

MATH 3310 SPRING 2022 MIDTERM EXAM

MATH 3310 Mathematical Modeling

Instructor: Korytowski

Midterm Exam

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Honor Statement: By signing below I confirm that I have neither given nor received any unauthorized assistance on this exam. Furthermore, I agree not to discuss this exam with anyone until the exam testing period is over.

Signature: Traae Bloxham

Date: 3/4/22

Instructions

- There are 6 questions worth a total of 50 marks. For any question you want you can choose to do it by hand or by code, but if you do it by hand show work.
- This exam is due Sunday March 6th by 11:59pm, submit it by email like you have been doing for assignments.

1. $y_0 = 90$ and $\Delta y_n = -0.3y_n$.

(3 marks) a) Find the recursion formula for y_{n+1} : $Y = 90 - [90 * (0.3)n]$

(2 marks) b) Find y_5 : $y_5 = -45$

2. Given the following values for x, and y, where x represents years since factory has opened, and y represents the number of workers working at the factory.

$x=1,2,3,4,5,6,7,8$

$y=50,80,250,700,2000,3999,5000,7000$

(8 marks) a) Find a polynomial fit for degree 2,3,4,5.

SEE CODE

(8 marks) b) Find the corresponding r^2 for each of the curve fits. Based on these values how do these graphs fit?

I have the R^2 value printing on the graphs generated by the code, each one is very good, being at .98 or higher

(8 marks) c) With valid reasoning, determine which if any of these graphs should or could be tossed out. Is one of these graphs a better fit than the others, and if so why?

Well, despite having the lowest R^2 value (still greater than .98), the degree 2 polynomial is the only one I like.

All of the others have strange fluctuations in their line, such as changing direction in between points, or the line's extension also shows unreliability.

The degree 2 is the only one with a simple upward only curvature and reasonable extension.

(8 marks) 3. You decide that you want to invest in a Chipotle fast food chain near ISU. You want to make sure that you remain profitable. Come up with variables (both important, at least one that can be ignored or tossed out, and at least one that can be made a constant) to accommodate this question.

Variable	Status
Utilities	Constant (the utilities will always be at least a certain amount.)
Supplies	
payroll	
income	
Customer Review Scores	Disregard
Average amount of customers in a specific time window	
Average amount spent	

(5 marks) 4. You are tasked to find the reliability of a system at your company. You have components A,B,C,D,E,F,G with corresponding reliability of 0.98, 0.97, 0.96, 0.95, 0.94, 0.93, 0.92. Furthermore you are told the components A,B,C are absolutely crucial to the system and if any of them fail the whole system will fail. Furthermore you are told that components D,E are similar and if either of them work that part of the system will run fine. Furthermore you are told that components F,G are similar and if either of them work that part of the system will run fine. You add on a new crucial component H, and the reliability of the system is now 80 percent. What is the reliability of component H?

$$\text{Reliability Rate (80)} = A(.98) * B(.97) * C(.96) * [1 - 1-D(.95) * 1-E(.94)] * [1 - 1-F(.93) * 1-G(.92)] * H$$

$$80 = .9047431777 * H \quad H = 88.42288284$$

(8 marks) 6. You enter a game show known as the Monty Hall Problem (a contestant is picked, and they get to choose 1 of three doors, two of which have bad prizes, one of which has a good prize). The host then opening one of the closed doors and asks the contestant if he would like to switch to the closed door, or keep their original choice). You are one of 6 possible contestants. You know the rest of the contestants, and know that they will always stick with their original choice, however you know mathematically that it is a better choice to switch doors. Assuming that each possible contestant has equal odds of being selected, run through 1000 simulations and find the number of times that the winning door was picked under these conditions. Make sure to provide your code as well, and running your code should directly print out the answer that you find.

See code, it should print in the terminal.

I tried it a few times, all the numbers came between 300-350, so right around the $\frac{1}{3}$ point.