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*PARAMETRIC*

# Chapter 5: On Confidence Intervals for Expected Response in $2^n$ Factorial Experiments with Exponentially Distributed Response Variables

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The exponential distribution is an important distribution in the analysis of lifetime data. Its one interesting characterization is that interoccurrence times between the successive events of a Poisson process are independent exponentially distributed. In industrial designed-experiments setting, exponentially distributed response variable can be encountered, for example, when the response is inter-occurrence time between successive defective products when the defectives are produced according to a Poisson process. Traditionally in such a situation, the logtransformed response variable is analyzed using ordinary least squares (OLS). However, this approach has its own limitations and the generalized linear models (GLM) appear to be a good alternative. In the present work, a comparative study is attempted for analyzing $2^n$ factorial experiments for exponentially distributed response variable among GLM, methods based on Edgeworth expansion and a method based on exact distribution of a pivotal quantity. The comparison is based on theoretical considerations and an extensive simulation study related to the coverages and expected length of confidence intervals (*LOCI*) for the expected response. The method based on exact distribution of a pivotal quantity turns out to be the best among all the approaches. Results of the analysis of a real dataset agree with the theoretical findings.

**Keywords:** Confidence Intervals, Edgeworth expansion, Exact method, Factorial experiments, Generalized linear models