STAT 532: Final Exam
Name:

This exam will be focused on a data set dealing with e-cigarettes. Recall from the M.S. comp:

> Researchers were studying the impacts of e-cigarette fluids on human fibroblast cells. They have a response variable that is cell viability that is a percentage of measured cells that remained viable after 24 hours (note that we do not have information on the number of cells explored, just the percentage that were not damaged = viable). They have explanatory variables that are the percentage of e-liquid concentrations, nicotine concentrations (in mg), and brand of e-cigarette (3 brands).

The data set is provided on the last page for your reference.

Q1. Frequentist Approach (5 points)

Briefly recap a frequentist-based approach you could use to analyze this data. The comp specifically asked about an interaction, but here just discuss the general approach for fitting the data in two or three sentences.

Q2. Normal Sampling Model

a. (8 points)

Suppose that you decide to use a normal sampling model for cell viability, write out a Bayesian three-way ANOVA (without any interactions). This should include a description of the parameters in the model, how you plan to treat the covariates (continuous/categorical), and appropriate priors.

b. (5 points)

Given MCMC samples for the model in part 2a, how would you compute contrasts the brands of e-cigarettes?

c. (5 point)

Suppose, there is a scientific justification for a two-way interaction between brand and nicotine concentration. Describe how this term could be added to the model in part b. What priors would be necessary for this addition to the model?

d. (8 points)

Write out a model for a hierarchical approach (without interactions) where the groups are brand. How does this approach differ from that of part b?

e. (6 points)

After fitting the model in Q2b and doing a posterior predictive check, you notice two potential problems with your sampling model: the responses should be constrained between zero and one (on the proportion scale or 0 to 100 on the percent scale) and there should be positive probability of zero cell viability. Propose solutions to address these two problems.

Appendix:

EliquidPerc	NicotineConc	Brand	ViabilityPerc
0.5	0	UV	85.9
0.5	0	E	70.2
0.5	0	RJ	40.5
0.5	12	UV	47.9
0.5	12	E	31.3
0.5	12	RJ	26.5
0.5	18	UV	82.9
0.5	18	E	89.4
0.5	18	RJ	24.6
0.5	24	UV	58.5
0.5	24	E	68.5
0.5	24	RJ	19.0
5.0	0	UV	42.6
5.0	0	E	33.0
5.0	0	RJ	16.4
5.0	12	UV	21.5
5.0	12	E	54.0
5.0	12	RJ	29.7
5.0	18	UV	25.0
5.0	18	E	36.8
5.0	18	RJ	18.0
5.0	24	UV	16.5
5.0	24	E	10.9
5.0	24	RJ	13.1
10.0	0	UV	20.7
10.0	0	E	1.3
10.0	0	RJ	27.1
10.0	12	UV	1.4
10.0	12	E	0.0
10.0	12	RJ	36.4
10.0	18	UV	1.2
10.0	18	E	0.8
10.0	18	RJ	1.0
10.0	24	UV	0.0
10.0	24	E	0.0
10.0	24	RJ	0.0