MCMCGuide10

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Contents


```
data(bang1, package = "R2MLwiN")
```

10.1 Simple logistic regression model

```
(mymodel1 <-
    runMLwiN(
      logit(use) ~ 1 + age,
      D = "Binomial",
      estoptions = list(
        EstM = 1),
      data = bang1))
```

```
## MLwiN is running, please wait......
```

```
##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
## Estimation algorithm:  MCMC      Elapsed time : 38.53s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2591.282   2589.292   1.990      2593.272
## ---------------------------------------------------------------------------------------------------
## The model formula:
## logit(use) ~ 1 + age
## Level 1: l1id
## ---------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                 Coef.   Std. Err.      z    Pr(>|z|)       [95% Cred.   Interval]    ESS
## Intercept   -0.43703     0.04725  -9.25   2.264e-20  ***    -0.52609    -0.34091   1095
## age          0.00633     0.00506   1.25      0.2112         -0.00356     0.01637   1058
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                   Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

```
summary(mymodel1@chains[, "FP_age"])
```

```
##
## Iterations = 1:5000
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 5000
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##           Mean             SD       Naive SE Time-series SE
##      6.327e-03      5.061e-03      7.157e-05      1.556e-04
##
## 2. Quantiles for each variable:
##
##      2.5%       25%       50%       75%     97.5%
## -0.003556  0.002927  0.006276  0.009770  0.016368
```

```
sixway(mymodel1@chains[, "FP_age", drop = FALSE], "beta_1")
```

15,000 iterations

```
(mymodel2 <-
    runMLwiN(
      logit(use) ~ 1 + age,
      D = "Binomial",
      estoptions = list(
        EstM = 1,
        mcmcMeth = list(iterations = 15000)),
      data = bang1))
```

```
## MLwiN is running, please wait......
```

```
##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
## Estimation algorithm:  MCMC      Elapsed time : 23.38s
## Number of obs:  1934 (from total 1934)          Number of iter.: 15000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2591.284   2589.290   1.994      2593.278
## ---------------------------------------------------------------------------------------------
## The model formula:
## logit(use) ~ 1 + age
## Level 1: l1id
## ---------------------------------------------------------------------------------------------
## The fixed part estimates:
##                  Coef.   Std. Err.       z   Pr(>|z|)       [95% Cred.   Interval]    ESS
## Intercept   -0.43781     0.04666  -9.38   6.45e-21   ***    -0.52870    -0.34622   3402
## age          0.00656     0.00514    1.28     0.2015          -0.00352     0.01686   3311
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## ---------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                    Coef.   Std. Err.   [95% Cred.   Interval]     ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   15000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

```r
sixway(mymodel1@chains[, "FP_age", drop = FALSE], "beta_1")
```

Change to 5000 iterations by default

```r
(mymodel3 <-
   runMLwiN(
      logit(use) ~ 1 + age + lc,
      D = "Binomial",
      estoptions = list(EstM = 1),
      data = bang1))
```

```
## MLwiN is running, please wait......
```

```
##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
## Estimation algorithm:  MCMC      Elapsed time : 23.33s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2519.976   2515.099   4.877      2524.852
## ---------------------------------------------------------------------------------------------------
## The model formula:
## logit(use) ~ 1 + age + lc
## Level 1: l1id
## ---------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                     Coef.   Std. Err.       z    Pr(>|z|)       [95% Cred.   Interval]   ESS
## Intercept        -1.26579     0.11517  -10.99   4.225e-28  ***    -1.48935    -1.04721   102
## age              -0.02186     0.00725   -3.01    0.002587  **     -0.03700    -0.00816   244
## lcOne_child       1.03150     0.14341    7.19   6.344e-13  ***     0.75458     1.29899   303
## lcTwo_children    1.18475     0.16572    7.15   8.725e-13  ***     0.86284     1.50298   201
## lcThree_plus      1.11811     0.16513    6.77   1.277e-11  ***     0.82670     1.45181   114
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                 Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

10.2 Random effects logistic regression model

```r
(mymodel4 <-
   runMLwiN(
      logit(use) ~ 1 + age + lc + (1 | district),
      D = "Binomial",
      estoptions = list(EstM = 1),
   data = bang1))
```

```
## MLwiN is running, please wait......
```

```
##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
```

```
##           N min     mean max N_complete min_complete mean_complete
## district 60   2 32.23333 118         60            2      32.23333
##          max_complete
## district          118
## Estimation algorithm:  MCMC      Elapsed time : 20.94s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2395.915   2354.503   41.412     2437.328
## ---------------------------------------------------------------------------------------------------
## The model formula:
## logit(use) ~ 1 + age + lc + (1 | district)
## Level 2: district     Level 1: l1id
## ---------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                      Coef.   Std. Err.       z    Pr(>|z|)       [95% Cred.   Interval]   ESS
## Intercept        -1.46065     0.12898   -11.32   9.878e-30   ***    -1.71772    -1.21598   108
## age              -0.02473     0.00747    -3.31   0.0009365   ***    -0.04016    -0.01094   377
## lcOne_child       1.08142     0.14487     7.46   8.349e-14   ***     0.78755     1.36517   298
## lcTwo_children    1.29737     0.15510     8.36   6.027e-17   ***     1.00176     1.59121   201
## lcThree_plus      1.27047     0.15697     8.09   5.795e-16   ***     0.96509     1.58183   139
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the district level:
##                    Coef.   Std. Err.   [95% Cred.   Interval]   ESS
## var_Intercept   0.30935     0.10079      0.16078     0.55109   417
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                  Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

```
summary(mymodel4@chains[, "RP2_var_Intercept"])
```

```
##
## Iterations = 1:5000
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 5000
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##           Mean             SD       Naive SE Time-series SE
##       0.309348       0.100789       0.001425       0.004937
##
## 2. Quantiles for each variable:
##
##   2.5%    25%    50%    75%  97.5%
## 0.1608 0.2379 0.2930 0.3612 0.5511
```

```
sixway(mymodel4@chains[, "RP2_var_Intercept", drop = FALSE], "sigma2u0")
```

10.3 Random coefficients for area type

```
(mymodel5 <-
    runMLwiN(
      logit(use) ~ 1 + age + lc + urban + (1 | district),
      D = "Binomial", estoptions = list(EstM = 1),
      data = bang1))
```

```
## MLwiN is running, please wait......
```

```
##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
##           N min     mean max N_complete min_complete mean_complete
## district 60   2 32.23333 118         60            2      32.23333
##          max_complete
## district          118
## Estimation algorithm:  MCMC      Elapsed time : 25.06s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2369.363   2330.577   38.786     2408.149
## -----------------------------------------------------------------------------------------------------
## The model formula:
## logit(use) ~ 1 + age + lc + urban + (1 | district)
## Level 2: district     Level 1: l1id
## -----------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                        Coef.   Std. Err.       z    Pr(>|z|)       [95% Cred.   Interval]   ESS
## Intercept        -1.71506     0.16280  -10.53   5.991e-26   ***    -2.04311    -1.40106    70
## age              -0.02679     0.00805   -3.33   0.0008673   ***    -0.04202    -0.01015   189
## lcOne_child       1.13969     0.15923    7.16   8.223e-13   ***     0.84281     1.45565   253
## lcTwo_children    1.39124     0.18170    7.66   1.903e-14   ***     1.03221     1.73964   152
## lcThree_plus      1.36047     0.18416    7.39   1.498e-13   ***     0.99559     1.73294    93
## urbanUrban        0.73553     0.12339    5.96   2.504e-09   ***     0.49766     0.97904   388
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## -----------------------------------------------------------------------------------------------------
## The random part estimates at the district level:
##                      Coef.   Std. Err.   [95% Cred.   Interval]   ESS
## var_Intercept   0.23668     0.08368      0.10751     0.43849   330
## -----------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                    Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

```
(mymodel6 <-
  runMLwiN(
    logit(use) ~ 1 + age + lc + urban + (1 + urban | district),
    D = "Binomial",
    estoptions = list(EstM = 1),
    data = bang1))
```

```
## MLwiN is running, please wait......
```

```
##
```

```
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
##           N min     mean max N_complete min_complete mean_complete
## district 60   2 32.23333 118         60            2      32.23333
##          max_complete
## district          118
## Estimation algorithm:  MCMC      Elapsed time : 32.59s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2328.933   2272.311   56.622     2385.556
## --------------------------------------------------------------------------------------------------------
## The model formula:
## logit(use) ~ 1 + age + lc + urban + (1 + urban | district)
## Level 2: district     Level 1: l1id
## --------------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                     Coef.   Std. Err.       z    Pr(>|z|)       [95% Cred.   Interval]   ESS
## Intercept        -1.72354     0.15906  -10.84   2.332e-27  ***    -2.03039    -1.39442    61
## age              -0.02727     0.00786   -3.47   0.0005197  ***    -0.04282    -0.01122   203
## lcOne_child       1.15731     0.15738    7.35   1.928e-13  ***     0.83848     1.46651   229
## lcTwo_children    1.37595     0.17441    7.89   3.039e-15  ***     1.02279     1.70107   186
## lcThree_plus      1.38420     0.17993    7.69   1.439e-14  ***     1.00169     1.73599   102
## urbanUrban        0.80537     0.18896    4.26   2.025e-05  ***     0.42332     1.18309   110
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## --------------------------------------------------------------------------------------------------------
## The random part estimates at the district level:
##                               Coef.   Std. Err.   [95% Cred.   Interval]   ESS
## var_Intercept               0.41802     0.13682      0.20269     0.73076   206
## cov_Intercept_urbanUrban   -0.43246     0.17573     -0.83467    -0.15496   127
## var_urbanUrban              0.73806     0.30328      0.29716     1.45696   142
## --------------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                 Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

10.4 Probit regression

10.5 Running a probit regression in MLwiN

Gibbs

```r
(mymodel7 <-
    runMLwiN(
      probit(use) ~ 1 + age + lc + urban + (1 + urban | district),
      D = "Binomial",
      estoptions = list(
        EstM = 1,
        mcmcMeth = list(
          fixM = 1,
          residM = 1)),
      data = bang1))
```

```
## MLwiN is running, please wait......

##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
##           N min     mean max N_complete min_complete mean_complete
## district 60   2 32.23333 118         60            2      32.23333
##          max_complete
## district          118
## Estimation algorithm:  MCMC      Elapsed time : 20.14s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2328.195   1007.337   1320.858   3649.052
## ---------------------------------------------------------------------------------------------------
## The model formula:
## probit(use) ~ 1 + age + lc + urban + (1 + urban | district)
## Level 2: district     Level 1: l1id
## ---------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                      Coef.   Std. Err.       z    Pr(>|z|)       [95% Cred.   Interval]    ESS
## Intercept         -1.03853     0.09948  -10.44    1.63e-25  ***    -1.24024    -0.84696    564
## age               -0.01616     0.00490   -3.30   0.0009643  ***    -0.02572    -0.00659   1731
## lcOne_child        0.68254     0.09656    7.07   1.566e-12  ***     0.49400     0.86843   1770
## lcTwo_children     0.82280     0.10595    7.77    8.12e-15  ***     0.61187     1.02849   1761
## lcThree_plus       0.81935     0.11088    7.39   1.476e-13  ***     0.60471     1.03509   1347
## urbanUrban         0.50127     0.10917    4.59   4.399e-06  ***     0.28980     0.72040    601
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the district level:
##                               Coef.   Std. Err.   [95% Cred.   Interval]   ESS
## var_Intercept               0.15505     0.04953      0.07702     0.26990   740
## cov_Intercept_urbanUrban   -0.16011     0.06674     -0.32193    -0.05679   521
## var_urbanUrban              0.26745     0.11815      0.09442     0.55287   399
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                  Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

Univariate MH by default

```
(mymodel8 <-
    runMLwiN(
      probit(use) ~ 1 + age + lc + urban + (1 + urban | district),
      D = "Binomial",
      estoptions = list(EstM = 1),
      data = bang1))
```

```
## MLwiN is running, please wait......

##
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
## MLwiN (version: 2.36)  multilevel model (Binomial)
##           N min     mean max N_complete min_complete mean_complete
```

```
## district 60   2 32.23333 118         60           2      32.23333
##          max_complete
## district          118
## Estimation algorithm:  MCMC      Elapsed time : 44.74s
## Number of obs:  1934 (from total 1934)          Number of iter.: 5000  Chains: 1  Burn-in: 500
## Bayesian Deviance Information Criterion (DIC)
## Dbar      D(thetabar)    pD      DIC
## 2327.162   2271.196   55.966     2383.128
## ---------------------------------------------------------------------------------------------------
## The model formula:
## probit(use) ~ 1 + age + lc + urban + (1 + urban | district)
## Level 2: district     Level 1: l1id
## ---------------------------------------------------------------------------------------------------
## The fixed part estimates:
##                     Coef.   Std. Err.       z    Pr(>|z|)       [95% Cred.   Interval]   ESS
## Intercept        -1.04763     0.09898  -10.58   3.511e-26  ***    -1.24631    -0.86649    63
## age              -0.01640     0.00466   -3.52   0.0004287  ***    -0.02549    -0.00736   241
## lcOne_child       0.69214     0.10000    6.92   4.471e-12  ***     0.50055     0.88713   281
## lcTwo_children    0.82995     0.10818    7.67   1.695e-14  ***     0.61289     1.04145   205
## lcThree_plus      0.82927     0.10760    7.71   1.289e-14  ***     0.62619     1.04235   109
## urbanUrban        0.50550     0.10936    4.62   3.791e-06  ***     0.30074     0.74285    92
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the district level:
##                              Coef.   Std. Err.   [95% Cred.   Interval]   ESS
## var_Intercept              0.15931     0.05075      0.07825     0.27472   136
## cov_Intercept_urbanUrban   -0.17052     0.06553     -0.32494    -0.07309   123
## var_urbanUrban             0.28121     0.11114      0.11954     0.54435   129
## ---------------------------------------------------------------------------------------------------
## The random part estimates at the l1id level:
##                 Coef.   Std. Err.   [95% Cred.   Interval]    ESS
## var_bcons_1   1.00000       1e-05      1.00000     1.00000   5000
## -*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-
```

```
library(texreg)
```

```
## Version:  1.36.18
## Date:     2016-10-22
## Author:   Philip Leifeld (University of Glasgow)
##
## Please cite the JSS article in your publications -- see citation("texreg").
```

```
##
## Attaching package: 'texreg'
```

```
## The following object is masked from 'package:magrittr':
##
##     extract
```

```
## The following object is masked from 'package:tidyr':
##
##     extract
```

```
screenreg(
  list(mymodel7, mymodel8),
  custom.model.names=c("Gibbs", "Metropolis"),
  groups = list(
```

```
    "Fixed Part" = 1:6,
    "Level-2"    = 7:9,
    "Level-1"    = 10:10),
  stars = numeric(0),
  include.nobs=FALSE,
  include.loglik=FALSE,
  include.deviance=FALSE,
  include.dbar=FALSE,
  include.dthetabar=FALSE,
  include.pd=FALSE,
  include.dic=FALSE)
```

```
##
## ====================================================================
##                                    Gibbs           Metropolis
## --------------------------------------------------------------------
## Fixed Part
##
##     FP_Intercept                    -1.04 *         -1.05 *
##                                    [-1.24; -0.85]  [-1.25; -0.87]
##     FP_age                          -0.02 *         -0.02 *
##                                    [-0.03; -0.01]  [-0.03; -0.01]
##     FP_lcOne_child                   0.68 *          0.69 *
##                                    [ 0.49;  0.87]  [ 0.50;  0.89]
##     FP_lcTwo_children                0.82 *          0.83 *
##                                    [ 0.61;  1.03]  [ 0.61;  1.04]
##     FP_lcThree_plus                  0.82 *          0.83 *
##                                    [ 0.60;  1.04]  [ 0.63;  1.04]
##     FP_urbanUrban                    0.50 *          0.51 *
##                                    [ 0.29;  0.72]  [ 0.30;  0.74]
## Level-2
##
##     RP2_var_Intercept                0.16 *          0.16 *
##                                    [ 0.08;  0.27]  [ 0.08;  0.27]
##     RP2_cov_Intercept_urbanUrban    -0.16 *         -0.17 *
##                                    [-0.32; -0.06]  [-0.32; -0.07]
##     RP2_var_urbanUrban               0.27 *          0.28 *
##                                    [ 0.09;  0.55]  [ 0.12;  0.54]
## Level-1
##
##     RP1_var_bcons_1                  1.00 *          1.00 *
##                                    [ 1.00;  1.00]  [ 1.00;  1.00]
## ====================================================================
## * 0 outside the confidence interval
```

```
cat("The effective sample sizes\n")
```

```
## The effective sample sizes
```

```
ESS.aa <- effectiveSize(mymodel7@chains[, 2:11])

ESS.bb <- effectiveSize(mymodel8@chains[, 2:11])

ctable <- cbind(round(ESS.aa), round(ESS.bb))

colnames(ctable) <- c("ESS(Gibbs)", "ESS(Metropolis)")
```

```
print(ctable)
```

```
##                                ESS(Gibbs) ESS(Metropolis)
## FP_Intercept                          564              63
## FP_age                               1731             241
## FP_lcOne_child                       1770             281
## FP_lcTwo_children                    1761             205
## FP_lcThree_plus                      1347             109
## FP_urbanUrban                         601              92
## RP2_var_Intercept                     740             136
## RP2_cov_Intercept_urbanUrban          521             123
## RP2_var_urbanUrban                    399             129
## RP1_var_bcons_1                      5000            5000
```

Hox, Joop, and Leoniek Wijngaards-de Meij. 2014. "The Multilevel Regression Model." In *The Sage Handbook of Regression Analysis and Causal Inference*, edited by Henning Best and Christof Wolf, 133–52. SAGE Publications Ltd. doi:10.4135/9781446288146.n7.

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