

Homework 2

Due 1/30/25

Reading Chapter 3 of the textbook will help you answer these questions. In lectures 3-4, you will have seen relevant background and examples which should help you solve these problems as well. Unless otherwise noted, write out by hand how to calculate the desired values. Also please keep the correct number of significant figures in each problem.

Please upload as a pdf or jpg file so that your homework can be annotated by the TA.

- 1) Use data from problem 3.4 from your book to a) calculate the sample average, b) calculate the sample standard deviation c) explain how the sample mean and standard deviation describe different features of the data (in other words, define sample mean and standard deviation in words) and d) brainstorm some possible sources of variation for this data set. Assume your data set has numbers with 3 significant figures. (For those with the 7th edition, use data set from problem 3.5)
- 2) For the same problem set in 3.4 (or 3.5 if using the 7th edition) a) find the sample median of these data and b) answer how much could the largest temperature measurement increase without changing the sample median? c) explain what the sample median describes about the data (in other words, define median in words), d) find the median if one more value was added to the set: 952°F. Finally, for part e) include the output table from Minitab which includes the average, standard deviation, and median for the original data set in the book (the one with 9 observations). Assume this data set has numbers with 3 significant figures.
- 3) Problem 3.5 (3.8 in 7th edition) from book and do a, b, and d (skip c) as well as these added parts: e) construct a box plot using the limits on whiskers talked about in class. Comment on the data trends you observe in this plot. f) construct a bar graph using excel (it will only have one bar) representing the average \pm the standard deviation if the sample. Caption this figure appropriately!

For each part, show how you would calculate things by hand (can use ... abbreviation but write out the formulas with some data inserted to illustrate), draft up the graphs by hand first, then show the output from software *for each part*.

A data set for problem 3 is provided below. You should be able to cut and paste into Minitab and Excel – you can sort these data in Excel from highest to lowest using the sort function. Let me know if you have trouble sorting the data!

| Data |
|------|
| 127 |
| 124 |
| 121 |
| 118 |
| 125 |
| 123 |
| 136 |
| 131 |
| 131 |
| 120 |
| 140 |
| 125 |
| 124 |
| 119 |
| 137 |
| 133 |
| 129 |
| 128 |
| 125 |
| 141 |
| 121 |
| 133 |
| 124 |
| 125 |
| 142 |
| 137 |
| 128 |
| 140 |
| 151 |
| 124 |
| 129 |
| 131 |
| 160 |
| 142 |
| 130 |
| 129 |
| 125 |
| 123 |
| 122 |
| 126 |

Note: Minitab does not use a simple average between two numbers to interpolate quartiles. You may get a different exact answer when you have to interpolate by hand using the average. Do not worry about this!

- 4) Assume that Z has a standard normal distribution. Use the table in Appendix II to solve each of the following below. Write out your probability formulas used to solve the problem and draw the problem out pictorially for full credit, and report 2 significant figures:

- a) $P(Z \leq 0.76)$
- b) $P(Z > 1.1)$
- c) $P(Z \leq -0.91)$
- d) $P(-1.35 \leq Z \leq 0.25)$

Find z such that:

- e) $P(Z > z) = 0.1$
- f) $P(Z > z) = 0.9$
- g) $P(-1.24 < Z < z) = 0.8$
- h) $P(-z < Z < z) = 0.95$

- i) g) Check at least one of these with minitab and show the output
- j) Write out the integral you are solving for part b (no need to integrate, but set it up)

- 5) The time until recharge for a battery in a laptop computer under common conditions is normally distributed with a mean of 260 minutes and a standard deviation of 50 minutes. Use the table in Appendix II to solve this problem.
- a) Let's say battery life is a critical quality characteristic and the customers really want more than 4 hours with a charge. What is the probability that the battery lasts more than four hours?
 - b) What value of life in minutes is exceeded with 95% probability?
 - c) Check your answer in Minitab and print the output
- 6) Problem 3.9 from your book (3.13 from the 7th edition). In this problem, you will generate a normal probability plot "by hand" and by using Minitab. For the one "by hand" calculate the cumulative frequency (remember, the cumulative frequencies are really probabilities) for the data point with rank 1 and find z_1 using the Appendix II. Calculate the rest of the cumulative frequencies using Excel, and find corresponding z_j using Minitab (you have to put the frequency values from Excel in as a column into Minitab then use the normal probability function to find the value of z_j). Then, using the value of z_j you obtained by Minitab, generate your normal probability plot in Excel. Remember to also input the data into Minitab directly and generate a Normal Probability Plot (this is much easier, of course) and remember to comment on if the normal assumption is reasonable.