_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars, data = data, random = ~ 1 | sitename)
mod_und_reml_snap_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars, data = data, random = ~ 1 | sitename)
mod_und_reml_year_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars, data = data, random = ~ 1 | sitename)

# Using under 18 poverty rate
mod_und_reml_2b_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, data = data, random = ~ 1 | sitename)
mod_und_reml_3_knn = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)

# F test comparing with/without poverty percent
anova(mod_und_reml_2b_knn, mod_und_reml_3_knn, test = "F")

## Warning in anova.lme(mod_und_reml_2b_knn, mod_und_reml_3_knn, test = "F"):
## fitted objects with different fixed effects. REML comparisons are not
## meaningful.

##           Model df      AIC      BIC    logLik
## mod_und_reml_2b_knn      1  7 792.9859 812.3211 -389.4929
## mod_und_reml_3_knn      2  6 788.8067 805.4308 -388.4034

# Using all age poverty percent
mod_und_ml_2b_knn = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, data = data, random = ~ 1 | sitename)
mod_und_ml_3_knn = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)

# F test comparing with/without poverty percent
anova(mod_und_ml_2b_knn, mod_und_ml_3_knn, test = "F")

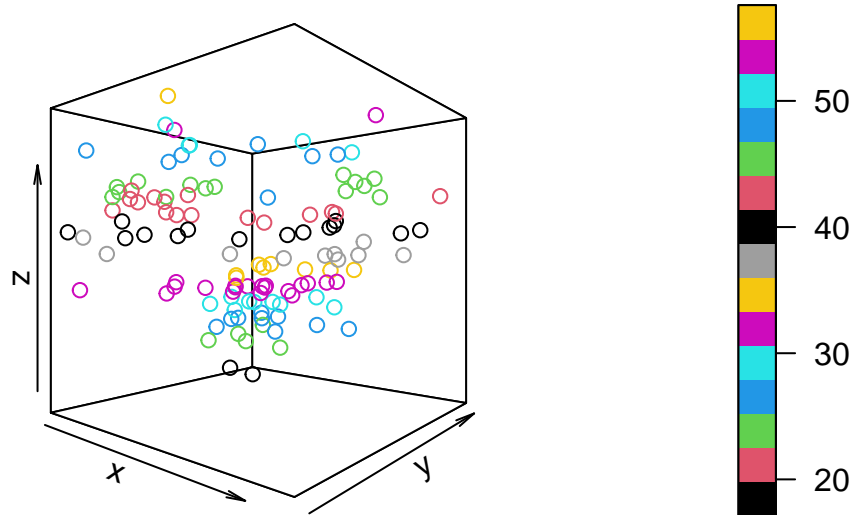
##           Model df      AIC      BIC    logLik
## mod_und_ml_2b_knn      1  7 784.3899 804.018 -385.1949
## mod_und_ml_3_knn      2  6 782.6588 799.483 -385.3294

# Find how to compare between reml and ml

```

```
scatter3D(knn_dat$UnemploymentRate, knn_dat$SNAP, knn_dat$violenceScore, col.var = as.integer(knn_dat$
```

```
## Warning in splitdotpersp(list(...), bty, NULL, x, y, z, plist = plist, breaks =
## breaks): NAs introduced by coercion
```



IMPUTE USING MEAN

```
setwd('C:/Users/danie/OneDrive/Documents/stats501/STATS501_project/data')
mean_dat = read_delim('violenceMean.csv', delim = ",") %>% transmute(year = year, sitename = sitename, v
```

```
## New names:
## * ' ' -> ...1
```

```
## Rows: 122 Columns: 10
```

```
## -- Column specification -----
## Delimiter: ","
## chr (1): sitename
## dbl (8): ...1, year, violence score, All Ages in Poverty Percent, Under Age ...
```

```
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

```
## Group by County
```

```
# Use all age poverty percent
```

```
mod_all_reml_mean = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
mod_all_ml_mean = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
# Use under 18 poverty percent
```

```
mod_und_reml_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + U
```

```
mod_und_ml_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + U
```

```
summary(mod_all_reml_mean)
```

```
## Linear mixed-effects model fit by REML
```

```
## Data: mean_dat
```

```
## AIC BIC logLik
```

```
## 837.7385 862.4429 -409.8692
```

```
##
```

```
## Random effects:
```

```
## Formula: ~1 | sitename
```

```
## (Intercept) Residual
```

```
## StdDev: 4.064386 5.232714
```

```
##
```

```
## Fixed effects: violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp
```

```
## Value Std.Error DF t-value p-value
```

```
## (Intercept) 2057.3739 594.7797 102 3.459052 0.0008
```

```
## AllAgesInPovertyPercent -0.0768 0.2712 102 -0.283227 0.7776
```

```
## MedianHouseholdIncomeInDollars 0.0000 0.0001 102 0.010092 0.9920
```

```
## UnemploymentRate 0.5756 0.3536 102 1.628011 0.1066
```

```
## Population 0.0000 0.0000 102 -0.419893 0.6754
```

```
## SNAP -0.0115 0.0661 102 -0.173590 0.8625
```

```
## year -1.0039 0.2999 102 -3.347135 0.0011
```

```
## Correlation:
```

```
## (Intr) AlAIIPP MdHIID UnmplR Popltn SNAP
```

```
## AllAgesInPovertyPercent 0.307
```

```
## MedianHouseholdIncomeInDollars 0.298 0.644
```

```
## UnemploymentRate -0.695 -0.223 0.136
```

```
## Population 0.091 0.041 0.048 -0.073
```

```
## SNAP 0.824 -0.026 -0.190 -0.772 0.040
```

```
## year -1.000 -0.314 -0.305 0.693 -0.093 -0.822
```

```
##
```

```
## Standardized Within-Group Residuals:
```

```
## Min Q1 Med Q3 Max
```

```
## -2.31419256 -0.59842608 -0.09587253 0.69997800 3.51171816
```

```
##
```

```
## Number of Observations: 122
```

```
## Number of Groups: 14
```

```
summary(mod_all_ml_mean)
```

```
## Linear mixed-effects model fit by maximum likelihood
```

```
## Data: mean_dat
##      AIC      BIC  logLik
##  785.8401 811.0762 -383.92
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      2.967799 5.212254
##
## Fixed effects:  violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unem
##
##              Value Std.Error  DF   t-value p-value
## (Intercept)      1896.8520  585.6933 102   3.238644  0.0016
## AllAgesInPovertyPercent      0.0152   0.2409 102   0.062995  0.9499
## MedianHouseholdIncomeInDollars      0.0000   0.0001 102  -0.252527  0.8011
## UnemploymentRate      0.5905   0.3580 102   1.649458  0.1021
## Population      0.0000   0.0000 102  -0.454247  0.6506
## SNAP      -0.0239   0.0666 102  -0.358348  0.7208
## year      -0.9235   0.2952 102  -3.128870  0.0023
## Correlation:
##              (Intr) AllAIPP MdHIID UnmplR Popltn SNAP
## AllAgesInPovertyPercent      0.305
## MedianHouseholdIncomeInDollars      0.232  0.654
## UnemploymentRate      -0.706 -0.217  0.167
## Population      0.096  0.055  0.046 -0.094
## SNAP      0.835 -0.014 -0.228 -0.774  0.051
## year      -1.000 -0.312 -0.239  0.704 -0.097 -0.833
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.3321691 -0.6870300 -0.1232251  0.7058273  3.6594416
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_und_reml_mean)
```

```
## Linear mixed-effects model fit by REML
## Data: mean_dat
##      AIC      BIC    logLik
##  838.5799 863.2843 -410.2899
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      3.742986 5.269992
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + U
##
##              Value Std.Error  DF   t-value p-value
## (Intercept)      2085.4478  591.9831 102   3.522816  0.0006
## UnderAge18InPovertyPercent      0.0419   0.1740 102   0.240880  0.8101
## MedianHouseholdIncomeInDollars      0.0000   0.0001 102   0.205785  0.8374
## UnemploymentRate      0.5453   0.3550 102   1.536311  0.1276
## Population      0.0000   0.0000 102  -0.418466  0.6765
## SNAP      -0.0152   0.0662 102  -0.229298  0.8191
```



```
## year                -1.0191    0.2985 102 -3.414729  0.0009
## Correlation:
##                    (Intr) UA18IP MdHIID UnmplR Popltn SNAP
## UnderAge18InPovertyPercent    0.306
## MedianHouseholdIncomeInDollars 0.279  0.648
## UnemploymentRate              -0.698 -0.223  0.143
## Population                    0.080  0.005  0.022 -0.070
## SNAP                          0.839  0.015 -0.176 -0.781  0.045
## year                        -1.000 -0.313 -0.286  0.697 -0.081 -0.837
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2914224 -0.6159392 -0.1061249  0.6787611  3.5278484
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_und_ml_mean)
```

```
## Linear mixed-effects model fit by maximum likelihood
## Data: mean_dat
##      AIC      BIC    logLik
##  785.5509 810.787 -383.7754
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      2.768164 5.238442
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars +
##
##              Value Std.Error DF   t-value p-value
## (Intercept)  1936.9837  582.2004 102   3.327005  0.0012
## UnderAge18InPovertyPercent    0.0896    0.1572 102   0.570052  0.5699
## MedianHouseholdIncomeInDollars  0.0000    0.0001 102  -0.028253  0.9775
## UnemploymentRate              0.5623    0.3586 102   1.567914  0.1200
## Population                    0.0000    0.0000 102  -0.465915  0.6423
## SNAP                        -0.0258    0.0666 102  -0.387570  0.6991
## year                      -0.9447    0.2934 102  -3.220349  0.0017
## Correlation:
##                    (Intr) UA18IP MdHIID UnmplR Popltn SNAP
## UnderAge18InPovertyPercent    0.300
## MedianHouseholdIncomeInDollars 0.214  0.657
## UnemploymentRate              -0.708 -0.218  0.173
## Population                    0.085  0.016  0.018 -0.090
## SNAP                          0.847  0.018 -0.217 -0.781  0.055
## year                        -1.000 -0.307 -0.221  0.707 -0.086 -0.846
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.3164773 -0.6608839 -0.1206841  0.6682911  3.6607343
##
## Number of Observations: 122
## Number of Groups: 14
```

```
# Dropping each predictor
```

```
mod_und_reml_pov_mean = lme(violenceScore ~ MedianHouseholdIncomeInDollars + UnemploymentRate + Population + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_med_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_unemp_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_pop_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_snap_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_year_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + year, random = ~ 1 | sitename, data = dat)
```

```
# Using under 18 poverty rate
```

```
mod_und_reml_2_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_2b_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_reml_3_mean = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = dat)
```

```
# F test comparing with/without poverty percent
```

```
anova(mod_und_reml_2_mean, mod_und_reml_2b_mean, mod_und_reml_3_mean, test = "F")
```

```
## Warning in anova.lme(mod_und_reml_2_mean, mod_und_reml_2b_mean,
## mod_und_reml_3_mean, : fitted objects with different fixed effects. REML
## comparisons are not meaningful.
```

```
##           Model df      AIC      BIC    logLik
## mod_und_reml_2_mean      1  8 819.7934 841.8221 -401.8967
## mod_und_reml_2b_mean     2  7 790.5186 809.8538 -388.2593
## mod_und_reml_3_mean      3  6 786.3693 802.9934 -387.1847
```

```
# Using all age poverty percent
```

```
mod_und_ml_2_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + SNAP + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_ml_2b_mean = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = dat)
```

```
mod_und_ml_3_mean = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = dat)
```

```
# F test comparing with/without poverty percent
```

```
anova(mod_und_ml_2_mean, mod_und_ml_2b_mean, mod_und_ml_3_mean, test = "F")
```

```
##           Model df      AIC      BIC    logLik
## mod_und_ml_2_mean      1  8 783.5516 805.9838 -383.7758
## mod_und_ml_2b_mean     2  7 781.7796 801.4078 -383.8898
## mod_und_ml_3_mean      3  6 780.1412 796.9653 -384.0706
```

IMPUTE USING MEDIAN

```
setwd('C:/Users/danie/OneDrive/Documents/stats501/STATS501_project/data')
med_dat = read_delim('violenceMedian.csv', delim = ",")
```

```
## New names:
## * ' ' -> ...1
```

```

## Rows: 122 Columns: 10

## -- Column specification -----
## Delimiter: ","
## chr (1): sitename
## dbl (8): ...1, year, violenceScore, AllAgesInPovertyPercent, UnderAge18InPov...

##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.

## Group by County

# Use all age poverty percent
mod_all_reml_med = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp

mod_all_ml_med = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unemp

# Use under 18 poverty percent
mod_und_reml_med = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + Un

mod_und_ml_med = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + Unemp

summary(mod_all_reml_med)

## Linear mixed-effects model fit by REML
##   Data: med_dat
##       AIC      BIC    logLik
##   832.5193 857.2237 -407.2597
##
## Random effects:
##   Formula: ~1 | sitename
##           (Intercept) Residual
## StdDev:    3.898349 5.123712
##
## Fixed effects:  violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars +      Unemp
##
##              Value Std.Error DF   t-value p-value
## (Intercept)    2030.8860   580.8703 102   3.496281  0.0007
## AllAgesInPovertyPercent    -0.0670    0.2631 102  -0.254440  0.7997
## MedianHouseholdIncomeInDollars    0.0000    0.0001 102   0.005735  0.9954
## UnemploymentRate    0.5227    0.3459 102   1.510900  0.1339
## Population    0.0000    0.0000 102  -0.451287  0.6527
## SNAP    -0.0076    0.0646 102  -0.117762  0.9065
## year    -0.9913    0.2929 102  -3.384245  0.0010
## Correlation:
##              (Intr) AlAIPP MdHIID UnmplR Popltn SNAP
## AllAgesInPovertyPercent    0.307
## MedianHouseholdIncomeInDollars 0.294  0.645
## UnemploymentRate    -0.696 -0.223  0.138
## Population    0.091  0.042  0.048 -0.075
## SNAP    0.825 -0.025 -0.192 -0.772  0.041
## year    -1.000 -0.314 -0.301  0.694 -0.093 -0.823
##

```

```
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2777491 -0.5962841 -0.1252982  0.6938285  3.5708739
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_all_ml_med)
```

```
## Linear mixed-effects model fit by maximum likelihood
##   Data: med_dat
##       AIC      BIC    logLik
##  780.2159 805.4521 -381.1079
##
## Random effects:
##   Formula: ~1 | sitename
##           (Intercept) Residual
## StdDev:    2.842025  5.102981
##
## Fixed effects:  violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars +      Unemp
##
##              Value Std.Error   DF   t-value p-value
## (Intercept)    1882.5951   571.7007  102    3.292973  0.0014
## AllAgesInPovertyPercent      0.0204    0.2334  102    0.087502  0.9304
## MedianHouseholdIncomeInDollars  0.0000    0.0001  102   -0.261194  0.7945
## UnemploymentRate              0.5341    0.3501  102    1.525660  0.1302
## Population                  0.0000    0.0000  102   -0.488374  0.6263
## SNAP                       -0.0186    0.0651  102   -0.285734  0.7757
## year                      -0.9170    0.2881  102   -3.182979  0.0019
##
## Correlation:
##              (Intr)  AlAIPP  MdHIID  UnmplR  Popltn  SNAP
## AllAgesInPovertyPercent      0.304
## MedianHouseholdIncomeInDollars  0.227  0.654
## UnemploymentRate             -0.706 -0.217  0.170
## Population                   0.096  0.056  0.046 -0.095
## SNAP                        0.835 -0.014 -0.230 -0.774  0.052
## year                       -1.000 -0.311 -0.234  0.705 -0.098 -0.834
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2949947 -0.6720752 -0.1261025  0.6659341  3.7245973
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_und_reml_med)
```

```
## Linear mixed-effects model fit by REML
##   Data: med_dat
##       AIC      BIC    logLik
##  833.3482 858.0525 -407.6741
##
## Random effects:
##   Formula: ~1 | sitename
```

```

##          (Intercept) Residual
## StdDev:    3.603202  5.15805
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars +
##
##              Value Std.Error  DF    t-value p-value
## (Intercept)      2058.1012  578.1333  102   3.559907  0.0006
## UnderAge18InPovertyPercent      0.0403    0.1692  102   0.238393  0.8121
## MedianHouseholdIncomeInDollars      0.0000    0.0001  102   0.187965  0.8513
## UnemploymentRate      0.4941    0.3472  102   1.423272  0.1577
## Population      0.0000    0.0000  102  -0.450888  0.6530
## SNAP      -0.0108    0.0647  102  -0.166041  0.8685
## year      -1.0060    0.2915  102  -3.451435  0.0008
## Correlation:
##              (Intr) UA18IP MdHIID UnmplR Popltn SNAP
## UnderAge18InPovertyPercent      0.306
## MedianHouseholdIncomeInDollars      0.276  0.649
## UnemploymentRate      -0.699 -0.222  0.145
## Population      0.080  0.006  0.022 -0.071
## SNAP      0.840  0.016 -0.178 -0.781  0.045
## year      -1.000 -0.313 -0.283  0.697 -0.082 -0.838
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2562531 -0.6028742 -0.1108445  0.6694404  3.5864056
##
## Number of Observations: 122
## Number of Groups: 14

```

```
summary(mod_und_ml_med)
```

```

## Linear mixed-effects model fit by maximum likelihood
##   Data: med_dat
##       AIC       BIC    logLik
##  779.9255 805.1617 -380.9628
##
## Random effects:
## Formula: ~1 | sitename
##          (Intercept) Residual
## StdDev:    2.65225  5.127931
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars +
##
##              Value Std.Error  DF    t-value p-value
## (Intercept)      1921.6615  568.2521  102   3.381706  0.0010
## UnderAge18InPovertyPercent      0.0878    0.1525  102   0.575907  0.5659
## MedianHouseholdIncomeInDollars      0.0000    0.0001  102  -0.047511  0.9622
## UnemploymentRate      0.5068    0.3507  102   1.445399  0.1514
## Population      0.0000    0.0000  102  -0.501662  0.6170
## SNAP      -0.0201    0.0651  102  -0.309275  0.7577
## year      -0.9376    0.2863  102  -3.274674  0.0014
## Correlation:
##              (Intr) UA18IP MdHIID UnmplR Popltn SNAP
## UnderAge18InPovertyPercent      0.300
## MedianHouseholdIncomeInDollars      0.209  0.658
## UnemploymentRate      -0.709 -0.218  0.175

```

```
## Population          0.085  0.017  0.017 -0.092
## SNAP                0.848  0.018 -0.220 -0.781  0.056
## year               -1.000 -0.306 -0.216  0.707 -0.086 -0.846
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2797321 -0.6453894 -0.1084600  0.6666405  3.7260209
##
## Number of Observations: 122
## Number of Groups: 14
```

```
# Dropping each predictor
```

```
mod_und_reml_pov_med = lme(violenceScore ~ MedianHouseholdIncomeInDollars + UnemploymentRate + Population + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_med_med = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_unemp_med = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_pop_med = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_snap_med = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_year_med = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
```

```
# Using under 18 poverty rate
```

```
mod_und_reml_2_med = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_2b_med = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_reml_3_med = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
```

```
# F test comparing with/without poverty percent
```

```
anova(mod_und_reml_2_med, mod_und_reml_2b_med, mod_und_reml_3_med, test = "F")
```

```
## Warning in anova.lme(mod_und_reml_2_med, mod_und_reml_2b_med,
## mod_und_reml_3_med, : fitted objects with different fixed effects. REML
## comparisons are not meaningful.
```

```
##           Model df      AIC      BIC    logLik
## mod_und_reml_2_med      1  8 814.5021 836.5308 -399.2511
## mod_und_reml_2b_med     2  7 785.1900 804.5253 -385.5950
## mod_und_reml_3_med      3  6 780.9909 797.6150 -384.4955
```

```
# Using all age poverty percent
```

```
mod_und_ml_2_med = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_ml_2b_med = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
mod_und_ml_3_med = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data = data)
```

```
# F test comparing with/without poverty percent
```

```
anova(mod_und_ml_2_med, mod_und_ml_2b_med, mod_und_ml_3_med, test = "F")
```

```
##           Model df      AIC      BIC    logLik
```

```
## mod_und_ml_2_med      1  8 777.9277 800.3599 -380.9638
## mod_und_ml_2b_med     2  7 776.1911 795.8192 -381.0955
## mod_und_ml_3_med      3  6 774.5656 791.3897 -381.2828
```

IMPUTE USING MODE

```
setwd('C:/Users/danie/OneDrive/Documents/stats501/STATS501_project/data')
mode_dat = read_delim('violenceMedian.csv', delim = ",")
```

```
## New names:
## * ' ' -> ...1
```

```
## Rows: 122 Columns: 10
```

```
## -- Column specification -----
## Delimiter: ","
## chr (1): sitename
## dbl (8): ...1, year, violenceScore, AllAgesInPovertyPercent, UnderAge18InPov...
```

```
##
## i Use 'spec()' to retrieve the full column specification for this data.
## i Specify the column types or set 'show_col_types = FALSE' to quiet this message.
```

Group by County

Use all age poverty percent

```
mod_all_reml_mode = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unempl
```

```
mod_all_ml_mode = lme(violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + Unempl
```

Use under 18 poverty percent

```
mod_und_reml_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + U
```

```
mod_und_ml_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + U
```

```
summary(mod_all_reml_mode)
```

Linear mixed-effects model fit by REML

```
## Data: mode_dat
```

```
## AIC BIC logLik
```

```
## 832.5193 857.2237 -407.2597
```

```
##
```

```
## Random effects:
```

```
## Formula: ~1 | sitename
```

```
## (Intercept) Residual
```

```
## StdDev: 3.898349 5.123712
```

```
##
```

```
## Fixed effects: violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars +
```

```
## Value Std.Error DF t-value p-value
```

```
## (Intercept) 2030.8860 580.8703 102 3.496281 0.0007
```

```
## AllAgesInPovertyPercent -0.0670 0.2631 102 -0.254440 0.7997
```

```
## MedianHouseholdIncomeInDollars    0.0000    0.0001 102  0.005735  0.9954
## UnemploymentRate                   0.5227    0.3459 102  1.510900  0.1339
## Population                         0.0000    0.0000 102 -0.451287  0.6527
## SNAP                              -0.0076    0.0646 102 -0.117762  0.9065
## year                              -0.9913    0.2929 102 -3.384245  0.0010
## Correlation:
##                                     (Intr) AlAIPP MdHIID UnmplR Popltn SNAP
## AllAgesInPovertyPercent            0.307
## MedianHouseholdIncomeInDollars    0.294  0.645
## UnemploymentRate                  -0.696 -0.223  0.138
## Population                        0.091  0.042  0.048 -0.075
## SNAP                             0.825 -0.025 -0.192 -0.772  0.041
## year                             -1.000 -0.314 -0.301  0.694 -0.093 -0.823
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2777491 -0.5962841 -0.1252982  0.6938285  3.5708739
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(mod_all_ml_mode)
```

```
## Linear mixed-effects model fit by maximum likelihood
## Data: mode_dat
##      AIC      BIC    logLik
## 780.2159 805.4521 -381.1079
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:    2.842025 5.102981
##
## Fixed effects:  violenceScore ~ AllAgesInPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate
##                                     Value Std.Error DF   t-value p-value
## (Intercept)                   1882.5951  571.7007 102   3.292973  0.0014
## AllAgesInPovertyPercent         0.0204   0.2334 102   0.087502  0.9304
## MedianHouseholdIncomeInDollars  0.0000   0.0001 102  -0.261194  0.7945
## UnemploymentRate                0.5341   0.3501 102   1.525660  0.1302
## Population                     0.0000   0.0000 102  -0.488374  0.6263
## SNAP                           -0.0186   0.0651 102  -0.285734  0.7757
## year                           -0.9170   0.2881 102  -3.182979  0.0019
## Correlation:
##                                     (Intr) AlAIPP MdHIID UnmplR Popltn SNAP
## AllAgesInPovertyPercent            0.304
## MedianHouseholdIncomeInDollars    0.227  0.654
## UnemploymentRate                  -0.706 -0.217  0.170
## Population                        0.096  0.056  0.046 -0.095
## SNAP                             0.835 -0.014 -0.230 -0.774  0.052
## year                             -1.000 -0.311 -0.234  0.705 -0.098 -0.834
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2949947 -0.6720752 -0.1261025  0.6659341  3.7245973
```



```
##
## Number of Observations: 122
## Number of Groups: 14

summary(mod_und_reml_mode)

## Linear mixed-effects model fit by REML
## Data: mode_dat
##      AIC      BIC    logLik
## 833.3482 858.0525 -407.6741
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      3.603202  5.15805
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars +
##
##              Value Std.Error DF   t-value p-value
## (Intercept)      2058.1012  578.1333 102   3.559907  0.0006
## UnderAge18InPovertyPercent      0.0403   0.1692 102   0.238393  0.8121
## MedianHouseholdIncomeInDollars      0.0000   0.0001 102   0.187965  0.8513
## UnemploymentRate      0.4941   0.3472 102   1.423272  0.1577
## Population      0.0000   0.0000 102  -0.450888  0.6530
## SNAP      -0.0108   0.0647 102  -0.166041  0.8685
## year      -1.0060   0.2915 102  -3.451435  0.0008
## Correlation:
##              (Intr) UA18IP MdHIID UnmplR Popltn SNAP
## UnderAge18InPovertyPercent      0.306
## MedianHouseholdIncomeInDollars      0.276  0.649
## UnemploymentRate      -0.699 -0.222  0.145
## Population      0.080  0.006  0.022 -0.071
## SNAP      0.840  0.016 -0.178 -0.781  0.045
## year      -1.000 -0.313 -0.283  0.697 -0.082 -0.838
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2562531 -0.6028742 -0.1108445  0.6694404  3.5864056
##
## Number of Observations: 122
## Number of Groups: 14

summary(mod_und_ml_mode)

## Linear mixed-effects model fit by maximum likelihood
## Data: mode_dat
##      AIC      BIC    logLik
## 779.9255 805.1617 -380.9628
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      2.65225  5.127931
##
```

```
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars +
##
##              Value Std.Error   DF   t-value p-value
## (Intercept)    1921.6615   568.2521  102   3.381706  0.0010
## UnderAge18InPovertyPercent    0.0878    0.1525  102   0.575907  0.5659
## MedianHouseholdIncomeInDollars    0.0000    0.0001  102  -0.047511  0.9622
## UnemploymentRate    0.5068    0.3507  102   1.445399  0.1514
## Population    0.0000    0.0000  102  -0.501662  0.6170
## SNAP    -0.0201    0.0651  102  -0.309275  0.7577
## year    -0.9376    0.2863  102  -3.274674  0.0014
## Correlation:
##              (Intr) UA18IP MdHIID UnmplR Popltn SNAP
## UnderAge18InPovertyPercent    0.300
## MedianHouseholdIncomeInDollars    0.209  0.658
## UnemploymentRate    -0.709 -0.218  0.175
## Population    0.085  0.017  0.017 -0.092
## SNAP    0.848  0.018 -0.220 -0.781  0.056
## year    -1.000 -0.306 -0.216  0.707 -0.086 -0.846
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.2797321 -0.6453894 -0.1084600  0.6666405  3.7260209
##
## Number of Observations: 122
## Number of Groups: 14
```

```
# Dropping each predictor
```

```
mod_und_reml_pov_mode = lme(violenceScore ~ MedianHouseholdIncomeInDollars + UnemploymentRate + Population + year, data = data, random = ~ 1 | sitename)
mod_und_reml_med_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + year, data = data, random = ~ 1 | sitename)
mod_und_reml_unemp_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + year, data = data, random = ~ 1 | sitename)
mod_und_reml_pop_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate + year, data = data, random = ~ 1 | sitename)
mod_und_reml_snap_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate + year, data = data, random = ~ 1 | sitename)
mod_und_reml_year_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + MedianHouseholdIncomeInDollars + UnemploymentRate + SNAP, data = data, random = ~ 1 | sitename)
```

```
# Using under 18 poverty rate
```

```
mod_und_reml_2_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + year, data = data, random = ~ 1 | sitename)
mod_und_reml_2b_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, data = data, random = ~ 1 | sitename)
mod_und_reml_3_mode = lme(violenceScore ~ UnemploymentRate + SNAP + year, data = data, random = ~ 1 | sitename)
```

```
# F test comparing with/without poverty percent
```

```
anova(mod_und_reml_2_mode, mod_und_reml_2b_mode, mod_und_reml_3_mode, test = "F")
```

```
## Warning in anova.lme(mod_und_reml_2_mode, mod_und_reml_2b_mode,
## mod_und_reml_3_mode, : fitted objects with different fixed effects. REML
## comparisons are not meaningful.
```

```
##              Model df      AIC      BIC    logLik
```

```
## mod_und_reml_2_mode      1  8 814.5021 836.5308 -399.2511
## mod_und_reml_2b_mode     2  7 785.1900 804.5253 -385.5950
## mod_und_reml_3_mode      3  6 780.9909 797.6150 -384.4955
```

```
# Using all age poverty percent
```

```
mod_und_ml_2_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + Population + SN
mod_und_ml_2b_mode = lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + year, r
mod_und_ml_3_mode = lme(violenceScore ~ UnemploymentRate + SNAP + year, random = ~ 1 | sitename, data =
```

```
# F test comparing with/without poverty percent
```

```
anova(mod_und_ml_2_mode, mod_und_ml_2b_mode, mod_und_ml_3_mode, test = "F")
```

```
##               Model df      AIC      BIC    logLik
## mod_und_ml_2_mode      1  8 777.9277 800.3599 -380.9638
## mod_und_ml_2b_mode     2  7 776.1911 795.8192 -381.0955
## mod_und_ml_3_mode      3  6 774.5656 791.3897 -381.2828
```

Warning in anova.lme(mod_und_reml_2_mode, mod_und_reml_2b_mode, mod_und_reml_3_mode, :
fitted objects with different fixed effects. REML comparisons are not meaningful.

Fit with year Add quadratic turns Interaction term Make 3d plots see if you can get them to move

```
summary(lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + I(SNAP^2) + year, ran
```

```
## Linear mixed-effects model fit by REML
```

```
##   Data: mode_dat
```

```
##           AIC      BIC    logLik
##   798.2612 820.2899 -391.1306
```

```
##
```

```
## Random effects:
```

```
## Formula: ~1 | sitename
```

```
##           (Intercept) Residual
```

```
## StdDev:      2.978612 5.212035
```

```
##
```

```
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate +          SNAP + I(SNAP^2)
```

```
##               Value Std.Error   DF   t-value p-value
```

```
## (Intercept)      1791.9642   618.3388  103   2.8980297  0.0046
```

```
## UnderAge18InPovertyPercent    0.0709    0.1186  103   0.5980813  0.5511
```

```
## UnemploymentRate      0.6197    0.3951  103   1.5685024  0.1198
```

```
## SNAP                -0.2450    0.3443  103  -0.7115974  0.4783
```

```
## I(SNAP^2)             0.0009    0.0013  103   0.6795690  0.4983
```

```
## year                 -0.8665    0.3151  103  -2.7498115  0.0070
```

```
## Correlation:
```

```
##               (Intr) UA18IP UnmplR SNAP    I(SNAP
```

```
## UnderAge18InPovertyPercent  0.185
```

```
## UnemploymentRate          -0.824 -0.384
```

```
## SNAP                      0.599  0.043 -0.617
```

```
## I(SNAP^2)                 -0.453 -0.005  0.502 -0.983
```

```
## year                      -1.000 -0.187  0.828 -0.619  0.475
```

```
##
```

```
## Standardized Within-Group Residuals:
```

```
##           Min           Q1           Med           Q3           Max
## -2.3914195 -0.6049174 -0.1412049  0.6856079  3.5327940
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(lme(violenceScore ~ UnderAge18InPovertyPercent*year + UnemploymentRate + SNAP + I(SNAP^2), random = ~1 | sitename, data = mode_dat, method = "REML")
```

```
## Linear mixed-effects model fit by REML
##   Data: mode_dat
##       AIC       BIC    logLik
##  806.6613 831.3656 -394.3306
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      2.929195 5.230856
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent * year + UnemploymentRate + SNAP + I(SNAP^2)
##
##              Value Std.Error DF   t-value p-value
## (Intercept)    2169.0240   815.0863 102   2.6610974  0.0090
## UnderAge18InPovertyPercent    -18.2254    25.1454 102  -0.7247994  0.4702
## year              -1.0533     0.4106 102  -2.5652214  0.0118
## UnemploymentRate     0.6342     0.3961 102   1.6010454  0.1125
## SNAP              -0.2695     0.3462 102  -0.7783838  0.4381
## I(SNAP^2)           0.0009     0.0013 102   0.7474538  0.4565
## UnderAge18InPovertyPercent:year     0.0091     0.0125 102   0.7278015  0.4684
## Correlation:
##              (Intr) UnA18IPP year   UnmplR SNAP   I(SNAP
## UnderAge18InPovertyPercent    -0.650
## year              -1.000  0.639
## UnemploymentRate    -0.600 -0.040   0.611
## SNAP                0.400  0.081  -0.422 -0.617
## I(SNAP^2)           -0.287 -0.085   0.309  0.503 -0.983
## UnderAge18InPovertyPercent:year  0.650 -1.000  -0.640  0.039 -0.081  0.085
##
## Standardized Within-Group Residuals:
##           Min           Q1           Med           Q3           Max
## -2.4325361 -0.6074005 -0.1380112  0.6903556  3.6262889
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate*year + SNAP + I(SNAP^2), random = ~1 | sitename, data = mode_dat, method = "REML")
```

```
## Linear mixed-effects model fit by REML
##   Data: mode_dat
##       AIC       BIC    logLik
##  799.8453 824.5497 -390.9226
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
```

```
## StdDev:      2.890447 5.145698
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate *      year + SNAP + I
##
##              Value Std.Error  DF    t-value p-value
## (Intercept)      995.9301  717.5819 102   1.3878975  0.1682
## UnderAge18InPovertyPercent    0.1454    0.1210 102   1.2011036  0.2325
## UnemploymentRate      242.1957  116.1213 102   2.0857137  0.0395
## year                -0.4771    0.3616 102  -1.3195238  0.1899
## SNAP                -0.0662    0.3507 102  -0.1887864  0.8506
## I(SNAP^2)           0.0003    0.0013 102   0.2121181  0.8324
## UnemploymentRate:year    -0.1203    0.0578 102  -2.0803639  0.0400
## Correlation:
##              (Intr) UA18IP UnmplR year    SNAP    I(SNAP
## UnderAge18InPovertyPercent  0.006
## UnemploymentRate          -0.531  0.280
## year                    -1.000 -0.013  0.515
## SNAP                     0.360  0.114  0.248 -0.386
## I(SNAP^2)                -0.256 -0.071 -0.223  0.282 -0.984
## UnemploymentRate:year      0.528 -0.281 -1.000 -0.513 -0.250  0.225
##
## Standardized Within-Group Residuals:
##              Min          Q1          Med          Q3          Max
## -2.118427309 -0.610834939 -0.007949652  0.686429130  3.368627808
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP*year + I(SNAP^2), random = ~1 | sitename))
```

```
## Linear mixed-effects model fit by REML
## Data: mode_dat
##      AIC      BIC    logLik
## 803.1789 827.8833 -392.5895
##
## Random effects:
## Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      2.748343 5.172139
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate +      SNAP * year + I
##
##              Value Std.Error  DF    t-value p-value
## (Intercept)      8145.719  3197.082 102   2.5478603  0.0123
## UnderAge18InPovertyPercent    0.078    0.114 102   0.6862355  0.4941
## UnemploymentRate      0.846    0.404 102   2.0957872  0.0386
## SNAP                -48.994    23.960 102  -2.0448269  0.0434
## year                -4.062    1.609 102  -2.5248654  0.0131
## I(SNAP^2)           -0.004    0.003 102  -1.4016837  0.1640
## SNAP:year           0.025    0.012 102   2.0341939  0.0445
## Correlation:
##              (Intr) UA18IP UnmplR SNAP    year    I(SNAP
## UnderAge18InPovertyPercent  0.005
## UnemploymentRate          0.105 -0.391
## SNAP                    -0.980  0.034 -0.269
## year                    -1.000 -0.006 -0.102  0.979
```

```
## I(SNAP^2)                -0.893  0.020  0.016  0.859  0.896
## SNAP:year                0.982 -0.034  0.260 -1.000 -0.981 -0.867
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.25253606 -0.62034190 -0.07711228  0.65922100  3.44013136
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(lme(violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP+ I(SNAP^2)*year, random = ~ 1 | sitename, data = mode_dat)
```

```
## Linear mixed-effects model fit by REML
##   Data: mode_dat
##       AIC      BIC    logLik
##   810.1059 834.8103 -396.0529
##
## Random effects:
##   Formula: ~1 | sitename
##      (Intercept) Residual
## StdDev:      2.592059 5.092316
##
## Fixed effects:  violenceScore ~ UnderAge18InPovertyPercent + UnemploymentRate + SNAP + I(SNAP^2)*year
##               Value Std.Error DF   t-value p-value
## (Intercept)    5948.942 1542.6476 102   3.856320  0.0002
## UnderAge18InPovertyPercent    0.084   0.1100 102   0.762088  0.4478
## UnemploymentRate      1.021   0.4033 102   2.530484  0.0129
## SNAP              1.090   0.5680 102   1.918981  0.0578
## I(SNAP^2)        -0.264   0.0897 102  -2.945070  0.0040
## year            -2.977   0.7835 102  -3.798961  0.0002
## I(SNAP^2):year      0.000   0.0000 102   2.955698  0.0039
## Correlation:
##               (Intr) UA18IP UnmplR SNAP   I(SNAP^2) year
## UnderAge18InPovertyPercent  0.052
## UnemploymentRate          -0.006 -0.393
## SNAP                      0.881  0.013 -0.083
## I(SNAP^2)                 -0.925  0.031 -0.314 -0.817
## year                     -1.000 -0.053  0.008 -0.885  0.924
## I(SNAP^2):year            0.922 -0.032  0.320  0.809 -1.000  -0.922
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -2.12709663 -0.62926870 -0.04438978  0.65523972  3.35057336
##
## Number of Observations: 122
## Number of Groups: 14
```

```
summary(lme(violenceScore ~ UnemploymentRate + SNAP+ I(SNAP^2)*year, random = ~ 1 | sitename, data = mode_dat)
```

```
## Linear mixed-effects model fit by REML
##   Data: mode_dat
##       AIC      BIC    logLik
##   806.0271 828.0558 -395.0136
```

```
##
## Random effects:
## Formula: ~1 | sitename
## (Intercept) Residual
## StdDev: 2.815921 5.045051
##
## Fixed effects: violenceScore ~ UnemploymentRate + SNAP + I(SNAP^2) * year
## Value Std.Error DF t-value p-value
## (Intercept) 5881.301 1531.6413 103 3.839868 0.0002
## UnemploymentRate 1.092 0.3734 103 2.924984 0.0042
## SNAP 1.085 0.5642 103 1.922710 0.0573
## I(SNAP^2) -0.262 0.0891 103 -2.940564 0.0040
## year -2.942 0.7779 103 -3.781819 0.0003
## I(SNAP^2):year 0.000 0.0000 103 2.950729 0.0039
## Correlation:
## (Intr) UnmplR SNAP I(SNAP^2) year
## UnemploymentRate 0.011
## SNAP 0.882 -0.089
## I(SNAP^2) -0.926 -0.328 -0.816
## year -1.000 -0.009 -0.887 0.926
## I(SNAP^2):year 0.924 0.335 0.808 -1.000 -0.923
##
## Standardized Within-Group Residuals:
## Min Q1 Med Q3 Max
## -2.15361750 -0.63396221 -0.05888986 0.65797071 3.34674569
##
## Number of Observations: 122
## Number of Groups: 14
```

```
library(scatterplot3d)
library(rgl)
```

```
with(mode_dat, plot3d(mode_dat$UnemploymentRate, mode_dat$SNAP, mode_dat$violenceScore, type= "s", col= "red", size= 100))
```

```
## Warning in f(...): NAs introduced by coercion
```