Topic   : Additional Interpolation Topics
Simulation : Danger of Extrapolation
Language   : Matlab r12
Authors   : Nathan Collier, Autar Kaw
Date   : 14 November 2002

Abstract   : During the technology boom of the late 1990's, the NASDAQ Composite
               Index that tracks mainly technology stocks had a phenomenal increase in its
               value. For example, at the end of year 1998, the NASDAQ index was at an all
               time high of 1570.35. It increase to 2192.69 by the end of 1999 and further to
               4069.31 by the end of 2000. Many people who had never ventured into stocks
               started investing in the technology stocks and mutual funds. Dreams of
               doubling their money every year were not considered unrealistic. So given
               below is the data of the NASDAQ index from 1994 to 1999. If you were
               extrapolating the data, what would you estimate the NASDAQ index to be at
               the end of 2000 and 2001? How different did it turn out to be?

```
clear all
% INPUTS: Enter the following

% Array of x-data
endofyear=[1 2 3 4 5 6];

% Array of y-data
NASDAQ=[751.96 1052.13 1291.03 1570.35 2192.69 4069.31];

% Note: Range of years actually between 1994 (Year 1) and 1999 (Year 6).
%       Numbers start from 1 to avoid round-off errors and near singularity
%       in matrix calculations. End of Year NASDAQ Composite Data taken from
%       www.bigcharts.com

% Extrapolated values
e1 = 7;
e2 = 8;

% Note: In the above scheme of representing years, year 7 would correspond
%       to 2000 and year 8 would correspond to 2001.

actual = [2470.52 1950.4];

% SOLUTION

% This calculates window size to be used in figures
set(0,'Units','pixels')
scnsize = get(0,'ScreenSize');
wid = round(scnsize(3));
hei = round(0.95*scnsize(4));
```

```
wind = [1, 1, wid, hei];

figure('Position',wind)

n=numel(endofyear);
p=polyfit(endofyear,NASDAQ,n-1);
x1=1:0.01:e2;
y1=polyval(p,x1);
plot(x1,y1,'k')
hold on
plot(endofyear, NASDAQ,'ro','MarkerSize',8,'MarkerFaceColor',[1,0,0])
plot([e1 e2], [polyval(p,e1)
polyval(p,e2)],'b+','LineWidth',3,'MarkerSize',10,'MarkerFaceColor',[1,0,0])
plot([e1 e2], actual,'ro','MarkerSize',8,'MarkerFaceColor',[0,1,0])
title('Data from 1994 to 1999 extrapolated using polynomial interplation to yield results
for 2000 and 2001','Fontweight','bold','FontSize',14)

%%%%%%%% COMPARISON %%%%%%%%%%%

figure('Position',wind)
title('Comparison of interpolated values and actual values using polynomial
inter.','Fontweight','bold','FontSize',14)
axis off
roww=3;
coll=4;
for j = 0:roww-1
for i = 0:coll-1
rectangle('Position',[0.1+i*0.8/coll,0.8-j*0.06,0.8/coll,0.06])
end
end
xbias = 0.01;
ybias = 0.03;
text(0.1+xbias,0.8+ybias,'End of Year')
text(0.3+xbias,0.8+ybias,'Actual')
text(0.5+xbias,0.8+ybias,'Polynomial Interpolation')
text(0.7+xbias,0.8+ybias,'Percent Relative True Error')
text(0.1+xbias,0.74+ybias,num2str(e1))
text(0.3+xbias,0.74+ybias,num2str(actual(1)))
text(0.5+xbias,0.74+ybias,num2str(polyval(p,e1)))
text(0.7+xbias,0.74+ybias,num2str(abs((actual(1)-polyval(p,e1))/actual(1)*100)))
text(0.1+xbias,0.68+ybias,num2str(e2))
text(0.3+xbias,0.68+ybias,num2str(actual(2)))
text(0.5+xbias,0.68+ybias,num2str(polyval(p,e2)))
text(0.7+xbias,0.68+ybias,num2str(abs((actual(2)-polyval(p,e2))/actual(2)*100)))
xlim([0,1])
ylim([0,1])
```

```
%%%%%%% Regression using cubic splines %%%%%%%

figure('Position',wind)

xx=1:0.01:e2;
yy=spline(endofyear,NASDAQ,xx);
plot(xx,yy)
hold on
fe1=spline(endofyear,NASDAQ,e1);
fe2=spline(endofyear,NASDAQ,e2);
plot(endofyear, NASDAQ,'ro','MarkerSize',8,'MarkerFaceColor',[1,0,0])
plot([e1 e2], [fe1 fe2],'b+','LineWidth',3,'MarkerSize',10,'MarkerFaceColor',[1,0,0])
plot([e1 e2], actual,'ro','MarkerSize',8,'MarkerFaceColor',[0,1,0])
title('Data from 1994 to 1999 extrapolated using splines to yield results for 2000 and
2001','Fontweight','bold','FontSize',14)

%%%%%%% COMPARISON %%%%%%%%%%%%

figure('Position',wind)
title('Comparison of interpolated values and actual values using
splines','Fontweight','bold','FontSize',14)
axis off
roww=3;
coll=4;
for j = 0:roww-1
for i = 0:coll-1
rectangle('Position',[0.1+i*0.8/coll,0.8-j*0.06,0.8/coll,0.06])
end
end
xbias = 0.01;
ybias = 0.03;
text(0.1+xbias,0.8+ybias,'End of Year')
text(0.3+xbias,0.8+ybias,'Actual')
text(0.5+xbias,0.8+ybias,'Cubic Spline Interpolation')
text(0.7+xbias,0.8+ybias,'Percent Relative True Error')
text(0.1+xbias,0.74+ybias,num2str(e1))
text(0.3+xbias,0.74+ybias,num2str(actual(1)))
text(0.5+xbias,0.74+ybias,num2str(fe1))
text(0.7+xbias,0.74+ybias,num2str(abs((actual(1)-fe1)/actual(1)*100)))
text(0.1+xbias,0.68+ybias,num2str(e2))
text(0.3+xbias,0.68+ybias,num2str(actual(2)))
text(0.5+xbias,0.68+ybias,num2str(fe2))
text(0.7+xbias,0.68+ybias,num2str(abs((actual(2)-fe2)/actual(2)*100)))
xlim([0,1])
ylim([0,1])
```

```matlab
%%%%%%%%% Summary %%%%%%%%%%%%

figure('Position',wind)
title('Summary of interpolated values and actual values','Fontweight','bold','FontSize',14)
axis off
roww=3;
coll=6;
for j = 0:roww-1
for i = 0:coll-1
rectangle('Position',[i/coll,0.8-j*0.06,1/coll,0.06])
end
end
xbias = 0.01;
ybias = 0.03;
text(xbias,0.8+ybias,'End of Year')
text(0.1667+xbias,0.8+ybias,'Actual')
text(0.3333+xbias,0.8+ybias,'Polynomial Interpolation')
text(0.5+xbias,0.8+ybias,'Relative True Error')
text(0.6667+xbias,0.8+ybias,'Cubic Spline Interp.')
text(0.8333+xbias,0.8+ybias,'Relative True Error')

text(xbias,0.74+ybias,num2str(e1))
text(0.1667+xbias,0.74+ybias,num2str(actual(1)))
text(0.3333+xbias,0.74+ybias,num2str(fe1))
text(0.5+xbias,0.74+ybias,num2str(abs((actual(1)-fe1)/actual(1)*100)))
text(0.6667+xbias,0.74+ybias,num2str(polyval(p,e1)))
text(0.8333+xbias,0.74+ybias,num2str(abs((actual(1)-polyval(p,e1))/actual(1)*100)))

text(0+xbias,0.68+ybias,num2str(e2))
text(0.1667+xbias,0.68+ybias,num2str(actual(2)))
text(0.3333+xbias,0.68+ybias,num2str(polyval(p,e2)))
text(0.5+xbias,0.68+ybias,num2str(abs((actual(2)-polyval(p,e2))/actual(2)*100)))
text(0.6667+xbias,0.68+ybias,num2str(fe2))
text(0.8333+xbias,0.68+ybias,num2str(abs((actual(2)-fe2)/actual(2)*100)))
xlim([0,1])
ylim([0,1])
```
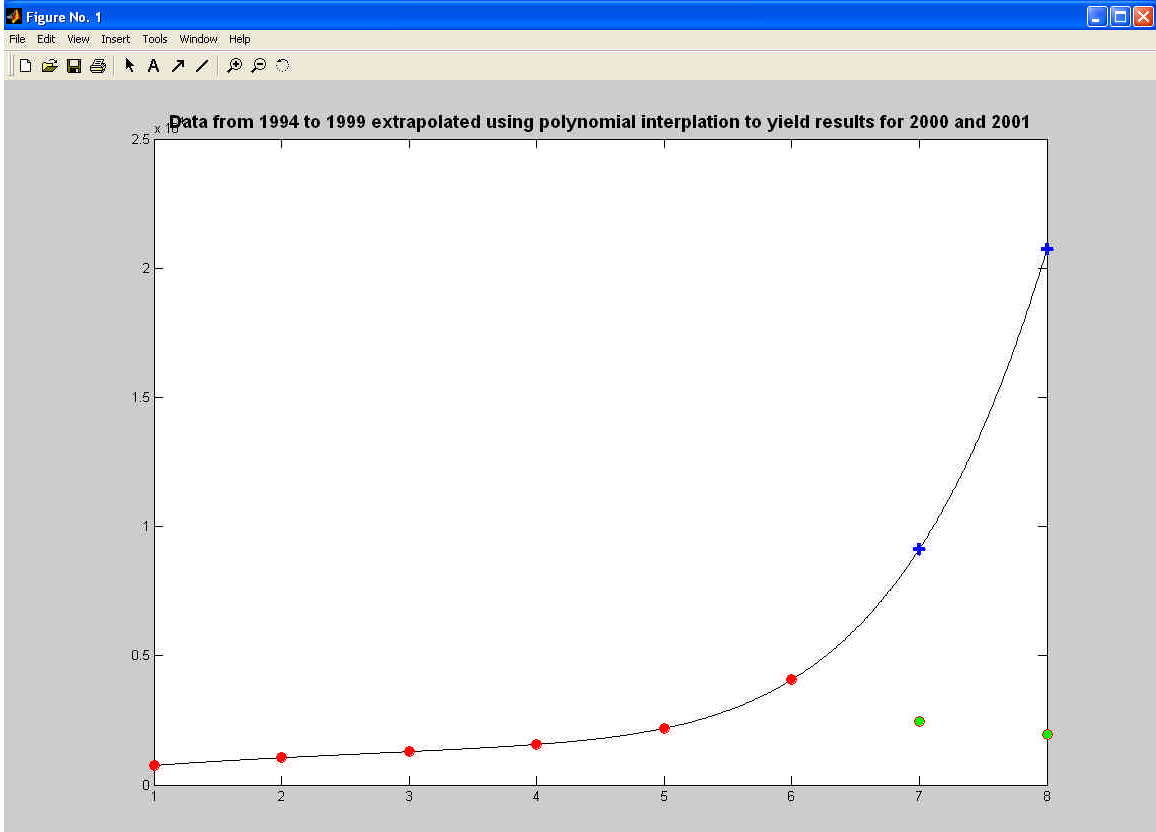
Figure No. 1

File Edit View Insert Tools Window Help

Data from 1994 to 1999 extrapolated using polynomial interplation to yield results for 2000 and 2001

start   8 matlab   Document4 - Microsof...   1:35 AM

Figure No. 2

File Edit View Insert Tools Window Help

Comparison of interpolated values and actual values using polynomial inter.

End of Year	Actual	Polynomial Interpolation	Percent Relative True Error
7	2470.52	9127.88	269.472
8	1950.4	20720.23	962.358

start   8 matlab   Document4 - Microsof...   1:35 AM

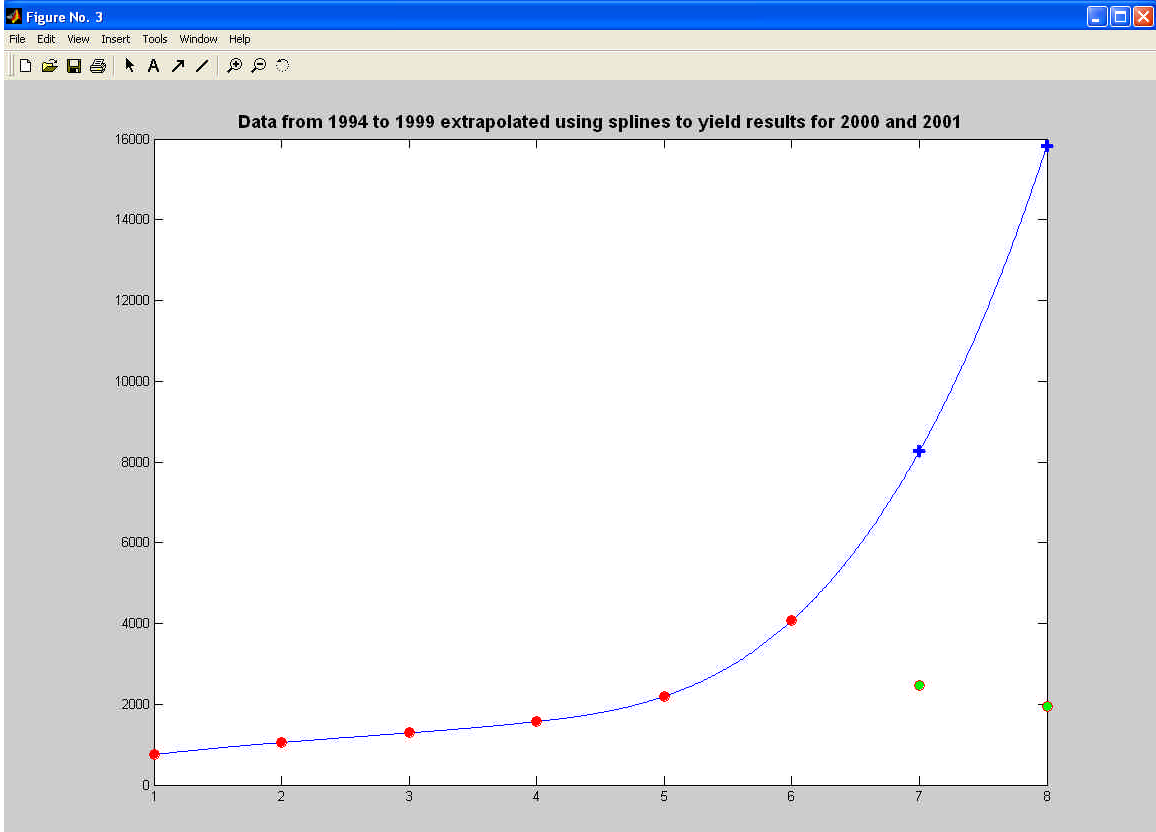**Data from 1994 to 1999 extrapolated using splines to yield results for 2000 and 2001**

Comparison of interpolated values and actual values using splines

End of Year	Actual	Cubic Spline Interpolation	Percent Relative True Error
7	2470.52	8260.3853	234.3582
8	1950.4	15826.0913	711.428

Summary of interpolated values and actual values

End of Year	Actual	Polynomial Interpolation	Relative True Error	Cubic Spline Interp.	Relative True Error
7	2470.52	8260.3853	234.3582	9127.88	269.472
8	1950.4	20720.23	962.358	15826.0913	711.428