# GLM

The generalized linear model (GLM) is a flexible generalization of ordinary least squares regression. The GLM generalizes linear regression by allowing the linear model to be related to the response variable (i.e. $Y$) via a link function (i.e. $g(.)$)and by allowing the magnitude of the variance of each measurement to be a function of its predicted value.

The GLM is described as follow: $$Y = \mu + \epsilon$$ And $$E\left[Y\right]=\mu=g^{-1}(X\beta) = g^{-1}(\eta)$$ Where:

- $\epsilon$ is the residuals or deviation from the mean
- $g(.)$ is the link function
- $g^{-1}(.)$ is the inverse-link function
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- $X$ is the independent variables or the exogenous factors
- $\beta$ is a parameter vector
- $\eta$ is the <u>linear predictor</u>: the quantity which incorporates the information about the independent variables into the model. $$\eta=X\beta$$
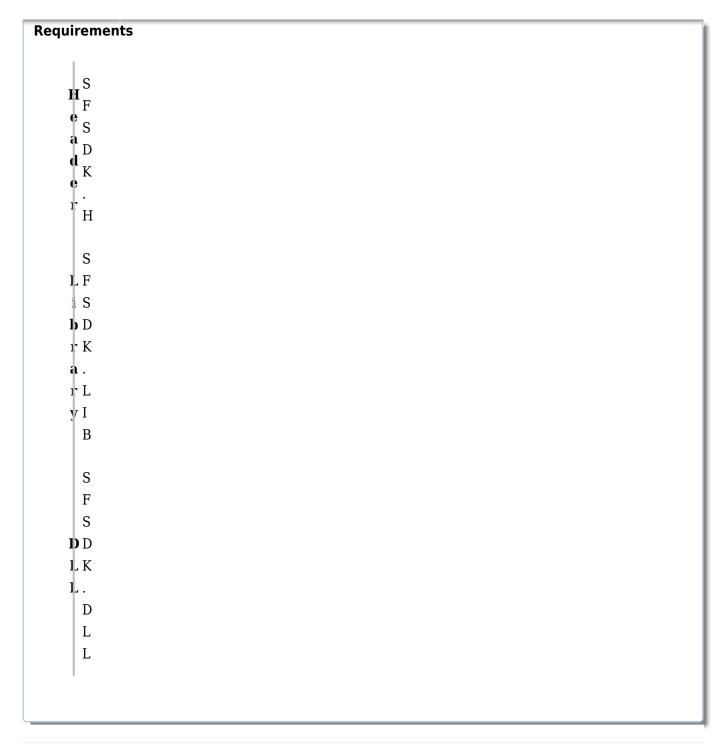
**Remarks**

1. Each outcome of the dependent variables,Y, is assumed to be generated from a particular distribution in the exponential family, a large range of probability distributions that includes the normal, binomial and Poisson distributions, among others.
2. The distribution mean of the $Y$ variable (i.e. $\mu$ depends solely on the independent variables, $X$. $$E\left[Y\right]=\mu=g^{-1}(X\beta)$$
3. The conditional variance of the dependent variable, Y, is constant: $$V(Y\|{X\beta})=\phi \times V({X\beta})$$ $(Where:)$
   - $V(.)$ is the variance function.
   - $\phi$ is the dispersion factor (constant value).

### Link Function

1. The Link Function provides the relationship between the linear predictor and the mean of the distribution function. here are many commonly used link functions, and their choice can be somewhat arbitrary. It can be convenient to match the domain of the link function to the range of the distribution function's mean.
2. NumXL supports five canonical link functions: Identity, Logit, Probit, Complementary Log-Log and Log. In the table below, we define the link function and outline the residuals distribution assumption.

| Distribution | Name | Link Function |
|---|---|---|
| Normal | Identity | $X\beta=\mu$ |
| Binomial | Logit | $X\beta = \ln\frac{\mu}{1-\mu}$ |
| Poisson | Log | $X\beta = \ln\mu$ |

## Requirements

| Header | SFSDK.H |
| Library | SFSDK.LIB |
| DLL | SFSDK.DLL |

## References

Hamilton, J .D.; [Time Series Analysis](), Princeton University Press (1994), ISBN 0-691-04289-6

Tsay, Ruey S.; [Analysis of Financial Time Series]() John Wiley & SONS. (2005), ISBN 0-471-690740

## See Also

[template("related")]