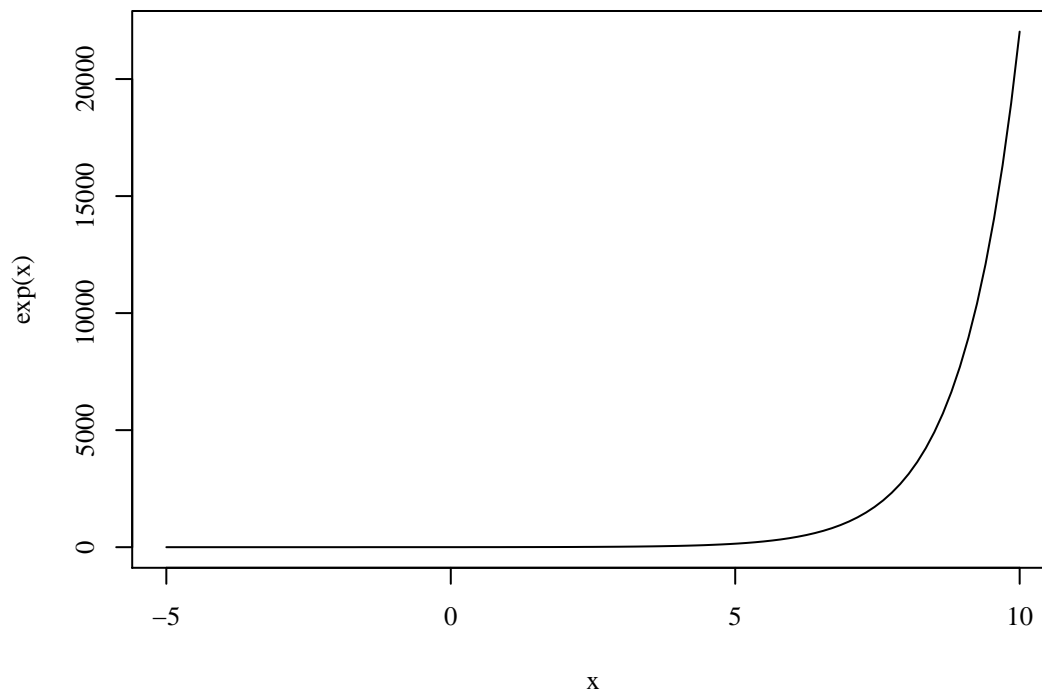


```
x <- seq(-2, 12, by = 0.1)
y <- exp(x)
plot(y ~ x, xlab = expression(paste(X*beta)), ylab = expression(
  exp(X*beta)), type = "l")
```

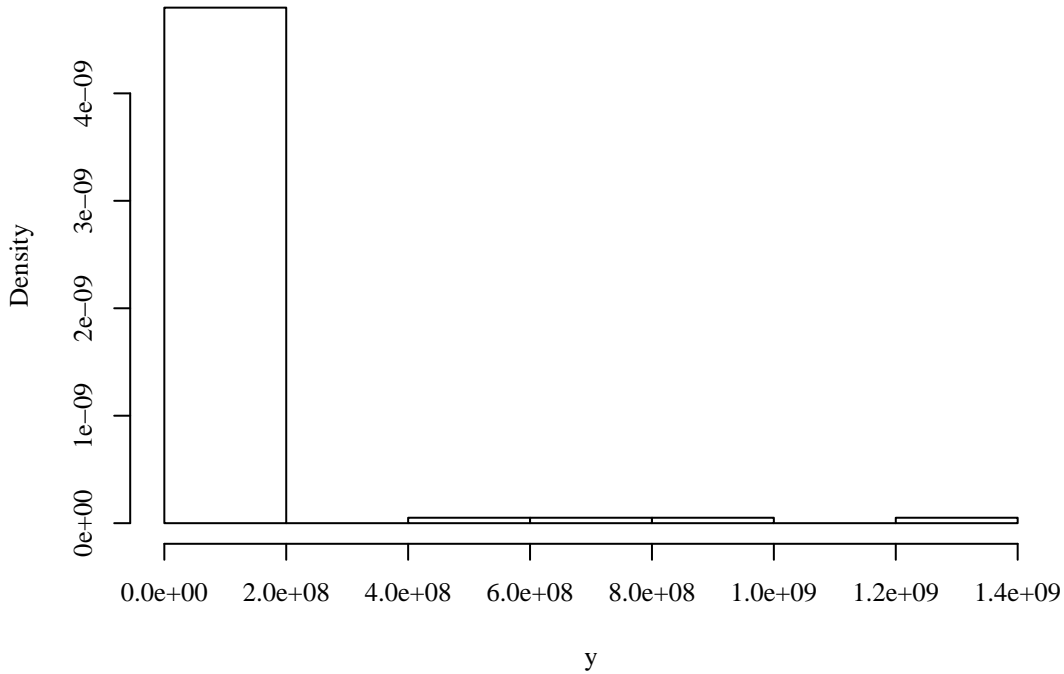
```
curve(exp(x), from = -5, to = 10, type = "l")
```



```
set.seed(132)
b0 <- .1; b1 <- 0.75; b2 <- -0.15
N <- 100
x1 <- rnorm(N, m=20, s=5)
x2 <- rnorm(N, m=10, s=3)
eta <- b0 + b1 * x1 + b2 * x2
input <- exp(eta)
y <- rpois(N, lambda = input)
dat <- data.frame(x1, x2, y)
```

```
hist(y, prob = TRUE, main = "Histogram")
```

Histogram



```
library(rockchalk)
library(faraway)
gavote$undercount <- gavote$ballots - gavote$votes
options.orig <- options()
options(width=65)
summarize(gavote)
```

```
Numeric variables
  perAA      gore      bush      other
min         0         249         271          5
med        0.233       2326       3597         86
max        0.765    154509    140494       7920
mean        0.243     7020.314    8929.057    381.654
sd          0.163    19317.780   18029.960   1150.975
skewness    0.477         6.111         5.141         5.399
kurtosis   -0.325        40.686        30.035        29.803
nobs        159         159         159         159
nmissing     0           0           0           0
  votes      ballots  undercount
min        832         881           0
med        6299        6712         296
max       263211    280975    17764
mean     16331.025    16926.503    595.478
sd       36623.274    37865.152   1584.281
skewness   5.081         5.129         8.798
kurtosis   27.360        28.094        87.478
nobs        159         159         159
nmissing     0           0           0

Nonnumeric variables
  equip      middle      econ
LEVER: 74      middle: 69
OS-CC: 44      poor : 72
OS-PC: 22      rich : 18
```

```

PAPER: 2
PUNCH: 17
nobs      : 159.000 nobs      : 159.000
nmiss     : 0.000  nmiss     : 0.000
entropy   : 1.846  entropy   : 1.396
normedEntropy: 0.795 normedEntropy: 0.881

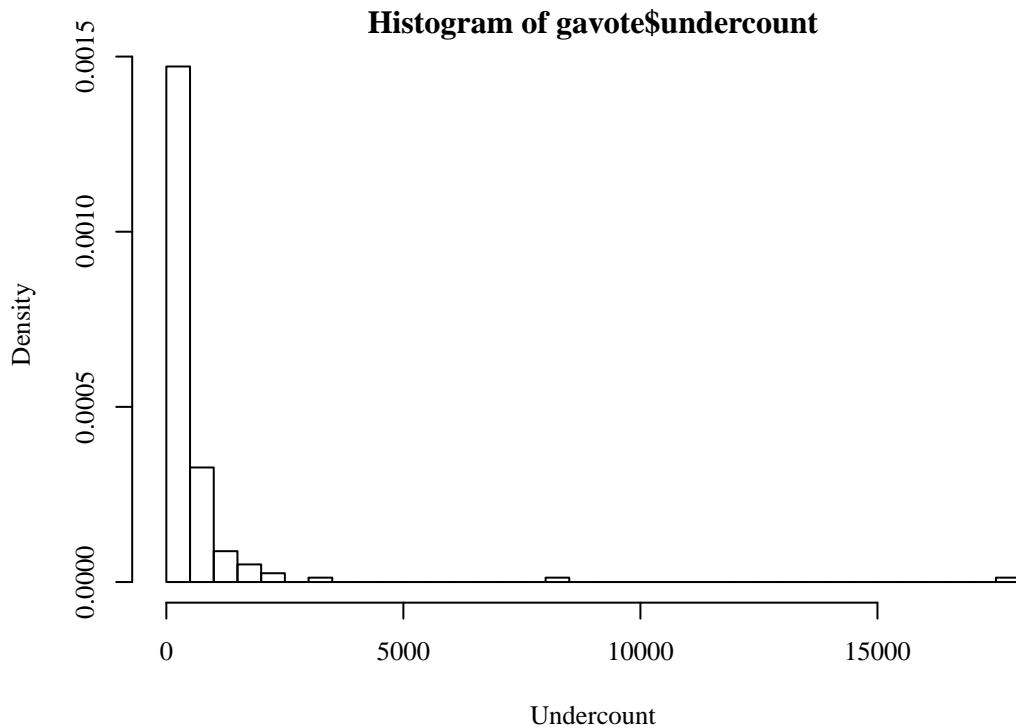
      rural      atlanta
rural: 117      Atlanta : 15
urban: 42      notAtlanta: 144

nobs      : 159.000 nobs      : 159.000
nmiss     : 0.000  nmiss     : 0.000
entropy   : 0.833  entropy   : 0.451
normedEntropy: 0.833 normedEntropy: 0.451

```

```
options(options.orig)
```

```
hist(gavote$undercount, breaks = 30, xlab= "Undercount", prob = TRUE)
```



```

myPois1<- glm(undercount ~ rural + perAA + equip, family =
  poisson, data = gavote)
summary(myPois1)

```

```

Call:
glm(formula = undercount ~ rural + perAA + equip, family = poisson,
    data = gavote)

```

```

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-77.623  -11.794   -2.844    8.385   165.005

```

```

Coefficients:
      Estimate Std. Error z value Pr(>|z|)
(Intercept)  4.536222   0.010373  437.32 <2e-16 ***
ruralurban   1.216001   0.007586  160.30 <2e-16 ***
perAA        2.213451   0.020352  108.76 <2e-16 ***
equipOS-CC   0.754020   0.010677   70.62 <2e-16 ***
equipOS-PC   0.937110   0.011196   83.70 <2e-16 ***
equipPAPER  -1.504971   0.094463  -15.93 <2e-16 ***
equipPUNCH   1.556716   0.010217  152.37 <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 184237  on 158  degrees of freedom
Residual deviance:  77702  on 152  degrees of freedom
AIC: 78893

Number of Fisher Scoring iterations: 6

```

```
predictOMatic(myPois1)
```

```

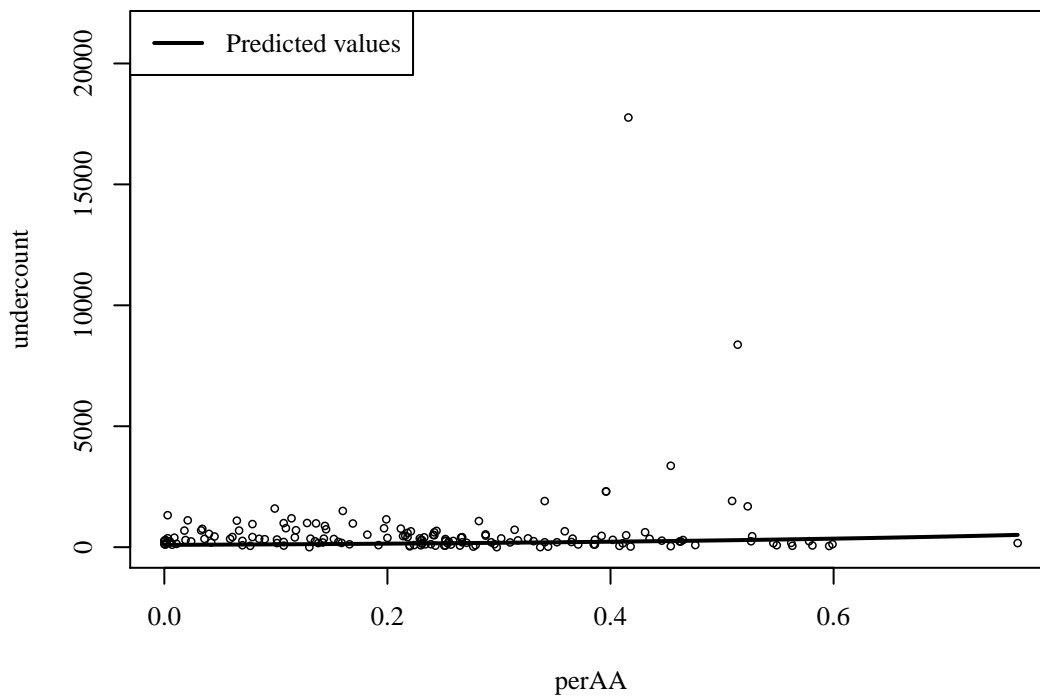
$rural
  rural    perAA equip      fit
1 rural 0.2429811 LEVER 159.8201
2 urban 0.2429811 LEVER 539.1800

$perAA
  rural    perAA equip      fit
1 rural 0.0000 LEVER  93.3375
2 rural 0.1115 LEVER 119.4648
3 rural 0.2330 LEVER 156.3279
4 rural 0.3480 LEVER 201.6438
5 rural 0.7650 LEVER 507.5077

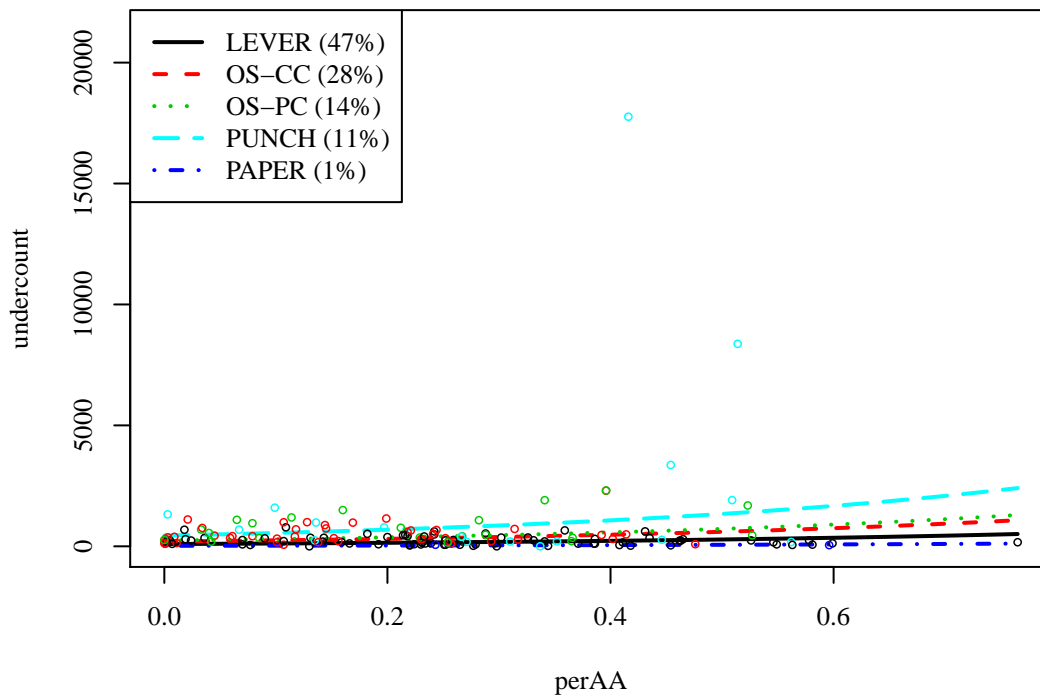
$equip
  rural    perAA equip      fit
1 rural 0.2429811 LEVER 159.82010
2 rural 0.2429811 OS-CC 339.70184
3 rural 0.2429811 OS-PC 407.95591
4 rural 0.2429811 PUNCH 758.06202
5 rural 0.2429811 PAPER  35.48384

```

```
library(rockchalk)
plotCurves(myPois1, plotx = "perAA")
```



```
library(rockchalk)
plotCurves(myPois1, plotx = "perAA", modx = "equip")
```



```
library(faraway)
```

```
library(MASS)
gavote$undercount <- gavote$ballots - gavote$votes
myNB1<- glm.nb(undercount ~ rural + perAA + equip, data = gavote)
summary(myNB1)
```

```
Call:
glm.nb(formula = undercount ~ rural + perAA + equip, data = gavote,
       init.theta = 1.392872977, link = log)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-4.0391  -0.9568  -0.2554   0.3143   3.5058

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  5.2137      0.1619  32.202 < 2e-16 ***
ruralurban   0.9094      0.1660   5.478 4.30e-08 ***
perAA        0.4746      0.4444   1.068  0.28556
equipOS-CC   0.5481      0.1696   3.231  0.00124 **
equipOS-PC   0.9117      0.2102   4.338 1.44e-05 ***
equipPAPER  -1.3644      0.6177  -2.209  0.02720 *
equipPUNCH   1.4606      0.2442   5.982 2.20e-09 ***

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for Negative Binomial(1.3929) family taken to be 1)

Null deviance: 358.48  on 158  degrees of freedom
Residual deviance: 180.33  on 152  degrees of freedom
AIC: 2228.8

Number of Fisher Scoring iterations: 1

            Theta:  1.393
        Std. Err.:  0.146

2 x log-likelihood:  -2212.833
```

```
predictOMatic(myNB1)
```

```
$rural
  rural    perAA equip      fit
1 rural 0.2429811 LEVER 206.2314
2 urban 0.2429811 LEVER 512.0371

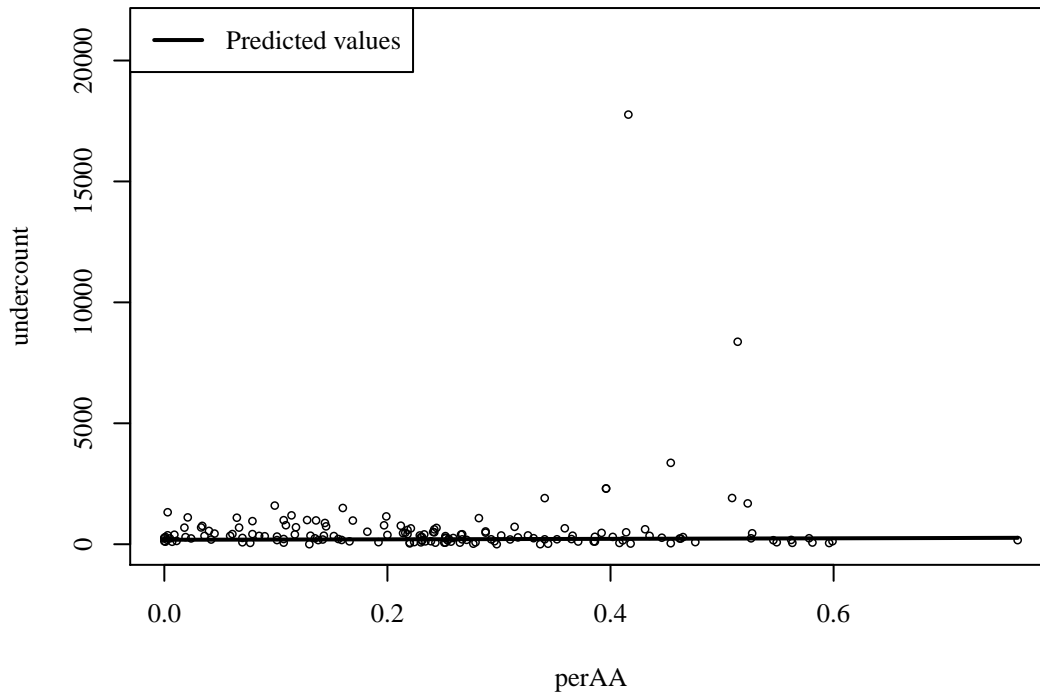
$perAA
  rural    perAA equip      fit
1 rural 0.0000 LEVER 183.7701
2 rural 0.1115 LEVER 193.7562
3 rural 0.2330 LEVER 205.2568
4 rural 0.3480 LEVER 216.7704
5 rural 0.7650 LEVER 264.2083

$equip
  rural    perAA equip      fit
1 rural 0.2429811 LEVER 206.23142
2 rural 0.2429811 OS-CC 356.76262
3 rural 0.2429811 OS-PC 513.21477
4 rural 0.2429811 PUNCH 888.53690
5 rural 0.2429811 PAPER  52.69805
```

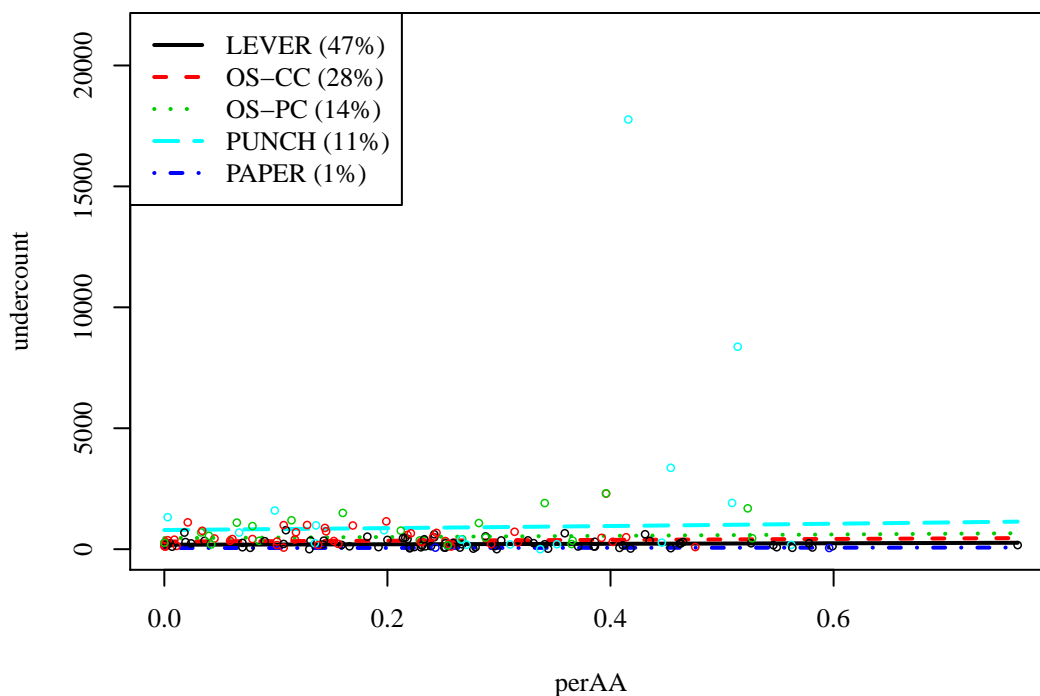
```
## ddir <- "../data"
## if(!file.exists(ddir)) dir.create(ddir)
```

```
## library(foreign)
## write.dta(gavote, file = file.path(ddir, "gavote.dta"))
## write.csv(gavote, file = file.path(ddir, "gavote.csv"),
  row.names = FALSE)
## saveRDS(gavote, file = file.path(ddir, "gavote.rds"))
```

```
library(rockchalk)
plotCurves(myNB1, plotx = "perAA")
```



```
library(rockchalk)
plotCurves(myNB1, plotx = "perAA", modx = "equip")
```

```
outreg(list("Poisson" = myPois1, "Neg. Binom" = myNB1), tight=
FALSE)
```

	Poisson		Neg. Binom	
	Estimate	(S.E.)	Estimate	(S.E.)
(Intercept)	4.536***	(0.010)	5.214***	(0.162)
ruralurban	1.216***	(0.008)	0.909***	(0.166)
perAA	2.213***	(0.020)	0.475	(0.444)
equipOS-CC	0.754***	(0.011)	0.548**	(0.170)
equipOS-PC	0.937***	(0.011)	0.912***	(0.210)
equipPAPER	-1.505***	(0.094)	-1.364*	(0.618)
equipPUNCH	1.557***	(0.010)	1.461***	(0.244)
N	159		159	
Deviance	77702.066		180.331	
$-2LLR(Model\chi^2)$	106535.170***		178.152***	

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$

```
anova(myPois1, myNB1, test = "LR")
```

Analysis of Deviance Table				
Model 1: undercount ~ rural + perAA + equip				
Model 2: undercount ~ rural + perAA + equip				
	Resid.	Df	Resid. Dev	Df Deviance Pr(>Chi)
1	152		77702	
2	152	180	0	77522

```
library(lmtest)
```

```
lrtest(myPois1, myNB1)
```

```
Likelihood ratio test
```

```
Model 1: undercount ~ rural + perAA + equip
```

```
Model 2: undercount ~ rural + perAA + equip
```

```
#Df LogLik Df Chisq Pr(>Chisq)
```

```
1 7 -39439
```

```
2 8 -1106 1 76666 < 2.2e-16 ***
```

```
---  
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
library(pscl)
```

```
myNB1<- glm.nb(undercount ~ rural + perAA + equip, data = gavote)
```

```
##These fail
```

```
##myZip1 <- zeroinfl(undercount ~ rural + perAA + equip | ., data  
= gavote, dist = "negbin", EM = TRUE)
```

```
## Succeeds
```

```
myZip1 <- zeroinfl(undercount ~ rural + perAA + equip | 1, data =  
gavote, dist = "negbin", EM = TRUE)
```

```
library(foreign)
```

```
stdir <- "../Stata/"
```

```
if(!file.exists(stdir)) dir.create(stdir)
```

```
write.dta(gavote, file = paste0(stdir, "gavote.dta7"))
```

```
warnings()
```

```
sessionInfo()
```

```
R version 3.5.1 (2018-07-02)
```

```
Platform: x86_64-pc-linux-gnu (64-bit)
```

```
Running under: Ubuntu 18.10
```

```
Matrix products: default
```

```
BLAS: /usr/lib/x86_64-linux-gnu/blas/libblas.so.3.8.0
```

```
LAPACK: /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.8.0
```

```
locale:
```

```
[1] LC_CTYPE=en_US.UTF-8 LC_NUMERIC=C  
[3] LC_TIME=en_US.UTF-8 LC_COLLATE=en_US.UTF-8  
[5] LC_MONETARY=en_US.UTF-8 LC_MESSAGES=en_US.UTF-8  
[7] LC_PAPER=en_US.UTF-8 LC_NAME=C  
[9] LC_ADDRESS=C LC_TELEPHONE=C  
[11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C
```

```
attached base packages:
```

```
[1] stats graphics grDevices utils datasets methods base
```

```
other attached packages:
```

```
[1] foreign_0.8-71 pscl_1.5.2 lmtest_0.9-36  
[4] zoo_1.8-2 MASS_7.3-51 faraway_1.0.7  
[7] rockchalk_1.8.128 stationery_0.98.5.5
```

```
loaded via a namespace (and not attached):
```

```
[1] zip_1.0.0 Rcpp_0.12.17 compiler_3.5.1 nloptr_1.0.4  
[5] plyr_1.8.4 tools_3.5.1 digest_0.6.15 lme4_1.1-17  
[9] evaluate_0.10.1 nlme_3.1-137 lattice_0.20-35 openxlsx_4.1.0  
[13] Matrix_1.2-14 pbivnorm_0.6.0 stringr_1.3.1 knitr_1.20  
[17] stats4_3.5.1 rprojroot_1.3-2 grid_3.5.1 rmarkdown_1.10
```

[21]	lavaan_0.6-1	carData_3.0-1	minqa_1.2.4	magrittr_1.5
[25]	backports_1.1.2	htmltools_0.3.6	kutils_1.51	splines_3.5.1
[29]	mnormt_1.5-5	xtable_1.8-2	stringi_1.2.3	