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F10:σ

1 Problem 1 -Description

This symbol notifies standard deviation(SD), it is a method that measures extent of variation or separation of data values. The symbol σ is taken from Greek letter sigma. If the value of standard deviation is low it indicates data points are close to the mean, while higher value indicates wider range of values.The values that goes into the function is called as domain, all possible outcome of function is co-domain and actual output from system is called Range. Things required to calculate standard deviation are mean and variance. Mean is calculated by summing up all values and dividing it by total number of values and variance is calculated by taking difference of each, squaring it and then averaging the results. Calculator will compute population and sample standard deviation.
The Range for standard deviation is between negative infinity to positive infinity
Properties of Standard Deviation
1. Measures spread-out numbers.
2. It is expressed in same unit as data.
3. Used to measure statistical results such as margin of errors.
4. Using standard deviation, we can calculate normal, extra-large and extra small values.

Population Standard Deviation
This is used when an entire population can be measured, and where every member of a population can be sampled. The following is the equation:

$$\sigma = \sqrt{\frac{1}{N}\Sigma_{i=1}^{N}(x_i - \mu)^2}$$

Where xi is one individual value,mu is the mean/expected value, N is the total number of values

Sample Standard Deviation
In this it is not possible to sample every member within a population, so above equation must be modified such that the deviation can be measured through random samples of the population.

$$s = \sqrt{\frac{1}{N-1}\Sigma_{i=1}^{N}(x_i - \bar{x})^2}$$

Where xi is one sample value,$\bar{x}$ is the sample mean and N is number of sample value.

2 Problem 2 -Requirements And Assumptions

2.1 Functional Requirements

1: Low priority , 5:High Priority

2.1.1 Input Requirement

When the user enters zero input/input=null, the function shall pop out an error stating "Input cannot be Null". As number divided by zero leads to infinity. (length !=0)
Priority of this requirement: 5

2.1.2 Length Requirement

When the user enters less than two inputs, the function shall display error message "Enter more than one input". This is because minimum length required to calculate standard deviation is 2.(min length=2)
Priority of this requirement: 5

2.1.3 Multiple inputs

User shall be able to enter 'n' inputs from the console provided by function.There is no limit for inputs. Function has to handle inputs.
Priority of this requirement: 3

2.1.4 Handling real numbers

As user enters real numbers, the function shall be able to accept, process it and output's as real numbers.
Priority of this requirement: 3

2.1.5 Calculate Mean

When calculating standard deviation function, the function shall automatically call mean and retrieve result without notice to user.
Priority of this requirement: 4

2.1.6 Calculate variance

When calculating standard deviation function, the function shall calculate variance explicitly or within the function and retrieve result without getting to user notice.
Priority of this requirement: 4

2.1.7 Display Output

User shall be able to see only final output of function which is Standard deviation value, and output will be displayed on console. User shall not have any problem while viewing output.
Priority of this requirement: 5

2.2 Non-Functional Requirements

2.2.1 Performance

It is analysed on how the function responds to given input provided at certain time.

2.2.2 Correctness

Correctness of the function is measurable by checking input-output behaviour.The generated output is verified by comparing results computed manually.

2.2.3 Consistency

The consistency of the function remains same throughout all calculators, as math definition for standard deviation is unchangeable. And consistency of output for all input also remains same.

2.2.4 Accessibility

Defines how easily the function is accessible by all kinds of stakeholders, in different platforms and with integration of hardware.

2.2.5 Usability

The function is easily usable by all stakeholders and also learn-able to achieve specific needs.

2.3 Constraints

1. Interfaces for calculating standard has already been defined and is not bounded to change.
2. Some calculators are region specific.
3. Mode for selecting standard deviation may vary from different calculators.
4. Users from non-mathematical background will have difficulties in accessing function through calculator.

2.4 Assumptions

1. All inputs provided by users are real numbers.
2. Inputs are of population standard deviation.
3. Users will be familiar with accessing functions in calculator.
4. All calculators that supports Math and Statistics contains standard deviation function.
5. Value of standard deviation directly proportional to data points or mean value.

3 Problem 3 - Pseudocode And Algorithm

Algorithm 1 Squareroot(number)- common for both Iterative and Recursive

```
begin:
1. SET Sqrt=number/2
2.       Do
3.          temp=sqrt
4.          Add temp value with (number/temp) and divide whole by 2
5.          CONTINUE WHILE ((temp - result) != 0)
6. RETURN result
end
```

3.1 Using Iterative Approach

Advantages:

1. Easier to understand.
2. Saves memory.
3. Iterative approach can enhance time and space requirement.
4. Fast in execution.

Disadvantages:

1. The iterative repeatedly dynamically allocate or resize memory blocks.
2. Time consuming to Recursive approach.
3. Contains duplicate code.
4. Iteration makes the code longer.

Algorithm 2 calculateMean(array) And CalculateStandardDeviation (array[])

begin:
1. SET Counter=0
2. FOR Counter<length THEN
3. Add all values
4. INCREMENT Counter by 1
5. mean= Total/length
6. RETURN mean

end
begin:
1. COMPUTE Mean(array)
2. SET Counter=0
4. FOR Counter<length THEN
5. Subtract each value from Mean
6. Square the subtracted value and keep adding with previous squared values
7. INCREMENT Counter by 1
9. result= calculatedsum/length
10. COMPUTE Squareroot(result)
11. RETURN computed result
12.REPEAT the algorithm for new value

end

3.2 Using Recursive Algorithm

Advantages:
1. Allows to allocate additional automatic objects at each function call.
2. Faster compared to Iterative approach.
3. Makes the problem more elegant.
4. Reduces Time complexity of a program.

Disadvantages:
1. Makes the execution slower.
2. Takes up more of stack storage.
3. Difficult to understand and trace.

Algorithm 3 calcStd(List)

begin:
calcAvg(List)
1. COMPUTE calcSum(list,0)
2. Divide sum by size of list
3. RETURN result
end
begin:
calcSum(List, i)
1. IF i< size of list THEN
2. Add each element(i) with its next element(calcSum(list,i+1))
3. RETURN result
4. ELSE
5. RETURN 0
end
begin:
calcpow(List,avg,i)
1. IF i< size THEN
2. Subtract each value with Avg
3. Square the result
4. RETURN square
5. ELSE
6. RETURN 0
end
begin:
sumSquareDiffs(List,avg,i)
1. IF i< size THEN
2. COMPUTE calcpow(List,avg,i)
3. keep adding result of each element
4. ELSE
5. RETURN 0
end
begin:
calcStd(List)
1. COMPUTE calcAvg(List)
2. COMPUTE sumSquareDiffs(List,avg,i) taking avg value from step2
3. COMPUTE Squareroot(sum) take sum value from step3 Squareroot() from algorithm 1
4. RETURN result
end

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