First Birth Timing Discrete Time Event History Analysis Code for the ChitwanABM

Author: Alex Zvoleff
Email: azvoleff@mail.sdsu.edu
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Follows analysis of Ghimire and Hoelter (2007), and Axinn and Ghimire (2010):

- Ghimire, D. J., and L. F. Hoelter. 2007. Land use and first birth timing in an agricultural setting. Population & Environment 28:289–320.
- Ghimire, D. J., and W. G. Axinn. 2010. Community context, land use, and first birth. Rural Sociology 75 (3):478–513.

Uses the `glmer` function from the R `glmer` package to conduct a multilevel discrete-time event history analysis of first birth timing using the monthly Chitwan Valley Family Study (CVFS) household registry data.

```
library(ggplot2)
library(lme4)
library(epicalc)  # for logistic.display
library(arm)  # for se.coef, se.fixef
# theme_update(theme_grey(base_size=10))
theme_update(theme_bw(base_size = 10))
# update_geom_defaults('point', aes(size=2)) update_geom_defaults('line',
# aes(size=.75))

load("data/first_preg_data-longformat-up_to_month_60.Rdata")

# Drop 'other' ethnicity for consistency with Massey et al. (2010)
first_preg_long <- first_preg_long[!(first_preg_long$ethnic == "Other"),
    ]
first_preg_long$ethnic <- factor(first_preg_long$ethnic)

# Load parent's characteristics to join to the dataset: I17 father's work
# I11 father school (ever) I15 mother's work I7 mother school (ever) I19
# mother's number of children
t1indiv <- read.xport("V:/Nepal/ICPSR_0538_Restricted/da04538-0012_REST.xpt")
old_respID <- sprintf("%07i", t1indiv$RESPID)
NBHID <- sprintf("%03i", as.numeric(substr(old_respID, 1, 3)))
HHID <- sprintf("%03i", as.numeric(substr(old_respID, 4, 5)))
SUBJID <- sprintf("%03i", as.numeric(substr(old_respID, 6, 7)))
t1indiv$RESPID <- paste(NBHID, HHID, SUBJID, sep = "")
parents_char_cols <- grep("^(I17|I11|I15|I7|I19)$", names(t1indiv))
parents_char <- t1indiv[parents_char_cols]
names(parents_char)[grep("^I17$", names(parents_char))] <- "father_work"
names(parents_char)[grep("^I11$", names(parents_char))] <- "father_school"
names(parents_char)[grep("^I15$", names(parents_char))] <- "mother_work"
names(parents_char)[grep("^I7$", names(parents_char))] <- "mother_school"
names(parents_char)[grep("^I19$", names(parents_char))] <- "mother_num_children"
parents_char[parents_char < 0] <- NA  # will be replaced with resampling
parents_char <- cbind(respid = t1indiv$RESPID, parents_char)
first_preg_long <- merge(first_preg_long, parents_char)

first_preg_long$marr_duration <- cut(first_preg_long$n_months_marr,
    breaks = c(0, 6, 12, 18, 24, 30, 36, 42, 999), right = FALSE)
first_preg_long$marr_duration <- relevel(first_preg_long$marr_duration,
    "[42,999)")
first_preg_long$schooling_yrs_cat <- cut(first_preg_long$n_months_marr,
    breaks = c(0, 4, 7, 11, 99), right = FALSE)

# Load the neighborhood-level data to merge neighborhood-level covariates
load("V:/Nepal/ICPSR_0538_Restricted/Recode/recoded_NBH_data.Rdata")
nbh_level_vars_cols <- grep("^(NEIGHID|elec_avail|avg_yrs_services_lt15|dist_nara|total_t1|percagveg_t1)$",
    names(nbh_recode))
nbh_level_vars <- nbh_recode[nbh_level_vars_cols]
```

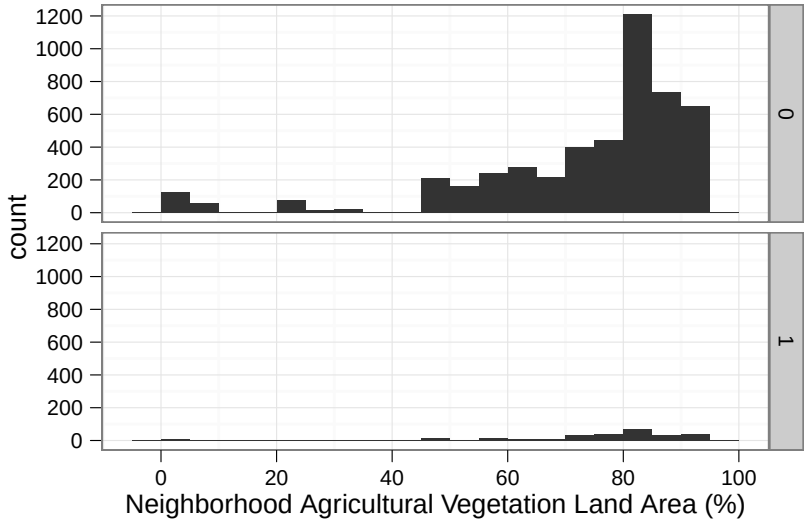
```
first_preg_long$originalNBH <- factor(sprintf("%03d", first_preg_long$originalNBH))
first_preg_long <- merge(first_preg_long, nbh_level_vars, by.x = "originalNBH",
    by.y = "NEIGHID")

# Convert total area from square meters to square kilometers
first_preg_long$total_t1 <- first_preg_long$total_t1/1e+06
```

Basic Statistics

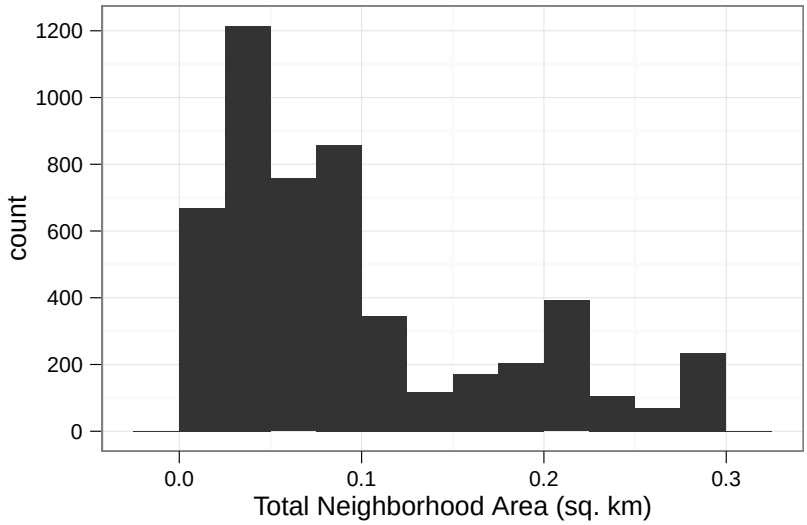
Total number of person-month records: 5140, from 330 women. Now look at a table of how those records are distributed (0 being no first birth, 1 being first birth).

```
qplot(percagveg_t1, facets = first_preg ~ ., geom = "histogram",
    xlab = "Neighborhood Agricultural Vegetation Land Area (%)", binwidth = 5,
    data = first_preg_long)
```



Agricultural Vegetation Area

```
qplot(total_t1, geom = "histogram", xlab = "Total Neighborhood Area (sq. km)",
    binwidth = 0.025, data = first_preg_long)
```



Total Neighborhood Area

```
table(first_preg_long$gender, exclude = NULL)
```

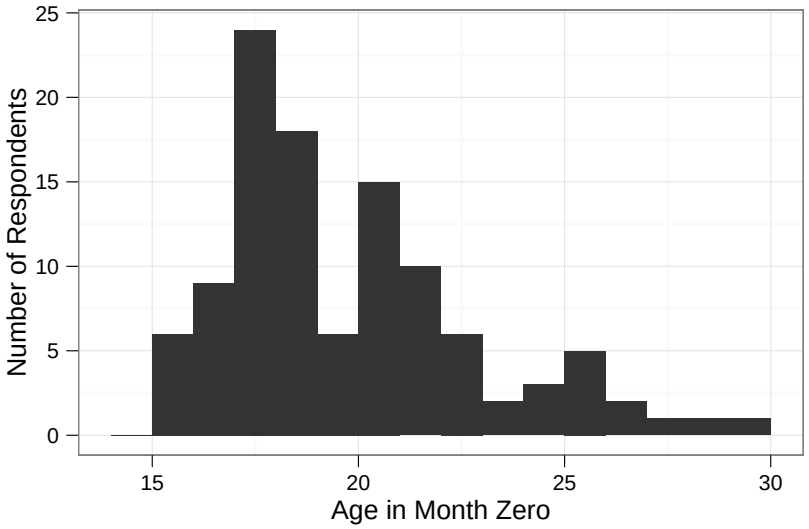
```
##
##   male female   <NA>
##      0   5140      0
```

```
table(first_preg_long$first_preg, exclude = NULL)
```

```
##
##    0    1 <NA>
## 4857  283    0
```

Make a quick plot of the age distribution of the sample in the first month:

```
qplot(age, geom = "bar", data = first_preg_long[first_preg_long$time ==
    1, ], xlab = "Age in Month Zero", ylab = "Number of Respondents", binwidth = 1)
```



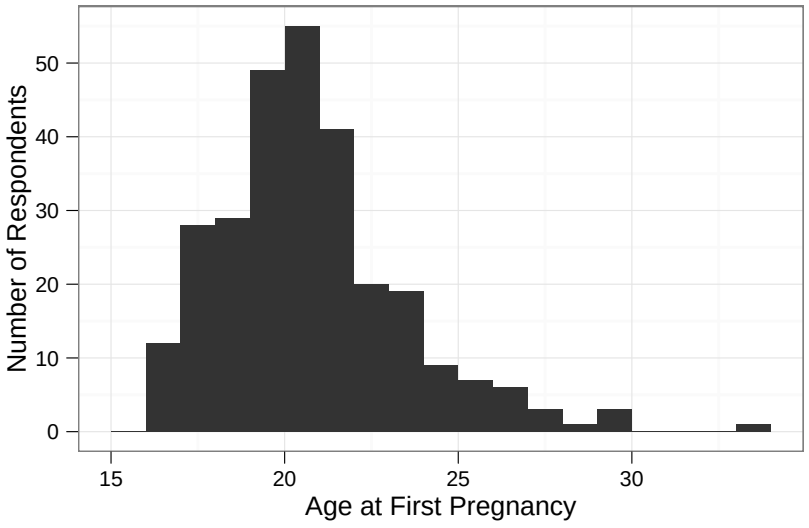
Age distribution of sample in initial month of data collection

Do a plot of the age at first birth:

```
table(first_preg_long[first_preg_long$first_preg == 1, ]$age, exclude = NULL)
```

```
##
##   16   17   18   19   20   21   22   23   24   25   26   27   28   29   33
##   12   28   29   49   55   41   20   19    9    7    6    3    1    3    1
## <NA>
##    0
```

```
qplot(age, geom = "bar", data = first_preg_long[first_preg_long$first_preg ==
    1, ], xlab = "Age at First Pregnancy", ylab = "Number of Respondents", binwidth = 1)
```



plot of chunk age-at-first-preg

```
xtabs(~first_preg + ethnic, data = first_preg_long, exclude = NULL)
```

```
##           ethnic
## first_preg UpHindu HillTibeto LowHindu Newar TeraiTibeto
##          0    2429       1102      325    96         905
##          1     158         38       20     9          58
```

```
xtabs(~first_preg + schooling_yrs_cat, data = first_preg_long, exclude = NULL)
```

```
##           schooling_yrs_cat
## first_preg [0,4) [4,7) [7,11) [11,99)
##          0   554   358    302    3285
##          1    48    43     35     155
```

```
xtabs(~first_preg + marr_duration, data = first_preg_long, exclude = NULL)
```

```
##           marr_duration
## first_preg [42,999) [0,6) [6,12) [12,18) [18,24) [24,30) [30,36) [36,42)
##          0     2075   804    461     338     279     311     281     308
##          1       42    82     53      46      22      12      16      10
```

```
xtabs(~first_preg + father_work, data = first_preg_long, exclude = NULL)
```

```
##           father_work
## first_preg    0    1
##          0 2100 2734
##          1  147  135
```

```
xtabs(~first_preg + mother_work, data = first_preg_long, exclude = NULL)
```

```
##           mother_work
## first_preg    0    1
##          0 3973  852
##          1  229   53
```

```
xtabs(~first_preg + father_school, data = first_preg_long, exclude = NULL)
```

```
##           father_school
## first_preg    0    1
##          0 2789 2068
##          1  158  125
```

```
xtabs(~first_preg + mother_school, data = first_preg_long, exclude = NULL)
```

```
##           mother_school
## first_preg    0    1
##          0 4199  631
##          1  244   39
```

```
xtabs(~first_preg + mother_num_children, data = first_preg_long,
    exclude = NULL)
```

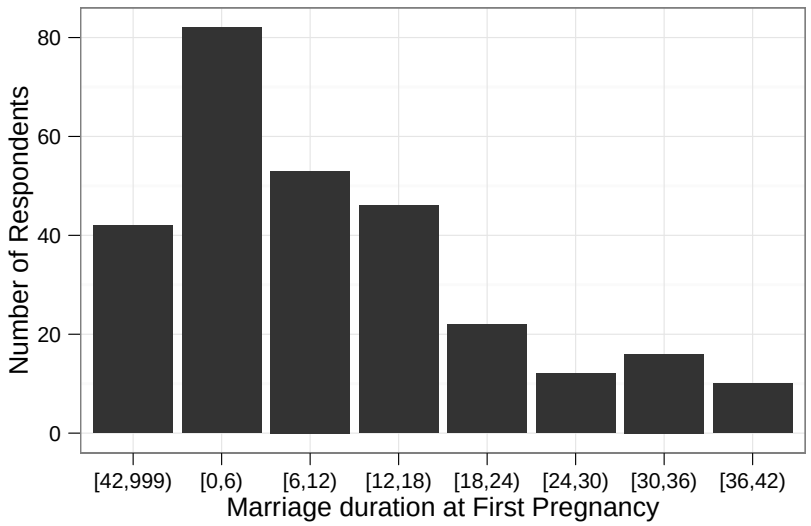
```
##           mother_num_children
## first_preg    1    2    3    4    5    6    7    8    9   10   11   12
##          0   69  187  456  892 1182  690  744  229  310   81   12    5
##          1    6   12   30   54   68   37   41   17    9    5    3    1
```

Do a plot of the marriage duration at first birth (using the categories established earlier):

```
table(first_preg_long[first_preg_long$first_preg == 1, ]$marr_duration,
    exclude = NULL)
```

```
##
## [42,999)    [0,6)   [6,12)  [12,18)  [18,24)  [24,30)  [30,36)  [36,42)
##       42       82       53       46       22       12       16       10
##     <NA>
##        0
```

```
qplot(marr_duration, data = first_preg_long[first_preg_long$first_preg ==
    1, ], xlab = "Marriage duration at First Pregnancy", ylab = "Number of Respondents")
```



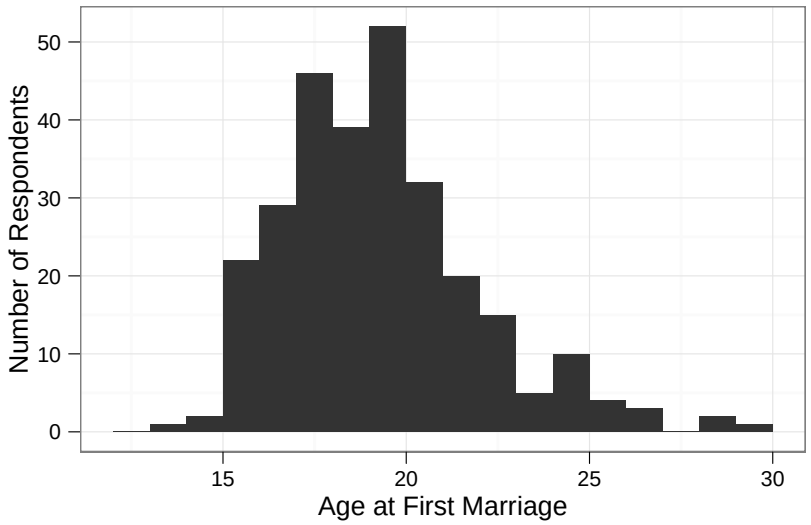
plot of chunk marr-durration-at-first-preg

And do a plot of the age at first marriage:

```
xtabs(~age_at_first_marr, data = first_preg_long[first_preg_long$first_preg ==
    1, ], exclude = NULL)
```

```
## age_at_first_marr
## 13 14 15 16 17 18 19 20 21 22 23 24 25 26 28 29
##  1  2 22 29 46 39 52 32 20 15  5 10  4  3  2  1
```

```
qplot(age_at_first_marr, geom = "bar", data = first_preg_long[first_preg_long$first_preg ==
    1, ], xlab = "Age at First Marriage", ylab = "Number of Respondents", binwidth = 1)
```



plot of chunk age-at-first-marr

Discrete-time Event History Models

```
model_formula <- "first_preg ~ percagveg_t1 +\nelec_avail +\navg_yrs_services_lt15 +\ndist_nara +\ntotal_t1 +\nethnic +\nschooling_yrs_cat +\nmths_marr_pre_1997 +\nmarr_duration +\nage_at_first_marr +\nfather_work +\nmother_work +\nfather_school +\nmother_school +\nmother_num_children"
```

Fixed effect model

```
first_preg_fixed <- glm(model_formula, data = first_preg_long, family = binomial)
save(first_preg_fixed, file = "models/first_preg_fixed.Rdata")
summary(first_preg_fixed)
```

```
##
## Call:
## glm(formula = model_formula, family = binomial, data = first_preg_long)
##
## Deviance Residuals:
##    Min      1Q  Median      3Q     Max
## -0.707  -0.411  -0.273  -0.211   3.077
##
## Coefficients:
##                          Estimate Std. Error z value Pr(>|z|)
```

```
## (Intercept)              -3.57348    0.89855   -3.98  7.0e-05 ***
## percagveg_t1             -0.00321    0.00444   -0.72  0.46925
## elec_avail                0.25954    0.16057    1.62  0.10600
## avg_yrs_services_lt15    -0.00377    0.00813   -0.46  0.64238
## dist_nara                 0.00674    0.01164    0.58  0.56269
## total_t1                 -0.87946    1.08680   -0.81  0.41839
## ethnicHillTibeto         -0.62301    0.20437   -3.05  0.00230 **
## ethnicLowHindu            0.01594    0.26002    0.06  0.95112
## ethnicNewar              -0.49201    0.38129   -1.29  0.19692
## ethnicTeraiTibeto        -0.03382    0.17735   -0.19  0.84877
## schooling_yrs_cat[4,7)    0.48076    0.23820    2.02  0.04356 *
## schooling_yrs_cat[7,11)   0.84738    0.45897    1.85  0.06485 .
## schooling_yrs_cat[11,99)  1.29348    0.55805    2.32  0.02046 *
## mths_marr_pre_1997       -0.00612    0.00789   -0.78  0.43779
## marr_duration[0,6)        2.40521    0.60248    3.99  6.5e-05 ***
## marr_duration[6,12)       1.94223    0.45577    4.26  2.0e-05 ***
## marr_duration[12,18)      1.70154    0.28495    5.97  2.4e-09 ***
## marr_duration[18,24)      1.14735    0.30612    3.75  0.00018 ***
## marr_duration[24,30)      0.41861    0.35481    1.18  0.23807
## marr_duration[30,36)      0.82217    0.32088    2.56  0.01040 *
## marr_duration[36,42)      0.26223    0.36802    0.71  0.47613
## age_at_first_marr        -0.03210    0.02515   -1.28  0.20186
## father_work              -0.32690    0.14235   -2.30  0.02165 *
## mother_work              -0.08111    0.17771   -0.46  0.64809
## father_school            -0.14205    0.13311   -1.07  0.28589
## mother_school            -0.08626    0.19383   -0.45  0.65631
## mother_num_children      -0.02250    0.03443   -0.65  0.51337
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 2124.9  on 4719  degrees of freedom
## Residual deviance: 1976.4  on 4693  degrees of freedom
##   (420 observations deleted due to missingness)
## AIC: 2030
##
## Number of Fisher Scoring iterations: 6
##
```

```
(first_preg_fixed_results <- cbind(coef = coef(first_preg_fixed),
    OR = exp(coef(first_preg_fixed))))
```

```
##                             coef       OR
## (Intercept)              -3.573483  0.02806
## percagveg_t1             -0.003210  0.99680
## elec_avail                0.259541  1.29634
## avg_yrs_services_lt15    -0.003773  0.99623
## dist_nara                 0.006737  1.00676
## total_t1                 -0.879457  0.41501
## ethnicHillTibeto         -0.623007  0.53633
## ethnicLowHindu            0.015941  1.01607
```

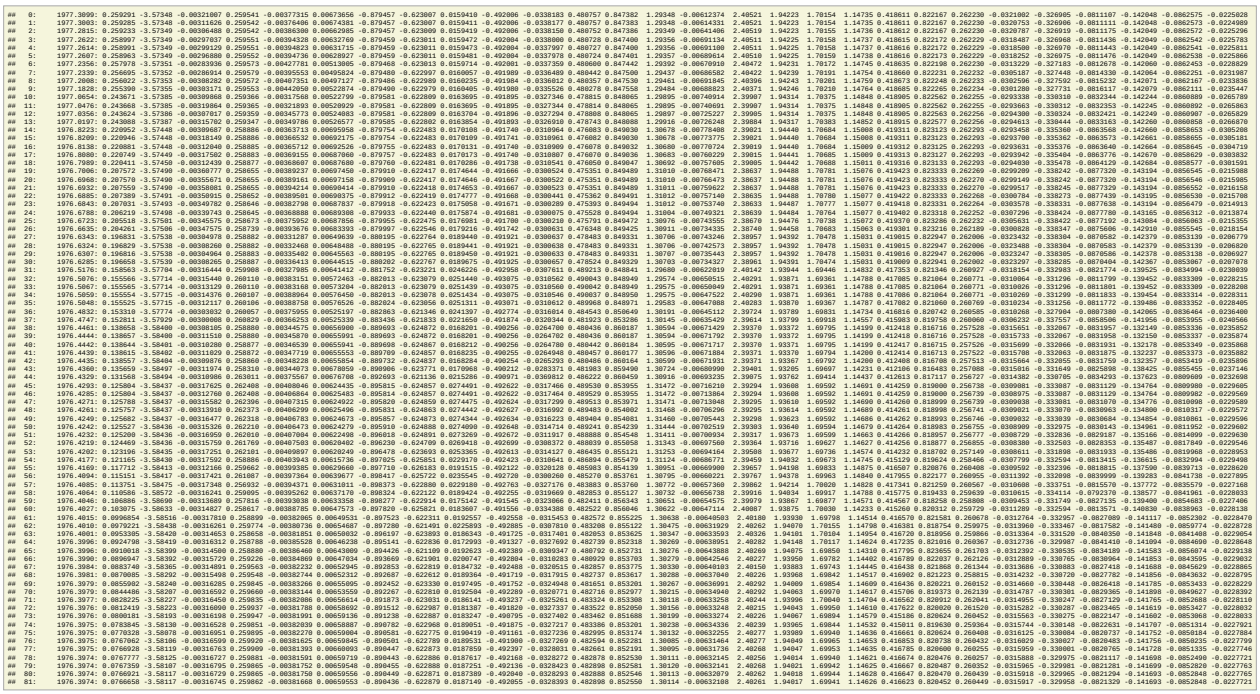
```
## ethnicNewar                -0.492006  0.61140
## ethnicTeraiTibeto          -0.033818  0.96675
## schooling_yrs_cat[4,7)      0.480757  1.61730
## schooling_yrs_cat[7,11)     0.847382  2.33353
## schooling_yrs_cat[11,99)    1.293478  3.64544
## mths_marr_pre_1997         -0.006124  0.99389
## marr_duration[0,6)          2.405213 11.08079
## marr_duration[6,12)         1.942226  6.97426
## marr_duration[12,18)        1.701540  5.48238
## marr_duration[18,24)        1.147354  3.14985
## marr_duration[24,30)        0.418611  1.51985
## marr_duration[30,36)        0.822167  2.27542
## marr_duration[36,42)        0.262230  1.29983
## age_at_first_marr          -0.032100  0.96841
## father_work                -0.326905  0.72115
## mother_work                -0.081111  0.92209
## father_school              -0.142048  0.86758
## mother_school              -0.086257  0.91736
## mother_num_children        -0.022503  0.97775
```

```
write.csv(first_preg_fixed_results$table, file = "models/first_preg_fixed_odds.csv")
```

```
## Error: $ operator is invalid for atomic vectors
```

Mixed-effects model - random intercept at neighborhood level

```
first_preg_2level_formula <- as.formula(paste(model_formula, "+ (1 | originalNBH)"))
(first_preg_2level <- glmer(first_preg_2level_formula, data = first_preg_long,
    family = binomial, verbose = TRUE))
```



```
## Generalized linear mixed model fit by the Laplace approximation
## Formula: first_preg_2level_formula
##    Data: first_preg_long
##   AIC  BIC logLik deviance
##  2032 2213   -988     1976
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  originalNBH (Intercept) 0.00588  0.0767
## Number of obs: 4720, groups: originalNBH, 119
##
## Fixed effects:
##                           Estimate Std. Error z value Pr(>|z|)
## (Intercept)              -3.58117    0.90254   -3.97  7.3e-05 ***
## percagveg_t1             -0.00317    0.00447   -0.71  0.47887
## elec_avail                0.25986    0.16223    1.60  0.10919
## avg_yrs_services_lt15    -0.00382    0.00822   -0.46  0.64229
## dist_nara                 0.00660    0.01177    0.56  0.57524
## total_t1                 -0.89044    1.10039   -0.81  0.41840
## ethnicHillTibeto         -0.62288    0.20577   -3.03  0.00247 **
## ethnicLowHindu            0.01871    0.26137    0.07  0.94292
## ethnicNewar              -0.49205    0.38327   -1.28  0.19920
## ethnicTeraiTibeto        -0.03284    0.17887   -0.18  0.85433
## schooling_yrs_cat[4,7)    0.48290    0.23844    2.03  0.04285 *
## schooling_yrs_cat[7,11)   0.85255    0.45947    1.86  0.06352 .
## schooling_yrs_cat[11,99)  1.30114    0.55862    2.33  0.01985 *
## mths_marr_pre_1997       -0.00632    0.00792   -0.80  0.42475
## marr_duration[0,6)        2.40261    0.60329    3.98  6.8e-05 ***
## marr_duration[6,12)       1.94017    0.45649    4.25  2.1e-05 ***
## marr_duration[12,18)      1.69941    0.28542    5.95  2.6e-09 ***
## marr_duration[18,24)      1.14626    0.30654    3.74  0.00018 ***
## marr_duration[24,30)      0.41662    0.35528    1.17  0.24094
## marr_duration[30,36)      0.82045    0.32126    2.55  0.01065 *
## marr_duration[36,42)      0.26045    0.36848    0.71  0.47968
## age_at_first_marr        -0.03159    0.02529   -1.25  0.21152
## father_work              -0.32996    0.14298   -2.31  0.02102 *
## mother_work              -0.08213    0.17843   -0.46  0.64530
## father_school            -0.14169    0.13378   -1.06  0.28955
## mother_school            -0.08528    0.19487   -0.44  0.66165
## mother_num_children      -0.02278    0.03460   -0.66  0.51035
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) prcg_1 elc_vl a___15 dst_nr ttl_t1 ethnHT ethnLH ethncN
## percagvg_t1 -0.363
## elec_avail  -0.110  0.079
## avg_yrs__15 -0.215  0.301 -0.166
## dist_nara   -0.224  0.016  0.379  0.100
## total_t1     0.062 -0.468 -0.038  0.030 -0.194
## ethncHllTbt -0.065 -0.009  0.020 -0.095 -0.221  0.159
## ethnicLwHnd -0.019 -0.042  0.172 -0.125 -0.045  0.077  0.179
## ethnicNewar -0.042  0.113  0.002 -0.126 -0.099  0.081  0.150  0.091
## ethnicTrTbt -0.111 -0.066  0.115  0.055 -0.132  0.227  0.284  0.205  0.116
## schl__[4,7) -0.255 -0.016  0.006 -0.010 -0.003 -0.004 -0.014  0.011  0.005
```

```
## sch__[7,11) -0.427 -0.013  0.005  0.000 -0.001 -0.011 -0.012  0.017 -0.014
## sc__[11,99) -0.613 -0.015  0.000 -0.006 -0.001 -0.006 -0.024  0.004 -0.017
## mths___1997 -0.322  0.076 -0.028 -0.038  0.021 -0.047  0.063 -0.063  0.054
## mrr_dr[0,6) -0.646 -0.006 -0.018  0.005 -0.017  0.009  0.027 -0.029 -0.020
## mrr_d[6,12) -0.487 -0.001 -0.004  0.013 -0.017 -0.002  0.034 -0.050 -0.033
## mrr_[12,18) -0.231 -0.013 -0.006  0.019 -0.039  0.038  0.062 -0.016 -0.052
## mrr_[18,24) -0.219  0.020  0.014  0.023  0.011  0.013  0.010 -0.022  0.011
## mrr_[24,30) -0.181  0.039  0.016  0.019  0.004 -0.004  0.017 -0.032  0.013
## mrr_[30,36) -0.183  0.028  0.012  0.019 -0.003  0.004  0.013 -0.026  0.009
## mrr_[36,42) -0.154  0.023  0.007  0.013 -0.006 -0.009  0.027  0.005  0.009
## ag_t_frst_m -0.523  0.015 -0.057 -0.087  0.068  0.006  0.086  0.013  0.021
## father_work -0.141  0.005  0.031 -0.005  0.001  0.211 -0.055 -0.049  0.059
## mother_work -0.082  0.088  0.051  0.038  0.154  0.021  0.121 -0.011  0.087
## father_schl -0.084  0.043 -0.092 -0.038 -0.039 -0.047  0.069 -0.012  0.026
## mother_schl -0.077  0.157 -0.049 -0.012 -0.020 -0.030 -0.030  0.085  0.043
## mthr_nm_chl -0.080 -0.081  0.021 -0.012 -0.031 -0.010 -0.005  0.078 -0.036
##             ethnTT s__[4, s__[7, s__[11 m___19 m_[0,6 m_[6,1 m_[12, m_[18,
## percagvg_t1
## elec_avail
## avg_yrs__15
## dist_nara
## total_t1
## ethncHllTbt
## ethnicLwHnd
## ethnicNewar
## ethnicTrTbt
## schl__[4,7)  0.002
## sch__[7,11)  0.000  0.520
## sc__[11,99) -0.003  0.427  0.697
## mths___1997  0.081  0.000 -0.002 -0.003
## mrr_dr[0,6)  0.043  0.235  0.560  0.855  0.349
## mrr_d[6,12)  0.065  0.000 -0.001  0.521  0.461  0.756
## mrr_[12,18)  0.050 -0.001 -0.001 -0.001  0.574  0.374  0.493
## mrr_[18,24)  0.014 -0.001 -0.002 -0.002  0.423  0.298  0.394  0.560
## mrr_[24,30)  0.002 -0.002 -0.002 -0.002  0.305  0.234  0.310  0.446  0.381
## mrr_[30,36) -0.011 -0.001 -0.001 -0.001  0.302  0.247  0.327  0.473  0.405
## mrr_[36,42)  0.015  0.000  0.000 -0.001  0.195  0.189  0.250  0.368  0.320
## ag_t_frst_m  0.092  0.008  0.015  0.012  0.151 -0.024 -0.020 -0.022 -0.004
## father_work  0.057 -0.005 -0.017 -0.017  0.004  0.031  0.034  0.047  0.015
## mother_work -0.045 -0.025 -0.013 -0.012 -0.004 -0.044 -0.054 -0.042 -0.005
## father_schl  0.000 -0.009 -0.014  0.000  0.005 -0.016 -0.023 -0.015  0.009
## mother_schl  0.127  0.001 -0.003 -0.018  0.061 -0.023 -0.034 -0.041 -0.005
## mthr_nm_chl -0.070 -0.017 -0.009 -0.004 -0.092 -0.018 -0.016 -0.006  0.026
##             m_[24, m_[30, m_[36, ag_t__ fthr_w mthr_w fthr_s mthr_s
## percagvg_t1
## elec_avail
## avg_yrs__15
## dist_nara
## total_t1
## ethncHllTbt
## ethnicLwHnd
## ethnicNewar
## ethnicTrTbt
## schl__[4,7)
```

```
## sch__[7,11)
## sc__[11,99)
## mths___1997
## mrr_dr[0,6)
## mrr_d[6,12)
## mrr_[12,18)
## mrr_[18,24)
## mrr_[24,30)
## mrr_[30,36)  0.331
## mrr_[36,42)  0.264  0.285
## ag_t_frst_m  0.000  0.005  0.031
## father_work  0.020  0.023  0.012  0.072
## mother_work -0.001 -0.019 -0.008  0.033 -0.290
## father_schl  0.011  0.001 -0.001  0.011 -0.076  0.106
## mother_schl -0.005 -0.015 -0.014  0.060 -0.073 -0.006 -0.143
## mthr_nm_chl  0.020  0.011  0.005 -0.156  0.049 -0.050  0.155 -0.043
```

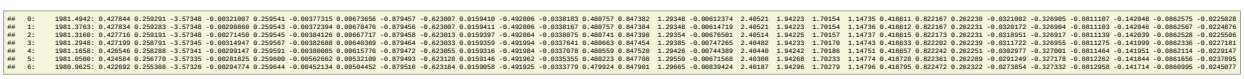
```
(first_preg_2level_or <- round(exp(fixef(first_preg_2level)), 4))
```

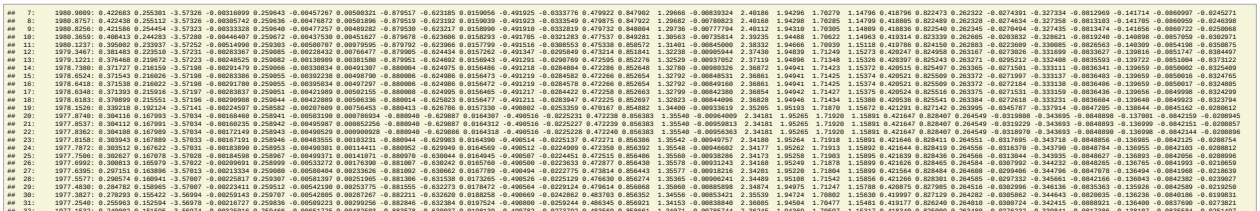
```
##              (Intercept)             percagveg_t1                elec_avail
##                   0.0278                   0.9968                   1.2968
##    avg_yrs_services_lt15                dist_nara                total_t1
##                   0.9962                   1.0066                   0.4105
##         ethnicHillTibeto           ethnicLowHindu              ethnicNewar
##                   0.5364                   1.0189                   0.6114
##        ethnicTeraiTibeto   schooling_yrs_cat[4,7)  schooling_yrs_cat[7,11)
##                   0.9677                   1.6208                   2.3456
## schooling_yrs_cat[11,99)       mths_marr_pre_1997       marr_duration[0,6)
##                   3.6735                   0.9937                  11.0520
##      marr_duration[6,12)     marr_duration[12,18)     marr_duration[18,24)
##                   6.9599                   5.4707                   3.1464
##     marr_duration[24,30)     marr_duration[30,36)     marr_duration[36,42)
##                   1.5168                   2.2715                   1.2975
##        age_at_first_marr              father_work              mother_work
##                   0.9689                   0.7190                   0.9211
##             father_school            mother_school      mother_num_children
##                   0.8679                   0.9183                   0.9775
```

```
save(first_preg_2level, file = "models/first_preg_2level.Rdata")
write.csv(first_preg_2level_or, file = "models/first_preg_2level_odds.csv")
```

Mixed-effects model - random intercepts at individual and neighborhood levels

```
library(languageR)
first_preg_3level_formula <- as.formula(paste(model_formula, "+ (1 | respid) + (1 | originalNBH)"))
(first_preg_3level <- glmer(first_preg_3level_formula, data = first_preg_long,
    family = binomial, verbose = TRUE))
```





```
## Generalized linear mixed model fit by the Laplace approximation
## Formula: first_preg_3level_formula
##    Data: first_preg_long
##   AIC  BIC logLik deviance
##  2034 2222   -988     1976
## Random effects:
##  Groups      Name        Variance Std.Dev.
##  respid      (Intercept) 1.77e-13 4.20e-07
##  originalNBH (Intercept) 5.88e-03 7.67e-02
## Number of obs: 4720, groups: respid, 324; originalNBH, 119
##
## Fixed effects:
##                            Estimate Std. Error z value Pr(>|z|)
## (Intercept)                -3.58116    0.90254   -3.97  7.3e-05 ***
## percagveg_t1               -0.00317    0.00447   -0.71  0.47889
## elec_avail                  0.25986    0.16223    1.60  0.10919
## avg_yrs_services_lt15      -0.00382    0.00822   -0.46  0.64225
## dist_nara                   0.00660    0.01177    0.56  0.57523
## total_t1                   -0.89046    1.10039   -0.81  0.41839
## ethnicHillTibeto           -0.62288    0.20577   -3.03  0.00247 **
## ethnicLowHindu              0.01873    0.26137    0.07  0.94289
## ethnicNewar                -0.49205    0.38327   -1.28  0.19920
## ethnicTeraiTibeto          -0.03283    0.17887   -0.18  0.85435
## schooling_yrs_cat[4,7)      0.48289    0.23844    2.03  0.04285 *
## schooling_yrs_cat[7,11)     0.85254    0.45947    1.86  0.06353 .
## schooling_yrs_cat[11,99)    1.30113    0.55862    2.33  0.01985 *
## mths_marr_pre_1997         -0.00632    0.00792   -0.80  0.42477
## marr_duration[0,6)          2.40261    0.60329    3.98  6.8e-05 ***
## marr_duration[6,12)         1.94017    0.45649    4.25  2.1e-05 ***
## marr_duration[12,18)        1.69942    0.28542    5.95  2.6e-09 ***
## marr_duration[18,24)        1.14626    0.30654    3.74  0.00018 ***
## marr_duration[24,30)        0.41663    0.35528    1.17  0.24093
## marr_duration[30,36)        0.82046    0.32126    2.55  0.01065 *
## marr_duration[36,42)        0.26044    0.36848    0.71  0.47969
```

```
## age_at_first_marr        -0.03159    0.02529   -1.25  0.21152
## father_work              -0.32996    0.14298   -2.31  0.02101 *
## mother_work              -0.08213    0.17844   -0.46  0.64532
## father_school            -0.14169    0.13379   -1.06  0.28955
## mother_school            -0.08528    0.19488   -0.44  0.66165
## mother_num_children      -0.02278    0.03460   -0.66  0.51028
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##             (Intr) prcg_1 elc_vl a___15 dst_nr ttl_t1 ethnHT ethnLH ethncN
## percagvg_t1 -0.363
## elec_avail  -0.110  0.079
## avg_yrs__15 -0.215  0.301 -0.166
## dist_nara   -0.224  0.016  0.379  0.100
## total_t1     0.062 -0.468 -0.038  0.030 -0.194
## ethncHllTbt -0.065 -0.009  0.020 -0.095 -0.221  0.159
## ethnicLwHnd -0.019 -0.042  0.172 -0.125 -0.045  0.077  0.179
## ethnicNewar -0.042  0.113  0.002 -0.126 -0.099  0.081  0.150  0.091
## ethnicTrTbt -0.111 -0.066  0.116  0.055 -0.132  0.227  0.284  0.205  0.116
## schl__[4,7) -0.255 -0.016  0.006 -0.010 -0.003 -0.004 -0.014  0.011  0.005
## sch__[7,11) -0.427 -0.013  0.005  0.000 -0.001 -0.011 -0.012  0.017 -0.014
## sc__[11,99) -0.613 -0.015  0.000 -0.006 -0.001 -0.006 -0.024  0.004 -0.017
## mths___1997 -0.322  0.076 -0.028 -0.038  0.021 -0.047  0.063 -0.063  0.054
## mrr_dr[0,6) -0.646 -0.006 -0.018  0.005 -0.017  0.009  0.027 -0.029 -0.020
## mrr_d[6,12) -0.487 -0.001 -0.004  0.013 -0.017 -0.002  0.034 -0.050 -0.033
## mrr_[12,18) -0.231 -0.013 -0.006  0.019 -0.039  0.038  0.062 -0.016 -0.052
## mrr_[18,24) -0.219  0.020  0.014  0.023  0.011  0.013  0.010 -0.022  0.011
## mrr_[24,30) -0.181  0.039  0.016  0.019  0.004 -0.004  0.017 -0.032  0.013
## mrr_[30,36) -0.183  0.028  0.012  0.019 -0.003  0.004  0.013 -0.026  0.009
## mrr_[36,42) -0.154  0.023  0.007  0.013 -0.006 -0.009  0.027  0.005  0.009
## ag_t_frst_m -0.523  0.015 -0.057 -0.087  0.068  0.006  0.086  0.013  0.021
## father_work -0.141  0.005  0.031 -0.005  0.001  0.211 -0.055 -0.049  0.059
## mother_work -0.082  0.088  0.051  0.038  0.154  0.021  0.121 -0.011  0.087
## father_schl -0.084  0.043 -0.092 -0.038 -0.039 -0.047  0.069 -0.012  0.026
## mother_schl -0.077  0.157 -0.049 -0.012 -0.020 -0.030 -0.030  0.085  0.043
## mthr_nm_chl -0.080 -0.081  0.021 -0.012 -0.031 -0.010 -0.005  0.078 -0.036
##             ethnTT s__[4, s__[7, s__[11 m___19 m_[0,6 m_[6,1 m_[12, m_[18,
## percagvg_t1
## elec_avail
## avg_yrs__15
## dist_nara
## total_t1
## ethncHllTbt
## ethnicLwHnd
## ethnicNewar
## ethnicTrTbt
## schl__[4,7)  0.002
## sch__[7,11)  0.000  0.520
## sc__[11,99) -0.003  0.427  0.697
## mths___1997  0.081  0.000 -0.002 -0.003
## mrr_dr[0,6)  0.043  0.235  0.560  0.855  0.349
## mrr_d[6,12)  0.065  0.000 -0.001  0.521  0.461  0.756
## mrr_[12,18)  0.050 -0.001 -0.001 -0.001  0.574  0.374  0.493
```

```
## mrr_[18,24)  0.014 -0.001 -0.002 -0.002  0.423  0.298  0.394  0.560
## mrr_[24,30)  0.002 -0.002 -0.002 -0.002  0.305  0.234  0.310  0.446  0.381
## mrr_[30,36) -0.011 -0.001 -0.001 -0.001  0.302  0.247  0.327  0.473  0.405
## mrr_[36,42)  0.015  0.000  0.000 -0.001  0.195  0.189  0.250  0.368  0.320
## ag_t_frst_m  0.092  0.008  0.015  0.012  0.151 -0.024 -0.020 -0.022 -0.004
## father_work  0.057 -0.005 -0.017 -0.017  0.004  0.031  0.034  0.047  0.015
## mother_work -0.045 -0.025 -0.013 -0.012 -0.004 -0.044 -0.054 -0.042 -0.005
## father_schl  0.000 -0.009 -0.014  0.000  0.005 -0.016 -0.023 -0.015  0.009
## mother_schl  0.127  0.001 -0.003 -0.018  0.061 -0.023 -0.034 -0.041 -0.005
## mthr_nm_chl -0.070 -0.017 -0.009 -0.004 -0.092 -0.018 -0.016 -0.006  0.026
##             m_[24, m_[30, m_[36, ag_t__ fthr_w mthr_w fthr_s mthr_s
## percagvg_t1
## elec_avail
## avg_yrs__15
## dist_nara
## total_t1
## ethncHllTbt
## ethnicLwHnd
## ethnicNewar
## ethnicTrTbt
## schl__[4,7)
## sch__[7,11)
## sc__[11,99)
## mths___1997
## mrr_dr[0,6)
## mrr_d[6,12)
## mrr_[12,18)
## mrr_[18,24)
## mrr_[24,30)
## mrr_[30,36)  0.331
## mrr_[36,42)  0.264  0.285
## ag_t_frst_m  0.000  0.005  0.031
## father_work  0.020  0.023  0.012  0.072
## mother_work -0.001 -0.019 -0.008  0.033 -0.290
## father_schl  0.011  0.001 -0.001  0.011 -0.076  0.106
## mother_schl -0.005 -0.015 -0.014  0.060 -0.073 -0.006 -0.143
## mthr_nm_chl  0.020  0.011  0.005 -0.156  0.049 -0.050  0.155 -0.043
```

```
save(first_preg_3level, file = "models/first_preg_3level.Rdata")
(first_preg_3level_or <- round(exp(fixef(first_preg_3level)), 4))
```

```
##             (Intercept)             percagveg_t1               elec_avail
##                  0.0278                   0.9968                   1.2968
##    avg_yrs_services_lt15                dist_nara                total_t1
##                  0.9962                   1.0066                   0.4105
##         ethnicHillTibeto           ethnicLowHindu               ethnicNewar
##                  0.5364                   1.0189                   0.6114
##        ethnicTeraiTibeto   schooling_yrs_cat[4,7)  schooling_yrs_cat[7,11)
##                  0.9677                   1.6208                   2.3456
## schooling_yrs_cat[11,99)       mths_marr_pre_1997       marr_duration[0,6)
##                  3.6734                   0.9937                  11.0520
##      marr_duration[6,12)     marr_duration[12,18)     marr_duration[18,24)
##                  6.9600                   5.4708                   3.1464
```

```
##     marr_duration[24,30)     marr_duration[30,36)     marr_duration[36,42)
##                   1.5168                   2.2715                   1.2975
##        age_at_first_marr              father_work              mother_work
##                   0.9689                   0.7190                   0.9212
##            father_school           mother_school      mother_num_children
##                   0.8679                   0.9183                   0.9775
```

```
write.csv(first_preg_3level_or, file = "models/first_preg_3level_odds.csv")
```

Conclusions

Model overview

Model	AIC	Log Likelihood
Fixed	2030.4038	-988.2019
2-level (random int. at NBH level)	2032.3974	-988.1987
3-level (random int. at resp and NBH level)	2034.3975	-988.1987