"Reproducing, with diabetic data (n=935), the "Evolucio_FG" (pdf and html) document"

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Version 1.0

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May 24, 2022

1 Version History

Version	Effective Date	Changes
1	15-May-2022	Replicant el document “Evolucio FG.html” amb les dades que em van enviar i que pentanyen als diabètics

Contents

2 Càrrega de packages, dades, funcions

```
rm(list=ls())
library(compareGroups)
library(tidyverse)
library(magrittr)
library(emmeans)
library(lme4)
library(multcomp)
library(lmerTest)
library(gdata)
library(Hmisc)

setwd("/Users/jvila/Dropbox/JLupon/FGdiabet/")

load("./dat/datpre.rda")
```

Creació de 2 funcions:

```
Mixed_models_FG <- function(x, y){
  #Model time continuous
  lmer(y ~ x + x:VISIT_YEARS + (1|id), data=dades) -> model_temps_num
  model_temps_num %>% cftest -> cftest_temps_num
  model_temps_num %>% anova -> anova_temps_num

  #Model time categorical
  lmer(y ~ x + x:VISIT_YEARS_Cat + (1|id), data=dades) -> model_temps_cat
  model_temps_cat %>% cftest -> cftest_temps_cat
  model_temps_cat %>% anova -> anova_temps_cat

  emmeans(model_temps_cat, ~ VISIT_YEARS_Cat*x) -> emmeans_model_temps_cat

  plot(emmeans_model_temps_cat) + coord_flip() -> plot_emmeans

  return(list(model_tnum = model_temps_num, anova_tnum = anova_temps_num, cftest_tnum = cftest_temps_num,
              model_tcat = model_temps_cat, anova_tcat = anova_temps_cat, cftest_tcat = cftest_temps_cat,
              emmeans_model_tcat = emmeans_model_temps_cat, plot_marginal_means = plot_emmeans))
}

logitudinal_plot <- function(dades_plot){
    dades_plot %>% as.data.frame -> dades_plot
    figura <- ggplot(data = dades_plot, aes(x =  VISIT_YEARS_Cat, y = emmean, group=x, fill=x)) +
      # geom_point(size=5, col=I("black")) +
      geom_line(aes(x = VISIT_YEARS_Cat, y = emmean, col=I("black")), lwd=1.3) +
      geom_ribbon(aes(ymin = asymp.LCL,ymax = asymp.UCL), lwd=1.5, width=0.5, alpha = 0.5) +
      theme_grey(base_size = 20) + xlab("Years") + ylab("...") + # facet_grid(x~.) +
      theme(axis.text.x=element_text(angle=90, hjust=1)) + theme(legend.title = element_blank())
  return(figura)
}
```

Elimino els que tenen seguiment >= 15anys, con es va fer a "Evolucio FG.html"

```
# registres eliminats
length(subset(datpre, VISIT_YEARS >=15)$id)
```

```
## [1] 95
```

```
# aquest registres s'eliminen en individus:
length(unique(subset(datpre, VISIT_YEARS >=15)$id))
```

```
## [1] 22
```

```
# es treballa amb registres:
dades <- subset(datpre, VISIT_YEARS < 15)
length(unique(dades$id))
```

```
## [1] 935
```

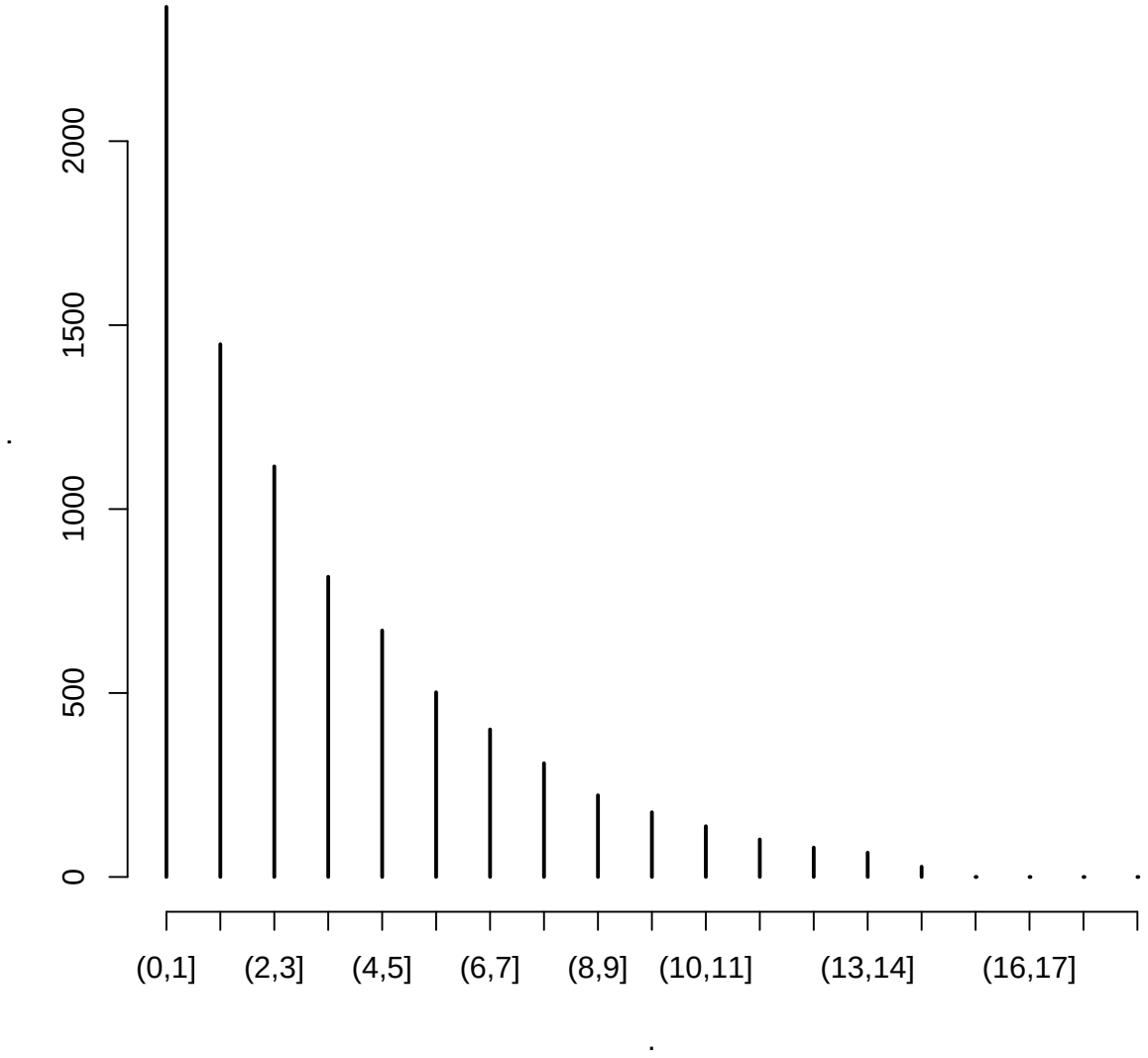
```
dades$VISIT_YEARS %>% summary
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   0.500   2.000   3.155   4.500  14.750
```

```
dades$VISIT_YEARS_Cat <- cut(dades$VISIT_YEARS, breaks = 0:19)
dades$VISIT_YEARS_Cat %>% table -> table_years_follow_up
table_years_follow_up
```

```
## .
##   (0,1]   (1,2]   (2,3]   (3,4]   (4,5]   (5,6]   (6,7]   (7,8]   (8,9]  (9,10]
##    2365    1448    1116     816     670     502     401     309     222     176
## (10,11] (11,12] (12,13] (13,14] (14,15] (15,16] (16,17] (17,18] (18,19]
##     138     102      80      66      28       0       0       0       0
```

```
table_years_follow_up %>% plot
```

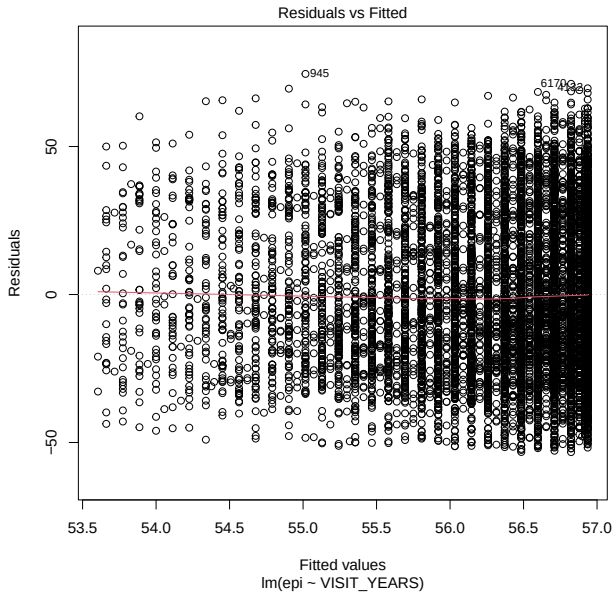

2000
1500
1000
500
0
(0,1]
(2,3]
(4,5]
(6,7]
(8,9]
(10,11]
(13,14]
(16,17]

3 Simple time model

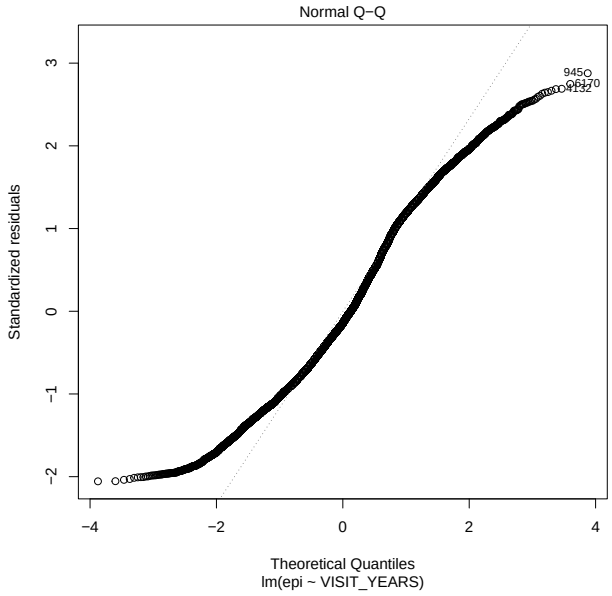
El que hi ha en aquesta secció, no veig que serveixi per res

3.1 Using VISIT_YEARS as numeric

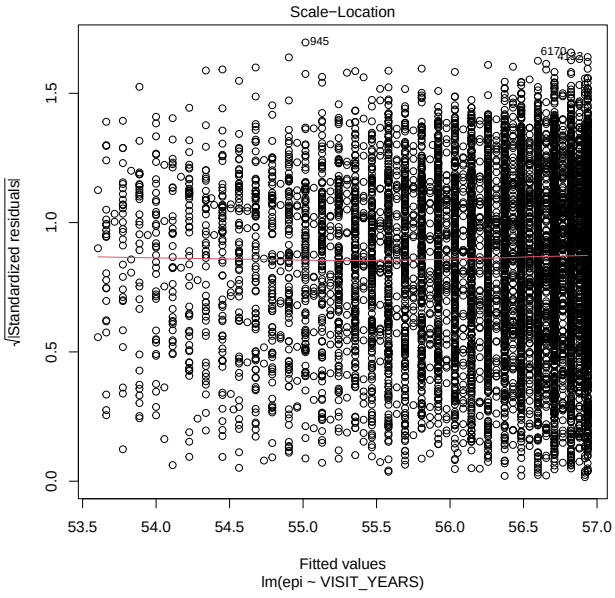
```
library(sjlabelled)
xdades <- dades[, c("epi", "VISIT_YEARS")]
model_1 <- lm(epi ~ VISIT_YEARS, data=zap_labels(dades[, c("epi", "VISIT_YEARS")]))
model_1 %>% summary

##
## Call:
## lm(formula = epi ~ VISIT_YEARS, data = zap_labels(dades[, c("epi",
##     "VISIT_YEARS")]))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.254 -20.415  -3.709  20.296  74.538
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 56.93633    0.37779 150.710  < 2e-16 ***
## VISIT_YEARS -0.22588    0.08455  -2.672  0.00756 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 25.9 on 9372 degrees of freedom
## Multiple R-squared:  0.000761,       Adjusted R-squared:  0.0006544
## F-statistic: 7.138 on 1 and 9372 DF,  p-value: 0.00756


model_1 %>% plot(c(1))
```



```
model_1 %>% plot(c(2))
```




```
model_1 %>% plot(c(3))
```



3.2 Using VISIT_YEARS as categories

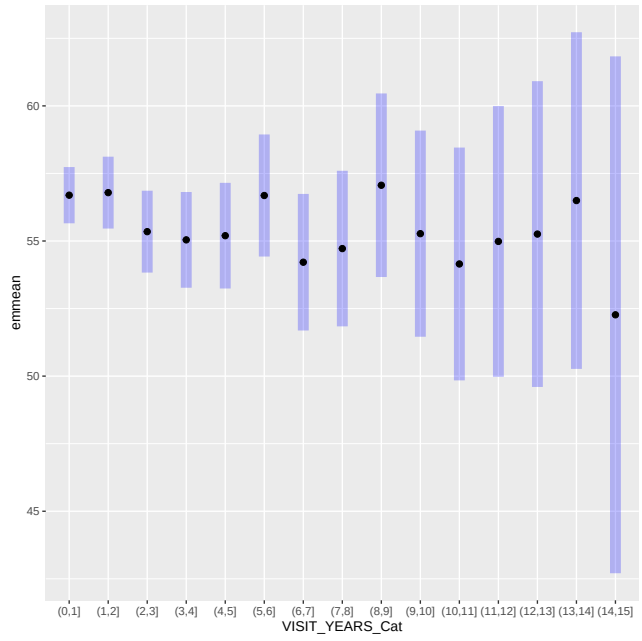
```
tapply(dades$epi, dades$VISIT_YEARS_Cat, mean)
```

```
##    (0,1]    (1,2]    (2,3]    (3,4]    (4,5]    (5,6]    (6,7]    (7,8]
## 56.69582 56.79033 55.34612 55.04201 55.19698 56.68379 54.21536 54.71985
##    (8,9]   (9,10]  (10,11]  (11,12]  (12,13]  (13,14]  (14,15]  (15,16]
## 57.06360 55.27159 54.15029 54.98474 55.25662 56.49650 52.26909       NA
##  (16,17]  (17,18]  (18,19]
##       NA       NA       NA
```

```r
model_2 <- lm(epi ~ VISIT_YEARS_Cat, data=dades)
emmeans(model_2, ~ VISIT_YEARS_Cat)
```

```
##  VISIT_YEARS_Cat emmean    SE   df lower.CL upper.CL
##  (0,1]              56.7 0.531 8424     55.7     57.7
##  (1,2]              56.8 0.678 8424     55.5     58.1
##  (2,3]              55.3 0.773 8424     53.8     56.9
##  (3,4]              55.0 0.904 8424     53.3     56.8
##  (4,5]              55.2 0.997 8424     53.2     57.2
##  (5,6]              56.7 1.152 8424     54.4     58.9
##  (6,7]              54.2 1.289 8424     51.7     56.7
##  (7,8]              54.7 1.469 8424     51.8     57.6
##  (8,9]              57.1 1.733 8424     53.7     60.5
##  (9,10]             55.3 1.946 8424     51.5     59.1
##  (10,11]            54.2 2.198 8424     49.8     58.5
##  (11,12]            55.0 2.556 8424     50.0     60.0
##  (12,13]            55.3 2.886 8424     49.6     60.9
##  (13,14]            56.5 3.178 8424     50.3     62.7
##  (14,15]            52.3 4.879 8424     42.7     61.8
##
## Confidence level used: 0.95
```

```r
plot(emmeans(model_2, ~ VISIT_YEARS_Cat)) + coord_flip()
```



4 Mixed model

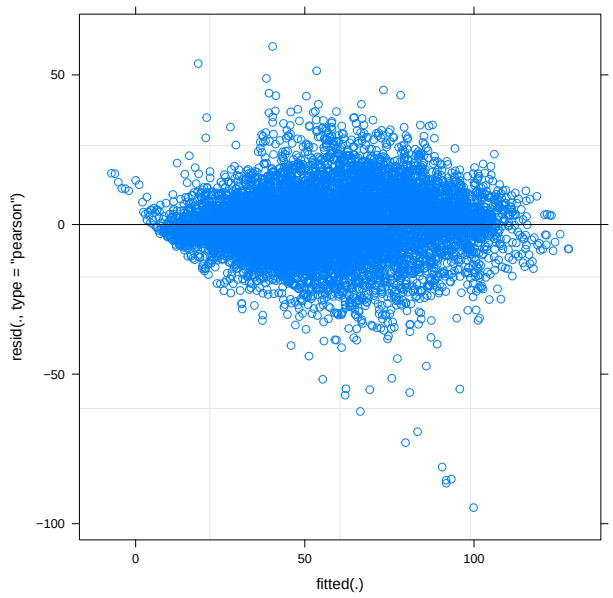
En aquesta secció s'analitza com canvia el epi al llarg dels anys, tenim en compte que un pacient té moltes mesures

4.1 Using VISIT_YEARS as numeric

```
model_3 <- lmer(epi ~ VISIT_YEARS + (1|id), data=dades)
model_3 %>% cftest
```

```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = epi ~ VISIT_YEARS + (1 | id), data = dades)
##
## Linear Hypotheses:
##                     Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0 57.95424    0.81145   71.42   <2e-16 ***
## VISIT_YEARS == 0 -2.04541    0.04794  -42.66   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_3 %>% plot
```



4.2 Using VISIT_YEARS as categories

```
model_4 <- lmer(epi ~ VISIT_YEARS_Cat + (1|id), data=dades)
model_4 %>% cftest
```

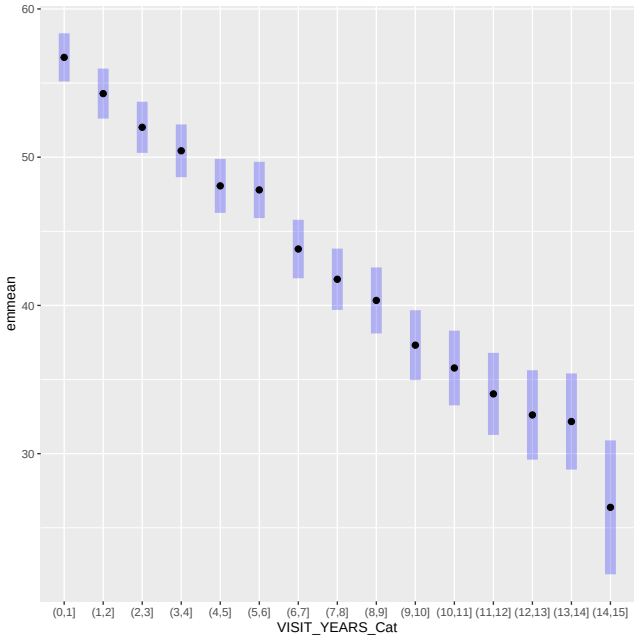
```
##
##          Simultaneous Tests for General Linear Hypotheses
##
```

```
## Fit: lmer(formula = epi ~ VISIT_YEARS_Cat + (1 | id), data = dades)
##
## Linear Hypotheses:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0               56.7313     0.8297  68.375  < 2e-16 ***
## VISIT_YEARS_Cat(1,2] == 0      -2.4418     0.3934  -6.207 5.41e-10 ***
## VISIT_YEARS_Cat(2,3] == 0      -4.7164     0.4348 -10.847  < 2e-16 ***
## VISIT_YEARS_Cat(3,4] == 0      -6.3008     0.4885 -12.898  < 2e-16 ***
## VISIT_YEARS_Cat(4,5] == 0      -8.6672     0.5290 -16.383  < 2e-16 ***
## VISIT_YEARS_Cat(5,6] == 0      -8.9398     0.5929 -15.077  < 2e-16 ***
## VISIT_YEARS_Cat(6,7] == 0     -12.9256     0.6531 -19.790  < 2e-16 ***
## VISIT_YEARS_Cat(7,8] == 0     -14.9662     0.7262 -20.608  < 2e-16 ***
## VISIT_YEARS_Cat(8,9] == 0     -16.3942     0.8384 -19.554  < 2e-16 ***
## VISIT_YEARS_Cat(9,10] == 0    -19.4115     0.9270 -20.940  < 2e-16 ***
## VISIT_YEARS_Cat(10,11] == 0   -20.9515     1.0328 -20.285  < 2e-16 ***
## VISIT_YEARS_Cat(11,12] == 0   -22.6993     1.1869 -19.126  < 2e-16 ***
## VISIT_YEARS_Cat(12,13] == 0   -24.1191     1.3340 -18.081  < 2e-16 ***
## VISIT_YEARS_Cat(13,14] == 0   -24.5641     1.4664 -16.751  < 2e-16 ***
## VISIT_YEARS_Cat(14,15] == 0   -30.3509     2.1729 -13.968  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
emmeans_model_temps_cat <- emmeans(model_4, ~ VISIT_YEARS_Cat)

emmeans_model_temps_cat
```

```
##  VISIT_YEARS_Cat emmean    SE  df asymp.LCL asymp.UCL
##  (0,1]             56.7 0.830 Inf      55.1      58.4
##  (1,2]             54.3 0.860 Inf      52.6      56.0
##  (2,3]             52.0 0.880 Inf      50.3      53.7
##  (3,4]             50.4 0.908 Inf      48.7      52.2
##  (4,5]             48.1 0.930 Inf      46.2      49.9
##  (5,6]             47.8 0.968 Inf      45.9      49.7
##  (6,7]             43.8 1.006 Inf      41.8      45.8
##  (7,8]             41.8 1.055 Inf      39.7      43.8
##  (8,9]             40.3 1.135 Inf      38.1      42.6
##  (9,10]            37.3 1.202 Inf      35.0      39.7
##  (10,11]           35.8 1.286 Inf      33.3      38.3
##  (11,12]           34.0 1.413 Inf      31.3      36.8
##  (12,13]           32.6 1.539 Inf      29.6      35.6
##  (13,14]           32.2 1.655 Inf      28.9      35.4
##  (14,15]           26.4 2.305 Inf      21.9      30.9
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
plot(emmeans_model_temps_cat) + coord_flip()
```


60
50
40
30
emmean
(0,1]
(1,2]
(2,3]
(3,4]
(4,5]
(5,6]
(6,7]
(7,8]
(8,9]
(9,10]
(10,11]
(11,12]
(12,13]
(13,14]
(14,15]
VISIT_YEARS_Cat

5 Mixed model adding SEX

En aquesta secció s'analitza com canvia el epi al llarg dels anys segons el SEX

```
model_sex <- Mixed_models_FG(dades$SEX, dades$epi)
model_sex$anova_tnum
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## x                2992    2992     1  957.0  22.988  1.89e-06 ***
## x:VISIT_YEARS 239574  119787     2 8619.6 920.376 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_sex$anova_tcat
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                    Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## x                    3010  3010.2     1 1008.6  24.528 8.583e-07 ***
## x:VISIT_YEARS_Cat 209029  7465.3    28 7509.8  60.830 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_sex$cftest_tcat
```

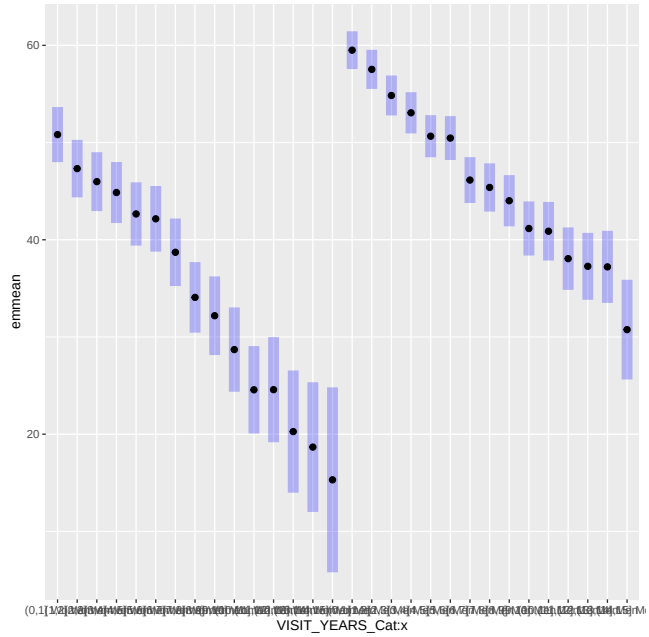
```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS_Cat + (1 | id), data = dades)
##
## Linear Hypotheses:
##                                      Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0                      50.8208     1.4465  35.133  < 2e-16 ***
## xMen == 0                              8.6841     1.7534   4.953 7.32e-07 ***
## xWomen:VISIT_YEARS_Cat(1,2] == 0      -3.5005     0.7091  -4.936 7.96e-07 ***
## xMen:VISIT_YEARS_Cat(1,2] == 0        -1.9769     0.4718  -4.190 2.79e-05 ***
## xWomen:VISIT_YEARS_Cat(2,3] == 0      -4.8400     0.7868  -6.151 7.68e-10 ***
## xMen:VISIT_YEARS_Cat(2,3] == 0        -4.6606     0.5205  -8.953  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(3,4] == 0      -5.9601     0.8936  -6.670 2.56e-11 ***
## xMen:VISIT_YEARS_Cat(3,4] == 0        -6.4437     0.5821 -11.070  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(4,5] == 0      -8.1651     0.9957  -8.200 2.22e-16 ***
## xMen:VISIT_YEARS_Cat(4,5] == 0        -8.8510     0.6234 -14.199  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(5,6] == 0      -8.6667     1.0951  -7.914 2.44e-15 ***
## xMen:VISIT_YEARS_Cat(5,6] == 0        -9.0422     0.7038 -12.848  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(6,7] == 0     -12.1082     1.1705 -10.344  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(6,7] == 0       -13.3622     0.7855 -17.010  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(7,8] == 0     -16.7466     1.2888 -12.994  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(7,8] == 0       -14.1226     0.8773 -16.097  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(8,9] == 0     -18.6346     1.5796 -11.797  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(8,9] == 0       -15.4889     0.9873 -15.687  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(9,10] == 0    -22.1180     1.7677 -12.513  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(9,10] == 0      -18.3461     1.0867 -16.882  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(10,11] == 0   -26.2561     1.8687 -14.051  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(10,11] == 0     -18.6273     1.2368 -15.061  < 2e-16 ***
```

```
## xWomen:VISIT_YEARS_Cat(11,12] == 0 -26.2404     2.4172 -10.856  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(11,12] == 0   -21.4463     1.3607 -15.762  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(12,13] == 0 -30.5545     2.9165 -10.477  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(12,13] == 0   -22.2355     1.4993 -14.831  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(13,14] == 0 -32.1492     3.1315 -10.266  < 2e-16 ***
## xMen:VISIT_YEARS_Cat(13,14] == 0   -22.2942     1.6577 -13.449  < 2e-16 ***
## xWomen:VISIT_YEARS_Cat(14,15] == 0 -35.5162     4.6664  -7.611 2.71e-14 ***
## xMen:VISIT_YEARS_Cat(14,15] == 0   -28.7493     2.4516 -11.727  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_sex$emmeans_model_tcat
```

```
##  VISIT_YEARS_Cat x     emmean    SE  df asymp.LCL asymp.UCL
##  (0,1]           Women   50.8 1.447 Inf     47.99      53.7
##  (1,2]           Women   47.3 1.507 Inf     44.37      50.3
##  (2,3]           Women   46.0 1.545 Inf     42.95      49.0
##  (3,4]           Women   44.9 1.601 Inf     41.72      48.0
##  (4,5]           Women   42.7 1.661 Inf     39.40      45.9
##  (5,6]           Women   42.2 1.723 Inf     38.78      45.5
##  (6,7]           Women   38.7 1.772 Inf     35.24      42.2
##  (7,8]           Women   34.1 1.852 Inf     30.45      37.7
##  (8,9]           Women   32.2 2.065 Inf     28.14      36.2
##  (9,10]          Women   28.7 2.213 Inf     24.37      33.0
##  (10,11]         Women   24.6 2.295 Inf     20.07      29.1
##  (11,12]         Women   24.6 2.760 Inf     19.17      30.0
##  (12,13]         Women   20.3 3.207 Inf     13.98      26.6
##  (13,14]         Women   18.7 3.404 Inf     12.00      25.3
##  (14,15]         Women   15.3 4.854 Inf      5.79      24.8
##  (0,1]           Men     59.5 0.991 Inf     57.56      61.4
##  (1,2]           Men     57.5 1.026 Inf     55.52      59.5
##  (2,3]           Men     54.8 1.050 Inf     52.79      56.9
##  (3,4]           Men     53.1 1.082 Inf     50.94      55.2
##  (4,5]           Men     50.7 1.105 Inf     48.49      52.8
##  (5,6]           Men     50.5 1.153 Inf     48.20      52.7
##  (6,7]           Men     46.1 1.204 Inf     43.78      48.5
##  (7,8]           Men     45.4 1.266 Inf     42.90      47.9
##  (8,9]           Men     44.0 1.345 Inf     41.38      46.7
##  (9,10]          Men     41.2 1.419 Inf     38.38      43.9
##  (10,11]         Men     40.9 1.537 Inf     37.86      43.9
##  (11,12]         Men     38.1 1.639 Inf     34.85      41.3
##  (12,13]         Men     37.3 1.756 Inf     33.83      40.7
##  (13,14]         Men     37.2 1.893 Inf     33.50      40.9
##  (14,15]         Men     30.8 2.617 Inf     25.63      35.9
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
model_sex$plot_marginal_means
```




```
fiber.emt <- emtrends(model_sex$model_tnum, "x", var = "VISIT_YEARS")
fiber.emt
```

```
##  x     VISIT_YEARS.trend     SE  df asymp.LCL asymp.UCL
##  Women             -2.37 0.0915 Inf     -2.54     -2.19
##  Men               -1.92 0.0562 Inf     -2.03     -1.81
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
pairs(fiber.emt)
```

```
##  contrast    estimate    SE  df z.ratio p.value
##  Women - Men   -0.441 0.107 Inf  -4.101  <.0001
##
## Degrees-of-freedom method: asymptotic
```

```
model_sex$emmeans_model_tcat %>% logitudinal_plot + ylab('eFGR')
```


60
40
20
eFGR
(0,1]
(1,2]
(2,3]
(3,4]
(4,5]
(5,6]
(6,7]
(7,8]
(8,9]
(9,10]
(10,11]
(11,12]
(12,13]
(13,14]
(14,15]
Years
Women
Men

6 Mixed model adding DIABET

Aquests models no els faig ja que precissament hem seleccionat diabetics

7 Mixed model adding FE (categories)

En aquesta secció s'analitza com canvia el epi al llarg dels anys segons categories de FE

```
dades$FE_cat <- cut(dades$FE, breaks = c(4,40,49,86))
dades$FE_cat_rec <- as.factor(dades$FE_cat)
levels(dades$FE_cat_rec) <- c('EF<=40%', 'EF 41-49%', 'EF>=50')
table(dades$FE_cat_rec, dades$FE_cat)
```

```
##
##              (4,40] (40,49] (49,86]
##   EF<=40%     7571       0       0
##   EF 41-49%      0     816       0
##   EF>=50         0       0     987
```

```
model_FE <- Mixed_models_FG(dades$FE_cat_rec, dades$epi)
model_FE$anova_tnum
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## x                3063    1531     2  965.3   11.79 8.736e-06 ***
## x:VISIT_YEARS 242281   80760     3 8624.9  621.75 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_FE$cftest_tnum
```

```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS + (1 | id), data = dades)
##
## Linear Hypotheses:
##                                Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0               60.06823    0.91694  65.509  < 2e-16 ***
## xEF 41-49% == 0                -6.04518    2.65460  -2.277   0.0228 *
## xEF>=50 == 0                  -10.77636    2.36580  -4.555 5.24e-06 ***
## xEF<=40%:VISIT_YEARS == 0      -1.94634    0.05197 -37.452  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS == 0    -2.95915    0.17284 -17.121  < 2e-16 ***
## xEF>=50:VISIT_YEARS == 0       -2.26742    0.17419 -13.017  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_FE$anova_tcat
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                    Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## x                    2996  1498.0     2 1017.8  12.270 5.424e-06 ***
## x:VISIT_YEARS_Cat  215721  5261.5    41 7502.6  43.099 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

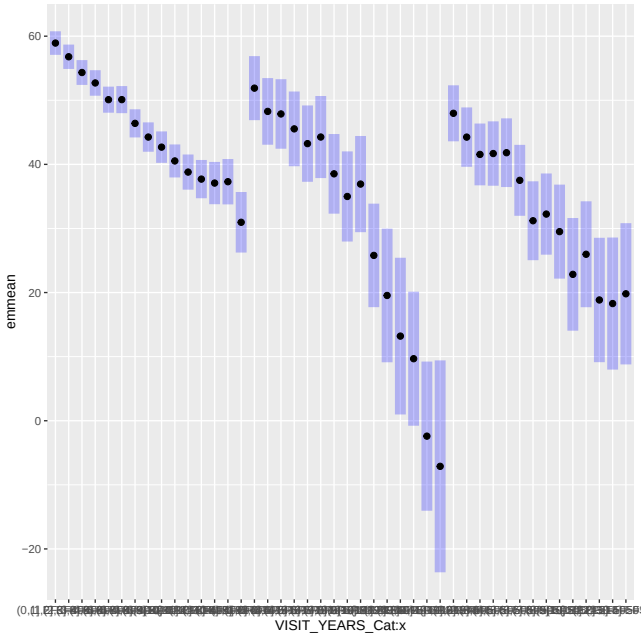
```
model_FE$cftest_tcat
```

```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS_Cat + (1 | id), data = dades)
##
## Linear Hypotheses:
##                                          Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0                          58.9267     0.9377  62.842  < 2e-16 ***
## xEF 41-49% == 0                           -7.0337     2.7162  -2.590 0.009610 **
## xEF>=50 == 0                             -10.9599     2.4185  -4.532 5.85e-06 ***
## xEF<=40%:VISIT_YEARS_Cat(1,2] == 0        -2.1359     0.4407  -4.847 1.25e-06 ***
## xEF 41-49%:VISIT_YEARS_Cat(1,2] == 0      -3.6293     1.2372  -2.933 0.003352 **
## xEF>=50:VISIT_YEARS_Cat(1,2] == 0         -3.7133     1.1856  -3.132 0.001736 **
## xEF<=40%:VISIT_YEARS_Cat(2,3] == 0        -4.5933     0.4807  -9.555  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(2,3] == 0      -4.0273     1.4658  -2.748 0.006004 **
## xEF>=50:VISIT_YEARS_Cat(2,3] == 0         -6.4149     1.3657  -4.697 2.64e-06 ***
## xEF<=40%:VISIT_YEARS_Cat(3,4] == 0        -6.2247     0.5351 -11.633  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(3,4] == 0      -6.3548     1.8282  -3.476 0.000509 ***
## xEF>=50:VISIT_YEARS_Cat(3,4] == 0         -6.2771     1.5401  -4.076 4.58e-05 ***
## xEF<=40%:VISIT_YEARS_Cat(4,5] == 0        -8.8321     0.5758 -15.339  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(4,5] == 0      -8.6571     1.9250  -4.497 6.89e-06 ***
## xEF>=50:VISIT_YEARS_Cat(4,5] == 0         -6.1466     1.8092  -3.397 0.000680 ***
## xEF<=40%:VISIT_YEARS_Cat(5,6] == 0        -8.8243     0.6456 -13.669  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(5,6] == 0      -7.6285     2.2670  -3.365 0.000766 ***
## xEF>=50:VISIT_YEARS_Cat(5,6] == 0        -10.4571     1.9375  -5.397 6.76e-08 ***
## xEF<=40%:VISIT_YEARS_Cat(6,7] == 0       -12.5304     0.7144 -17.539  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(6,7] == 0     -13.3701     2.1224  -6.299 2.99e-10 ***
## xEF>=50:VISIT_YEARS_Cat(6,7] == 0        -16.7642     2.3753  -7.058 1.69e-12 ***
## xEF<=40%:VISIT_YEARS_Cat(7,8] == 0       -14.6655     0.7878 -18.616  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(7,8] == 0     -16.9015     2.7050  -6.248 4.15e-10 ***
## xEF>=50:VISIT_YEARS_Cat(7,8] == 0        -15.7228     2.4985  -6.293 3.12e-10 ***
## xEF<=40%:VISIT_YEARS_Cat(8,9] == 0       -16.2380     0.9055 -17.933  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(8,9] == 0     -14.9685     3.0197  -4.957 7.16e-07 ***
## xEF>=50:VISIT_YEARS_Cat(8,9] == 0        -18.4603     3.1290  -5.900 3.64e-09 ***
## xEF<=40%:VISIT_YEARS_Cat(9,10] == 0      -18.3926     0.9907 -18.566  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(9,10] == 0    -26.0974     3.3808  -7.719 1.18e-14 ***
## xEF>=50:VISIT_YEARS_Cat(9,10] == 0       -25.1286     3.9846  -6.306 2.86e-10 ***
## xEF<=40%:VISIT_YEARS_Cat(10,11] == 0     -20.1300     1.1015 -18.275  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(10,11] == 0   -32.3476     4.7652  -6.788 1.14e-11 ***
## xEF>=50:VISIT_YEARS_Cat(10,11] == 0      -21.9939     3.6806  -5.976 2.29e-09 ***
## xEF<=40%:VISIT_YEARS_Cat(11,12] == 0     -21.2263     1.2557 -16.904  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(11,12] == 0   -38.6888     5.7711  -6.704 2.03e-11 ***
## xEF>=50:VISIT_YEARS_Cat(11,12] == 0      -29.1249     4.5054  -6.464 1.02e-10 ***
## xEF<=40%:VISIT_YEARS_Cat(12,13] == 0     -21.8450     1.4440 -15.128  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(12,13] == 0   -42.2152     4.7814  -8.829  < 2e-16 ***
## xEF>=50:VISIT_YEARS_Cat(12,13] == 0      -29.6836     4.8388  -6.134 8.55e-10 ***
## xEF<=40%:VISIT_YEARS_Cat(13,14] == 0     -21.6319     1.5852 -13.646  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(13,14] == 0   -54.2967     5.4417  -9.978  < 2e-16 ***
## xEF>=50:VISIT_YEARS_Cat(13,14] == 0      -28.1607     5.2338  -5.381 7.43e-08 ***
## xEF<=40%:VISIT_YEARS_Cat(14,15] == 0     -27.9631     2.2493 -12.432  < 2e-16 ***
## xEF 41-49%:VISIT_YEARS_Cat(14,15] == 0   -59.0081     8.0945  -7.290 3.10e-13 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_FE$emmeans_model_tcat
```

```
##  VISIT_YEARS_Cat x          emmean    SE  df asymp.LCL asymp.UCL
##  (0,1]           EF<=40%     58.93 0.938 Inf    57.089     60.76
##  (1,2]           EF<=40%     56.79 0.969 Inf    54.891     58.69
##  (2,3]           EF<=40%     54.33 0.988 Inf    52.397     56.27
##  (3,4]           EF<=40%     52.70 1.016 Inf    50.711     54.69
##  (4,5]           EF<=40%     50.09 1.038 Inf    48.061     52.13
##  (5,6]           EF<=40%     50.10 1.078 Inf    47.989     52.22
##  (6,7]           EF<=40%     46.40 1.121 Inf    44.199     48.59
##  (7,8]           EF<=40%     44.26 1.169 Inf    41.970     46.55
##  (8,9]           EF<=40%     42.69 1.251 Inf    40.236     45.14
##  (9,10]          EF<=40%     40.53 1.314 Inf    37.958     43.11
##  (10,11]         EF<=40%     38.80 1.400 Inf    36.053     41.54
##  (11,12]         EF<=40%     37.70 1.525 Inf    34.712     40.69
##  (12,13]         EF<=40%     37.08 1.683 Inf    33.783     40.38
##  (13,14]         EF<=40%     37.29 1.806 Inf    33.756     40.83
##  (14,15]         EF<=40%     30.96 2.410 Inf    26.240     35.69
##  (0,1]           EF 41-49%   51.89 2.549 Inf    46.897     56.89
##  (1,2]           EF 41-49%   48.26 2.652 Inf    43.066     53.46
##  (2,3]           EF 41-49%   47.87 2.768 Inf    42.441     53.29
##  (3,4]           EF 41-49%   45.54 2.975 Inf    39.708     51.37
##  (4,5]           EF 41-49%   43.24 3.040 Inf    37.278     49.19
##  (5,6]           EF 41-49%   44.26 3.267 Inf    37.860     50.67
##  (6,7]           EF 41-49%   38.52 3.170 Inf    32.310     44.74
##  (7,8]           EF 41-49%   34.99 3.587 Inf    27.960     42.02
##  (8,9]           EF 41-49%   36.92 3.828 Inf    29.421     44.43
##  (9,10]          EF 41-49%   25.80 4.121 Inf    17.719     33.87
##  (10,11]         EF 41-49%   19.55 5.319 Inf     9.120     29.97
##  (11,12]         EF 41-49%   13.20 6.238 Inf     0.979     25.43
##  (12,13]         EF 41-49%    9.68 5.336 Inf    -0.780     20.14
##  (13,14]         EF 41-49%   -2.40 5.937 Inf   -14.039      9.23
##  (14,15]         EF 41-49%   -7.12 8.435 Inf   -23.648      9.42
##  (0,1]           EF>=50      47.97 2.229 Inf    43.597     52.34
##  (1,2]           EF>=50      44.25 2.363 Inf    39.622     48.88
##  (2,3]           EF>=50      41.55 2.460 Inf    36.730     46.37
##  (3,4]           EF>=50      41.69 2.562 Inf    36.669     46.71
##  (4,5]           EF>=50      41.82 2.734 Inf    36.462     47.18
##  (5,6]           EF>=50      37.51 2.823 Inf    31.976     43.04
##  (6,7]           EF>=50      31.20 3.139 Inf    25.050     37.36
##  (7,8]           EF>=50      32.24 3.232 Inf    25.910     38.58
##  (8,9]           EF>=50      29.51 3.742 Inf    22.172     36.84
##  (9,10]          EF>=50      22.84 4.485 Inf    14.049     31.63
##  (10,11]         EF>=50      25.97 4.216 Inf    17.710     34.24
##  (11,12]         EF>=50      18.84 4.951 Inf     9.137     28.55
##  (12,13]         EF>=50      18.28 5.256 Inf     7.981     28.59
##  (13,14]         EF>=50      19.81 5.622 Inf     8.787     30.83
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
model_FE$plot_marginal_means
```



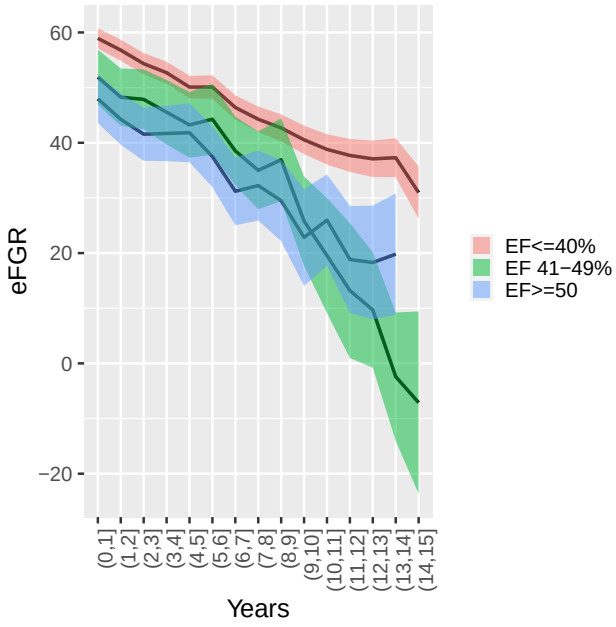

```
fiber.emt <- emtrends(model_FE$model_tnum, "x", var = "VISIT_YEARS")
fiber.emt
```

```
##  x          VISIT_YEARS.trend    SE  df asymp.LCL asymp.UCL
##  EF<=40%                -1.95 0.052 Inf     -2.05     -1.84
##  EF 41-49%              -2.96 0.173 Inf     -3.30     -2.62
##  EF>=50                 -2.27 0.174 Inf     -2.61     -1.93
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
pairs(fiber.emt)
```

```
##  contrast               estimate    SE  df z.ratio p.value
##  EF<=40% - (EF 41-49%)     1.013 0.180 Inf   5.612  <.0001
##  EF<=40% - EF>=50          0.321 0.182 Inf   1.766  0.1810
##  (EF 41-49%) - EF>=50     -0.692 0.245 Inf  -2.819  0.0134
##
## Degrees-of-freedom method: asymptotic
## P value adjustment: tukey method for comparing a family of 3 estimates
```

```
model_FE$emmeans_model_tcat %>% logitudinal_plot + ylab('eFGR')
```


60
40
20
0
−20
eFGR
(0,1]
(1,2]
(2,3]
(3,4]
(4,5]
(5,6]
(6,7]
(7,8]
(8,9]
(9,10]
(10,11]
(11,12]
(12,13]
(13,14]
(14,15]
Years
EF<=40%
EF 41−49%
EF>=50

8 Mixed model adding Etiology

En aquesta secció s'analitza com canvia el epi al llarg dels anys segons categories de Etiology

```
dades$ETIOLOGIA_rec <- ifelse(dades$ETIOLOGIA == 1, 'Ischemic', 'Non ischemic')
model_ETIOLOGIA <- Mixed_models_FG(dades$ETIOLOGIA_rec, dades$epi)
model_ETIOLOGIA$anova_tnum
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                Sum Sq Mean Sq NumDF  DenDF  F value  Pr(>F)
## x                 628     628     1  955.4   4.8189 0.02839 *
## x:VISIT_YEARS  238450  119225     2 8611.9 915.1878 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_ETIOLOGIA$cftest_tnum
```

```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS + (1 | id), data = dades)
##
## Linear Hypotheses:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0                 56.43665    1.06529  52.978   <2e-16 ***
## xNon ischemic == 0                3.60121    1.64048   2.195   0.0281 *
## xIschemic:VISIT_YEARS == 0       -1.92428    0.06391 -30.109   <2e-16 ***
## xNon ischemic:VISIT_YEARS == 0 -2.20161    0.07243 -30.395   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_ETIOLOGIA$anova_tcat
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                    Sum Sq Mean Sq NumDF  DenDF F value  Pr(>F)
## x                     532   532.0     1 1006.9  4.3295 0.03771 *
## x:VISIT_YEARS_Cat  207762  7420.1    28 7510.6 60.3912 < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_ETIOLOGIA$cftest_tcat
```

```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS_Cat + (1 | id), data = dades)
##
## Linear Hypotheses:
##                                          Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0                          55.2599     1.0898  50.709  < 2e-16
## xNon ischemic == 0                         3.4903     1.6774   2.081 0.037457
## xIschemic:VISIT_YEARS_Cat(1,2] == 0       -2.6968     0.5194  -5.192 2.08e-07
## xNon ischemic:VISIT_YEARS_Cat(1,2] == 0   -2.0973     0.6014  -3.488 0.000487
```

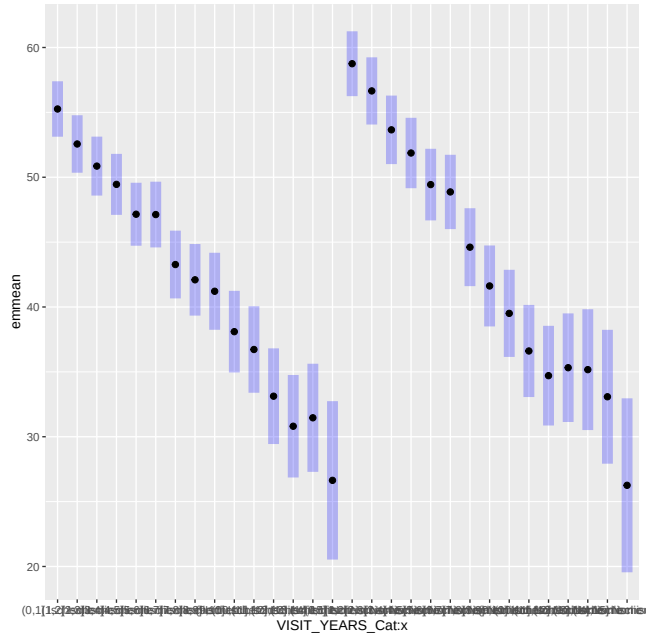
```
## xIschemic:VISIT_YEARS_Cat(2,3] == 0        -4.4012     0.5791  -7.600 2.95e-14
## xNon ischemic:VISIT_YEARS_Cat(2,3] == 0    -5.0960     0.6571  -7.755 8.88e-15
## xIschemic:VISIT_YEARS_Cat(3,4] == 0        -5.8094     0.6561  -8.855  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(3,4] == 0    -6.8821     0.7305  -9.421  < 2e-16
## xIschemic:VISIT_YEARS_Cat(4,5] == 0        -8.1107     0.7243 -11.198  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(4,5] == 0    -9.3170     0.7737 -12.042  < 2e-16
## xIschemic:VISIT_YEARS_Cat(5,6] == 0        -8.1364     0.8130 -10.007  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(5,6] == 0    -9.8830     0.8656 -11.417  < 2e-16
## xIschemic:VISIT_YEARS_Cat(6,7] == 0       -11.9884     0.8746 -13.708  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(6,7] == 0   -14.1415     0.9804 -14.424  < 2e-16
## xIschemic:VISIT_YEARS_Cat(7,8] == 0       -13.1658     0.9856 -13.358  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(7,8] == 0   -17.1293     1.0726 -15.970  < 2e-16
## xIschemic:VISIT_YEARS_Cat(8,9] == 0       -14.0478     1.1321 -12.408  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(8,9] == 0   -19.2414     1.2457 -15.446  < 2e-16
## xIschemic:VISIT_YEARS_Cat(9,10] == 0      -17.1624     1.2516 -13.712  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(9,10] == 0  -22.1411     1.3772 -16.077  < 2e-16
## xIschemic:VISIT_YEARS_Cat(10,11] == 0     -18.5361     1.3717 -13.513  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(10,11] == 0 -24.0440     1.5665 -15.349  < 2e-16
## xIschemic:VISIT_YEARS_Cat(11,12] == 0     -22.1358     1.5898 -13.923  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(11,12] == 0 -23.4296     1.7804 -13.160  < 2e-16
## xIschemic:VISIT_YEARS_Cat(12,13] == 0     -24.4513     1.7466 -13.999  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(12,13] == 0 -23.5798     2.0625 -11.433  < 2e-16
## xIschemic:VISIT_YEARS_Cat(13,14] == 0     -23.8008     1.8728 -12.709  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(13,14] == 0 -25.6693     2.3533 -10.908  < 2e-16
## xIschemic:VISIT_YEARS_Cat(14,15] == 0     -28.6223     2.9473  -9.711  < 2e-16
## xNon ischemic:VISIT_YEARS_Cat(14,15] == 0 -32.4943     3.2104 -10.122  < 2e-16
##
## (Intercept) == 0                          ***
## xNon ischemic == 0                        *
## xIschemic:VISIT_YEARS_Cat(1,2] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(1,2] == 0   ***
## xIschemic:VISIT_YEARS_Cat(2,3] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(2,3] == 0   ***
## xIschemic:VISIT_YEARS_Cat(3,4] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(3,4] == 0   ***
## xIschemic:VISIT_YEARS_Cat(4,5] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(4,5] == 0   ***
## xIschemic:VISIT_YEARS_Cat(5,6] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(5,6] == 0   ***
## xIschemic:VISIT_YEARS_Cat(6,7] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(6,7] == 0   ***
## xIschemic:VISIT_YEARS_Cat(7,8] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(7,8] == 0   ***
## xIschemic:VISIT_YEARS_Cat(8,9] == 0       ***
## xNon ischemic:VISIT_YEARS_Cat(8,9] == 0   ***
## xIschemic:VISIT_YEARS_Cat(9,10] == 0      ***
## xNon ischemic:VISIT_YEARS_Cat(9,10] == 0  ***
## xIschemic:VISIT_YEARS_Cat(10,11] == 0     ***
## xNon ischemic:VISIT_YEARS_Cat(10,11] == 0 ***
## xIschemic:VISIT_YEARS_Cat(11,12] == 0     ***
## xNon ischemic:VISIT_YEARS_Cat(11,12] == 0 ***
## xIschemic:VISIT_YEARS_Cat(12,13] == 0     ***
## xNon ischemic:VISIT_YEARS_Cat(12,13] == 0 ***
## xIschemic:VISIT_YEARS_Cat(13,14] == 0     ***
```

```
## xNon ischemic:VISIT_YEARS_Cat(13,14] == 0 ***
## xIschemic:VISIT_YEARS_Cat(14,15] == 0     ***
## xNon ischemic:VISIT_YEARS_Cat(14,15] == 0 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_ETIOLOGIA$emmeans_model_tcat
```

```
##  VISIT_YEARS_Cat x            emmean   SE  df asymp.LCL asymp.UCL
##  (0,1]           Ischemic       55.3 1.09 Inf      53.1      57.4
##  (1,2]           Ischemic       52.6 1.13 Inf      50.3      54.8
##  (2,3]           Ischemic       50.9 1.16 Inf      48.6      53.1
##  (3,4]           Ischemic       49.5 1.20 Inf      47.1      51.8
##  (4,5]           Ischemic       47.1 1.24 Inf      44.7      49.6
##  (5,6]           Ischemic       47.1 1.29 Inf      44.6      49.7
##  (6,7]           Ischemic       43.3 1.33 Inf      40.7      45.9
##  (7,8]           Ischemic       42.1 1.41 Inf      39.3      44.9
##  (8,9]           Ischemic       41.2 1.51 Inf      38.2      44.2
##  (9,10]          Ischemic       38.1 1.61 Inf      35.0      41.2
##  (10,11]         Ischemic       36.7 1.70 Inf      33.4      40.1
##  (11,12]         Ischemic       33.1 1.88 Inf      29.4      36.8
##  (12,13]         Ischemic       30.8 2.02 Inf      26.9      34.8
##  (13,14]         Ischemic       31.5 2.13 Inf      27.3      35.6
##  (14,15]         Ischemic       26.6 3.11 Inf      20.5      32.7
##  (0,1]           Non ischemic   58.8 1.28 Inf      56.3      61.2
##  (1,2]           Non ischemic   56.7 1.32 Inf      54.1      59.2
##  (2,3]           Non ischemic   53.7 1.35 Inf      51.0      56.3
##  (3,4]           Non ischemic   51.9 1.39 Inf      49.2      54.6
##  (4,5]           Non ischemic   49.4 1.41 Inf      46.7      52.2
##  (5,6]           Non ischemic   48.9 1.46 Inf      46.0      51.7
##  (6,7]           Non ischemic   44.6 1.53 Inf      41.6      47.6
##  (7,8]           Non ischemic   41.6 1.59 Inf      38.5      44.7
##  (8,9]           Non ischemic   39.5 1.71 Inf      36.2      42.9
##  (9,10]          Non ischemic   36.6 1.81 Inf      33.1      40.2
##  (10,11]         Non ischemic   34.7 1.96 Inf      30.9      38.5
##  (11,12]         Non ischemic   35.3 2.14 Inf      31.1      39.5
##  (12,13]         Non ischemic   35.2 2.38 Inf      30.5      39.8
##  (13,14]         Non ischemic   33.1 2.63 Inf      27.9      38.2
##  (14,15]         Non ischemic   26.3 3.42 Inf      19.6      33.0
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
model_ETIOLOGIA$plot_marginal_means
```



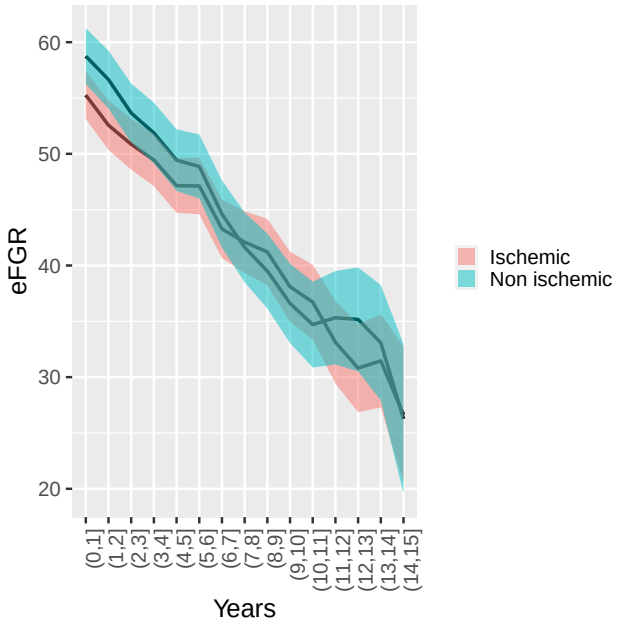

```
fiber.emt <- emtrends(model_ETIOLOGIA$model_tnum, "x", var = "VISIT_YEARS")
fiber.emt
```

```
##  x             VISIT_YEARS.trend     SE  df asymp.LCL asymp.UCL
##  Ischemic                  -1.92 0.0639 Inf     -2.05     -1.80
##  Non ischemic              -2.20 0.0724 Inf     -2.34     -2.06
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
pairs(fiber.emt)
```

```
##  contrast                estimate     SE  df z.ratio p.value
##  Ischemic - Non ischemic    0.277 0.0966 Inf   2.871  0.0041
##
## Degrees-of-freedom method: asymptotic
```

```
model_ETIOLOGIA$emmeans_model_tcat %>% logitudinal_plot + ylab('eFGR')
```


60
50
40
30
20
eFGR
(0,1]
(1,2]
(2,3]
(3,4]
(4,5]
(5,6]
(6,7]
(7,8]
(8,9]
(9,10]
(10,11]
(11,12]
(12,13]
(13,14]
(14,15]
Years
Ischemic
Non ischemic

9 Mixed model adding Mortality

No veig clar aquests models. Hi ha variables explicatives (p.e. el SEX), però la mortalitat és un **outcome** i aquí s'utilitza com si fods una variable explicativa que expliqués els valors de "epi" quan és al revés: els valors de "epi" expliquen el outcome mortalitat. Ho vàreu publicar així??

```
model_MORT <- Mixed_models_FG(dades$mort_rec, dades$epi)
model_MORT$anova_tnum
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##               Sum Sq Mean Sq NumDF  DenDF  F value    Pr(>F)
## x               4976    4976     1  932.5   36.741 1.957e-09 ***
## x:VISIT_YEARS 195730  195730     1 8650.8 1445.111 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_MORT$cftest_tnum
```

```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS + (1 | id), data = dades)
##
## Linear Hypotheses:
##                       Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0     63.75948    1.36670  46.652  < 2e-16 ***
## x == 0              -10.04407    1.65705  -6.061 1.35e-09 ***
## x:VISIT_YEARS == 0   -2.38711    0.06279 -38.015  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_MORT$anova_tcat
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                    Sum Sq Mean Sq NumDF  DenDF F value    Pr(>F)
## x                    5818  5817.7     1  945.2  45.125 3.189e-11 ***
## x:VISIT_YEARS_Cat 161860 11561.4    14 7536.5  89.676 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
model_MORT$cftest_tcat
```

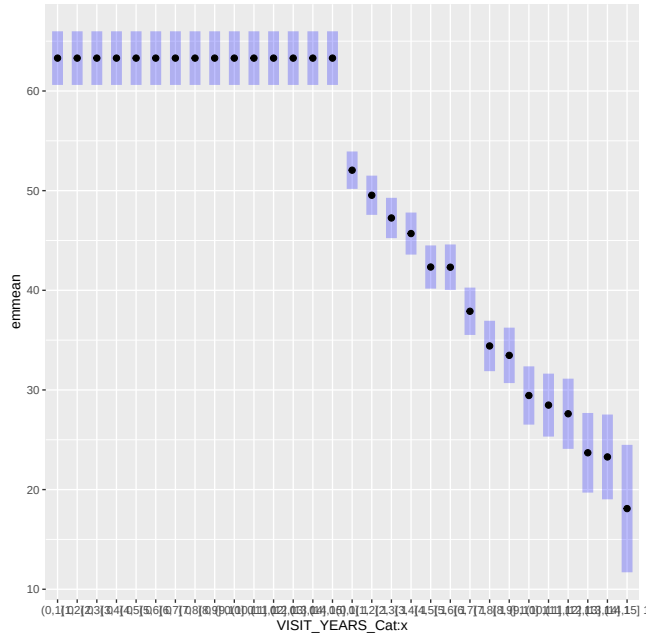
```
##
##          Simultaneous Tests for General Linear Hypotheses
##
## Fit: lmer(formula = y ~ x + x:VISIT_YEARS_Cat + (1 | id), data = dades)
##
## Linear Hypotheses:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept) == 0                 63.3013     1.3734  46.092  < 2e-16 ***
## x == 0                          -11.2483     1.6745  -6.718 1.85e-11 ***
## x:VISIT_YEARS_Cat(1,2] == 0      -2.5149     0.4968  -5.062 4.15e-07 ***
## x:VISIT_YEARS_Cat(2,3] == 0      -4.7953     0.5522  -8.684  < 2e-16 ***
```

```
## x:VISIT_YEARS_Cat(3,4] == 0    -6.3584     0.6305 -10.085  < 2e-16 ***
## x:VISIT_YEARS_Cat(4,5] == 0    -9.7179     0.6802 -14.287  < 2e-16 ***
## x:VISIT_YEARS_Cat(5,6] == 0    -9.7359     0.7705 -12.636  < 2e-16 ***
## x:VISIT_YEARS_Cat(6,7] == 0   -14.1575     0.8400 -16.854  < 2e-16 ***
## x:VISIT_YEARS_Cat(7,8] == 0   -17.6383     0.9493 -18.579  < 2e-16 ***
## x:VISIT_YEARS_Cat(8,9] == 0   -18.5824     1.1180 -16.621  < 2e-16 ***
## x:VISIT_YEARS_Cat(9,10] == 0  -22.6098     1.2092 -18.698  < 2e-16 ***
## x:VISIT_YEARS_Cat(10,11] == 0 -23.5744     1.3541 -17.409  < 2e-16 ***
## x:VISIT_YEARS_Cat(11,12] == 0 -24.4434     1.5699 -15.570  < 2e-16 ***
## x:VISIT_YEARS_Cat(12,13] == 0 -28.3585     1.8417 -15.398  < 2e-16 ***
## x:VISIT_YEARS_Cat(13,14] == 0 -28.7747     1.9870 -14.481  < 2e-16 ***
## x:VISIT_YEARS_Cat(14,15] == 0 -33.9580     3.1424 -10.806  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## (Univariate p values reported)
```

```
model_MORT$emmeans_model_tcat
```

```
##  VISIT_YEARS_Cat x emmean    SE  df asymp.LCL asymp.UCL
##  (0,1]           0   63.3 1.373 Inf      60.6      66.0
##  (1,2]           0   63.3 1.373 Inf      60.6      66.0
##  (2,3]           0   63.3 1.373 Inf      60.6      66.0
##  (3,4]           0   63.3 1.373 Inf      60.6      66.0
##  (4,5]           0   63.3 1.373 Inf      60.6      66.0
##  (5,6]           0   63.3 1.373 Inf      60.6      66.0
##  (6,7]           0   63.3 1.373 Inf      60.6      66.0
##  (7,8]           0   63.3 1.373 Inf      60.6      66.0
##  (8,9]           0   63.3 1.373 Inf      60.6      66.0
##  (9,10]          0   63.3 1.373 Inf      60.6      66.0
##  (10,11]         0   63.3 1.373 Inf      60.6      66.0
##  (11,12]         0   63.3 1.373 Inf      60.6      66.0
##  (12,13]         0   63.3 1.373 Inf      60.6      66.0
##  (13,14]         0   63.3 1.373 Inf      60.6      66.0
##  (14,15]         0   63.3 1.373 Inf      60.6      66.0
##  (0,1]           1   52.1 0.958 Inf      50.2      53.9
##  (1,2]           1   49.5 1.004 Inf      47.6      51.5
##  (2,3]           1   47.3 1.032 Inf      45.2      49.3
##  (3,4]           1   45.7 1.077 Inf      43.6      47.8
##  (4,5]           1   42.3 1.106 Inf      40.2      44.5
##  (5,6]           1   42.3 1.165 Inf      40.0      44.6
##  (6,7]           1   37.9 1.212 Inf      35.5      40.3
##  (7,8]           1   34.4 1.290 Inf      31.9      36.9
##  (8,9]           1   33.5 1.419 Inf      30.7      36.3
##  (9,10]          1   29.4 1.492 Inf      26.5      32.4
##  (10,11]         1   28.5 1.612 Inf      25.3      31.6
##  (11,12]         1   27.6 1.797 Inf      24.1      31.1
##  (12,13]         1   23.7 2.039 Inf      19.7      27.7
##  (13,14]         1   23.3 2.171 Inf      19.0      27.5
##  (14,15]         1   18.1 3.263 Inf      11.7      24.5
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
model_MORT$plot_marginal_means
```



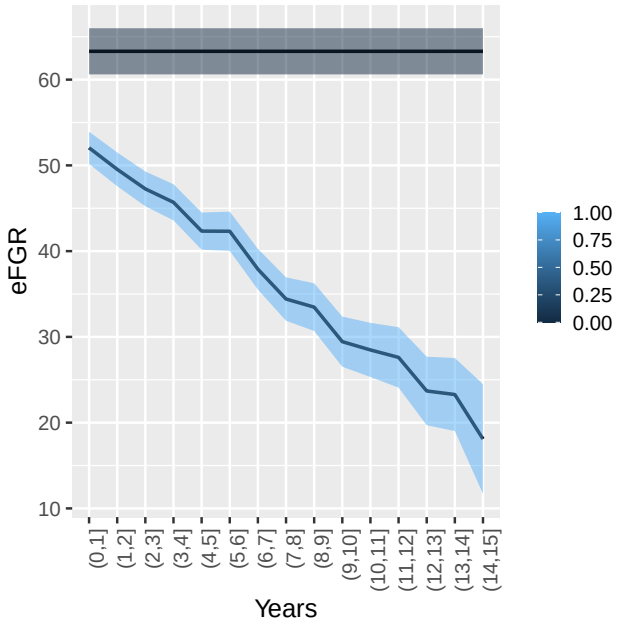

```
fiber.emt <- emtrends(model_MORT$model_tnum, "x", var = "VISIT_YEARS")
fiber.emt
```

```
##  x VISIT_YEARS.trend     SE  df asymp.LCL asymp.UCL
##  0              0.00 0.0000 Inf      0.00      0.00
##  1             -2.39 0.0628 Inf     -2.51     -2.26
##
## Degrees-of-freedom method: asymptotic
## Confidence level used: 0.95
```

```
pairs(fiber.emt)
```

```
##  contrast estimate     SE  df z.ratio p.value
##  0 - 1        2.39 0.0628 Inf  38.015  <.0001
##
## Degrees-of-freedom method: asymptotic
```

```
model_MORT$emmeans_model_tcat %>% logitudinal_plot + ylab('eFGR')
```


eFGR
60
50
40
30
20
10
(0,1]
(1,2]
(2,3]
(3,4]
(4,5]
(5,6]
(6,7]
(7,8]
(8,9]
(9,10]
(10,11]
(11,12]
(12,13]
(13,14]
(14,15]
Years
1.00
0.75
0.50
0.25
0.00