Aim:- To find the solution of given linear equations by Gauss Jacobi method

Apparatus Required : Asus Laptop (15), Windows 11, MATLAB 2021a

Theory :-

The first iterative method is called Jacobi method, named after Carl Gustav Jacob Jacobi (1804-1851) to solve the system of linear equations. This method makes two assumptions

1 The system given by

$$a_{11}x_1 + a_{12}x_2 + \cdots a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + \cdots a_{2n}x_n = b_2$$
$$\vdots$$
$$a_{n1}x_1 + a_{n2}x_2 + \cdots a_{nn}x_n = b_n$$

has a unique solution.

2 The coefficient matrix A has no zero on its main diagonal namely, $a_{11}, a_{22}, a_{33} \cdots a_{nn}$ are non zeros. If any of the diagonal entries are zero then we should interchange the rows or columns to obtain a coefficient matrix that has non zero entries on the main diagonal.

To begin solve the 1st equation for x_1, the 2nd equation for x_2 and so on to obtain the rewritten equations

$$x_1 = \frac{1}{a_{11}}(b_1 - a_{12}x_2 - a_{13}x_3 \cdots - a_{1n}x_n)$$

$$x_2 = \frac{1}{a_{22}}(b_2 - a_{21}x_1 - a_{23}x_3 \cdots - a_{2n}x_n)$$

$$\vdots$$

$$x_n = \frac{1}{a_{nn}}(b_n - a_{n1}x_1 - a_{n2}x_2 \cdots - a_{nn-1}x_{n-1})$$

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Then make an initial guess of solution $x^0 = (x_1^0, x_2^0, x_3^0 \ldots x_n^0)$ Substitute these values into the right hand side the of the rewritten equations to obtains the first approximation, $(x_1^1, x_2^1, x_3^1, \ldots x_n^1)$. This accomplishes one iteration. In the same way, the substituting the first approximations x-values into the right hand side of the rewritten equations.

By repeated iterations, we form a sequence of approximation $x^k = (x_1^k, x_2^k, x_3^k, \ldots x_n^k)'$

$$k = 1, 2, 3 \ldots$$

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The Jacobi method:

for each $k \geq 1$ generate the components x_i^k of x^k form x^{k-1} by:

$$x_i^{(k)} = \frac{1}{a_{ii}} \left[\sum_{j=1}^{n} \left(-a_{ij} x_j^{(k-1)} \right) + b_i \right]$$

$$\text{for } i = 1, 2, \ldots n$$

Given Equations:

(i) To find the solution of given equations by gauss - Jacobi method

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$$20x + 2y + 6z = 28$$
$$x + 20y + 9z = -23$$
$$2x - 7y - 20z = -57$$

Soln:

$$x = \frac{1}{23}(28 - 2y - 6z)$$

$$y = \frac{1}{20}(-23 - x - 9z)$$

$$z = \frac{1}{20}(-57 - 2x + 7y)$$

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n	x	y	z
	0	0	0
1	1.4	-1.15	2.85
2	0.66	-2.5025	3.3925
3	0.6325	-2.7096	3.7919
4	0.5334	-2.888	3.8616
5	0.5363	-2.9144	3.9141
6	0.5172	-2.9379	3.9231
7	0.5169	-2.9412	3.93
8	0.5151	-2.9443	3.9311
9	0.5151	-2.9448	3.932
10.			

$x \approx 0.5151$

$y \approx -2.9448$

$z \approx 3.9320$

ii) To find solⁿ of given equation by Gauss-Jacobi method

$$10x - 5y - 2z = 3$$

$$4x - 10y + 3z = -3$$

$$x + 6y + 10z = -3$$

Solⁿ:

$$x = \frac{1}{10}(3 + 5y + 2z)$$

$$y = \frac{-1}{10}(-3 - 4x - 3z)$$

$$z = \frac{1}{10}(-3 - x - 6y)$$

n	x	y	z
	0	0	0
1	0.3	0.3	-0.3
2	0.39	0.33	-0.51
3	0.363	0.303	-0.537
4	0.3441	0.2841	-0.5181
5	0.3384	0.2822	-0.50487
6	0.3401	0.2839	-0.5032
7	0.3413	0.2857	-0.5043
8			
9	0.3416	0.2852	-0.5052

x = 0.3416   z = -0.5052
y = 0.2852

MATLAB Code :

```
Clear all
clc

A = input('Enter the coefficient matrix A:');
B = Input('Enter the Constant
P= [A B];
[row col] = size(P);
x = zeros(row, 1);
C = zeros(row, 1);
Err = Ones (row, 1);
tol = input('Enter the tolerance:');
While Err >tol
    for m=1 : row
        C(m,1)=(P(m,col) - sum(A(m,:)x(:,1))+A(m,m)*x(m,1))
                                                    /P(m,m);
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        Err(m,1) = abs(c(m,1) - x(m,1));
    end
    x(:,1) = c(:,1);
end
disp('The required solution is :');
disp(x);
```

(ii) INPUT :

Enter the Coefficient matrix A : [10 -5 -2; 4 -10 3; 1 6 10]

Enter the constant matrix B : [3, -3; -3]

Enter the tolerance : 0.0001

OUTPUT

The required Solution is

0.3415

0.2850

-0.5052

(i) INPUT

Enter the coefficient matrixA : [20 2 ~~6~~ 5; 1 20 9; 2 -7 20]

Enter the constant matrix B : [28; -23, -57]

Enter the tolerance : 0.0001.

OUT PUT

The required Solution is

0.5151

-2.9448

3.4320.

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CONCLUSION: we have done this experiment in MATLAB software By this experiment we find the solution of Linear equation by using guass Jacobi method and verify the result with MATLAB output sucesfully.

Reference:

BS Grewal. "Numerical methods in engineering and science" by mercury learning and information Lic 3rd edition 2014.

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