county_models_present

Theodore Dounias

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```
#DATA
names(demographics) <- tolower(names(demographics))

model_dt <- turnouts_county_data(turnout_list)

model_dt$dates <- as.factor(model_dt$dates)
model_dt$types <- as.factor(model_dt$types)

model_dt <- filter(model_dt, !is.na(model_dt$reg))

model_dt <- left_join(model_dt, demographics, by = "county")

model_dt$county <- as.factor(model_dt$county)

#MODELS

##MODEL 1

md_1 <- glm(data = model_dt, turnout ~ pct_white + pct_urban + county)

summary(md_1)
```

```
##
## Call:
## glm(formula = turnout ~ pct_white + pct_urban + county, data = model_dt)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -0.38095  -0.15980  -0.03896   0.17156   0.56682
##
## Coefficients: (2 not defined because of singularities)
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)         0.684609   0.930859   0.735   0.4623
## pct_white          -0.091375   1.004528  -0.091   0.9276
## pct_urban          -0.277328   0.393461  -0.705   0.4812
## countyAlamosa      -0.008657   0.205569  -0.042   0.9664
## countyArapahoe      0.059868   0.108177   0.553   0.5802
## countyArchuleta    -0.074504   0.080693  -0.923   0.3562
## countyBaca         -0.038293   0.125250  -0.306   0.7599
## countyBent          0.031705   0.125245   0.253   0.8002
## countyBoulder       0.058465   0.221585   0.264   0.7920
## countyBroomfield    0.118109   0.252452   0.468   0.6401
## countyChaffee       0.096121   0.189179   0.508   0.6116
## countyCheyenne     -0.004180   0.124061  -0.034   0.9731
## countyClear Creek -0.158121   0.117195  -1.349   0.1777
## countyConejos      -0.147084   0.518922  -0.283   0.7769
## countyCostilla     -0.140564   0.626891  -0.224   0.8227
```

```
## countyCrowley     -0.114716   0.363623  -0.315   0.7525
## countyCuster       0.001746   0.117203   0.015   0.9881
## countyDelta       -0.024595   0.093877  -0.262   0.7934
## countyDenver      -0.002660   0.086058  -0.031   0.9753
## countyDolores     -0.115033   0.117797  -0.977   0.3292
## countyDouglas      0.095437   0.272803   0.350   0.7266
## countyEagle       -0.029321   0.084352  -0.348   0.7283
## countyEl Paso      0.032358   0.153918   0.210   0.8336
## countyElbert      -0.098869   0.117751  -0.840   0.4014
## countyFremont      0.039704   0.169325   0.234   0.8147
## countyGarfield     0.002705   0.083721   0.032   0.9742
## countyGilpin      -0.195298   0.117816  -1.658   0.0979 .
## countyGrand       -0.096441   0.107068  -0.901   0.3681
## countyGunnison    -0.091462   0.146485  -0.624   0.5326
## countyHinsdale     0.054785   0.117729   0.465   0.6418
## countyHuerfano     0.018049   0.161901   0.111   0.9113
## countyJackson     -0.034279   0.126263  -0.271   0.7861
## countyJefferson    0.094609   0.234286   0.404   0.6865
## countyKiowa        0.007118   0.117766   0.060   0.9518
## countyKit Carson   0.042564   0.080601   0.528   0.5976
## countyLa Plata    -0.108083   0.085798  -1.260   0.2082
## countyLake        -0.044992   0.110657  -0.407   0.6844
## countyLarimer      0.072687   0.260269   0.279   0.7801
## countyLas Animas  -0.006712   0.177205  -0.038   0.9698
## countyLincoln     -0.071115   0.172840  -0.411   0.6809
## countyLogan        0.091242   0.140329   0.650   0.5158
## countyMesa         0.042887   0.243655   0.176   0.8603
## countyMineral      0.016145   0.121265   0.133   0.8941
## countyMoffat       0.007592   0.187606   0.040   0.9677
## countyMontezuma   -0.114966   0.099263  -1.158   0.2472
## countyMontrose     0.016583   0.091876   0.180   0.8568
## countyMorgan       0.016310   0.089452   0.182   0.8554
## countyOtero       -0.001323   0.134714  -0.010   0.9922
## countyOuray       -0.116254   0.117889  -0.986   0.3244
## countyPark        -0.122114   0.117321  -1.041   0.2983
## countyPhillips    -0.119730   0.173567  -0.690   0.4906
## countyPitkin      -0.065013   0.178769  -0.364   0.7162
## countyProwers     -0.008041   0.096114  -0.084   0.9334
## countyPueblo       0.016798   0.096983   0.173   0.8625
## countyRio Blanco  -0.075465   0.130767  -0.577   0.5641
## countyRio Grande  -0.066331   0.247587  -0.268   0.7889
## countyRoutt       -0.028231   0.201408  -0.140   0.8886
## countySaguache    -0.195286   0.377335  -0.518   0.6050
## countySan Juan    -0.163076   0.136682  -1.193   0.2333
## countySan Miguel  -0.217148   0.122666  -1.770   0.0772 .
## countySedgwick    -0.014318   0.134360  -0.107   0.9152
## countySummit      -0.083251   0.215208  -0.387   0.6990
## countyTeller      -0.061382   0.147748  -0.415   0.6780
## countyWashington   0.009425   0.120239   0.078   0.9375
## countyWeld               NA         NA      NA       NA
## countyYuma               NA         NA      NA       NA
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

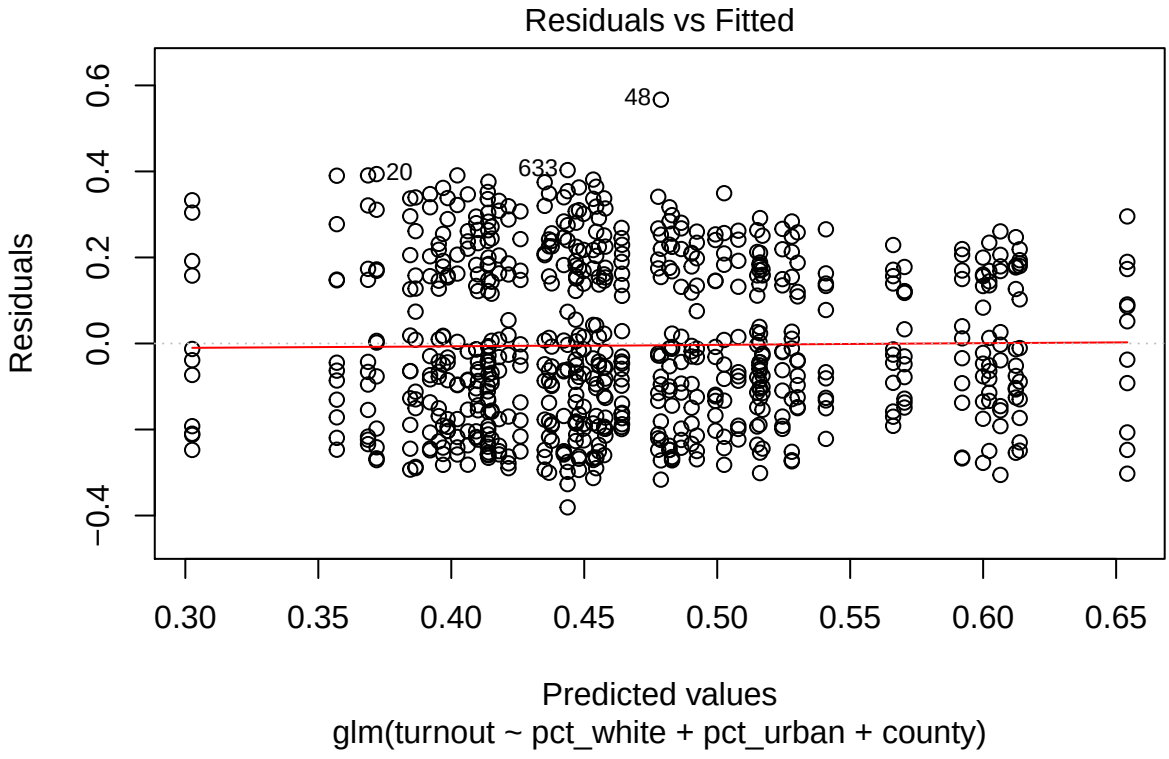
```
## (Dispersion parameter for gaussian family taken to be 0.03975454)
##
##     Null deviance: 29.081  on 703  degrees of freedom
## Residual deviance: 25.443  on 640  degrees of freedom
## AIC: -209.65
##
## Number of Fisher Scoring iterations: 2
```

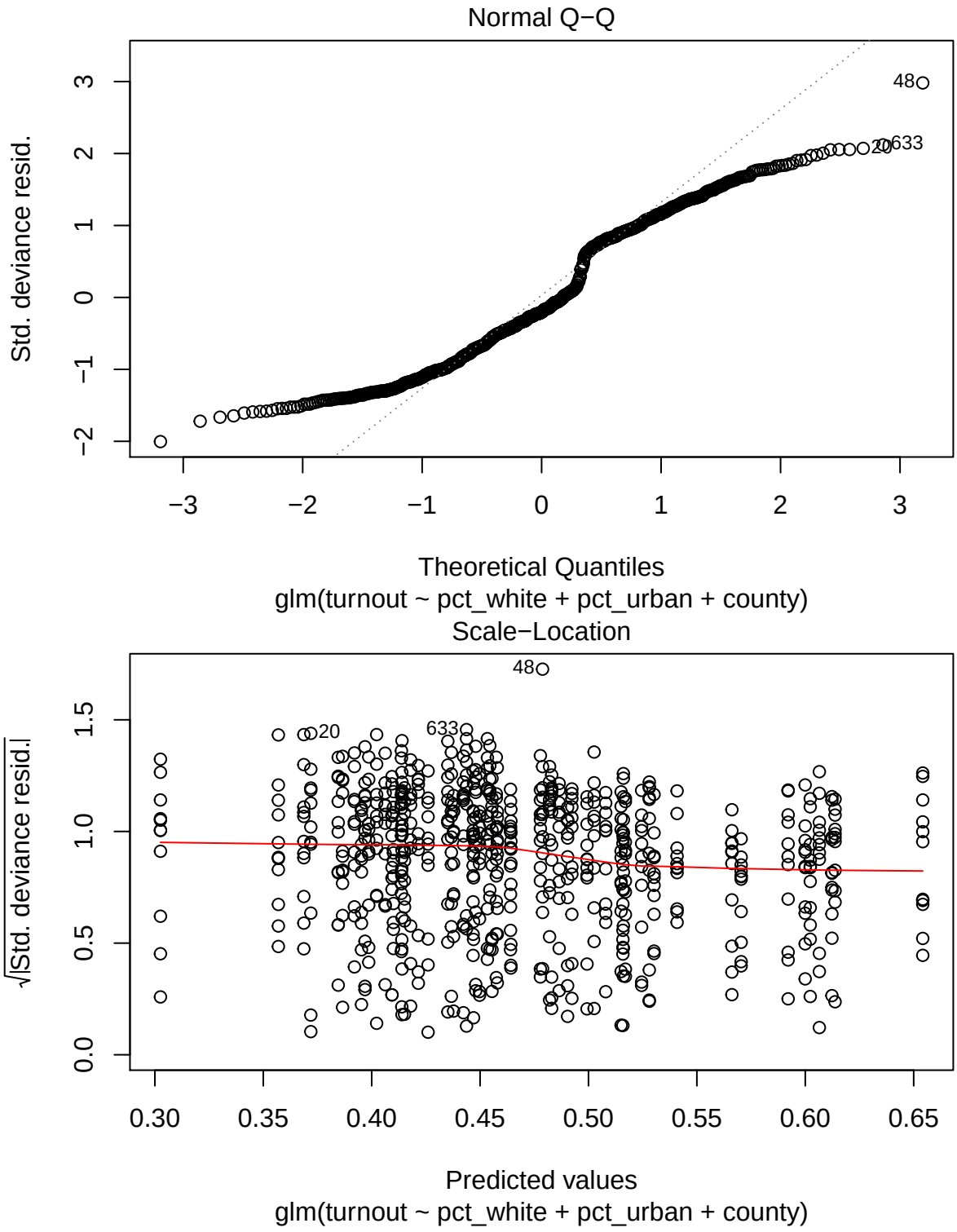
```
alias(md_1)
```

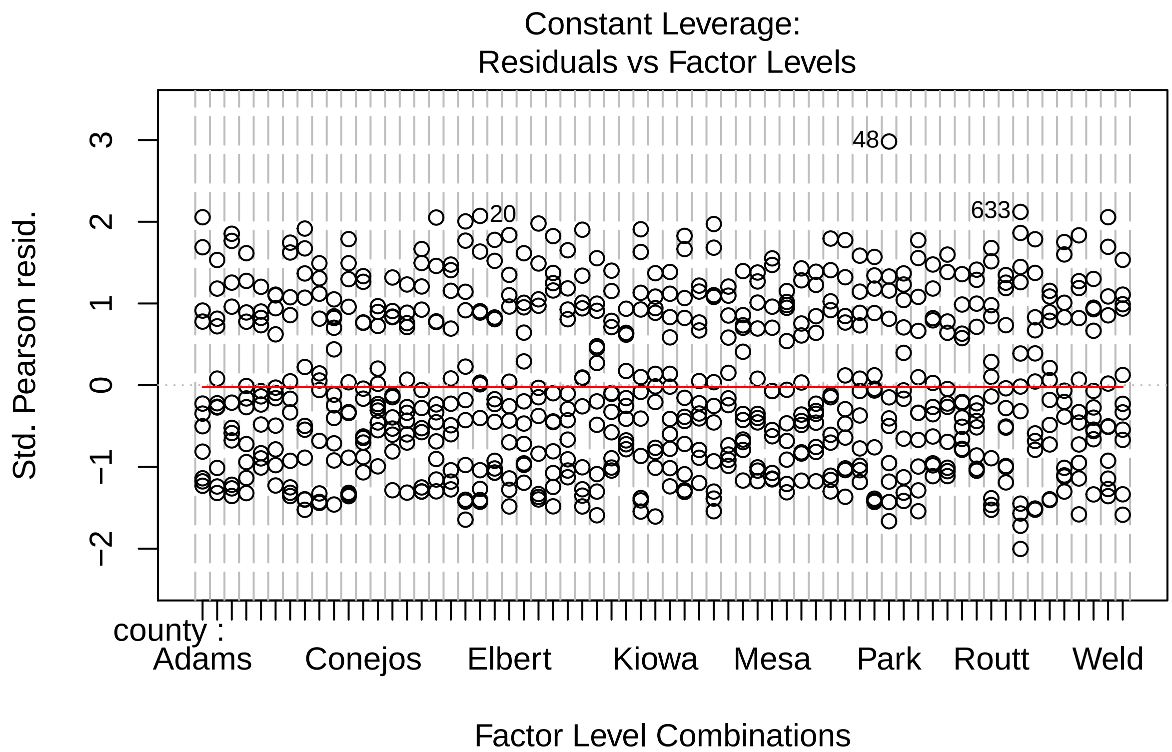
```
## Model :
## turnout ~ pct_white + pct_urban + county
##
## Complete :
##            (Intercept)         pct_white           pct_urban
## countyWeld       -175022/14401        241646/18301         63771/11986
## countyYuma      1096113/223165         -20283/5591        -88025/28456
##            countyAlamosa       countyArapahoe      countyArchuleta
## countyWeld         31771/14184           -1167/814        -19541/59323
## countyYuma  -56607947/48890606         14351/33588          -7077/8639
##            countyBaca          countyBent          countyBoulder
## countyWeld    9313819/16329946         52261/48971    -8690355/2741239
## countyYuma        -30837/17833    -4901944/5743483     6610138/8424127
##            countyBroomfield    countyChaffee       countyCheyenne
## countyWeld        -43345/11988        -41244/15821           3376/6437
## countyYuma       651479/624640        74926/454405       -136609/79581
##            countyClear Creek   countyConejos       countyCostilla
## countyWeld        -3605/410346          17375/2619       819665/101389
## countyYuma    -2116724/1348153         -16175/4764       -285911/75365
##            countyCrowley       countyCuster        countyDelta
## countyWeld          32253/7145   4830023/630240906        -29090/38123
## countyYuma      -663147/235765        -36753/23341        -57121/74964
##            countyDenver        countyDolores       countyDouglas
## countyWeld         -4606/86059        39235/269149      -526300/135883
## countyYuma          2241/30376           -1053/653     7023643/7351665
##            countyEagle         countyEl Paso       countyElbert
## countyWeld        -14025/14252      -537711/244774        61465/439959
## countyYuma     280987/82844472       217117/420068        -43283/26869
##            countyFremont       countyGarfield      countyGilpin
## countyWeld            -844/355      -218255/225898      292350/1971329
## countyYuma          12242/43533     -187971/2734111        -18091/11214
##            countyGrand         countyGunnison      countyHinsdale
## countyWeld      -161087/261786       -177199/97508       -67063/425201
## countyYuma        -24505/21889    -2535865/6373808    -2845411/1860753
##            countyHuerfano      countyJackson       countyJefferson
## countyWeld         49734/30085           4113/6775          -3804/1135
## countyYuma          -7681/5858    -5025679/2889480            883/1018
##            countyKiowa         countyKit Carson    countyLa Plata
## countyWeld         -5906/36301  -49758115/74618496        -18133/30924
## countyYuma    -4205181/2752433   -8254913/14949194        -14456/19073
##            countyLake          countyLarimer       countyLas Animas
## countyWeld       232649/288801        -79018/21369       339345/183248
## countyYuma      -356387/532603         83364/94219        -15272/13693
##            countyLincoln       countyLogan         countyMesa
## countyWeld          13313/8023  -46162729/23811154       -277901/80165
```

```
## countyYuma  -91380249/45050111              97/836         72291/89836
##             countyMineral       countyMoffat        countyMontezuma
## countyWeld           -790/1881           -2458/933        78785/158916
## countyYuma      -628641/431429        88001/261487          -4293/3659
##             countyMontrose      countyMorgan        countyOtero
## countyWeld    -7389218/7341891           2003/4772         24295/20184
## countyYuma         -5301/13304       -79174/134813      -437845/525624
##             countyOuray         countyPark          countyPhillips
## countyWeld           -553/3100     773212/12714297       475971/284617
## countyYuma    -2396579/1573081      -857548/539605        -71808/35339
##             countyPitkin        countyProwers       countyPueblo
## countyWeld         -19878/8225       121741/215059          6185/13974
## countyYuma        9441/5053207 -80960349/113296186        -12733/43389
##             countyRio Blanco    countyRio Grande    countyRoutt
## countyWeld       181081/240797         43797/15170         -18986/6949
## countyYuma          -4567/2567      -293663/167380            479/6596
##             countySaguache      countySan Juan      countySan Miguel
## countyWeld           9140/1943         71941/78708         20982/45061
## countyYuma       -174398/60873      -546771/299825    -3179054/1869549
##             countySedgwick      countySummit        countyTeller
## countyWeld       280491/328748        -80291/26312      -845323/470939
## countyYuma          -4801/2657           4309/7442           -533/1136
##             countyWashington
## countyWeld    6104257/17804938
## countyYuma                -5/3
```

```
plot(md_1)
```




Normal Q−Q
Std. deviance resid.
48
20
633
−3
−2
−1
0
1
2
3
Theoretical Quantiles
glm(turnout ~ pct_white + pct_urban + county)
Scale−Location
√|Std. deviance resid.|
48
20
633
0.0
0.5
1.0
1.5
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
Predicted values
glm(turnout ~ pct_white + pct_urban + county)




```r
md_1_cv <- cv.glm(model_dt, md_1, K=5)
```

```
## Warning in predict.lm(object, newdata, se.fit, scale = 1, type =
## ifelse(type == : prediction from a rank-deficient fit may be misleading

## Warning in predict.lm(object, newdata, se.fit, scale = 1, type =
## ifelse(type == : prediction from a rank-deficient fit may be misleading

## Warning in predict.lm(object, newdata, se.fit, scale = 1, type =
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## ifelse(type == : prediction from a rank-deficient fit may be misleading

## Warning in predict.lm(object, newdata, se.fit, scale = 1, type =
```

```
## ifelse(type == : prediction from a rank-deficient fit may be misleading
```

```
md_1_cv$delta
```

```
## [1] 0.04432898 0.04337861
```

```
##MODEL 2

md_2 <- lmer(data = model_dt, turnout ~ pct_white + pct_urban + (1|county))

arm::display(md_2)
```

```
## lmer(formula = turnout ~ pct_white + pct_urban + (1 | county),
##     data = model_dt)
##             coef.est coef.se
## (Intercept)  0.49     0.05
## pct_white    0.03     0.05
## pct_urban   -0.12     0.02
##
## Error terms:
##  Groups   Name        Std.Dev.
##  county   (Intercept) 0.00
##  Residual             0.20
## ---
## number of obs: 704, groups: county, 64
## AIC = -252.9, DIC = -298.7
## deviance = -280.8
```

```
summary(md_2)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: turnout ~ pct_white + pct_urban + (1 | county)
##    Data: model_dt
##
## REML criterion at convergence: -262.9
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.3050 -0.8218 -0.1456  0.9135  2.6318
##
## Random effects:
##  Groups   Name        Variance  Std.Dev.
##  county   (Intercept) 7.428e-20 2.725e-10
##  Residual             3.946e-02 1.986e-01
## Number of obs: 704, groups:  county, 64
##
## Fixed effects:
##             Estimate Std. Error        df t value Pr(>|t|)
## (Intercept)   0.49203    0.04510 701.00000  10.909  < 2e-16 ***
## pct_white     0.03365    0.05323 701.00000   0.632    0.528
## pct_urban    -0.11828    0.02188 701.00000  -5.407 8.82e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
```

```
##           (Intr) pct_wh
## pct_white -0.968
## pct_urban -0.503  0.336
```

```
ranef(md_2)
```

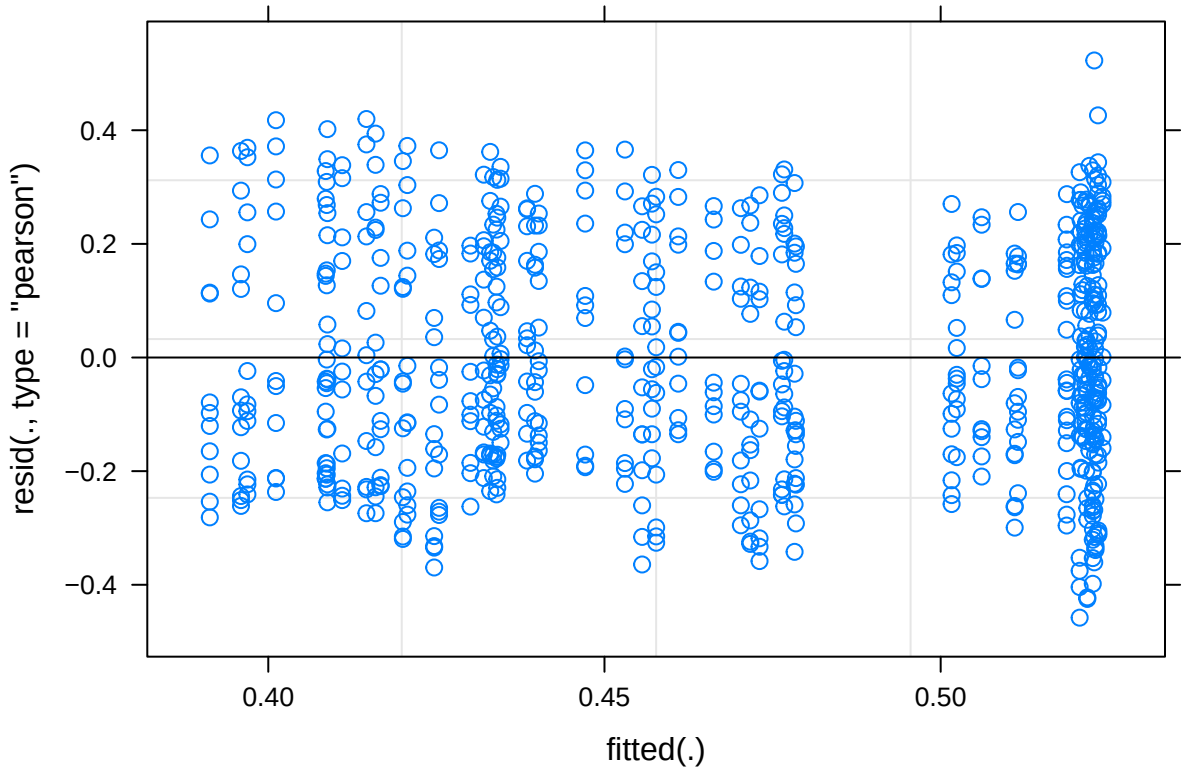
```
## $county
##                (Intercept)
## Adams       -5.639479e-19
## Alamosa      4.440962e-19
## Arapahoe     3.486192e-19
## Archuleta   -9.166268e-19
## Baca         9.237483e-19
## Bent         1.074526e-18
## Boulder      1.442052e-19
## Broomfield   1.104455e-18
## Chaffee      1.675729e-18
## Cheyenne     1.621136e-18
## Clear Creek -1.671050e-18
## Conejos     -1.400398e-19
## Costilla     2.792734e-19
## Crowley      1.145014e-19
## Custer       1.642520e-18
## Delta        1.172380e-19
## Denver      -7.110009e-19
## Dolores     -7.485403e-19
## Douglas      8.028805e-19
## Eagle       -9.958168e-19
## El Paso     -2.050538e-19
## Elbert      -4.150185e-19
## Fremont      3.051074e-19
## Garfield    -2.364408e-19
## Gilpin      -2.410078e-18
## Grand       -9.043801e-19
## Gunnison    -1.576786e-18
## Hinsdale     2.708360e-18
## Huerfano     1.315891e-18
## Jackson      1.014080e-18
## Jefferson    8.116924e-19
## Kiowa        1.720338e-18
## Kit Carson   1.200951e-18
## La Plata    -1.649427e-18
## Lake        -7.200193e-19
## Larimer      3.970802e-19
## Las Animas   4.966655e-19
## Lincoln      4.576345e-19
## Logan        1.519890e-18
## Mesa        -1.517905e-19
## Mineral      1.856827e-18
## Moffat      -3.891256e-19
## Montezuma   -1.417010e-18
## Montrose     5.130259e-19
## Morgan       5.070040e-19
## Otero        3.374114e-19
## Ouray       -8.373674e-19
```

```
## Park         -9.118196e-19
## Phillips     -5.464854e-19
## Pitkin       -1.470787e-18
## Prowers       1.515902e-19
## Pueblo        1.076986e-19
## Rio Blanco    1.896524e-19
## Rio Grande   -4.564709e-20
## Routt        -7.490440e-19
## Saguache     -1.516595e-18
## San Juan     -1.592728e-18
## San Miguel   -2.800300e-18
## Sedgwick      1.475658e-18
## Summit       -2.528358e-18
## Teller       -8.596100e-19
## Washington    1.867231e-18
## Weld         -3.810774e-19
## Yuma          8.152546e-19
```

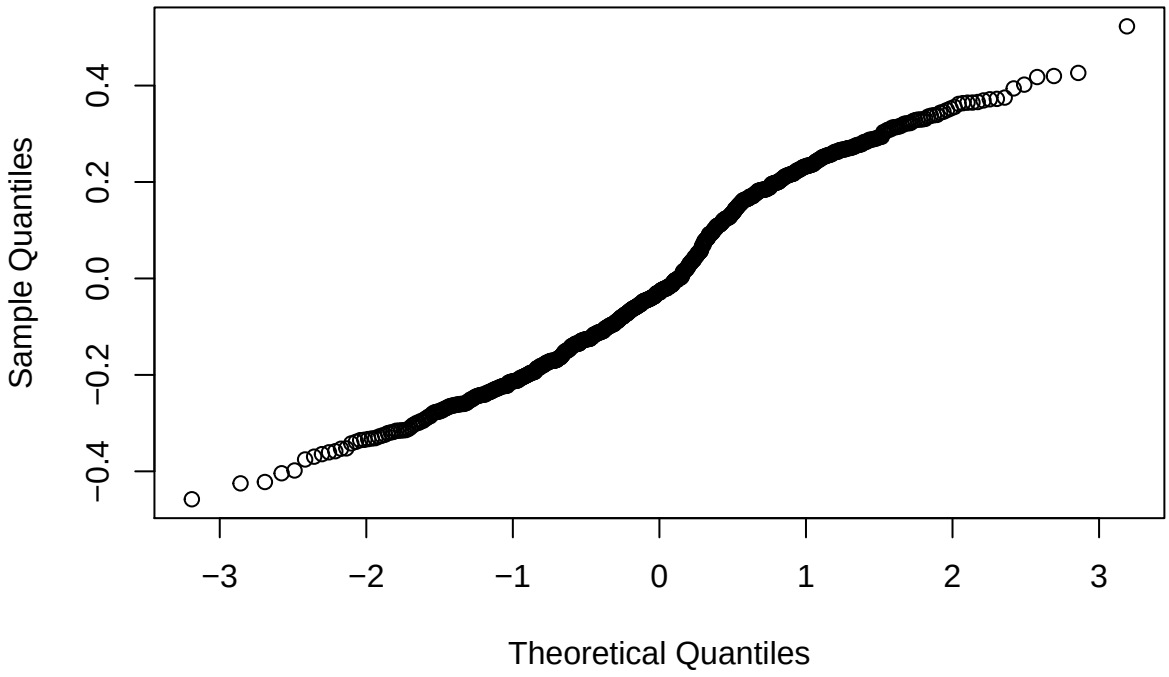
```
fixef(md_2)
```

```
## (Intercept)   pct_white   pct_urban
##  0.49202848  0.03364891 -0.11827707
```

```
plot(md_2)
```




```
qqnorm(residuals(md_2))
```




```
##MODEL 3

md_3 <- lmer(data = model_dt, turnout ~ 1 + types + pct_vbm +
               pct_urban + pct_white + pct_vbm*types + (1|county))

arm::display(md_3)
```

```
## lmer(formula = turnout ~ 1 + types + pct_vbm + pct_urban + pct_white +
##     pct_vbm * types + (1 | county), data = model_dt)
##                       coef.est coef.se
## (Intercept)            0.46     0.08
## typesGeneral           0.19     0.07
## typesMidterm           0.25     0.07
## typesPrimary          -0.07     0.07
## pct_vbm                0.00     0.07
## pct_urban             -0.12     0.02
## pct_white              0.03     0.05
## typesGeneral:pct_vbm   0.15     0.07
## typesMidterm:pct_vbm  -0.06     0.07
## typesPrimary:pct_vbm  -0.09     0.07
##
## Error terms:
##  Groups   Name        Std.Dev.
##  county   (Intercept) 0.05
##  Residual             0.06
## ---
## number of obs: 704, groups: county, 64
## AIC = -1716.4, DIC = -1866
## deviance = -1803.2
```

```r
summary(md_3)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## turnout ~ 1 + types + pct_vbm + pct_urban + pct_white + pct_vbm *
##     types + (1 | county)
##    Data: model_dt
##
## REML criterion at convergence: -1740.4
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.6562 -0.6606 -0.0802  0.5676  4.3284
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  county   (Intercept) 0.002992 0.05470
##  Residual             0.003725 0.06103
## Number of obs: 704, groups:  county, 64
##
## Fixed effects:
##                         Estimate Std. Error         df t value Pr(>|t|)
## (Intercept)             0.455323   0.078735 420.449168   5.783 1.43e-08 ***
## typesGeneral            0.189513   0.070405 646.568238   2.692 0.007291 **
## typesMidterm            0.251514   0.068701 648.003082   3.661 0.000272 ***
## typesPrimary           -0.071025   0.069101 643.013614  -1.028 0.304412
## pct_vbm                -0.001898   0.066976 651.651005  -0.028 0.977397
## pct_urban              -0.116833   0.021088  60.776531  -5.540 6.88e-07 ***
## pct_white               0.032829   0.051294  60.687975   0.640 0.524567
## typesGeneral:pct_vbm    0.152441   0.073724 645.355240   2.068 0.039063 *
## typesMidterm:pct_vbm   -0.056684   0.071323 647.009558  -0.795 0.427056
## typesPrimary:pct_vbm   -0.087717   0.070528 642.824976  -1.244 0.214055
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) typsGn typsMd typsPr pct_vb pct_rb pct_wh typG:_ typM:_
## typesGenerl -0.774
## typesMidtrm -0.795  0.882
## typesPrimry -0.770  0.858  0.881
## pct_vbm     -0.832  0.923  0.949  0.920
## pct_urban   -0.272 -0.004 -0.004  0.003 -0.007
## pct_white   -0.532  0.000 -0.001 -0.003 -0.003  0.336
## typsGnrl:p_  0.748 -0.992 -0.853 -0.830 -0.896  0.003  0.000
## typsMdtrm:_  0.776 -0.860 -0.992 -0.860 -0.930  0.003  0.000  0.836
## typsPrmry:_  0.765 -0.851 -0.874 -0.996 -0.917 -0.004  0.003  0.828  0.857
```

```r
ranef(md_3)
```

```
## $county
##               (Intercept)
## Adams       -2.382243e-02
## Alamosa      1.969410e-02
```

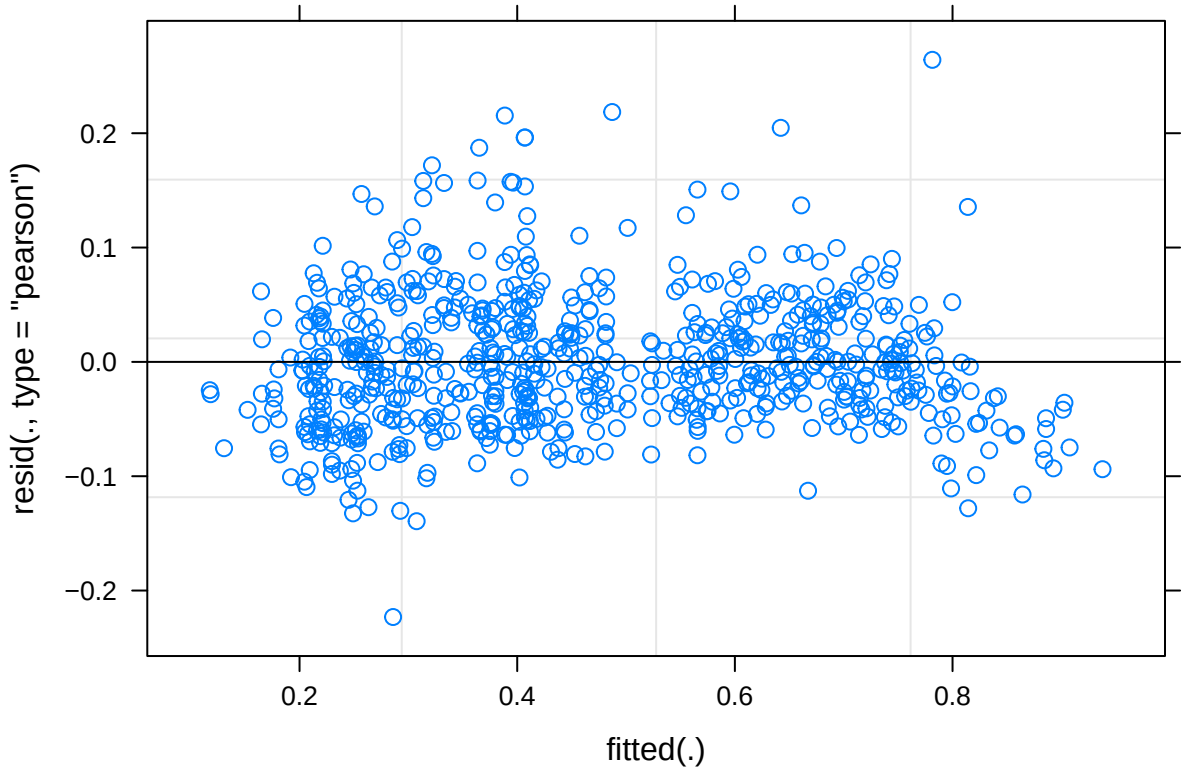
```
## Arapahoe     1.563754e-02
## Archuleta   -4.076580e-02
## Baca         4.163323e-02
## Bent         4.817540e-02
## Boulder      6.821945e-03
## Broomfield   4.824689e-02
## Chaffee      7.299585e-02
## Cheyenne     7.269259e-02
## Clear Creek -7.425510e-02
## Conejos     -4.511463e-03
## Costilla     8.871632e-03
## Crowley      7.995174e-03
## Custer       6.592292e-02
## Delta        6.205391e-03
## Denver      -3.033145e-02
## Dolores     -3.033967e-02
## Douglas      3.533863e-02
## Eagle       -4.259044e-02
## El Paso     -9.378466e-03
## Elbert      -1.680383e-02
## Fremont      1.478907e-02
## Garfield    -9.545322e-03
## Gilpin      -1.078281e-01
## Grand       -3.751637e-02
## Gunnison    -6.620471e-02
## Hinsdale     1.118020e-01
## Huerfano     5.869779e-02
## Jackson      4.021378e-02
## Jefferson    3.549839e-02
## Kiowa        7.679425e-02
## Kit Carson   4.774945e-02
## La Plata    -6.971753e-02
## Lake        -3.743398e-02
## Larimer      1.785076e-02
## Las Animas   2.034062e-02
## Lincoln      2.195112e-02
## Logan        6.589940e-02
## Mesa        -6.954947e-03
## Mineral      8.092664e-02
## Moffat      -1.890444e-02
## Montezuma   -5.966571e-02
## Montrose     2.333387e-02
## Morgan       2.283675e-02
## Otero        1.556119e-02
## Ouray       -3.441299e-02
## Park        -4.039314e-02
## Phillips    -2.230239e-02
## Pitkin      -6.950923e-02
## Prowers      4.117000e-03
## Pueblo       5.630350e-03
## Rio Blanco   9.746122e-03
## Rio Grande   8.541873e-05
## Routt       -3.068352e-02
## Saguache    -6.832954e-02
```

```
## San Juan    -7.344061e-02
## San Miguel  -1.192599e-01
## Sedgwick     6.580142e-02
## Summit      -1.115885e-01
## Teller      -3.725114e-02
## Washington   8.303556e-02
## Weld        -1.645519e-02
## Yuma         3.730376e-02
```

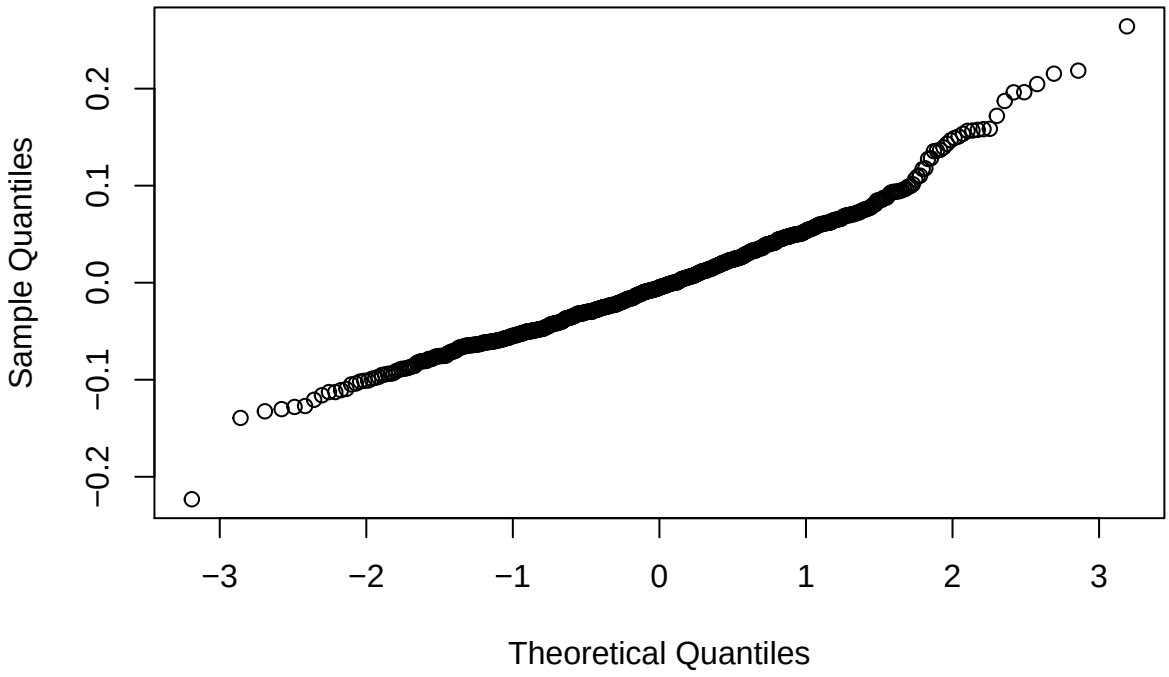
```
fixef(md_3)
```

```
##           (Intercept)         typesGeneral         typesMidterm
##            0.45532312           0.18951337           0.25151371
##         typesPrimary              pct_vbm            pct_urban
##           -0.07102476          -0.00189834          -0.11683342
##            pct_white typesGeneral:pct_vbm typesMidterm:pct_vbm
##            0.03282919           0.15244096          -0.05668361
## typesPrimary:pct_vbm
##           -0.08771676
```

```
plot(md_3)
```




```
qqnorm(residuals(md_3))
```




```
#Significant difference by adding extra variables
anova(md_2, md_3)
```

```
## refitting model(s) with ML (instead of REML)
```

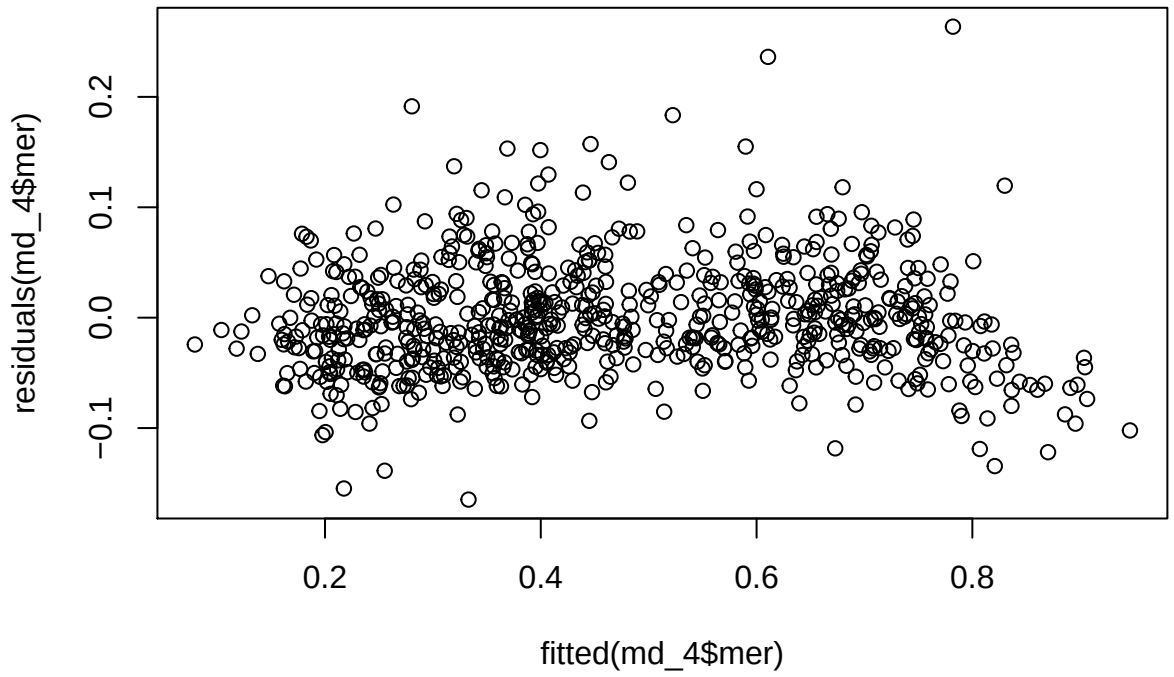
```
## Data: model_dt
## Models:
## md_2: turnout ~ pct_white + pct_urban + (1 | county)
## md_3: turnout ~ 1 + types + pct_vbm + pct_urban + pct_white + pct_vbm *
## md_3:     types + (1 | county)
##      Df      AIC      BIC logLik deviance  Chisq Chi Df Pr(>Chisq)
## md_2  5  -270.82  -248.03 140.41  -280.82
## md_3 12 -1779.20 -1724.52 901.60 -1803.20 1522.4      7  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##MODEL 4

model_dt$dates <-  as.integer(model_dt$dates)

md_4 <- gamm4(turnout ~ 1 + types + types +
                pct_urban + pct_white + pct_vbm*types + s(dates, k = 7),
              random =~ (1|county),
              data = model_dt)

summary(md_4$mer)
```

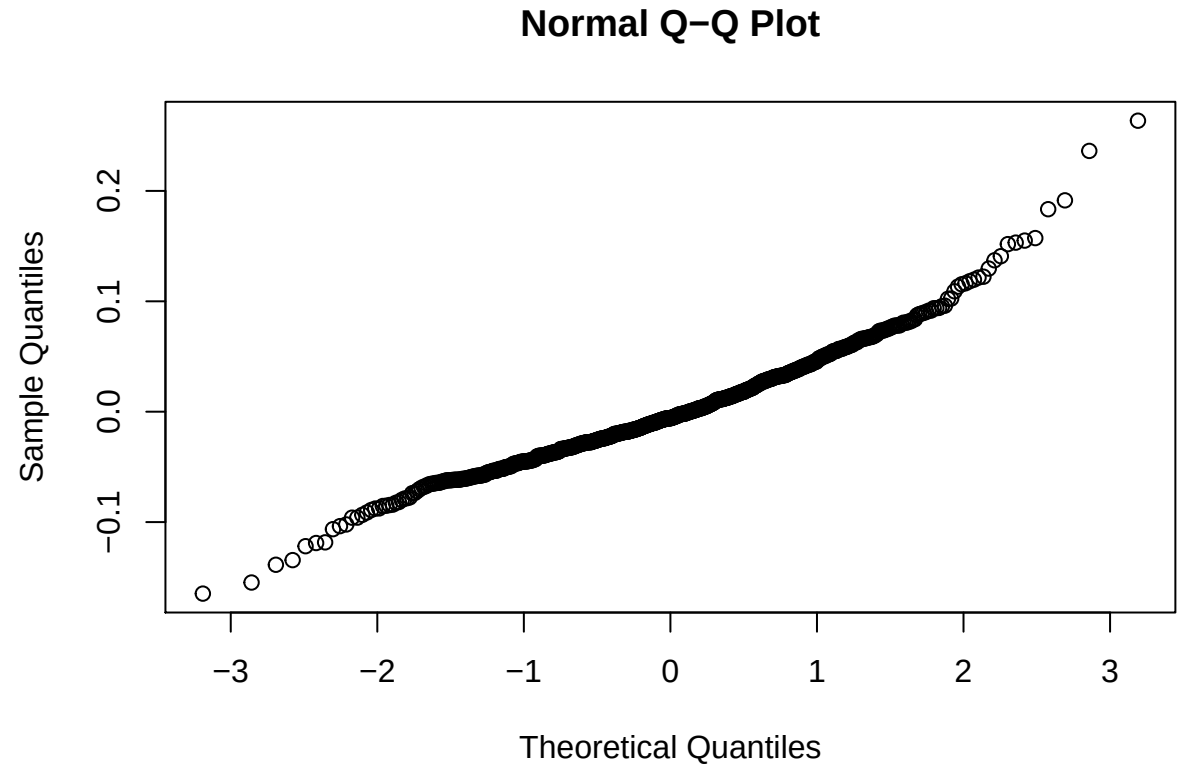
```
## Linear mixed model fit by REML ['lmerMod']
##
## REML criterion at convergence: -1899.4
##
```

```
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -3.1206 -0.6102 -0.1110  0.5546  4.9920
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  county   (Intercept) 0.002962 0.05442
##  Xr       s(dates)    0.967661 0.98370
##  Residual             0.002788 0.05281
## Number of obs: 704, groups:  county, 64; Xr, 5
##
## Fixed effects:
##                         Estimate Std. Error t value
## X(Intercept)            0.469534   0.072036   6.518
## XtypesGeneral           0.254063   0.064603   3.933
## XtypesMidterm           0.070291   0.062977   1.116
## XtypesPrimary          -0.170327   0.061898  -2.752
## Xpct_urban             -0.119413   0.020723  -5.762
## Xpct_white              0.031336   0.050401   0.622
## Xpct_vbm                0.002371   0.058353   0.041
## XtypesGeneral:pct_vbm   0.085084   0.067613   1.258
## XtypesMidterm:pct_vbm   0.106871   0.064296   1.662
## XtypesPrimary:pct_vbm -0.005732   0.061585  -0.093
## Xs(dates)Fx1           -0.113090   0.019823  -5.705
##
## Correlation of Fixed Effects:
##             X(Int) XtypsG XtypsM XtypsP Xpct_r Xpct_w Xpct_v XtyG:_ XtyM:_
## XtypesGenrl -0.715
## XtypesMdtrm -0.741  0.822
## XtypesPrmry -0.736  0.833  0.882
## Xpct_urban  -0.292 -0.001  0.000  0.005
## Xpct_white  -0.571  0.001  0.000 -0.002  0.336
## Xpct_vbm    -0.792  0.864  0.887  0.883 -0.008 -0.003
## XtypsGnrl:_  0.661 -0.967 -0.747 -0.764  0.000 -0.002 -0.836
## XtypsMdtr:_  0.705 -0.779 -0.968 -0.833 -0.001 -0.001 -0.880  0.751
## XtypsPrmr:_  0.719 -0.808 -0.846 -0.972 -0.005  0.002 -0.903  0.789  0.846
## Xs(dats)Fx1 -0.015  0.116  0.138  0.107  0.011  0.004  0.013 -0.156 -0.146
##             XtyP:_
## XtypesGenrl
## XtypesMdtrm
## XtypesPrmry
## Xpct_urban
## Xpct_white
## Xpct_vbm
## XtypsGnrl:_
## XtypsMdtr:_
## XtypsPrmr:_
## Xs(dats)Fx1 -0.112
```

```
plot(fitted(md_4$mer), residuals(md_4$mer))
```




```
qqnorm(residuals(md_4$mer))
```



CV MSE

```
#Get folds from data
set.seed(1)
folds <- split(sample(nrow(model_dt), nrow(model_dt),replace=FALSE), as.factor(1:5))
```

```
## Warning in split.default(sample(nrow(model_dt), nrow(model_dt), replace =
```

```
## FALSE), : data length is not a multiple of split variable
```

```
#Model 2
mse <- rep(0,5)

for(i in 1:5){
  md_2.fit <- lmer(data = model_dt, subset = -folds[[i]], turnout ~ pct_white + pct_urban + (1|county))

  mse[i] <- mean((model_dt$turnout - predict(md_2.fit, model_dt))[folds[[i]]]^2)
}

mean(mse)
```

```
## [1] 0.04001409
```

```
#Model 3
mse <- rep(0,5)

for(i in 1:5){
  md_3.fit <- lmer(data = model_dt, subset = -folds[[i]], turnout ~ 1 + types + pct_vbm +
                 pct_urban + pct_white + pct_vbm*types + (1|county))

  mse[i] <- mean((model_dt$turnout - predict(md_3.fit, model_dt))[folds[[i]]]^2)
}

mean(mse)
```

```
## [1] 0.004320114
```

```
#Model 4
mse <- rep(0,5)

model_dt$dates <-  as.integer(model_dt$dates)

for(i in 1:5){
  md_4.fit <- gamm4(turnout ~ 1 + types + types +
                  pct_urban + pct_white + pct_vbm*types + s(dates, k = 7),
                random =~ (1|county),
                data = model_dt, subset = -folds[[i]])

  mse[i] <- mean((model_dt$turnout - predict(md_4.fit$gam, model_dt))[folds[[i]]]^2)
}

mean(mse)
```

```
## [1] 0.005763717
```