
Assignment for linear equations

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Problem 1

```
clear all; clc;
% a
A1 = [2 1; 3 -9]; b1 = [5;7];
if rank(A1)==rank([A1 b1])
    disp("The linear equations of (a) is solvable.");
    if rank(A1)==2
        disp("The linear equations of (a) has unique solution.");
        r1 = A1\b1;
        fprintf("x = %.2f, y = %.2f \n", r1(1), r1(2));
    else
        disp("Unique solution does not exist for (a).");
    end
else
    disp("The linear equations of (a) is not solvable.");
end
% b
A2 = [-8 -5; -2 7]; b2 = [4;10];
if rank(A2)==rank([A2 b2])
    disp("The linear equations of (b) is solvable.");
    if rank(A2)==2
        disp("The linear equations of (b) has unique solution.");
        r2 = A2\b2;
        fprintf("x = %.2f, y = %.2f \n", r2(1), r2(2));
    else
        disp("Unique solution does not exist for (b).");
    end
else
    disp("The linear equations of (b) is not solvable.");
end
% c
A3 = [12 -5 0; -3 4 7; 6 2 3]; b3 = [11;-3;22];
if rank(A3)==rank([A3 b3])
    disp("The linear equations of (c) is solvable.");
    if rank(A3)==3
        disp("The linear equations of (c) has unique solution.");
    end
end
```

```

        r3 = A3\b3;
        fprintf("x = %.2f, y = %.2f, x3 = %.2f \n", r3(1), r3(2),
r3(3));
    else
        disp("Unique solution does not exist for (c).");
    end
else
    disp("The linear equations of (c) is not solvable.");
end
% d
A4 = [6 -3 4; 12 5 -7; -5 2 6]; b4 = [41;-26;16];
if rank(A4)==rank([A4 b4])
    disp("The linear equations of (d) is solvable.");
    if rank(A4)==3
        disp("The linear equations of (d) has unique solution.");
        r4 = A4\b4;
        fprintf("x = %.2f, y = %.2f, x3 = %.2f \n", r4(1), r4(2),
r4(3));
    else
        disp("Unique solution does not exist for (d).");
    end
else
    disp("The linear equations of (d) is not solvable.");
end

```

```

The linear equations of (a) is solvable.
The linear equations of (a) has unique solution.
x = 2.48, y = 0.05
The linear equations of (b) is solvable.
The linear equations of (b) has unique solution.
x = -1.18, y = 1.09
The linear equations of (c) is solvable.
The linear equations of (c) has unique solution.
x = 3.00, y = 5.00, x3 = -2.00
The linear equations of (d) is solvable.
The linear equations of (d) has unique solution.
x = 2.00, y = -2.68, x3 = 5.23

```

Problem 2

```

clear all; clc;
% a
disp("The solution is C = inv(B)*(inv(A)*B-A)");
% b
A = [7 9; -2 4]; B = [4 -3; 7 6];
C = B\A;
disp(C);

The solution is C = inv(B)*(inv(A)*B-A)
-0.8536    -1.6058
 1.5357     1.3372

```

Problem 3

```
clear all; clc;
% a
A1 = [-2 1; -2 1]; b1 = [-5;3];
if rank(A1)==rank([A1 b1])
    disp("The linear equations of (a) is solvable.");
    if rank(A1)==2
        disp("The linear equations of (a) has unique solution.");
        r1 = A1\b1;
        fprintf("x = %.2f, y = %.2f \n", r1(1), r1(2));
    else
        disp("Unique solution does not exist for (a).");
    end
else
    disp("The linear equations of (a) is not solvable.");
end
% b
A2 = [-2 1; -8 4]; b2 = [3;12];
if rank(A2)==rank([A2 b2])
    disp("The linear equations of (b) is solvable.");
    if rank(A2)==2
        disp("The linear equations of (b) has unique solution.");
    else
        disp("Unique solution does not exist for (b).");
        B = rref([A2 b2]);
        fprintf("x = %.2f + %.2fy; y is an arbitrary real number \n",
            B(1,3), -B(1,2));
    end
else
    disp("The linear equations of (b) is not solvable.");
end
% c
A3 = [-2 1; -2 1]; b3 = [-5; -5.00001];
if rank(A3)==rank([A3 b3])
    disp("The linear equations of (c) is solvable.");
    if rank(A3)==2
        disp("The linear equations of (c) has unique solution.");
    else
        disp("Unique solution does not exist for (c).");
    end
else
    disp("The linear equations of (c) is not solvable.");
end
% d
A4 = [1 5 -1 6; 2 -1 1 -2; -1 4 -1 3; 3 -7 -2 1]; b4 = [19;7;30;-75];
if rank(A4)==rank([A4 b4])
    disp("The linear equations of (d) is solvable.");
    if rank(A4)==4
        disp("The linear equations of (d) has unique solution.");
        r4 = A4\b4;
        fprintf("x1 = %.2f, x2 = %.2f, x3 = %.2f, x4 = %.2f \n",
            r4(1), r4(2), r4(3), r4(4));
    end
end
```

```

else
    disp("Unique solution does not exist for (d).");
end
else
    disp("The linear equations of (d) is not solvable.");
end

```

The linear equations of (a) is not solvable.
The linear equations of (b) is solvable.
Unique solution does not exist for (b).
 $x = -1.50 + 0.50y$; y is an arbitrary real number
The linear equations of (c) is not solvable.
The linear equations of (d) is solvable.
The linear equations of (d) has unique solution.
 $x_1 = 5.00$, $x_2 = 14.62$, $x_3 = -12.12$, $x_4 = -11.87$

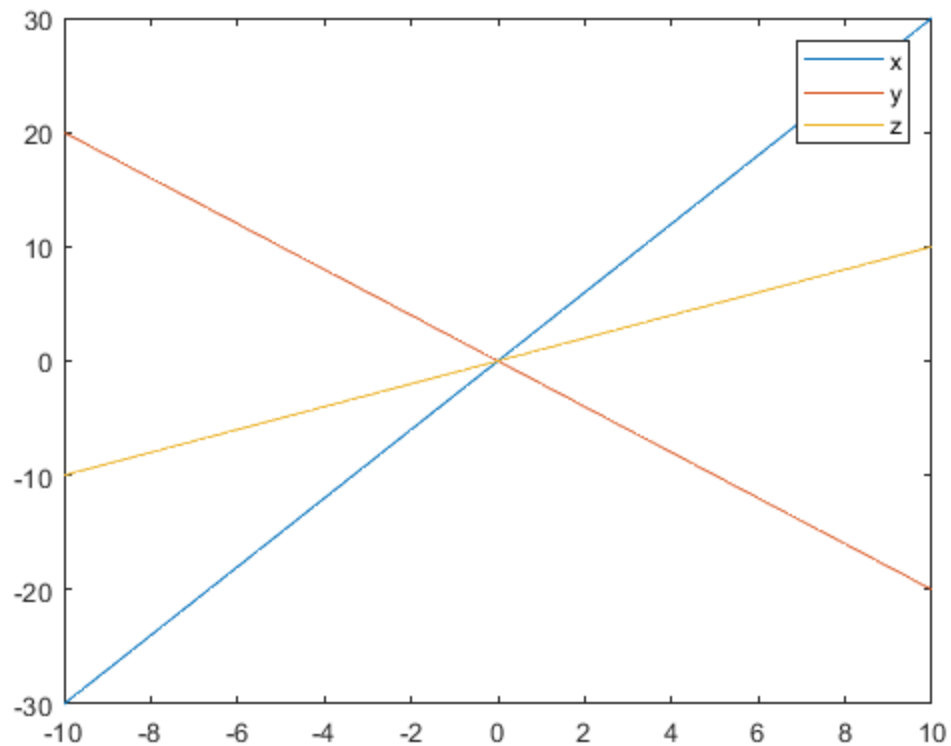
Problem 4

```

clear all; clc;
% given values
A = [1 -5 -2; 6 3 1; 7 3 -5]; b = [11;13;10];
% a
B = rref([A b]);
fprintf("x = %.2fc, y = %.2fc, z = %.2fc \n", B(1,4),B(2,4),B(3,4));
% b
c = -10:0.1:10;
x = B(1,4)*c; y = B(2,4)*c; z = B(3,4)*c;
plot(c,x,c,y,c,z);
legend('x','y','z');

x = 3.00c, y = -2.00c, z = 1.00c

```

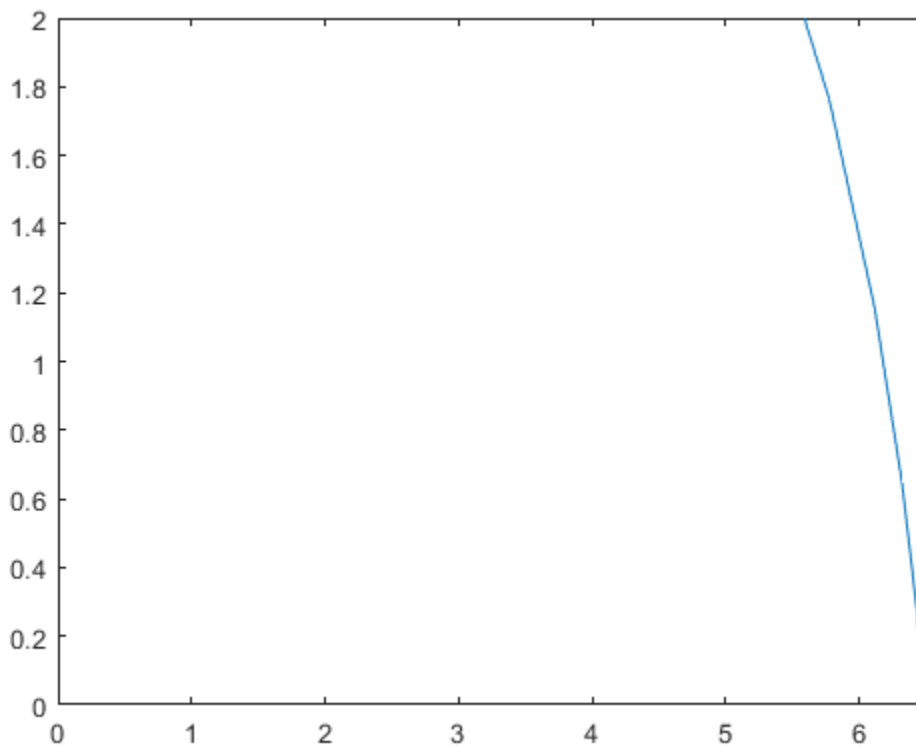


Problem 5

```
clear all; clc;
% a
% For simplification, a0 indicates  $\theta_1(0)$  and b0 indicates  $\theta_2(0)$ 
% at indicates  $\theta_1(t)$  and bt indicates  $\theta_2(t)$ 
% $at = a0+a1*t^3+a2*t^4+a3*t^5$
% $0 = 3*a1*t^2+4*a2*t^3+5*a3*t^4$
% $0 = 6*a1*t+12*a2*t^2+20*a3*t^3$
%
% $bt = b0+b1*t^3+b2*t^4+b3*t^5$
% $0 = 3*b1*t^2+4*b2*t^3+5*b3*t^4$
% $0 = 6*b1*t+12*b2*t^2+20*b3*t^3$
%
% b
tf = 2;
M = [tf^3 tf^4 tf^5;
      3*tf^2 4*tf^3 5*tf^4;
      6*tf 12*tf^2 20*tf^3];
o1 = [(19+43)*pi/180; 0; 0]; o2 = [(151-44)*pi/180; 0; 0];
a = M\o1; b = M\o2;
fprintf("a1 = %.2f, a2 = %.2f, a3 = %.2f \n", a(1), a(2), a(3));
fprintf("b1 = %.2f, b2 = %.2f, b3 = %.2f \n", b(1), b(2), b(3));
```

```
% c
L1 = 4; L2 = 3;
t = 0:0.1:2;
theta1 = -19*pi/180 + a(1)*t.^3 + a(2)*t.^4 + a(3)*t.^5;
theta2 = 44*pi/180 + b(1)*t.^3 + b(2)*t.^4 + b(3)*t.^5;
x = L1*cos(theta1)+L2*cos(theta1+theta2);
y = L1*sin(theta1)+L2*sin(theta1+theta2);
plot(x, y);
xlim([0 6.5]);
ylim([0 2]);

a1 = 1.35, a2 = -1.01, a3 = 0.20
b1 = 2.33, b2 = -1.75, b3 = 0.35
```



Problem 6

```
clear all; clc;
% given values
D = [0.01 0.125 0.06 0.05];
R = [0.036 4.01 0.408 0.038];
T = [20 0 0 0 -10];
% find the three other temperature and the heat loss rate
A = [1+R(1)/R(2) -R(1)/R(2) 0;
     1 0 R(1)/R(4);
     0 -R(4)/R(3) 1+R(4)/R(3)];
b = [T(1);T(1)+R(1)/R(4)*T(5);T(5)];
```

```
r = A\b;
T(2:4) = r;
fprintf("T1 = %.2f°C, T2 = %.2f°C, T3 = %.2f°C \n",T(2),T(3),T(4));
fprintf("q = %.2f \n",(T(1)-T(2))/(10*R(1)));

T1 = 19.76°C, T2 = -7.02°C, T3 = -9.75°C
q = 0.67
```

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