# Stat238: Lab 4

September 16

- This lab explores the grid-based approximations to the posterior when the posterior does not have a familiar distributional form.
- It's based on 3.12 in BDA and follows the approach discussed in the reading in Chapter 3.
- Some components of this will likely appear on PS2.

**Consider the following data on the number of fatal accidents on scheduled airline flights per year. Assume that the number of accidents in year $t$ follows a Poisson distribution with mean $\alpha + \beta t$ and that the number of accidents is conditionally independent between years, given $\alpha$ and $\beta$.**

| Year | '76 | '77 | '78 | '79 | '80 | '81 | '82 | '83 | '84 | '85 |
|---|---|---|---|---|---|---|---|---|---|---|
| Accidents | 24 | 25 | 31 | 31 | 22 | 21 | 26 | 20 | 16 | 22 |

1. Choose a non-informative prior distribution for $(\alpha, \beta)$.
2. Write the joint posterior density for $(\alpha, \beta)$. Do you recognize any known distributional form for $\alpha|\beta, y$ or $\beta|\alpha, y$?
3. Calculate crude estimates and uncertainties for $(\alpha, \beta)$ using a non-Bayesian analysis.
4. Plot the contours of the joint posterior density. If you're doing this in R, the *contour()* function should work - see *help(contour)*, which will indicate that you need the posterior calculated on a grid (see *expand.grid()*), but then need the values in the form of a matrix.
5. Draw 1000 random samples from the joint posterior density of $(\alpha, \beta)$. Overlay them on the contour plot. Do things seem consistent?
6. Create simulation draws and plot a histogram of the posterior predictive distribution for the *number* of fatal accidents in 1986. Compute a 95% posterior predictive credible interval.
7. Find and plot the 95% highest posterior density (HPD) region for $(\alpha, \beta)$ using the discrete approximation.
8. Consider your discrete approximation. How many calculations of the posterior density did you do? How many would you have had to do if the parameter vector had 10 parameters instead of two? How long do you project it would take (roughly) to do the computation in 10 dimensions and how big would a file containing the results be (each number requires 8 bytes). This is the curse of dimensionality in the context of Bayesian computation.