```
%Hritk kumar
%202051088
%Ma202_Lab02
```

```
%Q1
syms A m n N
N=4; % Size of the matrix
for i=1:N
 for j=1:N
 A(i,j)= 1/(i+j-1);
 end
end
disp(A)
```

$$\begin{pmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

```
Ain=A^-1;
cond(A)
```

ans =

$$\sqrt{\frac{\sqrt{\sigma_2}}{6\,{\sigma_4}^{1/6}}+\frac{\sqrt{\frac{628361585696\,\sqrt{6}\,\sqrt{\frac{4162457018}{7815437776125}+\frac{16\,\sqrt{3}\,\sqrt{4621318097}\,\mathrm{i}}{868381975125}}}{148899515625}+\frac{915862834\,{\sigma_4}^{1/3}\,\sqrt{\sigma_2}}{40516875}-}{6\,{\sigma_4}^{1/6}\,{\sigma_2}^{1/4}}}$$

where

$$\sigma_1 = \sqrt{2858465861238784\,{\sigma_3}^{1/3}+{\sigma_3}^{2/3}+6153440329728000000000000}$$

$$\sigma_2 = \frac{457931417\,{\sigma_4}^{1/3}}{40516875}+9\,{\sigma_4}^{2/3}+\frac{326021}{78764805}$$

$$\sigma_3 = 48269565260952344985600000000000000+166988328468480000000000000000\,\sqrt{3}\,\sqrt{4621318}$$

$$\sigma_4 = \frac{2081228509}{211016819955375}+\frac{8\,\sqrt{3}\,\sqrt{4621318097}\,\mathrm{i}}{23446313328375}$$

```
det(A)*det(Ain)
```

```
ans = 1
```

```
%Q2
x = [0,0.25,0.5,0.75,0.90,0.95,0.99]
```

```
x = 1×7
         0    0.2500    0.5000    0.7500    0.9000    0.9500    0.9900
```

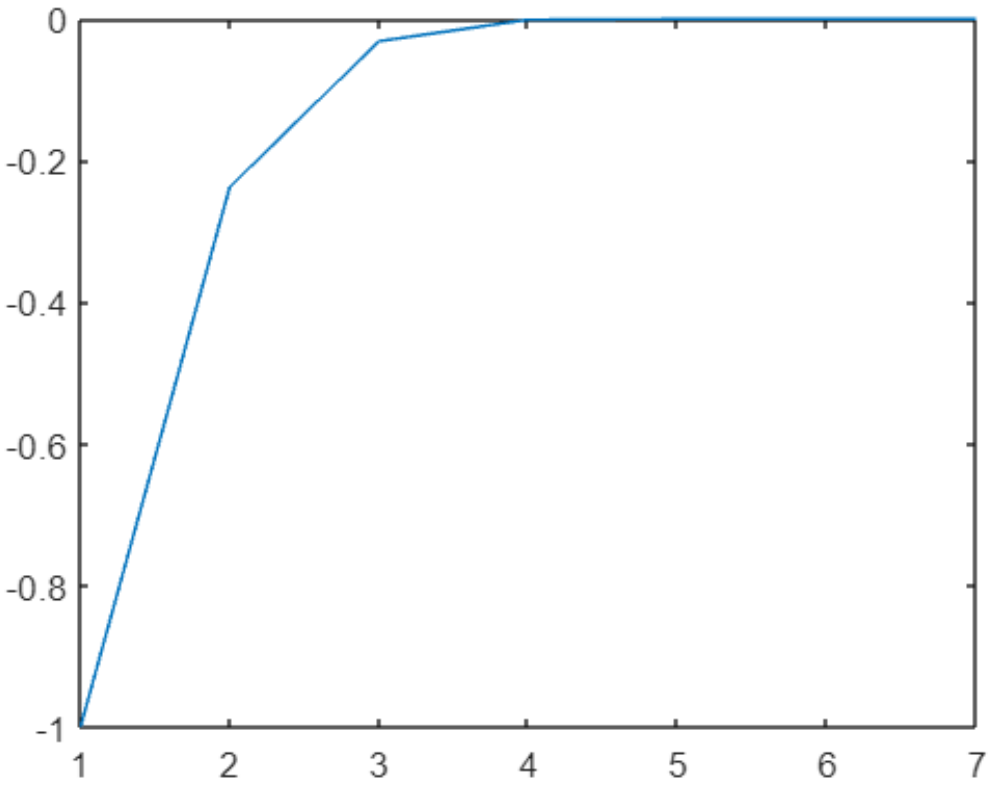
```
p = (x-1).^5
```

```
p = 1×7
   -1.0000   -0.2373   -0.0312   -0.0010   -0.0000   -0.0000   -0.0000
```

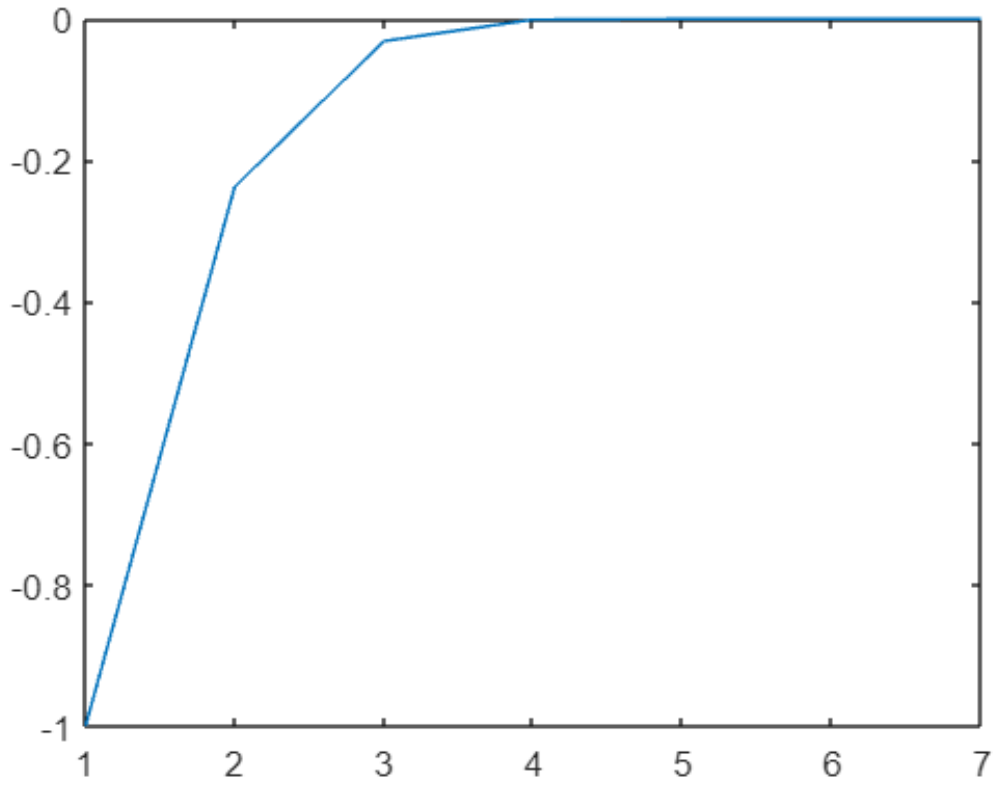
```
q = x.^5-5*x.^4+10*x.^3-10*x.^2+5*x-1
```

```
q = 1×7
   -1.0000   -0.2373   -0.0312   -0.0010   -0.0000   -0.0000   -0.0000
```

```
plot(p)
```




```
plot(q)
```




```
%Q3
x = [1,10,100,10000,100000];
for i = 1:5
 A(i) = sqrt(2*x(i)^2 +1)+1
end
```

A =

$$\begin{pmatrix} \frac{6152031499462229}{2251799813685248} & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

A =

$$\begin{pmatrix} \frac{6152031499462229}{2251799813685248} & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{8544143013451155}{562949953421312} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

A =

$$\begin{pmatrix} \frac{6152031499462229}{2251799813685248} & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{8544143013451155}{562949953421312} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{5011130385235165}{35184372088832} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{1}{4} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

A =

$$\begin{pmatrix} \frac{6152031499462229}{2251799813685248} & \frac{1}{2} & \frac{1}{3} & \frac{1}{4} \\ \frac{8544143013451155}{562949953421312} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{5011130385235165}{35184372088832} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{3887635527594689}{274877906944} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

A =

$$\begin{pmatrix} \frac{6152031499462229}{2251799813685248} & \frac{607404394977691}{4294967296} & \frac{1}{3} & \frac{1}{4} \\ \frac{8544143013451155}{562949953421312} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} \\ \frac{5011130385235165}{35184372088832} & \frac{1}{4} & \frac{1}{5} & \frac{1}{6} \\ \frac{3887635527594689}{274877906944} & \frac{1}{5} & \frac{1}{6} & \frac{1}{7} \end{pmatrix}$$

```
%(B.)
for j = 1:5
 B(i) = 2*x(i)^2/(sqrt(2*x(i)^2 +1)+1)
end
```

B =

$$
\begin{pmatrix}
144 & -10296 & 240240 & -2702700 & 17297280 \\
-10296 & 981552 & -25765740 & 309188880 & -2061259200 \\
240240 & -25765740 & 721440720 & -9018009000 & 61837776000 \\
-2702700 & 309188880 & -9018009000 & 115945830000 & -811620810000 \\
\frac{4859166440344791}{34359738368} & -2061259200 & 61837776000 & -811620810000 & 5771525760000 \\
-68612544 & 8409937536 & -257554337040 & 3434057827200 & -24725216355840 \\
176432256 & -22076086032 & 686811565440 & -9271956133440 & 67432408243200 \\
-299304720 & 38044955520 & -1198416098880 & 16342037712000 & -119841609888000 \\
332560800 & -42800574960 & 1361836476000 & -18725251545000 & 138278780640000 \\
-232792560 & 30263032800 & -970938969000 & 13443770340000 & -99868008240000 \\
93117024 & -12206089896 & 394350596640 & -5492740453200 & 41012462050560 \\
-16224936 & 2141691552 & -69604975440 & 974469656160 & -7308522421200
\end{pmatrix}
$$

B =

$$
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144 & -10296 & 240240 & -2702700 & 17297280 \\
-10296 & 981552 & -25765740 & 309188880 & -2061259200 \\
240240 & -25765740 & 721440720 & -9018009000 & 61837776000 \\
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240240 & -25765740 & 721440720 & -9018009000 & 61837776000 & \\
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\end{pmatrix}$$

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-10296 & 981552 & -25765740 & 309188880 & -2061259200 & \\
240240 & -25765740 & 721440720 & -9018009000 & 61837776000 & \\
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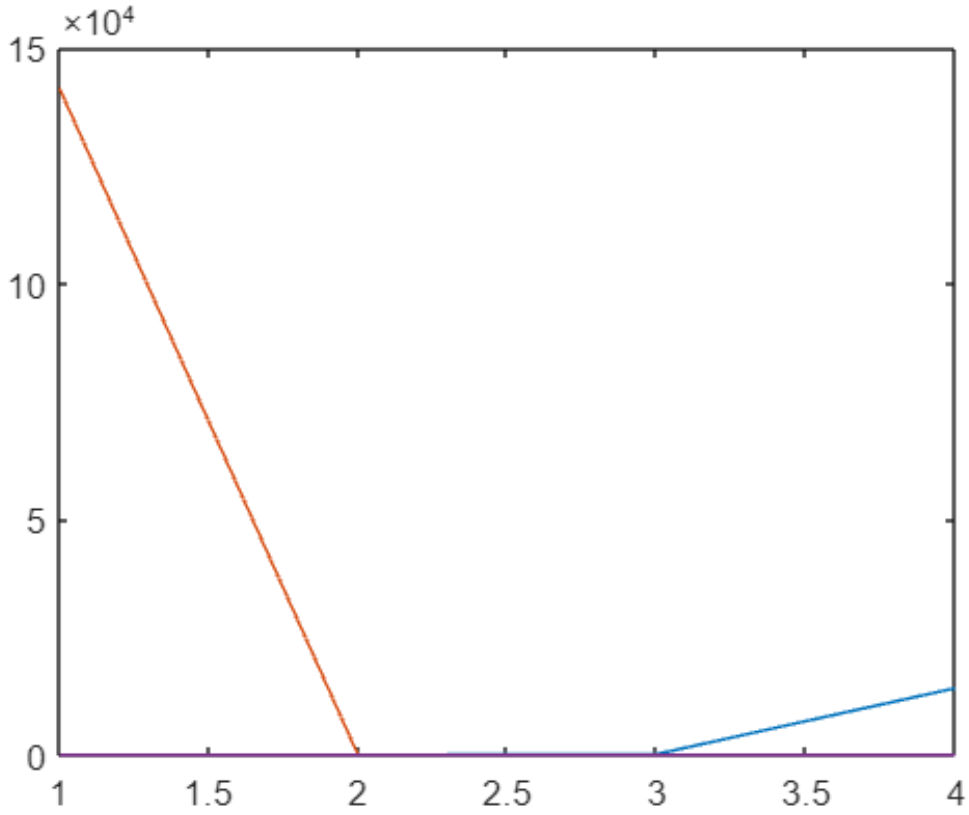
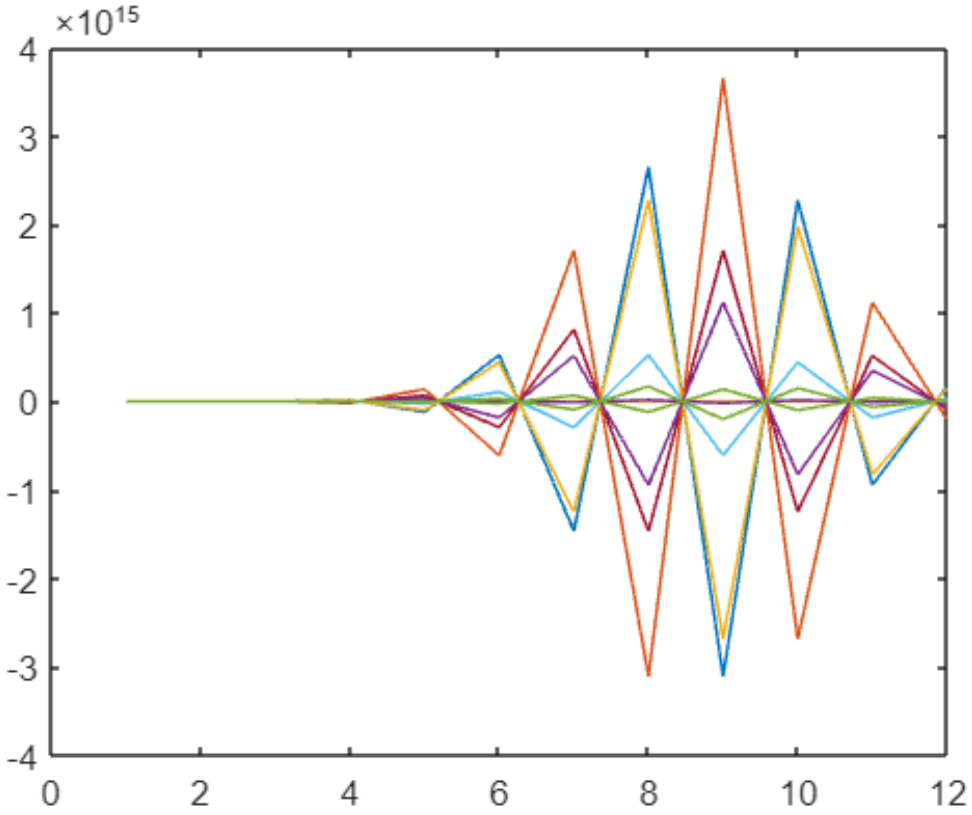
-16224936 & 2141691552 & -69604975440 & 974469656160 & -7308522421200 &
\end{pmatrix}$$

```
plot(A)
```




```
plot(B)
```




```
%Q4
x = [1,10,100,10000,100000];
f = sqrt(x).*(sqrt(x+1)-sqrt(x))
```

```
f = 1×5
    0.4142    0.4881    0.4988    0.5000    0.5000
```

```
%Q5
n=[-20,-19,19,20];
y=1e16;
x=36;
y.^n ./ exp(n.*x)
```

```
ans = 1×4
10^6 ×
    0.0000    0.0000    8.7614       NaN
```

```
(y./exp(x)).^n
```

```
ans = 1×4
10^7 ×
    0.0000    0.0000    0.8761    2.0322
```

```
%Q6
x1 = 9.8^201; x2 = 9.8^-201;
```

```
y1=10.2^199; y2=10.2^-199;
z = sqrt(x1^2 + y1^2)
```

```
z = Inf
```

```
z = y1*sqrt(((x1^2)/(y1^2))+1)
```

```
z = NaN
```

```
z = sqrt(x2^2 + y2^2)
```

```
z = 0
```

```
z = y2*sqrt(((x2^2)/(y2^2))+1)
```

```
z = NaN
```

```
%Q7
A=[1;2];
b=[2.9;3.9];
X=lineq(A,b);
disp(X);
```

```
    2.1400
```

```
%Q8
A=[1 2;3 4];
b=[-1;1];
X=lineq(A,b);
disp("a)")
```

```
a)
```

```
disp(X);
```

```
    3.0000
   -2.0000
```

```
A=[1 2;2 4];
b=[-1;1];
X=lineq(A,b);
disp("b)")
```

```
b)
```

```
disp(X);
```

```
    0.0400
    0.0800
```

```
A=[1 2];
b=3;
X=lineq(A,b);
disp("c)")
```

```
c)
```

```
disp(X);
```

```
    0.6000
    1.2000
```

```
A=[1;2];
b=[2.9;3.9];
X=lineq(A,b);
disp("d)")
```

```
d)
```

```
disp(X);
```

```
    2.1400
```

```
function X=lineq(A,b)
  m=size(A,1);
  n=size(A,2);
  %critically determined case
  if m==n
    %checking for singular matrix
    if cond(A) > 1e14
      X=pinv(A)*b;
    else
      X = inv(A)*b;
    end
  else
    %underdetermined case
    if m<n
      X=A'*pinv(A*A')*b;
    %overdetermined case
    else
      X=pinv(A'*A)*A'*b;
    end
  end
end
```