This quiz has 3 problems

Code 1) [10%]

Write a program to read an unknown-size ordered pairs data points and finds the equation of line of best fit ($Y=mX+b$), using the least square method. It should be assumed that the input data file has two columns where the first column includes the values of independent variable (X) and the second column includes the values of dependent variable (Y). Use **`XYdata.txt`** as the input data for your program. The following steps can be used to to find the equation of line of best fit based on least square method.

Step 1: Calculate the mean of the x -values and the mean of the y -values.

$$\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$\overline{Y} = \frac{\sum_{i=1}^{n} y_i}{n}$$

Step 2: The following formula gives the slope of the line of best fit:

$$m = \frac{\sum_{i=1}^{n} (x_i - \overline{X})(y_i - \overline{Y})}{\sum_{i=1}^{n} (x_i - \overline{X})^2}$$

Step 3: Compute the y -intercept of the line by using the formula:

$$b = \overline{Y} - m\overline{X}$$

Step 4: Use the slope m and the y -intercept b to form the equation of the line.

Code 2) [10%]

The following program reads an input 1D array (**`data.txt`**) and prints the length[1], average, standard deviation, and variance of the data. For this program write a module and call it **`code2module`**. This module should contain a subroutine called **`cal`**. Subroutine **`cal`** should take the 1D array and output average, standard deviation, and variance of the array. Additionally, subroutine **`cal`** should have an option to do the above calculations only for the first ***m*** elements of the array. So ***m*** should be considered as an optional argument of subroutine **`cal`**.

Note: The mean and variance of numbers $x_1, x_2, \ldots, x_n$ can be calculated using the following formulas:

$$\text{mean} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad \text{variance} = \frac{1}{n}\sum_{i=1}^{n} x_i^2 - \frac{1}{n^2}\left(\sum_{i=1}^{n} x_i\right)^2$$

The ***standard deviation*** is the square root of the variance.

```
program Code2
use code2module
implicit none
real,dimension(:), allocatable :: x
integer:: i,n,stat
real:: r,avg,stdDev,var
open(10,file='data.txt')
n=0
stat=0
do while(stat == 0)
     n=n+1
     read(10,*,iostat=stat)r
enddo
rewind(10)
allocate(x(n-1))
do i=1,n-1
  read(10,*) x(i)
end do
call cal(x,avg,stdDev,var)
Print*, 'Length of data is:', n-1
Print*, 'Average of data is:', avg
Print*, 'Standard deviation of data is:', stdDev
Print*, 'variance of data is:', var
end program Code2
```

[1] Length is the total number of elements

Code 3) [10%]

`JM.f90` includes a subroutine which computes the eigenvalues and eigenvectors of a real symmetric matrix, using Rutishauser's modifications of the classical Jacobi rotation method with threshold pivoting. Write a program uses this subroutine to compute eigenvalues and eigenvectors for the following matrix.

$$\begin{pmatrix} 16 & 20 & 16 & 10 \\ 20 & 8 & 4 & 10 \\ 16 & 4 & 6 & 20 \\ 10 & 10 & 20 & 12 \end{pmatrix}$$

Copy & paste your codes into the provided space on eClass, Quiz#3-Dec09 activity.