

UserGuide09

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

```
summary(bang)
```

```
##      woman      district      use
## Min.      : 1.0    Min.      : 1.00    Not_using:1728
## 1st Qu.: 717.5    1st Qu.:14.00    Using    :1139
## Median :1434.0    Median :29.00
## Mean    :1434.0    Mean   :29.25
## 3rd Qu.:2150.5    3rd Qu.:45.00
## Max.    :2867.0    Max.    :61.00
##
##           use4           lc           age
## Sterilization      : 302    None      : 774    Min.      :-14.0000
## Modern_reversible_method: 555    One_child   : 517    1st Qu.: -8.0000
## Traditional_method      : 282    Two_children: 461    Median   : -2.0000
## Not_using_contraception :1728    Three_plus  :1115    Mean      : -0.3279
##
##                                     3rd Qu.: 6.0000
##                                     Max.      : 19.0000
##
##      urban      educ      hindu      d_lit
## Rural:2063    None      :1806    Muslim:2480    Min.      :0.0000
## Urban: 804    Lower_primary      : 357    Hindu : 387    1st Qu.:0.0850
##           Upper_primary      : 265           Median :0.1100
##           Secondary_and_above: 439           Mean   :0.1115
##
##                                     3rd Qu.:0.1400
##                                     Max.      :0.3000
##
##      d_pray      cons
## Min.      :0.1000    Min.      :1
## 1st Qu.:0.2900    1st Qu.:1
## Median :0.4100    Median :1
## Mean    :0.4253    Mean   :1
## 3rd Qu.:0.5500    3rd Qu.:1
## Max.    :0.7800    Max.    :1
```

```
addmargins(with(bang, table(lc, use)))
```

```
##           use
## lc      Not_using Using Sum
## None      584    190 774
## One_child    283    234 517
## Two_children 234    227 461
## Three_plus   627    488 1115
## Sum          1728   1139 2867
```

9.3 A two-level random intercept model

```
(mymodel4 <- runMLwiN(
  logit(use) ~ 1 + lc + age + (1 | district),
  D = "Binomial",
  data = bang))

##
## -----
## MLwiN (version: 2.36) multilevel model (Binomial)
##           N min      mean max N_complete min_complete mean_complete
## district 60   3 47.78333 173           60           3      47.78333
##           max_complete
## district           173
## Estimation algorithm: IGLS MQL1           Elapsed time : 3.9s
## Number of obs: 2867 (from total 2867)           The model converged after 5 iterations.
## Log likelihood:      NA
## Deviance statistic:  NA
## -----
## The model formula:
## logit(use) ~ 1 + lc + age + (1 | district)
## Level 2: district      Level 1: llid
## -----
## The fixed part estimates:
##           Coef.      Std. Err.      z      Pr(>|z|)      [95% Conf.      Interval]
## Intercept      -1.36711      0.12338     -11.08    1.557e-28    ***      -1.60893      -1.12529
## lcOne_child      0.98998      0.12643      7.83    4.869e-15    ***        0.74218        1.23777
## lcTwo_children    1.27523      0.13816      9.23    2.711e-20    ***        1.00443        1.54603
## lcThree_plus     1.21568      0.14245      8.53    1.413e-17    ***        0.93648        1.49487
## age             -0.01878      0.00625     -3.00    0.002659    **       -0.03102       -0.00653
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## -----
## The random part estimates at the district level:
##           Coef.      Std. Err.
## var_Intercept    0.27409      0.07138
## -----
## The random part estimates at the llid level:
##           Coef.      Std. Err.
## var_bcons_1      1.00000      0.00000
## -----
(mymodel5 <- runMLwiN(
  logit(use) ~ 1 + lc + age + (1 | district),
  D = "Binomial",
  estoptions = list(
    nonlinear = c(N = 1, M = 2),
    startval = list(
      FP.b = mymodel4@FP,
      FP.v = mymodel4@FP.cov,
      RP.b = mymodel4@RP,
      RP.v = mymodel4@RP.cov)),
  data = bang))

##
## -----
```

```

## MLwiN (version: 2.36) multilevel model (Binomial)
##           N min      mean max N_complete min_complete mean_complete
## district 60   3 47.78333 173           60           3      47.78333
##           max_complete
## district      173
## Estimation algorithm: IGLS PQL2           Elapsed time : 4.01s
## Number of obs: 2867 (from total 2867)           The model converged after 5 iterations.
## Log likelihood:      NA
## Deviance statistic:  NA
## -----
## The model formula:
## logit(use) ~ 1 + lc + age + (1 | district)
## Level 2: district      Level 1: llid
## -----
## The fixed part estimates:
##           Coef.      Std. Err.      z      Pr(>|z|)      [95% Conf.      Interval]
## Intercept      -1.46602      0.12791     -11.46    2.058e-30    ***      -1.71671      -1.21532
## lcOne_child      1.06285      0.12882      8.25    1.575e-16    ***       0.81037       1.31533
## lcTwo_children    1.37010      0.14167      9.67    4.014e-22    ***       1.09242       1.64778
## lcThree_plus     1.30391      0.14595      8.93    4.104e-19    ***       1.01786       1.58997
## age             -0.02005      0.00640     -3.13    0.001747    **       -0.03260       -0.00749
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## -----
## The random part estimates at the district level:
##           Coef.      Std. Err.
## var_Intercept    0.30776      0.07899
## -----
## The random part estimates at the llid level:
##           Coef.      Std. Err.
## var_bcons_1      1.00000      0.00000
## -----
## -----
linearHypothesis(mymodel5, "RP2_var_Intercept = 0")
## Linear hypothesis test
##
## Hypothesis:
## RP2_var_Intercept = 0
##
## Model 1: restricted model
## Model 2: mymodel5
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1      2861
## 2      2860  1 15.181  9.769e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Variance partition coefficient

$$\frac{\exp(x)}{1 + \exp(x)}$$

```
set.seed(1)
```

```

invlogit <- function(x) exp(x)/(1 + exp(x))

u <- sqrt(coef(mymodel5)["RP2_var_Intercept"]) * qnorm(runif(5000))
str(u)

## num [1:5000] -0.348 -0.181 0.102 0.738 -0.464 ...
p1 <- invlogit(coef(mymodel5)["FP_Intercept"] + u)

p2 <- invlogit(coef(mymodel5)["FP_Intercept"] +
               coef(mymodel5)["FP_1cThree_plus"] +
               coef(mymodel5)["FP_age"] * -9.7 + u)

p3 <- invlogit(coef(mymodel5)["FP_Intercept"] +
               coef(mymodel5)["FP_age"] * 15.3 + u)

v1 <- p1 * (1 - p1)
lev2var1 <- sd(p1)^2
lev1var1 <- mean(v1)

v2 <- p2 * (1 - p2)
lev2var2 <- sd(p2)^2
lev1var2 <- mean(v2)

v3 <- p3 * (1 - p3)
lev2var3 <- sd(p3)^2
lev1var3 <- mean(v3)

cat(
  paste0("VPC = ", lev2var1/(lev2var1 + lev1var1)))
## VPC = 0.0491754292049843

cat(
  paste0(
    "VPC for a young women with 3+ children (low probability use) = ",
    na.omit(lev2var2/(lev2var2 + lev1var2))))
## VPC for a young women with 3+ children (low probability use) = 0.0702551162903106

cat(
  paste0(
    "VPC for an old woman with no children (high probability use) = ",
    lev2var3/(lev2var3 + lev1var3)))
## VPC for an old woman with no children (high probability use) = 0.0419272272718661

```

Literatur

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.

Zhang, Zhengzheng, Richard M. A. Parker, Christopher M. J. Charlton, George Leckie, and William J. Browne. 2016. "R2MLwiN: A Package to Run Mlwin from Within R." *Journal of Statistical Software* 72 (10). doi:10.18637/jss.v072.i10.