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| **Team Member Names:** |  |
| **Purdue Logins:** |  |
| **Section Number:** |  |
| **Team Number:** |  |

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| **Submission Instructions:**   1. Rename this answer sheet to be **Project\_M3\_*sss\_tt*.docx**, where ***sss*** is your section number (e.g., 001 for section 001) and ***tt*** is your team number (e.g., 07 for team 7). 2. Compress all deliverables into one zip file named M3\_*sss\_tt*.zip. Submit the zip file to the Blackboard drop box for M3 prior to Class 28. This folder must contain:    1. **Project\_M3\_*sss\_tt*.docx**    2. **Project\_M3Exec\_sss\_tt.m**    3. **Project\_M3Algorithm\_sss\_tt.m (and any additional sub-UDFs you create named using the file naming convention filename\_sss\_tt.m; sub-UDFs are not required)**    4. **Project\_M3Regression\_sss\_tt.m**   Notes:   * Only one(1) submission per team * Only the last submission to the M3 Dropbox will be graded.   + Check to make sure the files can be accessed after uploading to Blackboard. * After submission, distribute the submitted files to all team members*. Ensure all members of the team have copies of the submitted files.* |

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| **Particular Learning Objectives are highlighted throughout the document. However, all LOs that you have encountered throughout the semester may apply where appropriate to your work on the Milestones.** |

**Part 0: M2 Feedback Review**

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| **Learning Objective (LO): 22.00 Reflect on feedback for the purpose of improvement**  ***Evidence of Proficiency Requires*:**   * Feedback summarization is clear and useful * Response plan is clear and practical |

1. In your own words, summarize the feedback you received on project milestone M2 that could lead to improvements in your work.

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| <*insert your answer here*> |

1. Based on your feedback, what do you need to do to improve your parameter identification approaches? (Do not just reword your response to Part A. Do consider how you will incorporate your feedback into your work.)

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| <*insert your answer here*> |

Consult the M3 memo from FOS, Inc. for the details concerning your task. Respond to each of the prompts below in the space provided.

**Part 1: Flowchart & Coding**

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| **Learning Objective (LO): 21.04 Create a mathematical model that addresses the complexity of problem** |
| **Learning Objective (LO): 15.00 Construct and troubleshoot a flowchart using standard symbols and pseudocode (this includes all appropriate sub-LOs)** |

1. Your goal is to create an executive function to analyze the 100 time histories of temperature (deg F) provided by FOS, Inc. in a *fully automated* way, and identify the four relevant first-order system parameters (yL, yH, ts, and τ) from each time history. *Note that the 100 time histories provided to you represent two different test conditions: (i) 50 of the time histories are heating experiments, and (ii) the other 50 are for cooling experiments. They also represent 5 different FOS thermocouple designs.* Your executive function should call one user-defined function to process each time history provided by FOS. This one user-defined function uses the better-performing elements of your two algorithms from M2 with improvements you recommended in M2 incorporated. In the space below, draw a flowchart for your executive function. ***Note:*** This flowchart need only focus on the time-history parameter identification process, not the other steps the executive function will need to accomplish as described in later parts of this document.

<*insert your executive function flowchart here*>

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| **Learning Objective (LO): 11.00 Create and execute a user-defined function (this includes all appropriate sub-LOs)** |

B. Once you have completed the flowchart, translate your flowchart into an executive function named **Project\_M3Exec\_*sss*\_*tt*.m,** and name your parameter identification algorithm (from M2) **Project\_M3Algorithm\_*sss*\_*tt*.m**. The algorithm user-defined function must be called by the executive function with appropriate inputs and outputs being passed between the functions.

**Part 2: Descriptive Statistics**

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| **Learning Objective (LO): 08.00 Compute basic descriptive statistics of values stored in arrays using appropriate commands** |
| **Learning Objective (LO): 12.03 Manually compute the SSE (recall SSEmod is a bit different)** |

Complete the table with results from executing your MATLAB user-defined functions. Calculate the mean and standard deviation of time constants across all 20 time histories for each of the five thermocouple designs. Then, as you did in M2, calculate SSEmod for each time history and determine a mean SSEmod for each thermocouple design. Report that value on the table as well, and be sure to report appropriate units for each quantity on the table. Include appropriate units and number of decimal places for values in the table.

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| **Model Number** | ** Characteristics** | | **Mean SSEmod**  **(degF2)** |
| **Mean (sec)** | **Standard Deviation (sec)** |
| FOS-1 |  |  |  |
| FOS-2 |  |  |  |
| FOS-3 |  |  |  |
| FOS-4 |  |  |  |
| FOS-5 |  |  |  |

**Part 3: Regression Analysis for **

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| **Learning Objective (LO): 12.00 Perform linear regression** |
| **Learning Objective (LO): 13.00 Perform function discovery and data transformations** |

1. Write a user-defined function called **Project\_M3Regression\_*sss*\_*tt*.m** that determines the regression model for price as a function of time constant (τ); consult the M3 company memo for price data. The regression user-defined function must be called by the executive function with appropriate inputs and outputs being passed between the functions. You will need to carefully consider the shape of the relationship between price and the time constant. What function type best models this relationship?
2. The regression user-defined function must generate a plot showing the results of this analysis: plot price versus the time constants for all 100 points (not simply the mean values), and overlay your regression model on the same figure. The regression equation must be displayed on the plot in a suitable location.

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| **Learning Objective (LO): 07.00 Create and evaluate x-y plots suitable for technical presentation (this includes all appropriate sub-LOs)** |

<*insert your regression plot here*>

1. Report the metrics (with appropriate units) for your regression model in the table below.

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| **Parameter** | **Value** |
| SSE ($2) |  |
| SST ($2) |  |
| r2 |  |

**Part 4: Observations & Improvements**

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| **Learning Objective (LO): 21.02 Communicate ideas clearly and concisely**  ***Evidence of Proficiency Requires:***   * Purpose of communication is clear * Improvements are fully but concisely described   + All steps are included   + Appropriate technical language is used   + Clarifying images (e.g., sketches, graphs and/flow charts) are provided (as necessary) * External research is accompanied by an in-text citation and full reference |
| **Learning Objective (LO): 21.03 Evaluate model or algorithm development (e.g. ideas, work, functionality) using evidence-based rationales**  ***Evidence of Proficiency Requires:***   * Assumptions, claims, and critical decisions are clearly stated * An appropriate source of evidence is used to support assumptions, claims, and critical decisions * The evidence is clearly articulated * External research is accompanied by an in-text citation and full reference |

In M2, you were asked to generate ideas about how to improve your algorithm for first-order system parameter identification. In M3, you have improved your algorithm and applied your algorithm to 100 different time histories, and seen its performance across all that data. You have also created a regression model to characterize trends in your data. Based upon your M3 work, again consider potentially useful improvements and provide **two** specific ways you can **improve your parameter identification model**. Provide the details in the spaces below. You do not need to code these refinements right now (you will do this later in the project).

Be sure to:

* explain which parameter(s) your improvement will target,
* explain the improvement with a level of detail that can be understood by others (provide sketches or flowcharts as necessary to clarify your improvement),
* describe the metrics you will use to determine whether your proposed improvement really does improve your solution, and
* provide evidence-based rationales for each proposed improvement and the metrics selected. Your rationales should answer the questions:
  + What is your evidence that this improvement is necessary?
  + Why is this method for making the improvement a good idea - what is your evidence?
  + Why is this metric a good idea - what is your evidence?

**Algorithm Improvements**

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| **Improvement 1. Parameter(s) Targeted: \_\_**<*declare parameter(s) here*>**\_\_\_** |
| Description  <*insert your answer here*> |
| Metrics To Determine Improvement  <*insert your answer here*> |
| Rationale for Improvement and Metrics  <*insert your answer here*> |

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| **Improvement 2. Parameter(s) Targeted: \_\_**<*declare parameter(s) here*>**\_\_\_** |
| Description  <*insert your answer here*> |
| Metrics To Determine Improvement  <*insert your answer here*> |
| Rationale for Improvement and Metrics  <*insert your answer here*> |