Experiment – 9

Code:

Editor - Z:\MAT2002\Assignment 5\Experiment 9\E9_2.m

E9_1.m | E9_2.m

```
clc
clear all

syms n z y(n) Y
yn = y(n);
yn1 = y(n+1);
yn2 = y(n+2);
F = input('Input coefficients [a,b,c]: ');
a = F(1);
b = F(2);
c = F(3);

nh = input('Enter the non-homogenous part of f(n): ');
eqn = a*yn2+b*yn1+c*yn-nh;
ZTY = ztrans(eqn);

IC = input('Enter the initial conditions [y0,y1]: ');
y0 = IC(1);
y1 = IC(2);

ZTY = subs(ZTY,{'ztrans(y(n),n,z)','y(0)','y(1)'},{Y,y0,y1});
eq = collect(ZTY, Y);
Y = simplify(solve(eq,Y));
yn = simplify(iztrans(Y));
disp('The solution of the difference equation: ');
disp(yn);

m = linspace(0,20,100);
y = subs(yn,n,m);
stem(y, 'r--.');
title('Difference equation');
xlabel('n');
ylabel('y(n)');
grid on;
```

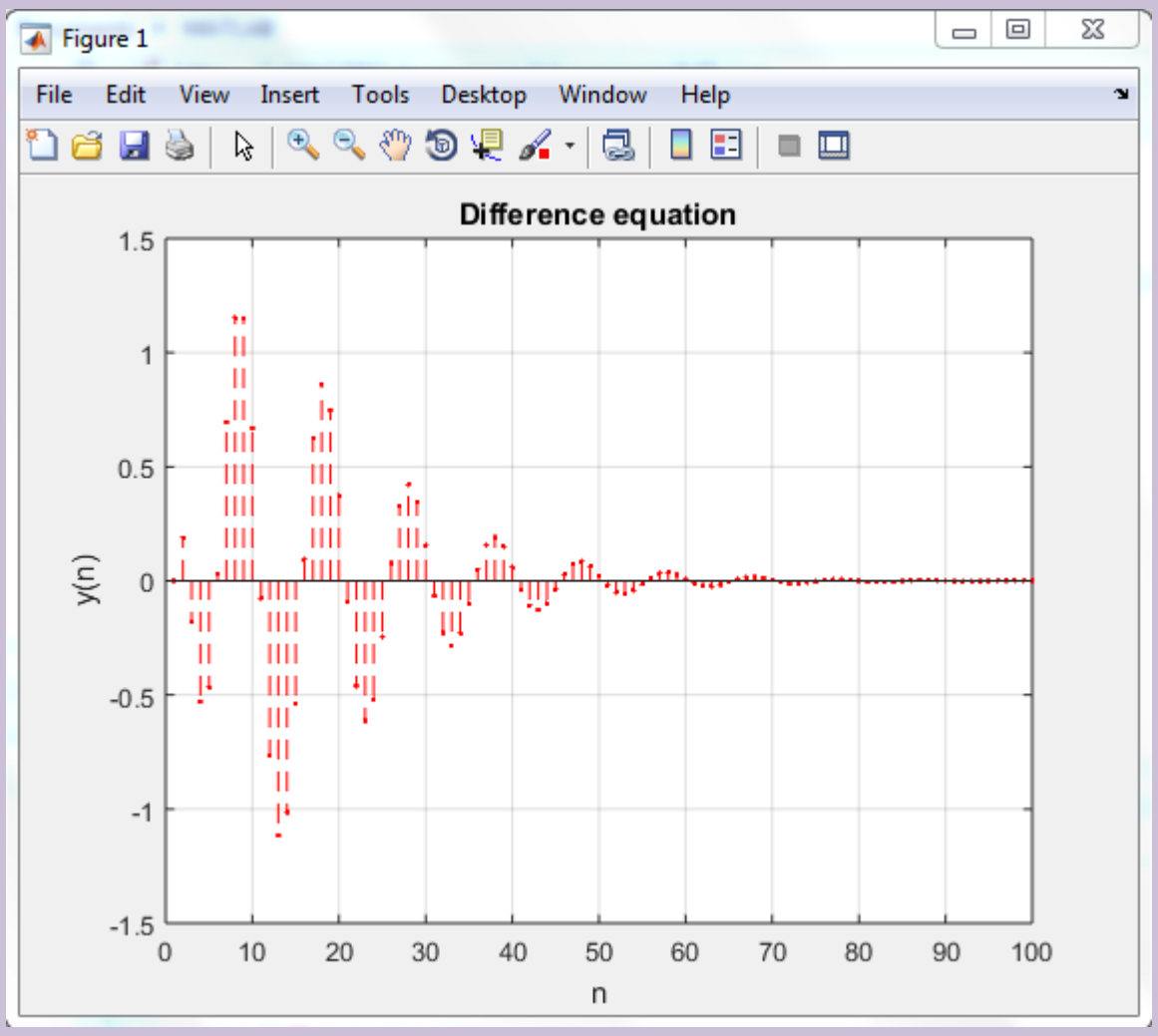
I/O - 1:

```
Command Window
New to MATLAB? See resources for Getting Started.

Input coefficients [a,b,c]: [9 9 2]
Enter the non-homogenous part of f(n): 0
Enter the initial conditions [y0,y1]: [1 1]
The solution of the difference equation:
5*(-1/3)^n - 4*(-2/3)^n
```

Graph - 1:

m = linspace(0,20,100)



Graph - 2:

m = 0:20

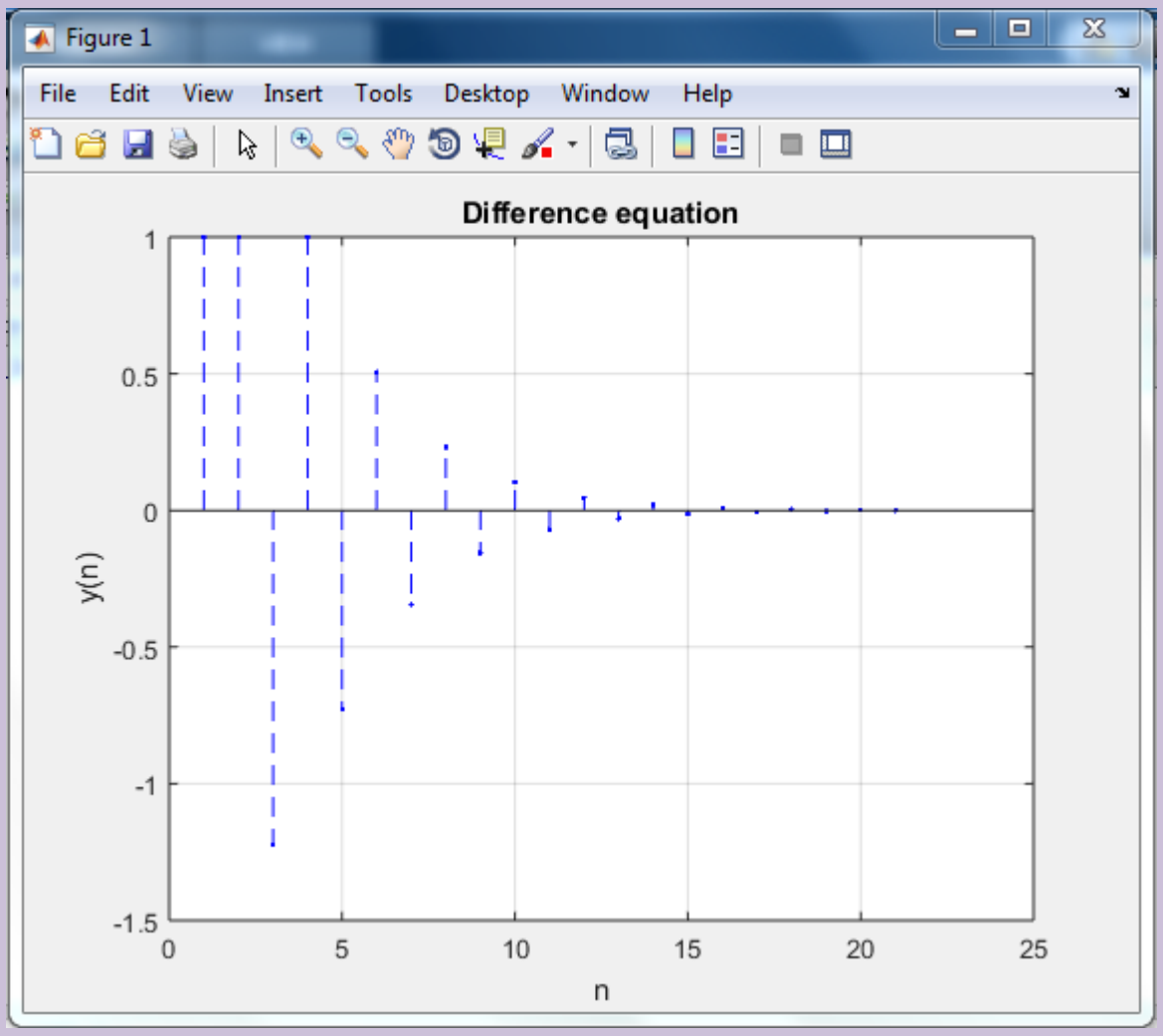


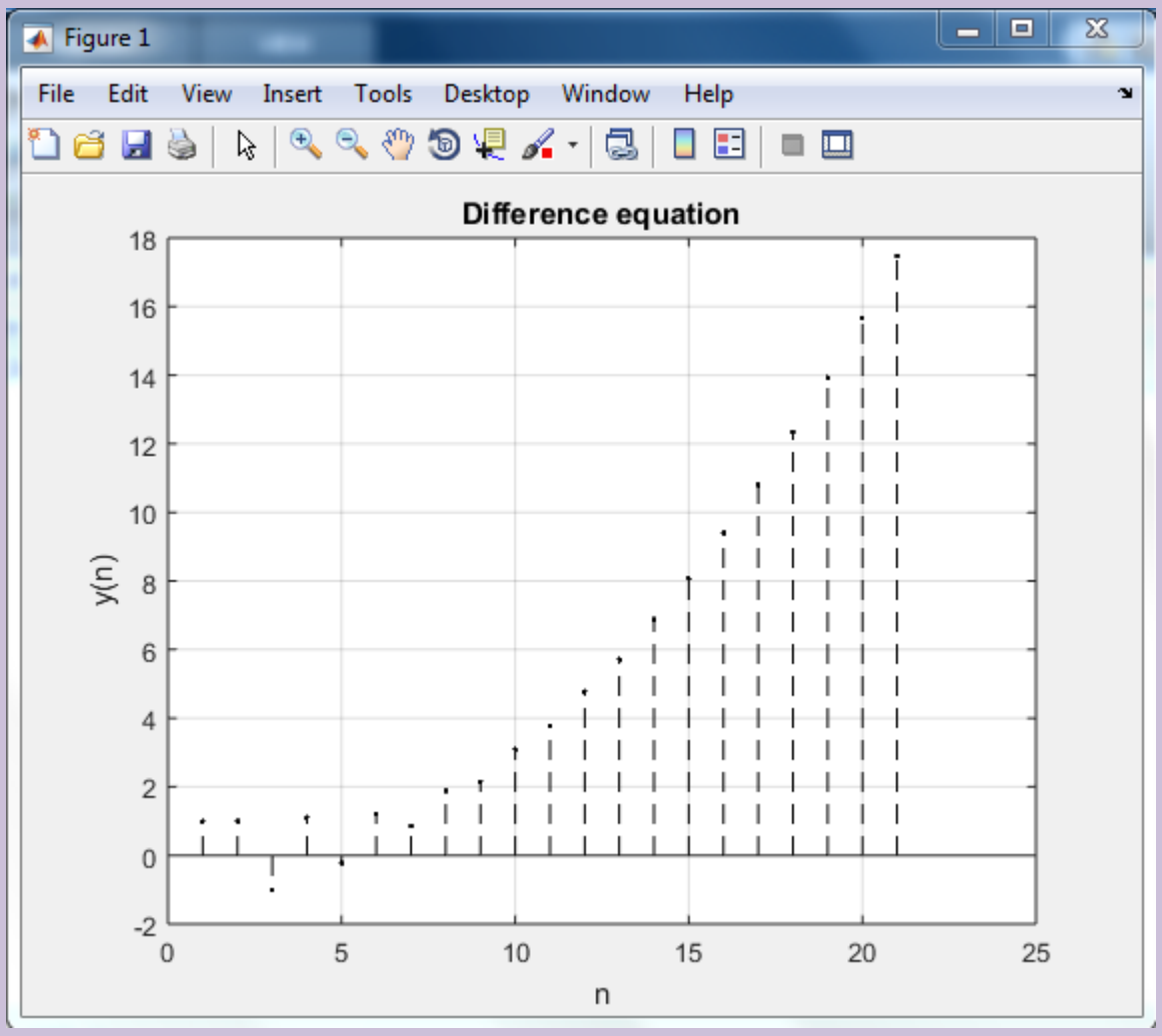
Figure 1
File Edit View Insert Tools Desktop Window Help
Difference equation
y(n)
n
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25

I/O - 2:

```
Command Window
New to MATLAB? See resources for Getting Started.

Input coefficients [a,b,c]: [9 9 2]
Enter the non-homogenous part of f(n): n^2 + 2
Enter the initial conditions [y0,y1]: [1 1]
The solution of the difference equation:
(3*n)/200 + nchoosek(n - 1, 2)/10 + (141*(-1/3)^n)/32 - (447*(-2/3)^n)/125 + 279/4000
```

Graph - 1:



classmate
Date
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Experiment - 9

→ Z-transform and their applications for solving difference equations

- If function u_n is defined for discrete values $(n = 0, 1, 2 \ldots)$ and $u_n = 0$ for $n < 0$

$$\bar{U}(z) = z\{u_n\} = \sum_{n=0}^{\infty} u_n / z^n$$

Inverse Z-transform:

$$u_n = z^{-1}\{\bar{U}(z)\}$$

- ztrans(f) : Z-transform of the scalar symbol f with the default independent variable n, Default return is a function of z

ztrans(f,w): Makes z a function of w, not z
ztrans(f,k,w): Takes f to be a function of the symbolic variable k

- iztrans(F) : Inverse z-transform
iztrans(F,k)
iztrans(F,k,w)

- collect(P, var) : Rewrites P in terms of power variable 'var' given as the second parameter
- stem(y): Plots the data sequence 'Y' as stems that extend from equally spaced automatically generated values of x-axis

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1. Z-transform of $y_n = 1/4^n$, $n \geq 0$

```
>> syms z n;
>> ztrans(1/4^n)
        ans =
            z(z-1/4)
```

2. Inverse z-transform of $y(z) = 2z/2z-1$

```
>> syms z n;
>> iztrans(2*z/(2*z-1))
        ans =
            (1/2)^n
```

- Solution of linear difference equations by Z-transform:

$$ay_{n+2} + by_{n+1} + cy = f(n)$$

Subject to initial conditions:

$$y_0 = \alpha \qquad y_1 = \beta$$

- Working procedure:

i] Input difference equation coefficients and RHS of equation

ii] Input initial conditions

iii] Apply z-transform, find $Y(z)$

iv] Apply inverse, find y_n

3. $9y_{n+2} + 9y_{n+1} + 2y_n = 0$

$$y_0 = 1 \qquad y_1 = 1$$
