

Homework 5

BIOE 498/598 PJ

Spring 2022

*This final assignment is an opportunity to compare the different types of experiment designs from this course. For each question, provide as specific an answer as you can, i.e. the number of runs or a specific type of design. Altogether, the assignment should take you 1–2 hours to complete. Submit your answers to Gradescope before **5pm on Friday, May 13**.*

Your goal is to optimize production of acetoin, a byproduct secreted by an engineered strain of the Gram positive bacterium *Lactococcus lactis*. A previous screening experiment identified five factors that affect the titers of acetoin. You will vary these factors over the following ranges:

Factor	Low Level	High Level	Units
pH	4.5	7.2	
stirring rate	40	60	RPM
lactose	80	120	mM
casamino acids	0.4	0.6	g/L
nisin	0.2	0.4	mM

- Lactose is the preferred carbon source for *L. lactis*.
- Casamino acids are a nitrogen source made from digested soy protein.
- Nisin is a peptide that induces expression of the acetoin production pathway.
- The units of the response variable (acetoin titer) are mg/L.

Question 1

Your manager decided that each run will be performed at production scale, meaning a 40 L fermentation reactor will be used. Each run is quite expensive and time consuming, so you decide to screen the five factors first in hopes of dropping two factors. Describe your screening plan, including how you will analyze the data and find the three factors to carry forward into optimization.

Question 2

Now that you've reduced the problem to three factors, design an RSM procedure to find the optimal operating conditions. Remember again that the fermenters are large and difficult to reconfigure between runs.

Question 3

Discuss the pros and cons of using GPR/surrogate optimization instead of the DOE/RSM procedure you outlined in Questions 1 and 2.

Question 4—for students in BIOE 598 PJ *only*

Write a brief (<1 page) proposal to use a method from this class in your own research (either a thesis or capstone project). Write the proposal for your adviser or supervisor who is unfamiliar with DOE/RSM/surrogate optimization/RL, outlining the benefits of the approach and what it would take to start using the methods in this class. The project does not need to be big, e.g., optimizing one of the lab's protocols.