

Math 155 MINITAB Assignment #2

Due Date: Friday, November 4

Follow all instructions carefully – make sure to print out *only* what you are specifically told to print out in the instructions. (This will save you a lot of time and effort!) Everything that you’ll be asked to turn in will be highlighted in **bold, underlined** type.

The premise: You are a quality control inspector working for Goodstone Tire and Rubber Company. Your job is to make sure that your company’s claims about the life of its tires are statistically sound. To this end, one of your tasks is to select a *random sample* of newly manufactured Goodstone tires, and have them road tested to measure the lifetime (in miles) of each tire. Then, you determine whether your results seem to support Goodstone’s public claim about the distribution of its tires’ lifetimes:

Goodstone’s claim:

Under normal driving conditions and with regular maintenance, the average (mean) lifetime of a Goodstone tire is 50,000 miles, with a standard deviation of 8,500 miles.

Minitab assignment:

1. Use Minitab to *simulate* a random 100-tire sample, assuming that the Goodstone claim is true.

Proceed as follows:

- a) Select [Calc/Random Data/Normal...] from the Minitab menu.
- b) Enter 100 for “number of rows of data to generate”, and enter the mean and standard deviation as given in “Goodstone’s claim.” Enter C1 as the column in which to store your data. Click “OK” to generate the sample, and check to make sure your 100 measurements (each of which represents one tire’s lifetime, measured in miles) are all there. Select [Stat/Display Descriptive Statistics], enter C1 in the “Variables” box, then click OK to generate the descriptive statistics for this sample.

2. Now that you’ve got the idea, repeat part 1, but this time enter C1-C25 (instead of just C1) in the “store in column(s)” box. This will simulate 25 random samples of 100 tires each. (Note: *do not* print out this worksheet!) Then, generate the descriptive statistics for all 25 of these samples, by entering C1-C25 (instead of just C1) in the “Variables” box.

3. Create a new worksheet. [File/New.../Minitab Worksheet]. In a column of the new worksheet, enter the sample means from your 25 samples you generated in part 2. You’ll find these listed together in the session window. (See the attached page for instructions on how to do this quickly, rather than manually typing all 25 numbers into a Minitab column.) Generate the descriptive statistics for this set of sample means. **Print out this worksheet, and print out the session window**, which should include *all* of the descriptive statistics you generated in parts 1, 2 and 3. (NOTE: Make sure you’re only printing out the worksheet you’ve created in Part 3; it only has 25 rows. Do NOT print out the worksheet with 100 rows that you created for Part 2!)

4. Compare the mean and standard deviation of the collection of sample means from Part 3 to the mean (50,000) and standard deviation (8,500) of the overall distribution of Goodstone tire lifetimes. What do you notice?

Write a few sentences that describe your observations. Write your observations on a separate sheet of paper; do NOT write them on this assignment sheet.

Note: there is a front and a back to these instructions. (You’re not finished yet!)

Parts 5-6 below are almost the same as parts 2-3; the difference is that we will increase our sample size from 100 to 10,000. (Notice that's four zeros, not three!) To be precise: we will now simulate random selections of 10,000 tires, rather than 100 tires as before. You will be asked to observe the effects of this increase in sample size on the mean and the standard deviation of the set of sample means.

5. Create a new worksheet [File/New.../Minitab Worksheet]. Repeat part 2, but this time enter 10000 (instead of 100) for the "number of rows." This will simulate 25 random samples of 10000 tires each. (Please *do not* print this worksheet! It is huge!) Then, generate the descriptive statistics for all 25 of these samples, as before.

6. Create another new worksheet [File/New.../Minitab Worksheet]. In a column of the new worksheet, enter the sample means from your 25 samples you generated in part 5. Generate the descriptive statistics for this set of sample means. **Print out this worksheet, and print out the session window**, which should include *all* of the descriptive statistics you generated in parts 5 and 6. (Note: make sure you're only printing the worksheet you created for Part 6; it should only have 25 rows. Do NOT print the giant worksheet you created in Part 5!)

7. Compare the *mean* of the collection of sample means from Part 6 (sample size $n=10000$) to the *mean* of the sample means from Part 4 (sample size $n=100$). What do you notice? Specifically, how does increasing the sample size tend to affect the *mean* of the collection of sample means? (In other words: if we were to repeat the above sequence of steps for larger and larger sample sizes -- say, $n=1$ million, then $n=1$ billion, etc. -- what do you think would happen to the mean of the collection of sample means?) **Write your response to this question.** Write your response on a separate sheet of paper; do NOT write it on this assignment sheet.

8. Compare the *standard deviation* of the collection of sample means from Part 6 (sample size $n=10000$) to the *standard deviation* of the sample means from Part 4 (sample size $n=100$). What do you notice? Specifically, how does increasing the sample size tend to affect the *standard deviation* of the collection of sample means? (In other words: if we were to repeat the above sequence of steps for larger and larger sample sizes -- say, $n=1$ million, then $n=1$ billion, etc. -- what would happen to the standard deviation of the collection of sample means?) **Write your response to this question.** Write your response on a separate sheet of paper; do NOT write it on this assignment sheet.

Summary: Here is what you will turn in:

- Printouts of the worksheets and session windows from parts 3 and 6 of the assignment. (These are the *only* printouts you should turn in.)
- Your written (or typed) responses to the questions in parts 4, 7, and 8.
- Nothing else!

Please put all written (or typed) responses on the same sheet of paper, and clearly indicate which sentence(s) are related to which part of the assignment. (Don't make me guess!) As always, write legibly (or type), and write all responses using complete sentences with proper grammar. Finally, please staple all pages together before turning them in.

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Note: Here's a quick way to copy all 25 sample means into a new worksheet (for parts 3 and 6) without having to manually enter them all into a Minitab column.

Step 1. After generating the descriptive statistics for C1-C25, use your mouse to select (highlight) all 25 columns, plus the column headers, as shown in the screenshot below:

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
C1	10000	0	49894	84.5	8451	14979	44269	49899	55517
C2	10000	0	49953	85.7	8574	13619	44232	49966	55617
C3	10000	0	49883	85.2	8522	16393	44268	49747	55547
C4	10000	0	50005	84.5	8446	13922	44380	50041	55526
C5	10000	0	50005	84.6	8457	21575	44130	49983	55684
C6	10000	0	50032	84.2	8421	15686	44324	49975	55712
C7	10000	0	50039	84.2	8422	17235	44446	49977	55667
C8	10000	0	50051	86.0	8598	14171	44269	49953	55911
C9	10000	0	50041	85.2	8519	13353	44379	49875	55839
C10	10000	0	50004	84.3	8430	19428	44336	49871	55641
C11	10000	0	50061	84.9	8494	19472	44364	50071	55836
C12	10000	0	49994	85.0	8498	18303	44129	50043	55839
C13	10000	0	50013	85.0	8502	16818	44339	49905	55739
C14	10000	0	49818	84.8	8485	16022	44042	49825	55507
C15	10000	0	50015	84.5	8454	17533	44338	49875	55657
C16	10000	0	50029	84.6	8459	22318	44223	50002	55742
C17	10000	0	50069	85.0	8499	19462	44372	49962	55786
C18	10000	0	49945	84.6	8460	15064	44285	49980	55632
C19	10000	0	50031	83.9	8395	16021	44385	49999	55741
C20	10000	0	49936	84.3	8435	18724	44213	49933	55705
C21	10000	0	50052	85.4	8538	21291	44081	50045	55961
C22	10000	0	49920	84.1	8405	16886	44214	49926	55476
C23	10000	0	50035	85.1	8507	15202	44266	50009	55838
C24	10000	0	50118	84.1	8413	13969	44465	50139	55766
C25	10000	0	49921	85.3	8529	12867	43996	49948	55777

Then, copy the text you just selected [Edit/Copy]. Make sure to include the column headers – “Variable,” “N,” etc. – in your selection; these will become the column headers in your new Minitab worksheet (below).

Step 2. Now, open a new worksheet. Select the grey cell (not a white cell) at the top of column C1:

	C1	C2	C3
1			
2			
3			
4			
5			

Now, select [Edit/Paste Cells]. A dialog box should appear. Make sure the option “use spaces as delimiters” is selected, and then click “OK.” You should now see something like this:

	C1-T	C2	C3	C4	C5	C6	C7	C8	C9	C10
	Variable	N	N*	Mean	SE	Mean_1	StDev	Minimum	Q1	Median
1	C1	10000	0	49894	84.5	8451	14979	44269	49899	55517
2	C2	10000	0	49953	85.7	8574	13619	44232	49966	55617
3	C3	10000	0	49883	85.2	8522	16393	44268	49747	55547
4	C4	10000	0	50005	84.5	8446	13922	44380	50041	55526
5	C5	10000	0	50005	84.6	8457	21575	44130	49983	55684

Note that all of the sample means are now in one column (probably C4, as in the above screenshot). This is the column for which you'll want to find the mean and standard deviation for parts 3 and 6 of the assignment.