PSP0

Personal Software Process (PSP) for Engineers: Part I

Points: 50

Program requirements

Program
requirements

Using PSP0, write a program to calculate the mean and standard deviation of a set of n real numbers.

Your program can read the n real numbers from the keyboard, a file, or some other source.

Use an array to store the n numbers for the calculations. If necessary, other data structure(s) may be used to hold the data.

Thoroughly test the program. At least two tests should use the data in the columns of Table 1. Expected results are provided in Table 2.

Column 1 Estimate Proxy Size	Column 2 Development Hours
160	15.0
591	69.9
114	6.5
229	22.4
230	28.4
270	65.9
128	19.4
1657	198.7
624	38.8
1503	138.2

Table 1

Test	Expected Value		Actual Value	
	Mean	*Std. Dev*	*Mean*	*Std. Dev*
Table 1: Column 1	550.6	572.03		
Table 1: Column 2	60.32	62.26		

Table 2

Mean and standard deviation

Overview

The mean is the average of a set of data. The average is the most common measure of location for a set of numbers. The average locates the center of the data.

Standard deviation is a measure of the spread or dispersion of a set of data. The more widely the values are spread out, the larger the standard deviation. For example, say we have two separate lists of exam results from a class of 30 students; one ranges from 31% to 98%, the other from 82% to 93%. The standard deviation would be larger for the results of the first exam.

Calculating mean and standard deviation

The formula for calculating the mean is

$$x_{avg} = \frac{\sum_{i=1}^{n} x_i}{n}$$

The formula for standard deviation, σ, is

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - x_{avg})^2}{n-1}}$$

where
- Σ is the symbol for summation
- i is an index to the n numbers
- x is the data in the set
- n is the number of items in the set

A mean and standard deviation example

A mean and standard deviation example	In this example, we will calculate mean and standard deviation of the data in Table 3.

x
186
699
132
272
291
331
199
1890
788
1601

Table 3

1. In this example, there are 10 items in the data set. Therefore, we set $n = 10$.
2. We can now solve the summation items in the mean formula.

$$x_{avg} = \frac{\sum_{i=1}^{n} x_i}{n}$$

n	x
1	186
2	699
3	132
4	272
5	291
6	331
7	199
8	1890
9	788
10	1601
Total	$\sum_{i=1}^{10} x_i = 6389$

3. We can then substitute the intermediate value into the formula.

$$x_{avg} = \frac{6389}{10}$$

$$x_{avg} = 638.9$$

A mean and standard deviation example, Continued

A mean and standard deviation example, cont.

4. We can now substitute x_{avg} to calculate the intermediate values for the standard deviation formula.

$$\sigma = \sqrt{\dfrac{\sum\limits_{i=1}^{n}\left(x_i - x_{avg}\right)^2}{n-1}}$$

n	x	$\left(x_i - x_{avg}\right)^2$
1	186	205,118.41
2	699	3,612.01
3	132	256,947.61
4	272	134,615.61
5	291	121,034.41
6	331	94,802.41
7	199	193,512.01
8	1890	1,565,251.21
9	788	22,230.81
10	1601	925,636.41
Total	$\sum\limits_{i=1}^{10} x_i = 6389$	$\sum\limits_{i=1}^{10}\left(x_i - x_{azvg}\right)^2 = 3,522,761.90$

5. We can then substitute the intermediate value into the formula.

$$\sigma = \sqrt{\dfrac{3,522,761.00}{9}}$$

$$\sigma = \sqrt{391,417.878}$$

$$\sigma = 625.633981$$

Assignment instructions:

Before starting on the program, review the top-level PSP0 process script below to ensure that you understand the "big picture" before you begin. Also, ensure that you have all of the required inputs before you begin the planning phase.

PSP0 Process Script

Purpose	To guide the development of module-level programs
Entry Criteria	- Problem description - PSP0 Project Plan Summary form - Time and Defect Recording logs - Defect Type standard - Stopwatch (optional)

Step	Activities	Description
1	Planning	- Produce or obtain a requirements statement. - Estimate the required development time. - Enter the plan data in the Project Plan Summary form. - Complete the Time Recording log.
2	Development	- Design the program. - Implement the design. - Compile the program, and fix and log all defects found. - Test the program, and fix and log all defects found. - Complete the Time Recording log.
3	Postmortem	Complete the Project Plan Summary form with actual time, defect, and size data.

Exit Criteria	- A thoroughly tested program - Completed Project Plan Summary form with estimated and actual data - Completed Time and Defect Recording logs

Assignment instructions, Continued

Planning phase   Plan this program following the PSP0 planning phase script.

PSP0 Planning Script

Purpose	To guide the PSP planning process
Entry Criteria	- Problem description - Project Plan Summary form - Time Recording log

Step	Activities	Description
1	Program Requirements	- Produce or obtain a requirements statement for the program. - Ensure that the requirements statement is clear and unambiguous. - Resolve any questions.
2	Resource Estimate	- Make your best estimate of the time required to develop this program. - Enter the plan time data in the Project Plan Summary form

Exit Criteria	
Exit Criteria	- Documented requirements statement - Completed Project Plan Summary form with estimated development time data - Completed Time Recording log

Verify that you have met all of the exit criteria for the planning phase, **then** proceed to the development phase.

Assignment instructions, Continued

Development phase   Develop the program following the PSP0 development phase script.

PSP0 Development Script

Purpose	To guide the development of small programs
Entry Criteria	- Requirements statement - Project Plan Summary form with estimated program development time - Time and Defect Recording logs - Defect Type standard

Step	Activities	Description
1	Design	- Review the requirements and produce a design to meet them. - Record in the Defect Recording log any requirements defects found. - Record time in the Time Recording log.
2	Code	- Implement the design. - Record in the Defect Recording log any requirements or design defects found. - Record time in the Time Recording log.
3	Compile	- Compile the program until error-free. - Fix all defects found. - Record defects in the Defect Recording log. - Record time in the Time Recording log.
4	Test	- Test until all tests run without error. - Fix all defects found. - Record defects in the Defect Recording log. - Record time in the Time Recording log.

Exit Criteria	- A thoroughly tested program - Completed Time and Defect Recording logs

Verify that you have met all of the exit criteria for the development phase, then proceed to the postmortem phase.

Assignment instructions, Continued

Postmortem phase

Conduct the postmortem following the PSP0 postmortem script.

PSP0 Postmortem Script

Purpose	To guide the PSP postmortem process
Entry Criteria	- Problem description and requirements statement - Project Plan Summary form with development time data - Completed Time and Defect Recording logs - A tested and running program

Step	Activities	Description
1	Defect Recording	- Review the Project Plan Summary to verify that all of the defects found in each phase were recorded. - Using your best recollection, record any omitted defects.
2	Defect Data Consistency	- Check that the data on every defect in the Defect Recording log are accurate and complete. - Verify that the numbers of defects injected and removed per phase are reasonable and correct. - Using your best recollection, correct any missing or incorrect defect data.
3	Time	- Review the completed Time Recording log for errors or omissions. - Using your best recollection, correct any missing or incomplete time data.

Exit Criteria	- A thoroughly tested program - Completed Project Plan Summary form - Completed Time and Defect Recording logs

Verify that you have met all of the exit criteria for the PSP0 postmortem phase, then submit your assignment.

Submitting your assignment

When you've completed the postmortem phase, submit your Program via Blackboard. Also submit all the forms (hardcopy or scan and submit via Blackboard). The submission package should have the following:

• PSP0 Project Plan Summary form
• Time Recording log
• Defect Recording log
• Design Form
• Source program listing (i.e, your java code)
• Test results (Fill Table 2 on page 2 and submit that table as a separate document titled TestResults)
• Student Reflection: Answer the following questions:
  1. In which Phase did you spend most of your effort? (look at the time spent in different phases of this assignment to answer this question)
  2. In which Phase did you introduce most number of defects?
  3. Did you find it useful to follow a systematic process and track your effort and defects?

Guidelines and evaluation criteria for this program

Evaluation criteria

Your process report must be
• complete
• legible
• in the specified order

Your process data must be
• accurate
• precise
• self-consistent

Suggestions

Keep your programs simple. You will learn as much from developing small programs as from large ones.

If you are not sure about something, ask your instructor for clarification.

Software is not a solo business, so you do not have to work alone.
- You must, however, produce your own estimates, designs, code, and completed forms and reports.
- You may have others review your work, and you may change it as a result.
- You should note any help you receive from others in your process report. Log the review time that you and your associates spend, and log the defects found or any changes made.