Bayesian Statistics, Assignment for Tuesday, Oct. 29 — SOLUTION

For Problem Set 10 — There were TWO problem sets numbered Problem Set 10 — OOPS — The other was due Friday, Nov. 1 and has already been returned

The Author Problem

Table 5.2

Rate	Hamilton	Madison
0 (exactly)	0	41
(0,1]	1	7
(1,2]	10	2
(2,3]	11	0
(3,4]	11	0
(4,5]	10	0
(5,6]	3	0
(6,7]	1	0
(7,8]	1	0
	48	**50**

What is going to be different in this problem vs. Donovan & Mickey's example?!? I just want you to assume that Federalist Paper 54 had 16 fewer words (but still had 2 occurrences of "upon"). That means that the frequency per thousand words is:

$$\frac{2}{1992} * 1000 = 1.004$$

This puts it in a different observation bin!! It is now in the (1, 2] bin. You will see that you get a very different result when you rework the calculation with Paper 54 in the (1, 2] bin. So let's do it! The explanation of the algebra we need to do is much longer than the actual algebra:

$$\Pr(H \mid \text{observed frequency is in bin } (1, 2]) = \frac{\Pr(\text{observed frequency is in bin } (1,2] \mid H) * \Pr(H)}{\Pr(\text{observed frequency is in bin } (1,2] \mid H) * \Pr(H) + \Pr(\text{observed frequency is in bin } (1,2] \mid \sim H) * \Pr(\sim H)} =$$

$$\frac{10/48 * 48/98}{10/48 * 48/98 + 2/50 * 50/98} = \frac{10}{10+2} = \frac{5}{6} = 0.83$$

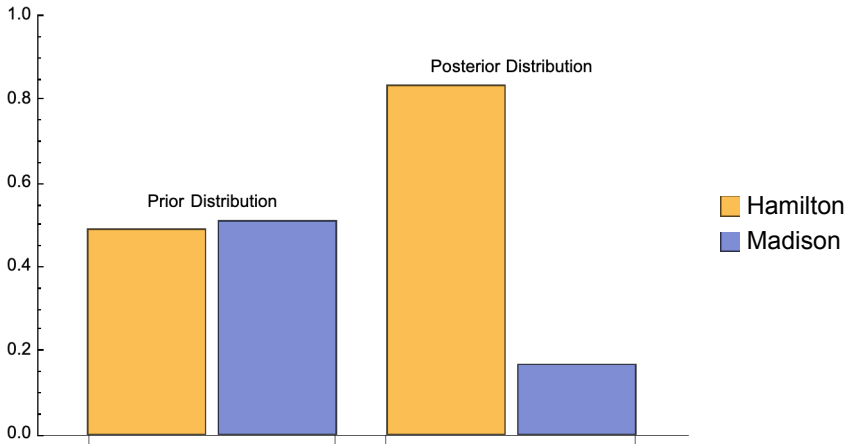
$$\Pr(\sim H \mid \text{observed frequency is in bin } (1, 2]) = \frac{\Pr(\text{observed frequency is in bin } (1,2] \mid \sim H) * \Pr(\sim H)}{\Pr(\text{observed frequency is in bin } (1,2] \mid H) * \Pr(H) + \Pr(\text{observed frequency is in bin } (1,2] \mid \sim H) * \Pr(\sim H)} =$$

$$\frac{2/50 * 50/98}{10/48 * 48/98 + 2/50 * 50/98} = \frac{2}{10+2} = \frac{1}{6} = 0.17$$

Let's make a plot now, like that on p. 57, but with our new results.

In[24]:=
```
BarChart[{{Legended[48 / 98, "Hamilton"], Legended[50 / 98, "Madison"]},
  {5 / 6, 1 / 6}}, ChartLayout → "Grouped", PlotRange → {All, {0, 1}},
 ChartLabels → {Placed[{"Prior Distribution", "Posterior Distribution"}, Above],
   Placed[{"", ""}, Above]}]
```

Out[24]=



If having just 16 fewer words changes the result so much, then this whole calculation is fishy.