Unit 4 - Week 2 - Linear Systems and Equations

Assignment 2

The due date for submitting this assignment has passed. Due on 2019-08-21, 23:59 IST.
As per our records you have not submitted this assignment.

Consider the following example of linear equations in three variables

$5x_1 + 4x_3 + x_4 = -6$
$4x_1 + 5x_2 + 2x_3 = 8$
$4x_1 + 4x_2 + 4x_3 + x_4 = 1$
$x_1 + 2x_2 + 2x_3 + 3x_4 = 2$

Please write the equations in the form $Ax = b$, and solve the following three problems based on this example.

Problem 1: Gauss Elimination (First operation)

In the first problem, you will report the results of performing Gauss Elimination (without partial pivoting). To do so, define a matrix Ab = [A | b], obtained by catenating matrix A with vector b. Perform one sequence of Gauss Elimination to obtain zeros in the first pivot column. The resulting matrix will be

$$Ab = \begin{bmatrix} * & * & * & * & * \\ 0 & \tilde{a}_{21} & * & * & \tilde{b}_2 \\ 0 & * & * & \tilde{a}_{34} & * \\ 0 & * & * & * & \tilde{b}_4 \end{bmatrix}$$

1) The value of element $\tilde{b}_2$ = _____ (i.e., second row of modified "b" vector)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 12.79,12.81

0.25 points

2) The value of element $\tilde{b}_4$ = _____ (i.e., last row of modified "b" vector)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 3.19,3.21

0.25 points

3) The value of element $\tilde{a}_{21}$ = _____

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 4.99,5.01

0.25 points

4) The value of element $\tilde{a}_{34}$ = _____

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.19,0.21

0.25 points

Problem 2: Gauss Elimination (Second operation)

Another step of Gauss Elimination was run to obtain:

$$Ab = \begin{bmatrix} * & * & * & * & * \\ 0 & * & * & * & * \\ 0 & 0 & * & * & * \\ 0 & 0 & * & \tilde{a}_{44} & \tilde{b}_4 \end{bmatrix}$$

5) The value of element $\tilde{a}_{44}$ = _____? Please report the result accurate to three significant digits.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 3.11,3.13

0.25 points

6) The value of element $\tilde{b}_4$ = _____? Please report the result accurate to three significant digits.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -1.93,-1.91

0.25 points

Thereafter, complete the Gauss Elimination to obtain lower-triangular matrix of the form

$$Ab = \begin{bmatrix} * & * & * & * & * \\ 0 & * & * & * & * \\ 0 & 0 & * & * & * \\ 0 & 0 & 0 & \tilde{a}_{44} & \tilde{b}_4 \end{bmatrix}$$

7) The value of element $\tilde{a}_{44}$ = _____? Please report the result accurate to three significant digits.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 2.30,2.33

0.25 points

8) The value of element $\tilde{b}_4$ = _____? Please report the result accurate to three significant digits.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 2.30,2.33

0.25 points

Problem 3: LU Decomposition

In the lectures, we saw that the result of Gauss Elimination can be used for LU decomposition. For the Matrix A in the above example, perform the LU decomposition. The Matrix obtained after Gauss Elimination in Problem-2 is the U matrix. The L matrix is given by the factors determined during Gauss Elimination. Let $L = \begin{bmatrix} d & 0 & 0 & 0 \\ \alpha_{21} & d & 0 & 0 \\ \alpha_{31} & \alpha_{32} & d & 0 \\ \alpha_{41} & \alpha_{42} & \alpha_{43} & d \end{bmatrix}$

9) The value of diagonal elements of L matrix is d = _____? 0.25 points

- 0
- 1
- Some other value

No, the answer is incorrect.
Score: 0
Accepted Answers:
1

10) The value of element α_{21} = _____?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.79,0.81

0.25 points

11) The value of element α_{31} = _____?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.79,0.81

0.25 points

12) The value of element α_{42} = _____?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.39,0.41

0.25 points

Problem 4: Back-substitution

Let us consider another example of an Ab matrix obtained after Gauss Elimination. (Please note I have used a different example to obtain this matrix). Please use Back-Substitution to obtain the solution to the linear equations. The Ab matrix is given by

$$Ab = \begin{bmatrix} 5 & 0 & 4 & 1 & -6 \\ 0 & 6.25 & -1.5 & -1 & 16 \\ 0 & 0 & 2 & 1 & -5 \\ 0 & 0 & 0 & 2 & 2 \end{bmatrix}$$

13) The value of the first element of the solution vector, x_1 = _____? (Please note that x_1 is the last value obtained in back-substitution)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.95,1.05

0.25 points

14) The value of x_2 = _____?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 1.95,2.05

0.25 points

15) The value of x_3 = _____?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) -3.05,-2.95

0.25 points

16) The value of x_4 = _____? (Please note that x_4 is the first value obtained in back-substitution, since we start from the end and calculate backwards)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.95,1.05

0.25 points

Problem 5: Application Problem

A Farm prepares a special feed, which is a mixture of corn, horse-gram and peas. Corn cost ₹ 40 per kg, Horse-gram cost ₹ 50 per kg and peas cost ₹ 90 per kg. The special feed is made such that the weight of corn is twice that of horse-gram. Please answer the following questions

17) How many kilograms of peas should be used to produce **140 kg** of the feed at **₹60 per kg**?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 49.9,50.1

0.5 points

18) How many kilograms of peas should be used to produce **100 kg** of the feed at **₹76 per kg**?

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 69.9,70.1

0.5 points