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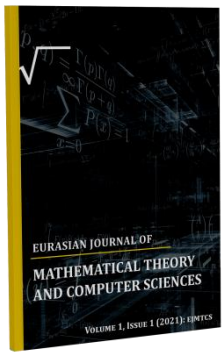

XUSUSIY HOSILALI DIFFERENSIAL TENGLAMALARNI MATLAB DASTURI YORDAMIDA YECHISH

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ABSTRACT

Ushbu maqolada Giperbolik turdagi xususiy hosilali differensial tenglamalarni matlab dasturi yordamida echilish qoidalari ko‘rsatib berilgan.

Giperbolik turdagi xususiy hosilali differensial tenglamalarni matlab dasturi yordamida echilishini ko‘rib chiqamiz. Quyidagi misolni qaraymiz:

Misol: $G = \{0 < x < 1, 0 < t < 1\}$ sohada

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$$

to‘r tenglamasinining

$$u(0,t) = u(1,t) = 0, \quad (1)$$

$$u(x,0) = \sin \pi x, \ \frac{\partial u}{\partial t}(x,0) = 0 \quad (2)$$

chegaraviy va dastlabki shartlarni qanotlantiradigan taqribiy echimi topilsin.

Yechish: Bu masalani to‘r metodi yordanida echamiz. Bu erda *h* va *l* qadamlarni o‘zimiz misol tanlab olamiz. Demak *h=0.04, l=0,05* bo‘lsin. Matlab dasturi yordamida qadamlarni va shu qadamdagi tugunlar qiymatlarini hisoblaymiz.

Biz yuqorida quyidagicha to‘r kiritgan edik:

$$G_{hl} = \{x_i = ih, i = \overline{0, M}, hM = 1; t_k = kl, k = \overline{0, N}, Nl = T\} \quad (3)$$

Demak (3) ga asosan *m* va *n* lar quyidagicha:

$$m = \frac{1}{h}, n = \frac{T}{l}$$

Misol shartiga ko‘ra *T=1* bo‘ladi.

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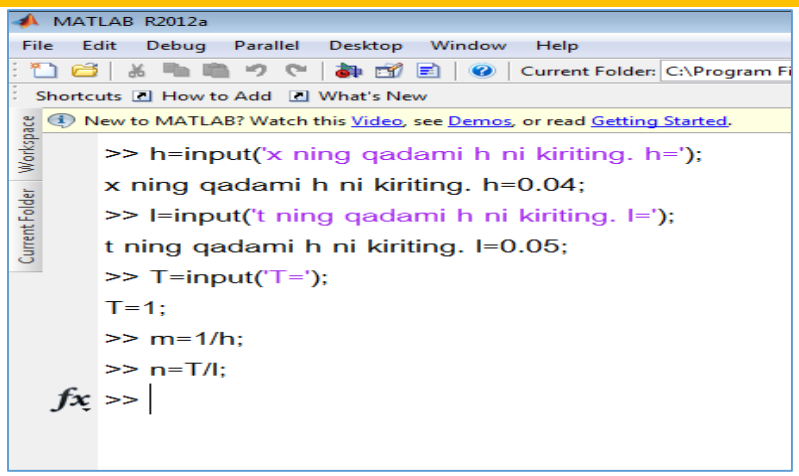
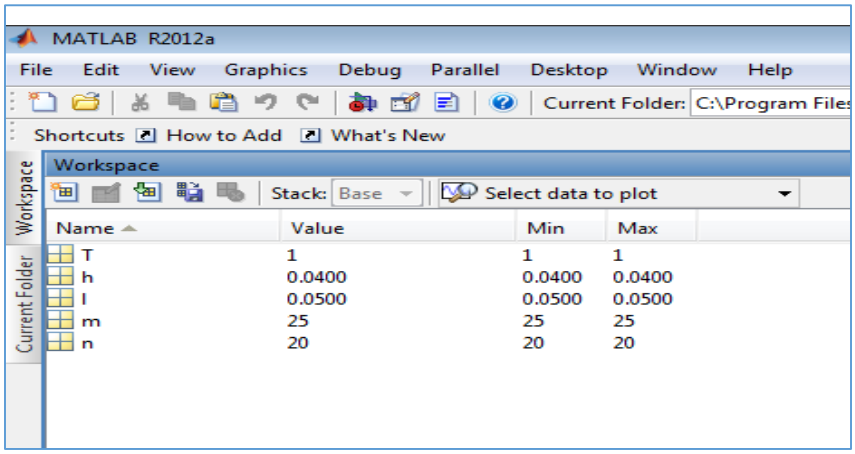


1.rasm

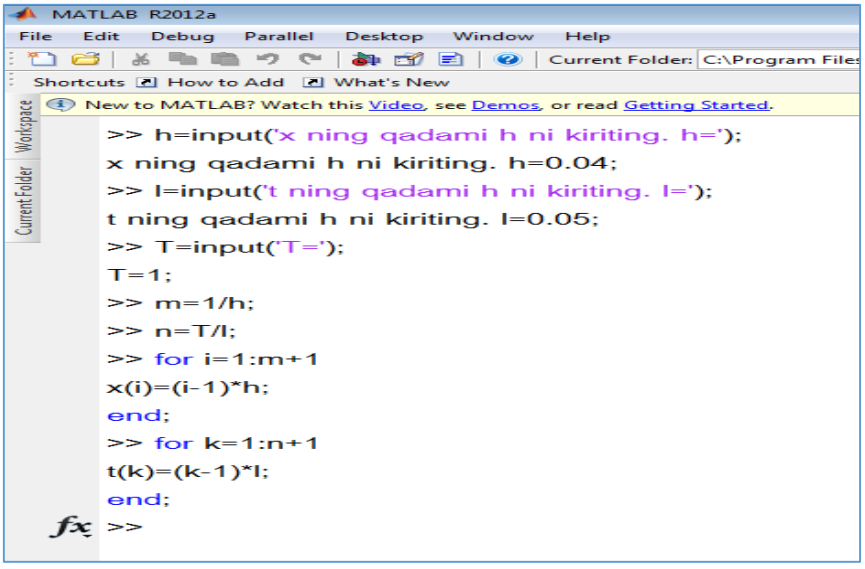
Bu erdan n va m ning qiymatlariga ega bo‘lamiz: Bu quyida ko‘rsatilgan. ***Workspake*** bo‘limiga kiramiz.



2.rasm

Yana (3) dan foydalamaniz va tugunlarning qiymatlari x_i va t_k larni quyidagicha topamiz:

$$x_i = ih, i = \overline{0, M}, hM = 1; t_k = kl, k = \overline{0, N}, Nl = T$$



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3.rasm

Izoh: Matlab dasturida massiv elemenlari birinchi elementdan boshlanadi. Ya'ni $x(0) = i * h$ desak dastur ishlamaydi shuning uchun $x(0)$ o'rniga $x(1)$ tanlanadi ya'ni bir qadam siljitiladi. Demak x_i va t_k larninig qiymatlariga ega bo'ldik.

Endi (2) dastlabki shartdan foydalanib y_{i0} va y_{i1} larni topamiz. Demak $y_{i0} = \phi(x_i), y_{i1} = \phi(x_i) + l\psi(x_i) + \frac{l^2}{2}\Delta_2\phi_i$ bo'ladi. Bunda $\Delta_2\phi_i = \frac{1}{h^2}(\phi(x_{i+1}) - 2\phi(x_i) + \phi(x_{i-1}))$ edi. Boshlang'ich shartga ko'ra $\phi(x) = \sin(\pi x), \psi(x) = 0$ bo'ladi.

Bu erda $f(x) = \phi(x), ff(x) = \psi(x)$ belgilashlar olingan.

```
Command Window
New to MATLAB? Watch this Video, see Demos, or read Getting Started.
>> h=input('x ning qadami h ni kiriting. h=');
x ning qadami h ni kiriting. h=0.04;
>>  l=input('t ning qadami h ni kiriting. l=');
t ning qadami h ni kiriting. l=0.05;
>> T=input('T=');
T=1;
>> m=1/h;
>> n=T/l;
>> for i=1:m+1
x(i)=(i-1)*h;
end;
>> for k=1:n+1
t(k)=(k-1)*l;
end;
>> for i=1:m+1
f(i)=sin(pi*(i-1));
end;
>> for i=1:m+1
ff(i)=0;
end;
>> for i=2:m
y(i,1)=f(i);
end;
>> for i=2:m
y(i,2)=f(i)+l*ff(i)+(l*l/(2*h*h))*(f(i+1)-2*f(i)+f(i-1));
end;
```

4.rasm

Endi (1) chegaraviy shartdan foydalanib $y_{0,k+1}$ va $y_{m,k+1}$ larni topamiz. Buning uchun quydagi formuladan foydalanamiz.

$$y_{0,k+1} = \mu_1(t_{k+1}), y_{M,k+1} = \mu_2(t_{k+1}), k = 0,1,2,,,1N-1.$$

Chegaraviy shartga ko'ra $\mu_1(t) = 0, \mu_2(t) = 0$ bo'ladi.

Qulaylik uchun $myu = \mu_1(t) = \mu_1(t) = 0$ belgilash kiritamiz.

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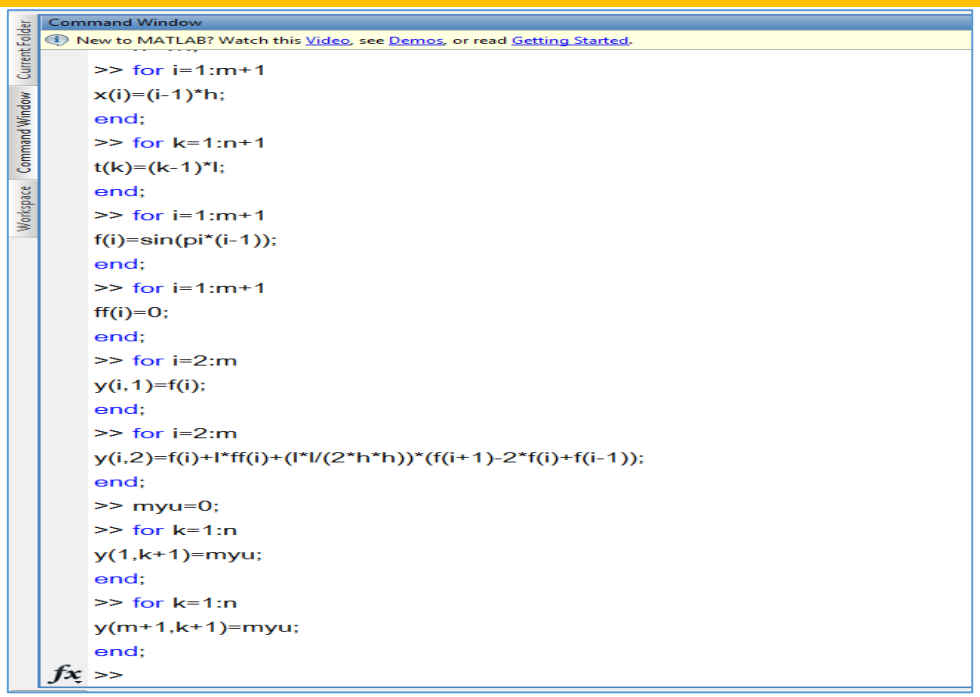
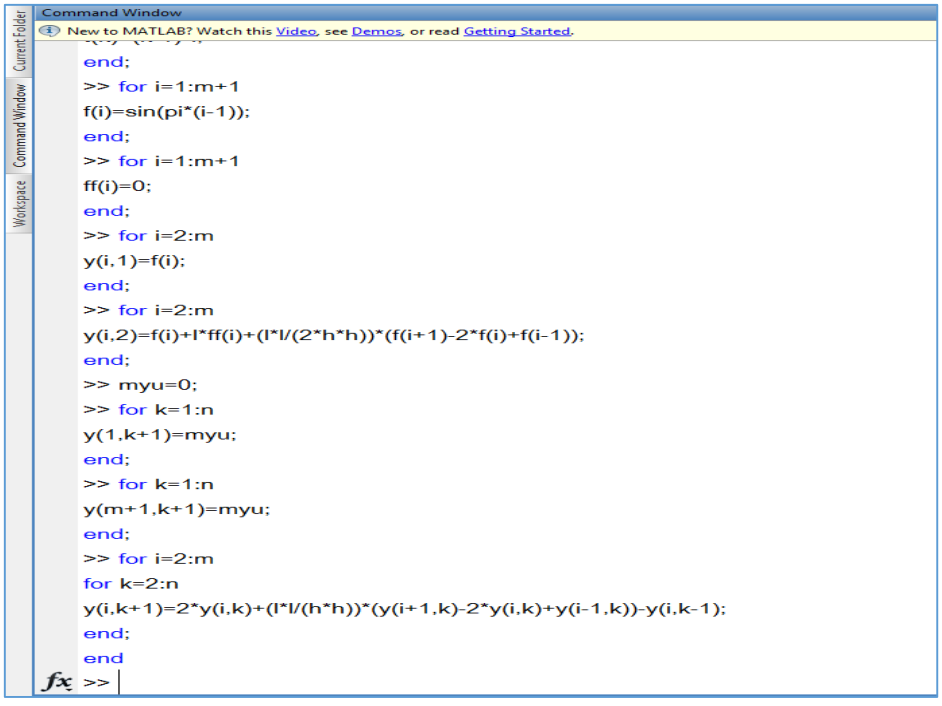


5.rasm

Endi qolgan tugindagi qiymatlarni hisoblaymiz.

$$y_{i,k+1} = 2y_{ik} + l^2\Delta_2 y_{ik} - y_{i,k-1}, i = 1,2,\ldots,M-1$$

Bu erda $\Delta_2 y_{ik} = \frac{1}{h^2}(y_{i+1,k} - 2y_{ik} + y_{i-1,k})$ bo‘ladi.



6.rasm

Demak natijani *Workspake* bo‘limidan olamiz.

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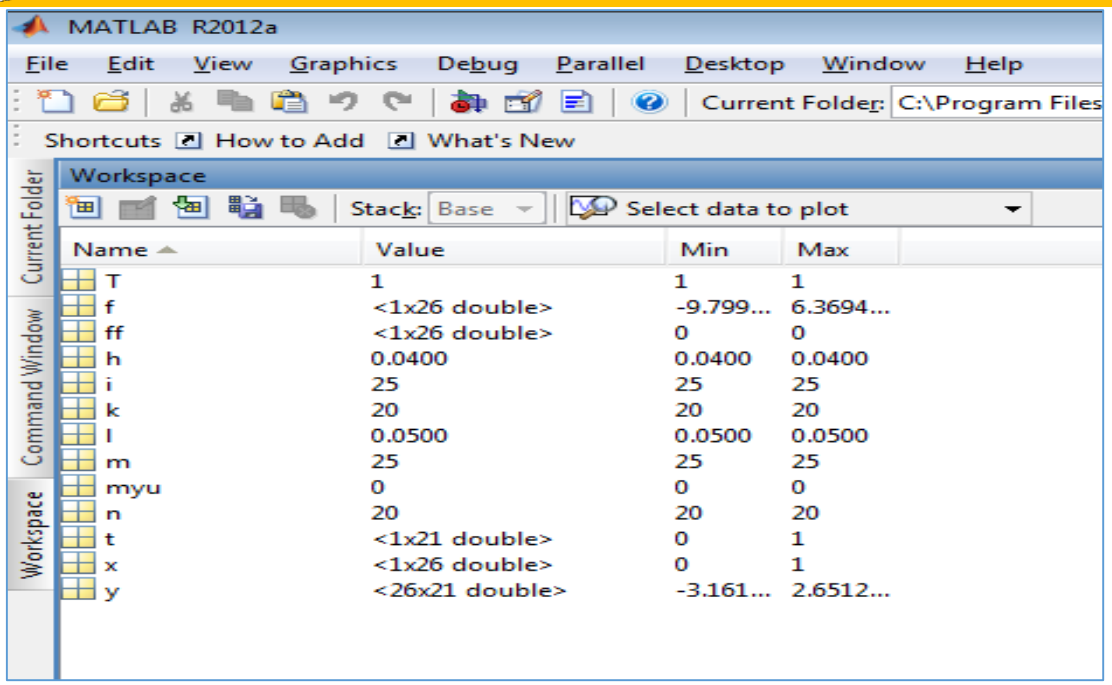
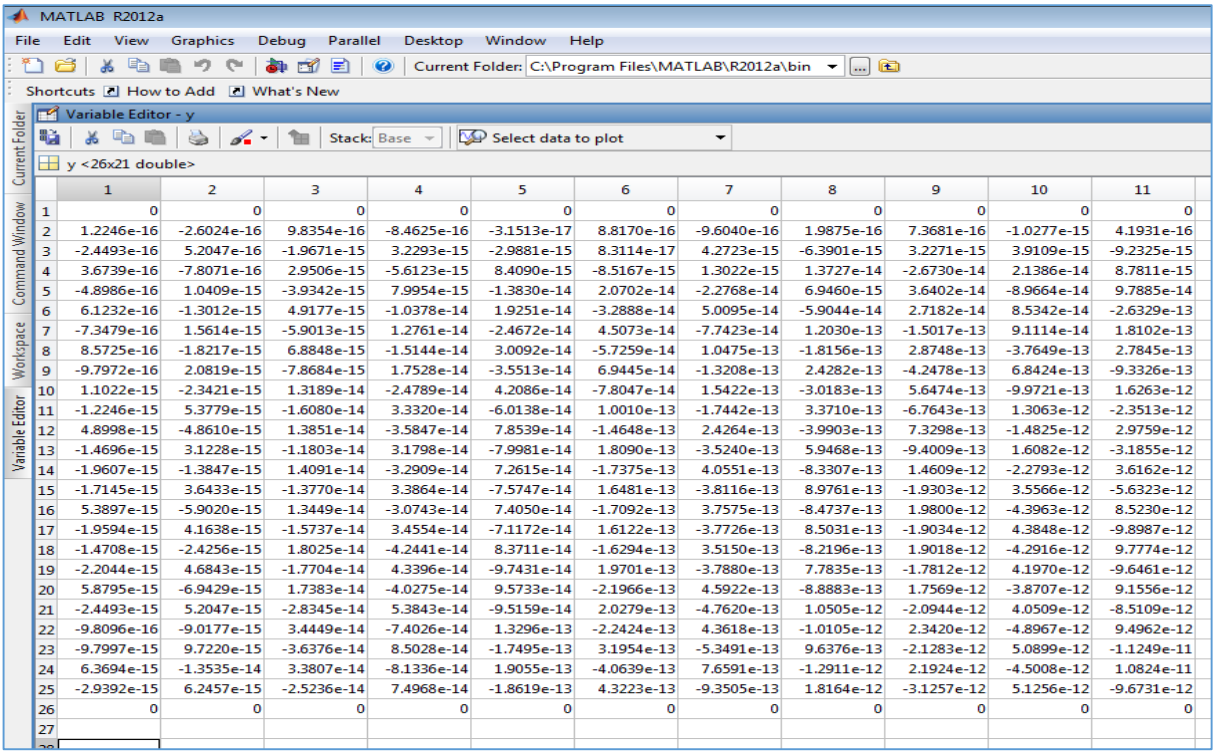


7.rasm



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3	-2.4493e-16	5.2047e-16	-1.9671e-15	3.2293e-15	-2.9881e-15	8.3114e-17	4.2723e-15	-6.3901e-15	3.2271e-15	3.9109e-15	-9.2325e-15
4	3.6739e-16	-7.8071e-16	2.9506e-15	-5.6123e-15	8.4090e-15	-8.5167e-15	1.3022e-15	1.3727e-14	-2.6730e-14	2.1386e-14	8.7811e-15
5	-4.8986e-16	1.0409e-15	-3.9342e-15	7.9954e-15	-1.3830e-14	2.0702e-14	-2.2768e-14	6.9460e-15	3.6402e-14	-8.9664e-14	9.7885e-14
6	6.1232e-16	-1.3012e-15	4.9177e-15	-1.0378e-14	1.9251e-14	-3.2888e-14	5.0095e-14	-5.9044e-14	2.7182e-14	8.5342e-14	-2.6329e-13
7	-7.3479e-16	1.5614e-15	-5.9013e-15	1.2761e-14	-2.4672e-14	4.5073e-14	-7.7423e-14	1.2030e-13	-1.5017e-13	9.1114e-14	1.8102e-13
8	8.5725e-16	-1.8217e-15	6.8848e-15	-1.5144e-14	3.0092e-14	-5.7259e-14	1.0475e-13	-1.8156e-13	2.8748e-13	-3.7649e-13	2.7845e-13
9	-9.7972e-16	2.0819e-15	-7.8684e-15	1.7528e-14	-3.5513e-14	6.9445e-14	-1.3208e-13	2.4282e-13	-4.2478e-13	6.8424e-13	-9.3326e-13
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13	-1.4696e-15	3.1228e-15	-1.1803e-14	3.1798e-14	-7.9981e-14	1.8090e-13	-3.5240e-13	5.9468e-13	-9.4009e-13	1.6082e-12	-3.1855e-12
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19	-2.2044e-15	4.6843e-15	-1.7704e-14	4.3396e-14	-9.7431e-14	1.9701e-13	-3.7880e-13	7.7835e-13	-1.7812e-12	4.1970e-12	-9.6461e-12
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26	0	0	0	0	0	0	0	0	0	0	0
27											

8.rasm

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Variable Editor - y

Stack: Base Select data to plot

y <26x21 double>

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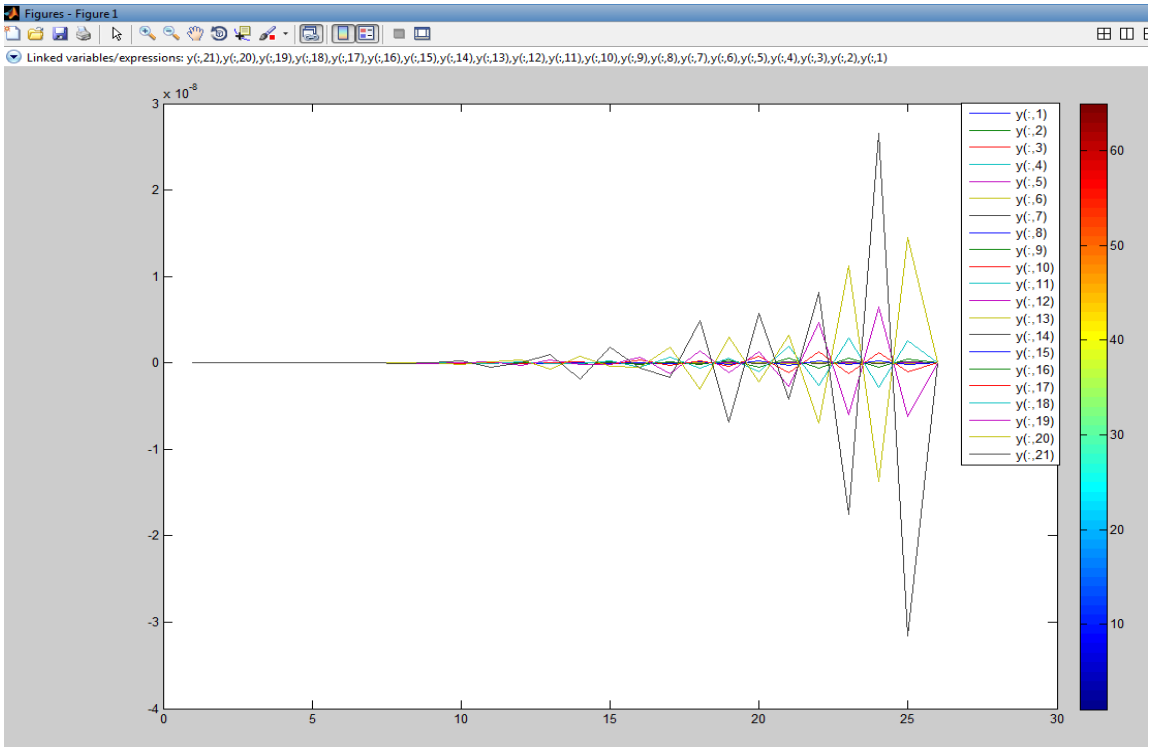
26	0	0	0	0	0	0	0	0	0	0
27										

9.rasm

Olingan jadvaldan ko‘rinib turibdi x_i ning qiymatlari ustun shaklida t_k ning qiymatlari satr shaklida joylashgan.



10-rasm

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