Show **all** of your work on this assignment and answer each question fully in the given context.

Please staple your assignment!

- **Problem 1:**
  (a) Provide a QQ-plot for the two data sets below. **Note:** Be careful about the size of the two data sets. [10 pts]
  (b) What can you say about the shape of the two data sets? [5 pts]

Suplier I	Suplier II
0.52	0.89
0.37	0.99
0.92	1.45
2.89	1.47
3.62	1.58
0.65	2.27
	2.63
	6.54

- **Problem 2:** (a) Explain the usefulness of theoretical QQ-plots [5 pts]
  (b) There is an excel file named "ballbearings.csv" as the relevant material of homework 3 on the course page (here). Use JMP to draw a Normal probability plot for **Group1** and **Group2** in the excel file separately.(You may use the tutorial, and just copy and paste the two QQ-plots)[5 pts for each plot]
  (c) Comment on the two QQ-plots you draw in part (b) of how similar the shapes of the data are to the theoretical quantile of Normal distribution and explain why.[10 pts]

- **Problem 3:** End Chapter Exercise, Problem 9 (page 116) [part (a) 10 pts- part (b) 5 pts]. **Note:** Summarizing the data means you should find the sample mean, sample standard deviation, median, IQR and range of the data. Then draw appropriate plots to discuss the distributional shape of the data

- **Problem 4:** There is a study with 5 factors, each with 3 levels, how many observations do we need to have a *full factorial study*? [5 pts]

- **Problem 5:** Frequently, several measurements of a quantity are made under similar conditions using a single measuring device and are then averaged to produce a final value. Which of the aspects of measurement can be improved by this measurement and averaging process?. [5 pts]

- **Problem 6:** Calculate the variance for the following samples (*note: if you are neat with your work, you may notice a pattern*):[3 pts each]

  1. Sample 1: -1.05, -1.0, -0.5, 0.15, 0.6, 0.65, 0.7, 1.25
  2. Sample 2: -2.1, -2.0, -1.0, 0.3, 1.2, 1.3, 1.4, 2.5
  3. Sample 3: -4.2, -4.0, -2.0, 0.6, 2.4, 2.6, 2.8, 5.0

4. Sample 4: -8.4, -8.0, -4.0, 1.2, 4.8, 5.2, 5.6, 10.0
5. Sample 5: -16.8, -16.0, -8.0, 2.4, 9.6, 10.4, 11.2, 20.0

- **Problem 7:** Mechanical engineers were interested in studying the effects of 2 chemical compounds (low Ca, high Ca) and 3 uni-axial pressure (P1, P2, P3) on metal bars lifetime. A total of 12 specimen were assigned to the possible combinations with two metal bars in each treatment. The lifetime of the bars were recorded after each run of the experiment.

  1. How many possible combinations of *compound* $\times$*pressure* are there available for a full factorial study? Draw a table for this design to get full credit.[5 pts]
  2. What is the response variable in this study?[2 pts]
  3. What are experimental variables in this study? [2 pts]
  4. What type of experimental variables are they in part 3 above?(Be careful with this question, we already know they are experimental variables and not response variable)[2 pts]
  5. For this full factorial study with two factors chemical compounds and uni-axial pressure, the six experimental runs are labeled as:

     No. 1: low- P1, No. 2: low-P2, No. 3: low-P3,
     No. 4: high- P1, No. 5: high- P2, and No. 6: high- P3.

     Based on the following random digits

     49502 18963 63920 39544 25804

     Which experiment should be done last?[4 pts]

  Total: 95 pts