

# Discussion 1

CUNY MSDS DATA 605

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**Book:** Beezer: A First Course in Linear Algebra

### Exercise

Find all solutions to the system of linear equations. Use your favorite computing device to row-reduce the augmented matrices for the systems, and write the solutions as a set, using correct set notation.

$$-x_1 + 5x_2 = -8$$

$$-2x_1 + 5x_2 + 5x_3 + 2x_4 = 9$$

$$-3x_1 - x_2 + 3x_3 + x_4 = 3$$

$$7x_1 + 6x_2 + 5x_3 + x_4 = 30$$

### Preparation

In order to solve this linear system, we need to set up our square matrix by taking the left side values from the equal sign and I will call it  $C$ ; our right side values of the equal sign will be represented in a vector, I will call it  $d$ .

```
C = matrix(data = c(-1,-2,-3,7,5,5,-1,6,0,5,3,5,0,2,1,1), nrow=4, ncol = 4)
d = c(-8,9,3,30)
```

Matrix  $C$ .

```
##      [,1] [,2] [,3] [,4]
## [1,]  -1   5   0   0
## [2,]  -2   5   5   2
## [3,]  -3  -1   3   1
## [4,]   7   6   5   1
```

Vector  $d$ .

```
## [1] -8  9  3 30
```

### Solving in R using ‘solve’

We can solve this equation by using the following command.

```
solve(C,d)
```

```
## [1] 3 -1 2 5
```

Answer

$$S = \{(x_1 = 3, x_2 = -1, x_3 = 2, x_4 = 5)\}$$

### Solving in R using ‘Row Reduction’ (Gauss-Jordan Elimination)

For this, we need to use the package ‘pracma’.

```
#install.packages("pracma")  
library("pracma")
```

Setup into a single matrix, I will call it  $G$ .

```
G = matrix(data = c(-1,-2,-3,7,5,5,-1,6,0,5,3,5,0,2,1,1,-8,9,3,30), nrow=4, ncol = 5)
```

Representation of matrix  $G$ .

```
##      [,1] [,2] [,3] [,4] [,5]  
## [1,]  -1   5   0   0  -8  
## [2,]  -2   5   5   2   9  
## [3,]  -3  -1   3   1   3  
## [4,]   7   6   5   1  30
```

We can solve this equation by using the following command.

```
rref(G)
```

```
##      [,1] [,2] [,3] [,4] [,5]  
## [1,]   1   0   0   0   3  
## [2,]   0   1   0   0  -1  
## [3,]   0   0   1   0   2  
## [4,]   0   0   0   1   5
```

Answer

$$S = \{(x_1 = 3, x_2 = -1, x_3 = 2, x_4 = 5)\}$$