

# Insolvency - (Quasi-)Poisson Model and Negative Binomial Model

February 1, 2012

First the insolvency data are loaded:

```
> library(catdata)
> data(insolvency)
> attach(insolvency)
```

For the number of insolvent firms between 1994 and 1996 a Poisson model is fitted with time as predictor. Time is considered as a number from 1 to 36, denoting the month from January 1994 to December 1996.

```
> ins1 <- glm(insolv ~ case + I(case^2), family=poisson(link=log), data=insolvency)
> summary(ins1)
```

Call:

```
glm(formula = insolv ~ case + I(case^2), family = poisson(link = log),
     data = insolvency)
```

Deviance Residuals:

	Min	1Q	Median	3Q	Max
	-3.2037	-0.9083	-0.2517	0.4880	3.0340

Coefficients:

	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	4.1916952	0.0617994	67.827	< 2e-16 ***
case	0.0197825	0.0073901	2.677	0.00743 **
I(case^2)	-0.0002670	0.0001896	-1.409	0.15897

---

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

(Dispersion parameter for poisson family taken to be 1)

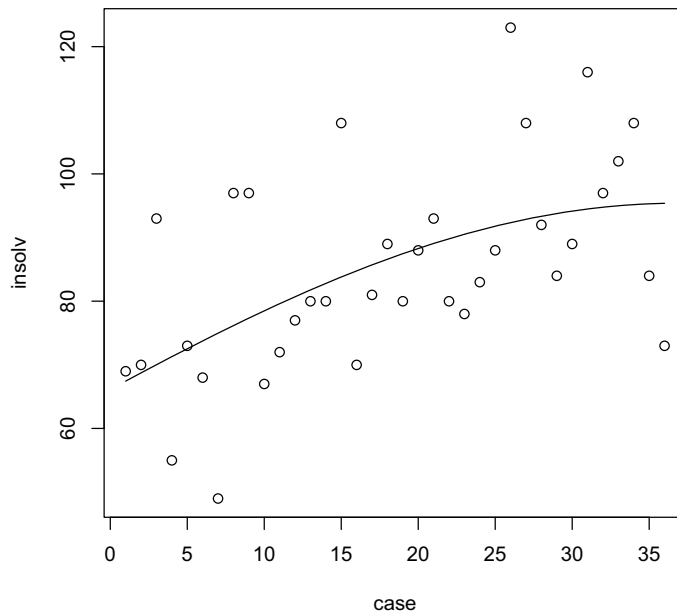
Null deviance: 108.128 on 35 degrees of freedom  
Residual deviance: 75.287 on 33 degrees of freedom  
AIC: 306.82

Number of Fisher Scoring iterations: 4

```
> # plot(ins1)
```

Scatter-Plot of number of insolvent firms dependent of the month (1-36). With estimated curve of the log-linear model.

```
> plot(case, insolv)
> points(ins1$fitted.values, type="l")
```



In many real-world datasets the variance of count-data is higher than predicted by the Poisson distribution. So next a Poisson model with dispersion parameter is fitted (Quasi-Poisson model).

```
> ins2 <- glm(insolv ~ case + I(case^2), family=quasipoisson, data=insolvency)
> summary(ins2)
```

Call:

```
glm(formula = insolv ~ case + I(case^2), family = quasipoisson,
    data = insolvency)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-3.2037	-0.9083	-0.2517	0.4880	3.0340

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	4.1916952	0.0939826	44.601	<2e-16 ***
case	0.0197825	0.0112387	1.760	0.0876 .
I(case^2)	-0.0002670	0.0002883	-0.926	0.3611

---

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

(Dispersion parameter for quasipoisson family taken to be 2.312738)

Null deviance: 108.128 on 35 degrees of freedom  
Residual deviance: 75.287 on 33 degrees of freedom  
AIC: NA

Number of Fisher Scoring iterations: 4

```
> # plot(ins2)
```

An alternativ to a quasi-poisson model the negative binomial distribution.

```
> library(MASS)
> ins3 <- glm.nb(insolv ~ case + I(case^2), data=insolvency)
> summary(ins3)
```

Call:

```
glm.nb(formula = insolv ~ case + I(case^2), data = insolvency,
       init.theta = 77.92952593, link = log)
```

Deviance Residuals:

	Min	1Q	Median	3Q	Max
	-2.3666	-0.6333	-0.1710	0.3350	2.0042

Coefficients:

	Estimate	Std. Error	z value	Pr(> z )
(Intercept)	4.1953863	0.0861256	48.712	<2e-16 ***
case	0.0192833	0.0105170	1.834	0.0667 .
I(case^2)	-0.0002546	0.0002728	-0.933	0.3506

---

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

(Dispersion parameter for Negative Binomial(77.9295) family taken to be 1)

Null deviance: 52.104 on 35 degrees of freedom  
Residual deviance: 36.312 on 33 degrees of freedom  
AIC: 296.27

Number of Fisher Scoring iterations: 1

Theta: 77.9  
Std. Err.: 35.5

2 x log-likelihood: -288.269

Since counts are rather large in addition a normal distribution model is fitted.

```
> ins4 <- glm(insolv ~ case + I(case^2), family=gaussian(link=log), data=insolvency)
> summary(ins4)
```

```
Call:
glm(formula = insolv ~ case + I(case^2), family = gaussian(link = log),
    data = insolvency)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-25.809	-8.744	-2.374	4.560	30.480

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	4.1836089	0.1005663	41.600	<2e-16 ***
case	0.0208026	0.0115423	1.802	0.0806 .
I(case^2)	-0.0002915	0.0002896	-1.007	0.3214

---

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

(Dispersion parameter for gaussian family taken to be 193.2793)

Null deviance: 9147.0 on 35 degrees of freedom  
Residual deviance: 6378.1 on 33 degrees of freedom  
AIC: 296.54

Number of Fisher Scoring iterations: 4