Assignment -1

August 6, 2016

Problems:

1 Write a computer program for the standard Gauss elimination method(i.e without pivoting) and solve the following set of linear equations.

$$3.01x1 + 2.22x2 + 4.1x3 = 4.5 \quad (1)$$
$$1.00x1 + 3.21x2 + 5.3x3 = 5.1 \quad (2)$$
$$0.3x1 – 0.44x2 + 6.6x3 = 7.1 \quad (3)$$

2 Extend the above program to include partial pivoting and solve the following set of linear equations .

$$2.54x1 + 1.3x2 + 2.1x3 = 4.4 \quad (4)$$
$$0.00002x1 + 1.5x2 – 4.3x3 = 3.33 \quad (5)$$
$$3.1x1 + 6.1x2 + 14.2x3 = 7.22 \quad (6)$$

Always use double precision always.

Hints for writing program:

First read the elements of the coefficient matrix "A".
loop $i = 1, n$
    loop $j = 1, n$
        read $a(i, j)$
    end loop j
end loop i
Elimination part:
loop $k = 1, n - 1$
    loop $i = k + 1, n$
        lambda= $a(i, k)/a(k, k)$
$a(i, k) = 0.0$
$b(i) = b(i) - lambda * a(k, j)$
do $j = k + 1, n$
$a(i, j) = a(i, j) - c * a(k, j)$
enddo

enddo
enddo

Back substitution: In the class we had written that for any given instant of the back substitution if we have already obtained the values of x_n, x_{n-1}, x_{n-2} - - - - - - -x_{k+2}, x_{k+1} and we are going to obtain the value of x_k from the k^{th} equation which is given by

$$a_{kk}x_k + a_{k,k+1}x_{k+1} + ... + a_{k,n-1}x_{n-1} + a_{k,n}x_n = b_k \tag{7}$$

From this the solution for x_k can be found out to be

$$x_k = \left(b_k - \sum_{j=k+1}^{n} a_{kj}x_j \right) \frac{1}{a_{kk}} \tag{8}$$

The code can be written as follows.

After all the above manipulations in the elimination process one can write

$x(n) = b(n)/a(n,n)$

Now we have to compute the sum.

do $i = n-1, 1, -1$

$sum = 0.0$! initialize the sum

do $j = i+1, n$

$sum = sum + a_{i,j} * x_j$

enddo

$x(i) = (b(i) - sum)/a(i,i)$

enddo

Now try to write the program with partial pivoting. First store the pivot element of the row number. Then search for other coefficient below the pivot element which is bigger than the current pivot element. If there is any, then consider that as the new pivot element by swapping the current row with the new row containing the bigger coefficient. Then follow the standard Gauss elimination method.

Important information

Your program should contain the following lines in the beginning.

```
================================================
! Lab No:
! Title :
! Date: dd/mm/year
! Name : Your name
! Roll No:
!Email : youremailid@iitg.ernet.in
================================================
```

Your code should have enough commented lines for others to understand.
The input and output should be clearly presented.
For example in the above case your code should produce

The matrix A and vector B

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Matrix A and vector be after elimination

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Solutions: x(1)=

x(2)=

x(3)=

and up to x(n)