HW5

Sunday, March 3, 2024 3:28 PM

1) a)

t	0	1	2	3	4	5	6
y	3.8	2.6	3.8	6.8	3.6	2.8	3.8
	1	2	3	4	5	6	7

$7 = 2N+1$

$N = 3$

$$B_k = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\cos\left(k\cdot\frac{\pi t_j}{3}\right)$$

@$k=0$) $B_0 = \frac{1}{6}\sum_{j=1}^{6} f(t_j) = 3.9$

@$k=1$) $B_1 = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\cos\left(\frac{\pi t_j}{3}\right) \approx -1.33$

@$k=2$) $B_2 = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\cos\left(\frac{4\pi t_j}{3}\right) \approx 1.4$

@$k=3=N$) $B_N = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\cos(\pi t_j) \approx -0.167$

$$A_k = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\sin\left(k\cdot\frac{\pi t_j}{3}\right)$$

@$k=0$) $A_0 = 0$

@$k=1$) $A_1 = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\sin\left(\frac{\pi t_j}{3}\right) \approx 0$

@$k=2$) $A_2 = \frac{1}{3}\sum_{j=1}^{6} f(t_j)\sin\left(\frac{2\pi t_j}{3}\right) \approx -0.115$

@$k=3=N$) $A_N = 0$

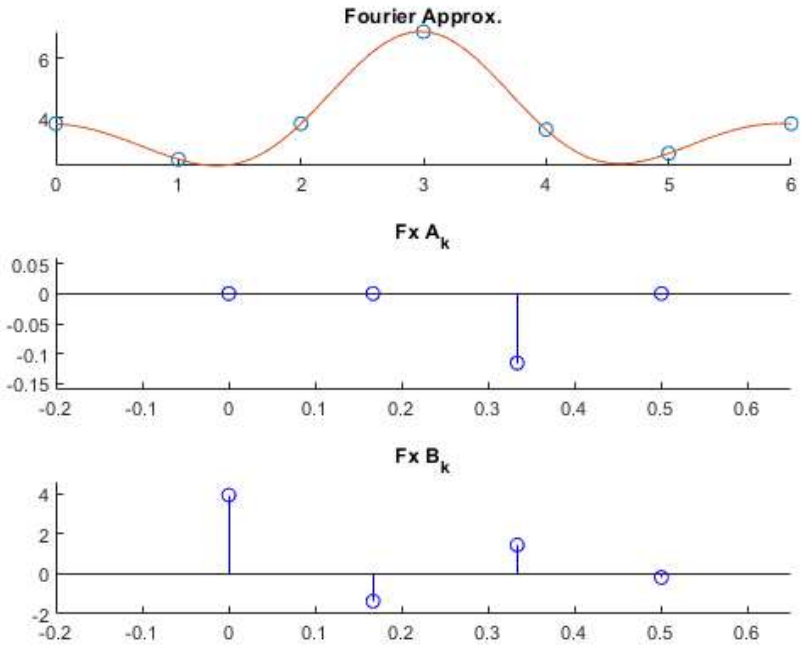
b)

k	A_k	B_k
0	0	3.9
1	0	-1.33
2	-0.115	1.4
3	0	-0.1667

Dom. frq. @ $k = 2$

```
clc; clear; clf;
t = 0:1:6;
y = [3.8 2.6 3.8 6.9 3.6 2.8 3.8];
[kp, Ak, Bk] = DFT(t,y);
tau = t(length(t));
tp = linspace(0, tau, 200);
ft = zeros(length(kp), length(tp));

for i = 1:length(kp)
    for j = 1:length(tp)
        ft(i,j) = Bk(i)*cos((kp(i)*2*pi*tp(j))/tau) + Ak(i)*sin((kp(i)*2*pi*tp(j))/tau);
    end
end

ft = sum(ft);
fk=kp/tau;

figure(1); tiledlayout(3,1);
ax1 = nexttile; hold on; plot(ax1,t,y,'o'); plot(tp, ft); title('Fourier Approx.'); hold off;
ax2 = nexttile; hold on; stem(ax2,fk,Ak, 'ob'); title(ax2, 'Fx A_k'); ax2.XLim = [-0.2 0.65]; ax2.YLim = [-0.16 0.06]; hold off;
ax3 = nexttile; hold on; stem(ax3,fk,Bk, 'ob'); title(ax3, 'Fx B_k'); ax3.XLim = [-0.2 0.65]; ax3.YLim = [-2 4.6]; hold off;

kp = kp';
Ak = Ak';
Bk = Bk';

tbl = table(kp, Ak, Bk); disp(tbl);
```

```
    kp         Ak            Bk
    __    __________    ________

    0              0      3.9167
    1     5.9212e-16     -1.3667
    2       -0.11547      1.4333
    3              0    -0.18333
```



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```
function [kp, Ak, Bk] = DFT(t,y)
    N = (length(y)-1)/2;
    dt = (t(2*N)-t(1))/(2*N-1);
    kp = 0:N;

    Ak(1) = 0; Ak(N+1)=0;
    Bk(1) = sum(y(1:2*N))/(2*N);

    for i=2:N
        Ak(i)=0;
        Bk(i)=0;

        for j=1:2*N
            Ak(i)=Ak(i)+y(j)*sin(pi*(i-1)*t(j)/(dt*N));
            Bk(i)=Bk(i)+y(j)*cos(pi*(i-1)*t(j)/(dt*N));
        end

        Ak(i)=Ak(i)/N;
        Bk(i)=Bk(i)/N;
    end
    Bk(N+1)=0;

    for j=1:2*N
        Bk(N+1)=Bk(N+1)+y(j)*cos(pi*N*t(j)/(dt*N));
    end

    Bk(N+1)=Bk(N+1)/(2*N);
end
```

```
Not enough input arguments.

Error in DFT (line 2)
    N = (length(y)-1)/2;
```

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