

CHINA WISDOM ENZYCLIC

18/ENG04/025

Electrical / Electronics engineering  
ENG 282

Mixing Problem

$$\frac{dm}{dt} = M_{in} - M_{out}$$

$$M_{in} = 50 \times (1 + \sin t)$$

$$M_{out} = \frac{30}{1200} = 0.025 = 2.5\% \text{ runs out}$$

Since the mixture is kept uniform  
2.5% m runs out

$$\therefore M_{out} = 0.025m$$

Inputting variables

$$\frac{dm}{dt} = 50(1 + \sin t) - 0.025m$$

$$\frac{dm}{dt} + 0.025m = 50(1 + \sin t)$$

$$\frac{dm}{dt} + 0.025m = 50 + 50 \sin t$$

Solve <sup>ode</sup> using integrating factor

$$m \cdot I \cdot f = \int Q \cdot I \cdot f \, dt$$

$$I \cdot f = e^{\int P dt}$$

From differential equation  $P = 0.025$

$$\int P dt = 0.025t$$

$$I \cdot f = e^{0.025t}$$

Inputting values

$$m \cdot e^{0.025t} = \int (50 + 50 \sin t) \cdot e^{0.025t} \, dt$$

$$m \cdot e^{0.025t} = \int 50e^{0.025t} + 50e^{0.025t} \sin t \, dt$$

$$m \cdot e^{0.025t} = \int 50e^{0.025t} + \int 50e^{0.025t} \sin t \, dt$$

$$m \cdot e^{0.025t} = 2000e^{0.025t} + \int 50e^{0.025t} \sin t \, dt$$

$$m \cdot e^{0.025t} = 2000e^{0.025t} + 50 \int e^{0.025t} \sin t \, dt$$

Using integration by parts to solve  $\int e^{0.025t}$   
 $M \cdot e^{0.025t} = 2000e^{0.025t} + 50 \int e^{0.025t} \cdot \sin(t) dt$

$uv - \int v du$   
 $u = e^{0.025t}$   $dv = \sin t$   
 $du = 0.025e^{0.025t}$   $v = -\cos t$   
 $\therefore -\cos t e^{0.025t} - \int -\cos t \cdot 0.025e^{0.025t}$   
 $-\cos t e^{0.025t} + 0.025 \int \cos t e^{0.025t}$

Using int by parts to solve  $\int \cos t e^{0.025t}$   
 $uv - \int v du$   
 $u = e^{0.025t}$   $dv = \cos t$   
 $du = 0.025e^{0.025t}$   $v = \sin t$

$0.025 [\sin t e^{0.025t} - \int \sin t \cdot 0.025e^{0.025t}]$   
 $0.025 [\sin t e^{0.025t} - 0.025 \int \sin t e^{0.025t}]$

Making  $\int \sin t e^{0.025t} = I$   
 $\int \sin t e^{0.025t} = -\cos t e^{0.025t} + 0.025 [\sin t e^{0.025t} - 0.025 \int \sin t e^{0.025t}]$

$I = -\cos t e^{0.025t} + 0.025 [\sin t e^{0.025t} - 0.025 I]$

$I = -\cos t e^{0.025t} + 0.025 \sin t e^{0.025t} - (6.25 \times 10^{-4}) I$

$1.000625 I = -\cos t e^{0.025t} + 0.025 \sin t e^{0.025t}$

$I = \frac{-\cos t e^{0.025t}}{1.000625} + 0.025 \sin t e^{0.025t}$

$\therefore M \cdot e^{0.025t} = 2000e^{0.025t} + 50 \left[ \frac{-\cos t e^{0.025t}}{1.000625} + 0.025 \sin t e^{0.025t} \right]$   
 $M \cdot e^{0.025t} = 2000e^{0.025t} - 50 \cos t e^{0.025t} + 1.25 \sin t e^{0.025t}$

$M = \frac{2000e^{0.025t}}{e^{0.025t}} - \frac{50 \cos t e^{0.025t}}{e^{0.025t}} + \frac{1.25 \sin t e^{0.025t}}{e^{0.025t}} + C$   
 $M = 2000 - 50 \cos t + 1.25 \sin t + C e^{-0.025t}$

when  $M = 150$ ,  $t = 0$

$\therefore 150 = 2000 - 50 \cos(0) + 1.25 \sin(0) + C e^{-0.025(0)}$

$150 = 2000 - 50 + C$

$150 = 1950 + C$

$C = -1800$

$\therefore M = 2000 - 50 \cos t + 1.25 \sin t - 1800 e^{-0.025t}$

```

1 - commandwindow
2 - clear
3 - clc
4 - t=0:0.5:450
5 - m=dsolve('Dm+0.025*m=50*(1+sin(t))','m(0)=150')
6 - pretty(m)
7 - m=2000 - (2000*1601^(1/2)*cos(t + atan(1/40)))/1601 - (2881850*exp(-t/40))
8 - plot(m,t)
9 - grid on
10 - grid minor
11 - title('DYNAMIC MODEL')
12 - xlabel('time(min)')
13 - ylabel('amount of salt(lb)')

```

### COMMAND WINDOW

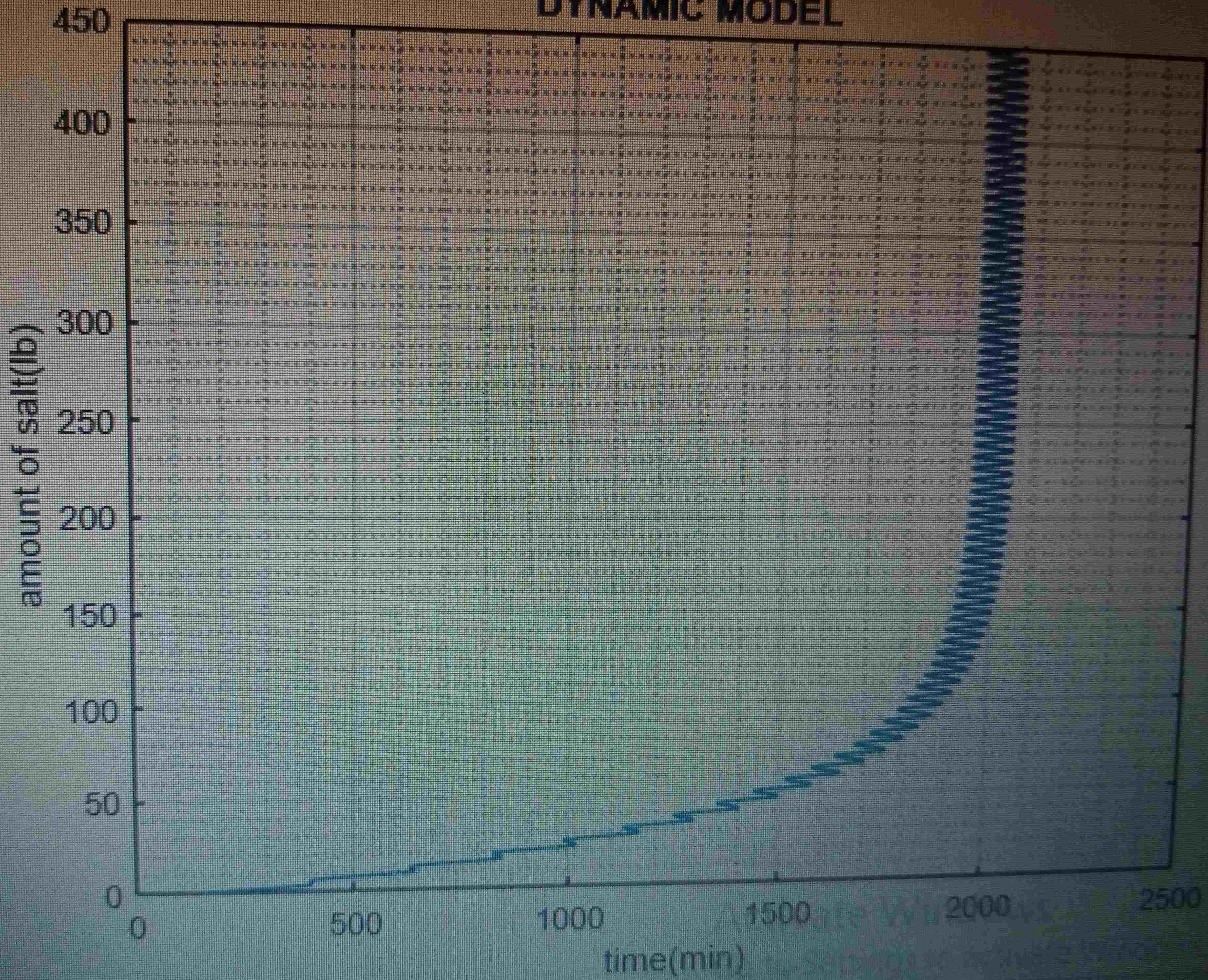
```

          /          / 1 \ \          /  t \
2000 sqrt(1601) cos| t + atan| -- | | exp| - -- | 2881850
          \          \ 40 / /          \ 40 /
-----
2000 - -----
          1601                               1601

```

Figure 1 x

### DYNAMIC MODEL



$p(-t/4)$

```
1 - commandwindow %CHIMA WISDOM ENYICHE
2 - clear %18/ENG04/025
3 - clc %ELECTRICAL/ELECTRONICS ENGINEERING
4 - t=0:500
5 - t1=reshape(t.',[],1)
6 - y=(50/0.05)+((50/1.0025)*(sin(t)))+((50*0.05/1.0025)*cos(t))-(802.49*exp(-0.05*t))
7 - y1=y(:,1:2:end)
8 - ym=1000-800*exp(-0.05*t)
9 - ym1=ym(:,2:2:end)
10 - ty=t1(1:2:end,:)
11 - tym=t1(2:2:end,:)
12 - y2=reshape(y1.',[],1)
13 - ym3=reshape(ym1.',[],1)
14 - ym4=[ym3;0]
15 - u=table(y2,ym4)
16 - z=stack(u,1:2)
17 - tym2=[tym;0]
18 - w=table(ty,tym2)
19 - i=stack(w,1:2)
20 - k=z(1:501,2)
21 - l=i(1:501,2)
22 - q=table2array(k)
23 - s=table2array(l)
24 - plot(q,s)
25 -
```

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- data.csv
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- untitled
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- untitled

▼ WORKSPACE

- Name
- i
- k
- l
- q
- s
- t
- ym

```

untitled12.m x +
13 - ym3=reshape(ym1. ,[],1)
14 - ym4=[ym3;0]
15 - u=table(y2,ym4)
16 - z=stack(u,1:2)
17 - tym2=[tym;0]
18 - w=table(ty,tym2)
19 - i=stack(w,1:2)
20 - k=z(1:501,2)
21 - l=i(1:501,2)
22 - q=table2array(k)
23 - s=table2array(l)
24 - plot(q,s)
25 - grid on
26 - grid minor
27 - title('dynamic model of main and mean systems')
28 - xlabel('time(t(mins))')
29 - ylabel('volume(v(liters))')
30 - wdata=('odevbesdata.xlsx')
31 - wdeta=('veriler')
32 - xlswrite(wdata,'t(min)',wdeta,'A1')
33 - xlswrite(wdata,'v(liters)',wdeta,'B1')
34 - xlswrite(wdata,A,wdeta,'A1')
35
36
  
```

Grid Remove G... X-Grid Y-Grid Text Arrow

Fitting Colormap Statistics Camera

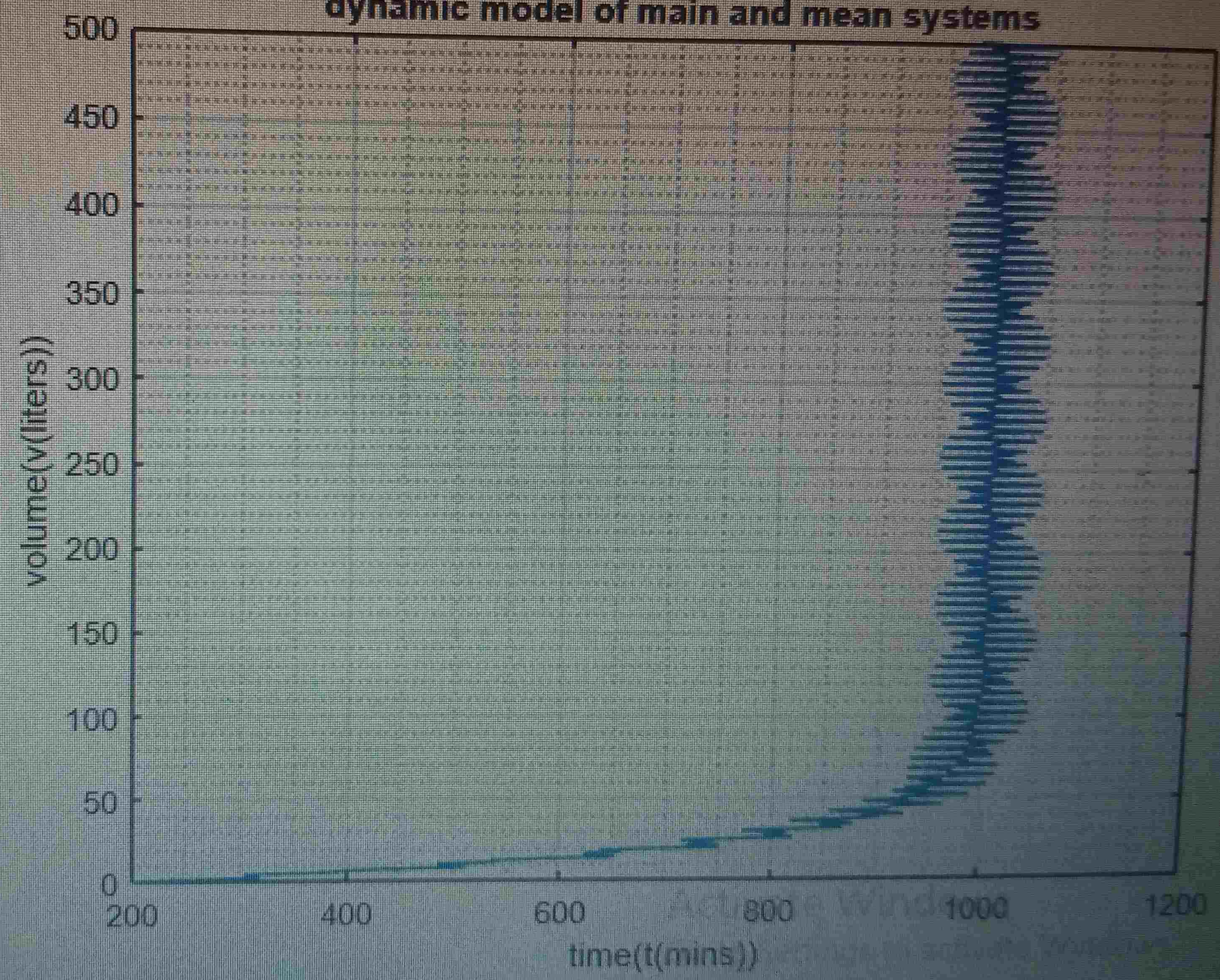
Plot Edit Inspector

TOOLS

EDIT

Figure 1 x +

### dynamic model of main and mean systems



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**B** *I* U D ab

Font

Alignment

Number

Conditional Formatting as Table Cell Styles Insert

Tables

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	t(min)	v(liters)												
2	0	0.2												
3	1	0.239												
4	2	0.3182												
5	3	0.3114												
6	4	0.3036												
7	5	0.377												
8	6	0.394												
9	7	0.4362												
10	8	0.5111												
11	9	0.4899												
12	10	0.484												
13	11	0.5384												
14	12	0.5349												
15	13	0.5824												
16	14	0.6512												
17	15	0.6221												

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