Statistics 700 Homework 2

Bayesian Parametric Models

Due date: 6:00 pm (EST) Oct. 3, 2017

Fly Safe. The table below gives the number of fatal accidents and deaths on scheduled airline flights per year over a ten-year period. We use these data as a numerical example for fitting discrete data models.

Year	Fatal accidents	Passenger deaths	Death rate
1976	24	734	0.19
1977	25	516	0.12
1978	31	754	0.15
1979	31	877	0.16
1980	22	814	0.14
1981	21	362	0.06
1982	26	764	0.13
1983	20	809	0.13
1984	16	223	0.03
1985	22	1066	0.15

Table 1: Worldwide airline fatalities. 1976-1985. Death rate is passenger deaths per 100 million passenger miles. Source: Statistical Abstract of the United States.

1. Assume that the numbers of fatal accidents in each year are independent with a Poisson (θ) distribution. Set a prior distribution for θ and determine the posterior distribution based on the data from 1976 through 1985. Under this model, give a 95% predictive interval for the number of fatal accidents in 1986. You can use the normal approximation to the gamma and Poisson or compute using simulation.

2. Assume that the numbers of fatal accidents in each year follow independent Poisson distributions with a constant rate and an exposure in each year proportional to the number of passenger miles flown. Set a prior distribution for

θ and determine the posterior distribution based on the data for 1976-1985. (Estimate the number of passenger miles flown in each year by dividing the appropriate columns of the table and ignoring round-off errors.) Give a 95% predictive interval for the number of fatal accidents in 1986 under the assumption that 8×10^{11} passenger miles are flown that year.

3. Repeat 1 above, replacing 'fatal accidents' with 'passenger deaths'.

4. Repeat 2 above, replacing 'fatal accidents' with 'passenger deaths'.

5. In which of the cases 1-4 above does the Poisson model seem more or less reasonable? Why? Discuss based on general principles, without specific reference to the numbers in the table.

Incidentally, in 1986, there were 22 fatal accidents, 546 passenger deaths, and a death rate of 0.06 per 100 million miles flown.

Make some progress on your project. What are the parameters of interest in your project? What kind of priors do you want to use? Why?