Chapter 3 Enteroviruses

3.1 General overview

Enterovirus, a kind of small (30 nm), nonenveloped, single-stranded RNA viruses, belongs to the family *Picornaviridae*. While most of the enterovirus infections are relatively mild and result in complete recovery of the patient, they can also cause severe and fatal diseases such as meningitis, encephalitis, myocarditis, neonatal sepsis, and polio. Infection occurs mainly via fecal-oral transmission and less commonly by respiratory droplets. While no known non-human reservoirs have been identified, water-borne, foodborne, and blood-borne transmissions have been reported (Stalkup and Chilukuri 2002).

3.2 Summary Data

Cliver (1981) challenged pigs with Porcine enterovirus type 3 and 7 via oral exposure route.

Table 3.1. Summary of the enterovirus data and best fits

Experiment Number	Reference	Host Type/Pathogen Strain	Route/ # of Doses	Dose Units	Response	Best Fit Model	Optimized Parameter (s)	LD_{50}
1	Cliver, 1981	pigs/ Porcine enterovirus type 3	oral/3	pfu	infection	Beta-Poisson	2.96E-04	2340.15
2	Cliver, 1981	pigs/ Porcine enterovirus type 7	oral/3	pfu	infection	Beta-Poisson	k=3.75E-03	185.10

The data from different experiments were not able to be statistically pooled.

3.3 Optimized Models and Fitting Analyses

3.3.1 Optimization Output for experiment 1

Table 3.2. Pigs/ Porcine enterovirus type 3 Strain model data

Dose	Infected	Non-infected	Total
1.00E+02	0	3	3
2.50E+02	0	6	6
1.00E+03	2	4	6

Cliver, 1981.

Table 3.3. Goodness of Fit and Model Selection

Model	Deviance	Δ	DF	$\chi^2_{0.95,1}$ *p-value*	$\chi^2_{0.95,m-k}$ *p-value*
Exponential	1.24	3.00 E-04	2	3.84 *0.986*	5.99 *0.537*
Beta Poisson	1.24		1		3.84 *0.265*
Exponential is best fitting model					

Table 3.4 Optimized parameters for the best fitting (Exponential), obtained from 10,000 bootstrap iterations

Parameter	MLE Estimate	Percentiles					
		0.5%	2.5%	5%	95%	97.5%	99.5%
k	2.96E-04	2.40E-17	2.40E-17	2.40E-17	7.19E-04	7.19E-04	1.03E-03
LD_{50} (spores)	2340.15	676.57	963.88	963.88	2.89E+16	2.89E+16	2.89E+16

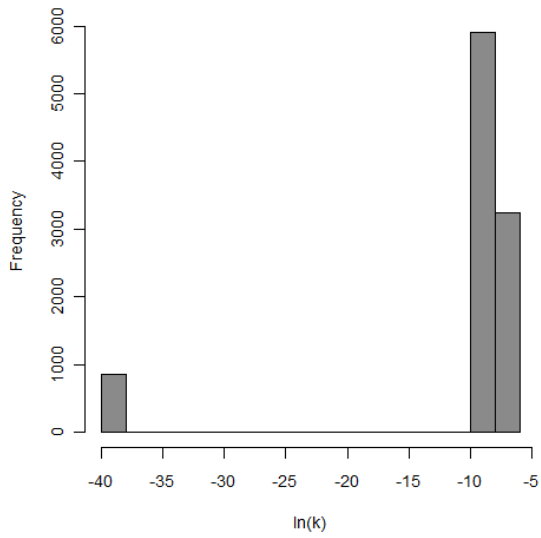

Figure 3.1 Parameter histogram for exponential model (uncertainty of the parameter)

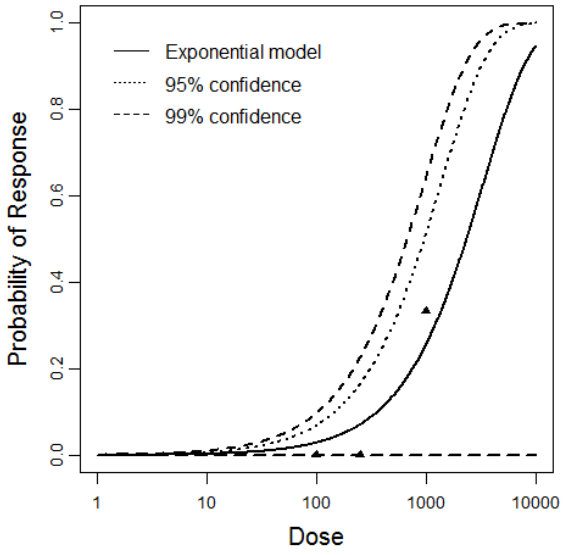

Figure 3.2 Exponential model plot, with confidence bounds around optimized model

3.3 Optimized Models and Fitting Analyses

3.3.2 Optimization Output for experiment 2

Table 3.5 pigs/ Porcine enterovirus type 7

Dose	Infected	Non-infected	Total
2.50E+02	4	2	6
2.50E+02	3	3	6
1.00E+03	5	0	5

Cliver, 1981.

Table 3.6. Goodness of Fit and Model Selection

Model	**Deviance**	**Δ**	**DF**	$\chi^2_{0.95,1}$ ***p-value***	$\chi^2_{0.95,m-k}$ ***p-value***
Exponential	0.61	1.00 E-04	2	3.84 *0.994*	5.99 *0.736*
Beta Poisson	0.61		1		3.84 *0.433*
Exponential is best fitting model					

Table 3.7 Optimized parameters for the best fitting (exponential), obtained from 10,000 bootstrap iterations

Parameter	MLE Estimate	Percentiles					
		0.5%	2.5%	5%	95%	97.5%	99.5%
k	3.75E-03	1.83E-03	2.19E-03	2.19E-03	5.62E-03	5.62E-03	5.62E-03
LD_{50} (spores)	185.10	123.36	123.36	123.36	316.32	316.32	378.96

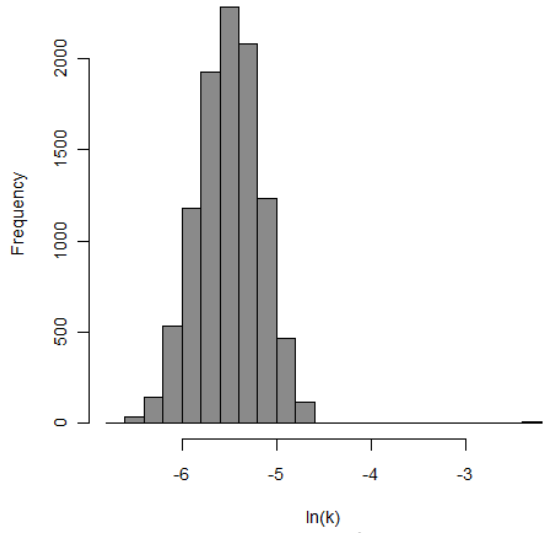

Figure 3.3 Parameter histogram for exponential model (uncertainty of the parameter)

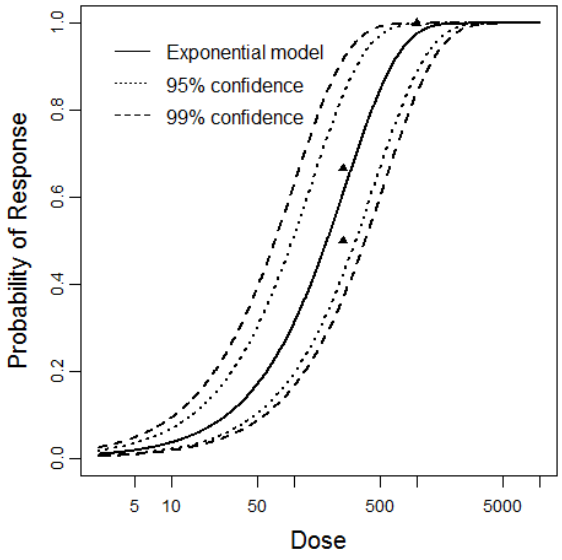

Figure 3.4 Exponential model plot, with confidence bounds around optimized model

3.4. Summary

The different LD_{50} for these two experiments indicates various virulence between pathogen strains.

References

Cliver, D. O. (1981). "Experimental infection by waterborne enteroviruses." Journal of Food Protection **44**: 861-865.

Stalkup, J. R. and S. Chilukuri (2002). "Enterovirus infections: a review of clinical presentation, diagnosis, and treatment." Dermatologic clinics **20**(2): 217-223.