MTH225 Spring2017 Final Problem 3

A series of trials is conducted to test whether two instruments for measuring the temperature in a kiln give comparable results. Instrument 1 is a standard thermocouple temperature sensor, while instrument 2 has an electronic infared-based sensor. The infrared sensor is presumed to be more accurate than the thermocouple.

The data is in `MTH225_Spring2017_Final_Problem3.csv`. The variables are:

- `temp` Actual temperature when set for 1300 degrees.
- `instrument` instrument 1 or 2

Use STAN to model the data as two samples from normal populations with possibly different means and standard deviations, and use the posterior draw to compare the value of the mean parameters to each other, and to estimate the probability that the mean temperature when set to 1300 degrees is higher for instrument 2.

The temperatures recorded in this experiment should be around 1300 degrees. Use a normal prior centered at 1300, with a standard deviation that gives a 95% probability that the value falls in the interval from 1100 to 1500.

Use a Cauchy(0,10) prior for the standard deviations.

You can use the Stan model file `two_sample_normal_unequal.stan` as a starting point.

- 2 points: Write R code to read the data and convert it to an R data frame.
- 1 point: Write the data block of a STAN model file that extracts the data from the R workspace.
- 1 point: Write the parameters block of a STAN model file that declares the paramter(s) of your model.
- 2 points: Write the model block of a STAN model file that specifies the priors and likelihood for your model.
- 1 point: Write R code to apply the `extract` function to the data structure output from the `stan` function.
- 1 point: Use the `extract()` function of the RSTAN package to obtain the values for the parameters from the posterior draw.
- 1 point: Compute 95% confidence intervals for the difference between the two mean temperatures. You can caluculate this as the quantile of the 4,000 differences

$$d_{ij} = \mu_{1j} - \mu_{2j} \quad j = 1, 2, \ldots, 4000$$

]

- 1 point: Use the posterior draw for this year's mean to estimate the probability that the mean for kiln 2 is higher than that for kiln 1. The proportion of times that μ_{2j} is larger than μ_{1j} over the 4,000 (μ_{1j}, μ_{2j}) pairs in the posterior draw provides an estimate of this probability.

(10 points possible)