Multithreading

Task:

To write a C/C++ program to input an array of number and calculate different statistical measures on the numbers. Each statistical measure should be computed using its own thread and the values should be reported after all worker threads finish execution.

Statistical features implemented:

1. Average (mean)
2. Minimum
3. Maximum
4. Median
5. Standard Deviation
6. Count of elements

Running instructions:

The `thread` library in c++ requires the addition of `-pthread` flag during compilation. Additionally, the `thread` library was introduced to C++ from c++11. Hence, c++11 or greater should be used to execute this program.
Command to compile and run the program:

```
g++ -std=c++11 -pthread -o multithreading main.cpp && ./multithreading
```

To verify that each statistical feature is being computed using different threads, an extra parameter can be passed through the command line to print the worker PIDs. The flag `print_pids` should be passed while running the program as follows:

```
g++ -std=c++11 -pthread -o multithreading main.cpp && ./multithreading
print_pids
```

Sample outputs:

There are two outputs for the program. The first picture shows the computed statistical measures.

```
ravi@ravi-Latitude-3460:~/workspace/OS/os-assignment/4_multithreading$ g++ -std=c++11 -pthread -o multithreading main.cpp && ./multithreading
Enter the size of array of numbers:
7
Enter the numbers:
90 81 78 95 79 72 85
The average is 82
The min element is 72
The max element is 95
The median is  81
The standard deviation is 19.1833
The total number of elements are 7
ravi@ravi-Latitude-3460:~/workspace/OS/os-assignment/4_multithreading$
```

To verify that the statistical measures were computed using different threads, the PID of each thread is printed before the thread completes execution.

```
ravi@ravi-Latitude-3460:~/workspace/OS/os-assignment/4_multithreading$ ./multithreading print_pids
Enter the size of array of numbers:
7
Enter the numbers:
90 81 78 95 79 72 85
PID for thread 1 - average: 139710281545472
PID for thread 2 - min: 139710273152768
PID for thread 3 - max: 139710264760064
PID for thread 4 - median: 139710185862912
PID for thread 5 - standard deviation: 139710177470208
PID for thread 6 - count elements: 139710169077504
The average is 82
The min element is 72
The max element is 95
The median is   81
The standard deviation is 19.1833
The total number of elements are 7
ravi@ravi-Latitude-3460:~/workspace/OS/os-assignment/4_multithreading$
```