Concept Quiz 3

ENGR 132 – Summer 2021

Instructions – Read Thoroughly and Carefully

Academic Integrity

You must follow the course and Purdue's academic integrity expectations. You are allowed to use the following resources:

- MATLAB and MathWorks documentation
- Class material (homework, class slides, online videos, etc.)
- Internet searches

You cannot share your instructions, answers, solutions, code, internet search links, or any other quiz material with any peer or electronic sharing site.

Saving Image Files

You will need to save figure windows as image files to submit to Gradescope. To save a MATLAB figure as an image file, click File > Save As from the figure window. **Always save the file as a PNG file**. Name the file using the format provided in the problem. The file name must always contain your Purdue career account login.

> **Hint**: Trouble viewing a full equation inside an instruction figure? Resize the figure window to see the full equation before you save the image. Three options to try: Drag the corner of the figure, use the quick edit tools in the figure, or use View > Property Editor. Video example: Resize a figure in MATLAB (Note: the process is the same for MATLAB Online or Desktop.)

Submission Requirements

Submit your solutions to **Concept Quiz 3 – ON TIME** on Gradescope. Your instructor will tell you the submission deadline for this quiz.

This assignment is timed. You have up to 1440 minutes (24 hours) to complete the quiz by the due date. Monitor the number of questions saved and the time remaining at the top of the quiz. **Save your answers after each problem**, or as many times as you want. Click **Submit & View Submission** at the bottom of the quiz to see what has been saved into Gradescope. Click **Resubmit** to add work or change your answers. You can re-submit your quiz as many times as you want until the due date. Your final submission will be graded. Click here and here for more help on the Gradescope submission interface.

As in your homework skills problems, you will submit a p-code function call with your PUID, your instruction text/information, and your solutions to the appropriate boxes or file submission areas.

All instruction text will contain a ***run receipt*** with the format:

```
su21_quiz3(PUID,problem_number) ran at DD-MM-YYYY HH:MM:SS.
```

Copy and paste this information with your instruction text into Gradescope.

Quiz Components

You will need the following items for this quiz. If you do not have access to these things, contact your instructor immediately.

- Your PUID number, MATLAB, access to Gradescope, internet access.
- This instructions document:
  - This problems document contains information you need for each problem on the quiz, but the problems are incomplete. To get the remaining information, you will use the file `su21_quiz3.p` in the same way you have been using the A##_skills.p files in your homework.
- The problem generator code file `su21_quiz3.p`, which will display important information for each problem. Remember, you will not "open" the file. You will **run** it following these instructions.
  - Open MATLAB. Copy `su21_quiz3.p` into your current file path in MATLAB. To run the file, type the following command into the MATLAB Command Window prompt:

    `>> su21_quiz3(`*`PUID`*`, `*`problem_number`*`)`

    Where you replace PUID with your 8-digit Purdue University ID number (leave off the leading 00) and replace *`problem_number`* with the problem number indicated in the problems document. Using an incorrect PUID is considered Academic Dishonesty.

- Template files for Problems 2, 3, 7, and 8: Quiz3_Prob2_template.m, Quiz3_Prob3_template.m, Quiz3_Prob7_template.m; and Quiz3_Prob8_template.m, respectively.

Tips for Success!

As soon as possible, run su21_quiz3.p with your PUID for all problems in this quiz. You want to make sure you get all your individualized instructions in place before you start working on the solutions to any problems.

The problem generator will give you information for each problem.

- All problems have instruction text and run receipts.
- Problems 3, 4 and 5 each have an instructional figure.
    - Save each figure window as a PNG. The filename format is Quiz3_Prob*X*_Instructions_*login*.png, where *X* is the problem number. See the problems below.
- In problems 1, 2, 3, and 8, make note of the CSV file that appears in your Current Folder.

For each problem: Copy and submit all your instruction components (including the run receipt) to Gradescope in the appropriate problem areas.

What if something goes wrong and you get a syntax error when you run su21_quiz3.p for one of the problems? Take a screen shot of the function call and the error displayed in MATLAB. Send that to your instructor and GTA as soon as possible. You need to allow enough time for them to respond to you with a solution for the syntax issue. Continue working on other problems while you wait for a response.

Need a new copy of a problem-generated CSV file? Delete any copies you have in your current folder and then re-run the problem generator code.

Late submission

Late submissions will be allowed on this quiz. The late submission window gives you an additional 24 hours to complete any work you did not submit on time. **Each problem** submitted late will receive a 25% penalty. Immediately after the due date, **Concept Quiz 3 – LATE** will open in Gradescope with a new 24-hour window. Submit late work there. **Important!** You will no longer have access to your answers from the on-time submission. DO NOT DUPLICATE WORK IN THE LATE ASSIGNMENT ***unless*** you intend to replace the on-time work with the late submission. Any work submitted to the late assignment will overwrite your on-time submission and will be graded as late. See the figure below for a summary of the Gradescope submission windows.

In Gradescope	
Concept Quiz 3 – ON TIME	Open until the due date. Problems submitted here that are not duplicated in a late submission will be graded for full credit.
Concept Quiz 3 – LATE	Open after the due date, for 24 extra hours. Problems submitted here will be graded with a 25% penalty. Any problem submitted to both assignments will be graded here, with the penalty.

Quiz Problems

Problem 1 (12 points)

You work for a company that has a historical model for a particular data set. Your supervisor wants you to examine the use of a least squares model instead.

Run `su21_quiz3(PUID,1)` to see the historical model and get a CSV file of the x-y data values. The Command Window display shows the coefficients of the historical model (in the form of a linear equation). The data are saved in a file in your Current Folder named **Quiz3_Prob1_Data_*PUID*.csv**, where *PUID* is the PUID number you entered into the p-code call. Use the information to find the results requested below.

A. Determine the least squares model for the data provided and write it in the form $y = mx + b$.
B. Determine the **coefficient of determination** (r^2) for both the historical model and the least-squares model.
C. State which model is a better choice. Explain your answer using evidence about the model's goodness of fit.
D. State what the r^2 values tell you about the quality of how the data were collected.

You can use Excel or MATLAB to complete any calculations for this problem.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(PUID,1)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit the CSV file with original data (Quiz3_Prob1_Data_PUID.csv).
- Enter your answer for Part A into the appropriate box
- Enter your answers for Part B into the appropriate boxes.
- Enter your answer for Part C into the appropriate box.
- Enter your answer for Part D into the appropriate box.

Problem 2 (12 points)

You must perform linear regression on a provided data set. You will use the data to do two things:

A. Produce a MATLAB figure that plots the original data and the least squares regression model line on the same axes, with proper plot formatting. ***Hint***: You can change the font size of specific plot elements using the name-value pair argument in the command. As an example: `title('Plot Title','fontsize',16)` will display the title in 16-pt font.
B. Use your least squares regression model to make predictions using independent variable values provided in the instruction text. Justify your predictions using your knowledge of the original data and your model.

Run `su21_quiz3(PUID,2)` to get your problem context, data, and values for making predictions. The data are saved to a file named **Quiz3_Prob2_Data_*PUID*.csv**, where *PUID* is the PUID number you entered into the p-code call in your current MATLAB folder.

Using the provided template **Quiz3_Prob2_template.m**, write a script that will import the data file into the script using a built-in MATLAB command and then generate the required results for Parts A and B above. Follow good programming standards. You do not need to use professional formatting commands to display your prediction values, but you do need to use professional judgement regarding the use of decimal places when you enter those values into Gradescope.

Save an image of your figure

Once your code is working, run it to generate the required figure. Save an image of your figure window for submission. Name the image file using the format: Quiz3_Prob2_figure_*login*.png

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(PUID,2)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit the CSV file with original data (Quiz3_Prob2_Data_PUID.csv).
- Part A: Submit your image file for Part A.
- Part B, Prediction 1: Enter your answer with justification.
- Part B, Prediction 2: Enter your answer with justification.
- Code: Submit your script that produces your results for Parts A and B (Quiz3_Prob2_login.m)

Problem 3 (10 points)

Use a provided data set of non-linear data and display it linearly using two different techniques. To get started, run `su21_quiz3(PUID,3)`. The problem generator will give you the following:

- A run receipt and basic problem information in the Command Window.
- A figure, named Figure 1, that displays an x-y data set as a plot. Save an image of this figure and name it with the format: Quiz3_Prob3_Instructions_*login*.png
- A data file named **Quiz3_Prob3_Data_*PUID*.csv**, where *PUID* is the PUID number you entered into the p-code call. This data file is saved in your current MATLAB folder and it contains the original, non-linear data values displayed in Figure 1.

Examine Figure 1 thoroughly. Using the provided template **Quiz3_Prob3_template.m** and the data file, import the data file into the script using a built-in MATLAB command. Then complete Part A and Part B.

Part A. Write the code to display the data linearly without transforming the data. This will be Figure 2 (Figure 1 was created when you ran su21_quiz3). Format the plot for technical presentation.

Part B. Write the code to linearize the data and then plot the linearized data in its own figure. This will be Figure 3. Format the plot for technical presentation.

Programming standards will not be assessed. Use the variable name `x` for the x data and the variable name `y` for the y data.

Save an image of each of your figures
Once your code is working, run it to generate the two required figures. Save an image of each figure window for submission. Name the image file using the format:
Quiz3_Prob3_PartA_*login*.png
Quiz3_Prob3_PartB_*login*.png

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(PUID,3)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit the CSV file with original data (Quiz3_Prob3_Data_PUID.csv).
- Submit the image file with the original data (Quiz3_Prob3_Instructions_*login*.png).
- Submit your image file for Part A (Quiz3_Prob3_PartA_login.png).
- Submit your image file for Part B (Quiz3_Prob3_PartB_login.png).
- Submit the m-file with your script that produces Figures 2 and 3 (Quiz3_Prob3_*login*.m).

Problem 4 (5 points)

This problem will show you a plot that displays a data set linearly using axis scaling, and you need to identify the data's function type. Run `su21_quiz3(PUID,4)` to see the plot in its own figure window. You may expand the figure window as needed to better view the plot.

Save an image of the provided figure
Save an image of figure window for submission. Name the image file with the format: Quiz3_Prob4_Instructions_*login*.png

Use that plot to determine the **function type** that best represents the raw data. Select one of these options:

A. Exponential
B. Linear
C. Logarithmic
D. Power

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(PUID,4)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit your image file (Quiz3_Prob4_Instructions_*login*.png).
- Select the appropriate function type from the provided choices.

Problem 5 (5 points)

This problem will show you a plot that displays data using axis scaling, and you need to identify which plotting command created it. Run `su21_quiz3(PUID,5)` to see the plot in its own figure window. You may expand the figure window as needed to better view the plot.

Save an image of the provided figure
Save an image of figure window for submission. Name the image file with the format: Quiz3_Prob5_Instructions_*login*.png

Use that plot to determine which **plotting command** generated the plot shown. Select one of these options:

A. `loglog`
B. `plot`
C. `semilogx`
D. `semilogy`

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(PUID,5)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit your image file (Quiz3_Prob5_Instructions_*login*.png).
- Select the appropriate function type from the provided choices.

Problem 6 (6 points)

Your teammate has linearized a data set and written a linearized model equation for the data. You must find the parameters m and b for the data and write the general form of the model equation using your parameters.

Run `su21_quiz3(PUID,6)` to see the linearized equation, which shows the coefficient values for M and B. Use those to find the numeric values for m and b. Write the general form of the model equation using your numeric values and use MATLAB syntax.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(PUID,6)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Enter your general model equation in the appropriate box.

Problem 7 (10 points)

You are working with a data set that is best represented by a given function. Your teammate has identified the function type and linearized the data. You will create a general model from the data and use the model to make a prediction. Run `su21_quiz3(PUID,7)` to see the function type, get the linearized data, and get the assigned x value at which you will calculate the prediction for y.

You have been provided a template **Quiz3_Prob7_template.m**. Use the template to write the MATLAB code to

- Assign the linearized vectors to variables (use the names provided in the instruction text);
- Calculate the linearized coefficients M and B. Store the coefficient values in a 1x2 vector variable named `linCoefs`;
- Determine the function parameters m, b. Name the parameters `m` and `b` in MATLAB;
- Place m and b in the general form of the model and use the model to predict the y value for the assigned x value. Name the predicted y value `y_pred`.

Using the script you wrote, determine the values of M, B, m, b, and the predicted y value. You will submit those values to Gradescope along with your code. **Note**: the template contains the print commands to display `M`, `B`, `m`, `b`, and `y_pred` to the Command Window with the required number of decimal places.

Programming standards will not be assessed. Use the variables stated in the directions for this problem.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(`*PUID*`,7)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Part A: Enter M and B in the appropriate boxes.
- Part B: Enter m and b in the appropriate boxes.
- Part C: Enter the predicted y value in the appropriate box.
- Part D: Submit your script with an appropriate name (Quiz3_Prob7_*login*.m).

Problem 8 (15 points)

Syntactic foams are a type of composite low-density foam where hollow spheres are set in a polymer resin. These foams have high strength and stiffness, low water absorbance, and long-term durability so they are useful in many marine applications. You are a materials engineer who works on a team that is testing a new syntactic foam for marine buoy applications. The team wants to understand how the material will behave while floating in seawater. They built cylindrical test buoys that use the new foam. Each buoy has the same cross-sectional area but a different height. All buoys are made from the same syntactic foam. The team conducted tests with the sample buoys, and one test measured the vertical oscillation period of each buoy while it was partially submerged in a testing tank to minimize wave effects. Your job is to write a MATLAB script to develop a model to describe the relationship between buoy height and oscillation period.

Run `su21_quiz3(`*PUID*`,8)` to get additional instruction text as well as a data file to use to solve the problem. After running `su21_quiz3(`*PUID*`,8)`, you will see a new file in your current MATLAB folder named **Quiz3_Prob8_Data_PUID.csv**, where PUID is the PUID number you entered into the p-code call.

You have been given a script template named **Quiz3_Prob8_template.m**. Use the template to write a script to solve the problem. Your script must follow good programming standards while completing the following steps.

- Create Figure 1 to display the original data in a 2x2 grid of subplots to show the data on various scaled axes.
    - For this figure, use short titles for each subplot.
    - Use the following subplot layout:

Scale: Linear X, Linear Y	Scale: Logarithmic X, Linear Y
Scale: Linear X, Logarithmic Y	Scale: Logarithmic X, Logarithmic Y

- Create Figure 2 to display the linearized model line and linearized data on one set of axes. Use professional plot formatting.
- Create Figure 3 to display the general model line and original data on one set of axes. Use professional plot formatting.
- Display the general model's function type, the linearized model with coefficients, and the general model with coefficients to the Command Window. Use professional text formatting.

After completing your script, run it to generate the figures and the text display.

Save each figure as a PNG file. Name each image file with the format: Quiz3_Prob8_Fig1_*login*.png, Quiz3_Prob8_Fig2_*login*.png, and Quiz3_Prob8_Fig3_*login*.png. Submit all requested information to Gradescope.

Submit your instructions and solutions to Gradescope

- Enter your function call `su21_quiz3(`*PUID*`,8)` using your PUID in the appropriate box.
- Copy the instruction text from the Command Window and paste it into the appropriate box. **Include the run receipt.**
- Submit your data file (Quiz3_Prob8_Data_*PUID*.csv).
- Enter your text display to the appropriate results box.
- Submit your PNG file for Figure 1 (Quiz3_Prob8_Fig1_login.png).
- Submit your PNG file for Figure 2 (Quiz3_Prob8_Fig2_login.png).
- Submit your PNG file for Figure 3 (Quiz3_Prob8_Fig3_login.png).
- Submit your script with an appropriate name (Quiz3_Prob8_*login*.m).