

# Lab 11 Jiyanshu Dhaka 220481

## 1. Poisson Regression: Aircraft Damage Data

### 1.1 Load Packages

```
if(!require("MASS"))install.packages("MASS",dependencies=TRUE)
```

```
## Loading required package: MASS
```

```
if(!require("broom"))install.packages("broom",dependencies=TRUE)
```

```
## Loading required package: broom
```

```
library(MASS);library(broom)
```

### 1.2 Input Data

```
dat1<-data.frame(  
y=c(0,1,0,0,0,0,1,0,0,2,1,1,1,1,2,3,1,1,1,2,0,1,1,2,5,1,1,5,5,7),  
x1=c(0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1),  
x2=c(4,4,4,5,5,5,6,6,6,7,7,7,8,8,8,7,7,7,10,10,10,12,12,12,8,8,8,14,14,14),  
x3=c(91.5,84,76.5,69,61.5,80,72.5,65,57.5,50,103,95.5,88,80.5,73,116.1,100.6,85,  
69.4,53.9,112.3,96.7,81.1,65.6,50,120,104.4,88.9,73.7,57.8))  
head(dat1)
```

```
##   y x1 x2  x3  
## 1 0  0  4 91.5  
## 2 1  0  4 84.0  
## 3 0  0  4 76.5  
## 4 0  0  5 69.0  
## 5 0  0  5 61.5  
## 6 0  0  5 80.0
```

### 1.3 Fit Model

```
fit1<-glm(y~x1+x2+x3,family=poisson(link="log"),data=dat1)  
summary(fit1)
```

```
##
## Call:
## glm(formula = y ~ x1 + x2 + x3, family = poisson(link = "log"),
##      data = dat1)
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -0.406023   0.877489  -0.463   0.6436
## x1           0.568772   0.504372   1.128   0.2595
## x2           0.165425   0.067541   2.449   0.0143 *
## x3          -0.013522   0.008281  -1.633   0.1025
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##      Null deviance: 53.883  on 29  degrees of freedom
## Residual deviance: 25.953  on 26  degrees of freedom
## AIC: 87.649
##
## Number of Fisher Scoring iterations: 5
```

## 1.4 Hypothesis Check

```
tidy(fit1);anova(fit1,test="Chisq")
```

```
## # A tibble: 4 × 5
##   term      estimate std.error statistic p.value
##   <chr>      <dbl>     <dbl>     <dbl>   <dbl>
## 1 (Intercept) -0.406     0.877     -0.463   0.644
## 2 x1          0.569     0.504      1.13    0.259
## 3 x2          0.165     0.0675    2.45    0.0143
## 4 x3         -0.0135    0.00828   -1.63    0.102
```

```
## Analysis of Deviance Table
##
## Model: poisson, link: log
##
## Response: y
##
## Terms added sequentially (first to last)
##
##      Df Deviance Resid. Df Resid. Dev  Pr(>Chi)
## NULL                29      53.883
## x1      1  15.5996      28      38.283 7.827e-05 ***
## x2      1   9.6492      27      28.634 0.001894 **
## x3      1   2.6811      26      25.953 0.101543
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 2. Gamma Regression: Worsted Yarn Data

### 2.1 Input Data

```
dat2<-data.frame(  
x1=c(-1,0,1,-1,0,1,-1,0,1,-1,0,1,-1,0,1,-1,0,1,-1,0,1),  
x2=c(-1,-1,-1,0,0,0,1,1,1,-1,-1,-1,0,0,0,1,1,1,-1,-1,-1,0,0,0,1,1,1),  
x3=c(-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,0,0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1),  
y=c(674,1414,3636,338,1022,1568,170,442,1140,370,1198,3184,266,620,1070,118,332,884,  
292,634,2000,210,438,566,90,220,360))  
head(dat2)
```

```
##   x1 x2 x3   y  
## 1 -1 -1 -1  674  
## 2  0 -1 -1 1414  
## 3  1 -1 -1 3636  
## 4 -1  0 -1  338  
## 5  0  0 -1 1022  
## 6  1  0 -1 1568
```

### 2.2 Fit Model

```
fit2<-glm(y~x1+x2+x3,family=Gamma(link="log"),data=dat2)  
summary(fit2)
```

```
##  
## Call:  
## glm(formula = y ~ x1 + x2 + x3, family = Gamma(link = "log"),  
##      data = dat2)  
##  
## Coefficients:  
##              Estimate Std. Error t value Pr(>|t|)  
## (Intercept)  6.34891    0.03422 185.511  < 2e-16 ***  
## x1           0.84251    0.04192  20.100 4.34e-16 ***  
## x2          -0.63132    0.04192 -15.062 2.10e-13 ***  
## x3          -0.38513    0.04192  -9.188 3.68e-09 ***  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
##  
## (Dispersion parameter for Gamma family taken to be 0.0316243)  
##  
##      Null deviance: 22.88613  on 26  degrees of freedom  
## Residual deviance:  0.76939  on 23  degrees of freedom  
## AIC: 332.76  
##  
## Number of Fisher Scoring iterations: 5
```

## 2.3 Hypothesis Check

```
anova(fit2,test="Chisq")
```

```
## Analysis of Deviance Table
##
## Model: Gamma, link: log
##
## Response: y
##
## Terms added sequentially (first to last)
##
##
##      Df Deviance Resid. Df Resid. Dev  Pr(>Chi)
## NULL                26    22.8861
## x1      1  12.6758      25    10.2104 < 2.2e-16 ***
## x2      1   6.8645      24   3.3459 < 2.2e-16 ***
## x3      1   2.5765      23   0.7694 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 3. Conclusion

made models for data about damage and yarn. The numbers show if factors matter. We used Poisson for counts and Gamma for time-like values. Both models checked factors using the `Chisq` test.

```
sessionInfo()
```

```

## R version 4.3.1 (2023-06-16 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 11 x64 (build 22621)
##
## Matrix products: default
##
##
## locale:
## [1] LC_COLLATE=English_India.utf8  LC_CTYPE=English_India.utf8
## [3] LC_MONETARY=English_India.utf8 LC_NUMERIC=C
## [5] LC_TIME=English_India.utf8
##
## time zone: Asia/Calcutta
## tzcode source: internal
##
## attached base packages:
## [1] stats      graphics  grDevices utils      datasets  methods   base
##
## other attached packages:
## [1] broom_1.0.5 MASS_7.3-60
##
## loaded via a namespace (and not attached):
## [1] vctrs_0.6.3      cli_3.6.1        knitr_1.44        rlang_1.1.1
## [5] xfun_0.40        purrr_1.0.2      generics_0.1.3    jsonlite_1.8.7
## [9] glue_1.6.2       backports_1.4.1  htmltools_0.5.6   sass_0.4.7
## [13] fansi_1.0.4      rmarkdown_2.25   evaluate_0.21     jquerylib_0.1.4
## [17] tibble_3.2.1     fastmap_1.1.1    yaml_2.3.7        lifecycle_1.0.3
## [21] compiler_4.3.1   dplyr_1.1.3      pkgconfig_2.0.3   tidyr_1.3.0
## [25] rstudioapi_0.15.0 digest_0.6.33     R6_2.5.1          tidyselect_1.2.0
## [29] utf8_1.2.3       pillar_1.9.0     magrittr_2.0.3    bslib_0.5.1
## [33] tools_4.3.1      cachem_1.0.8

```