Introduction to Matlab:

Numerical Operations

Numerical Interpolation

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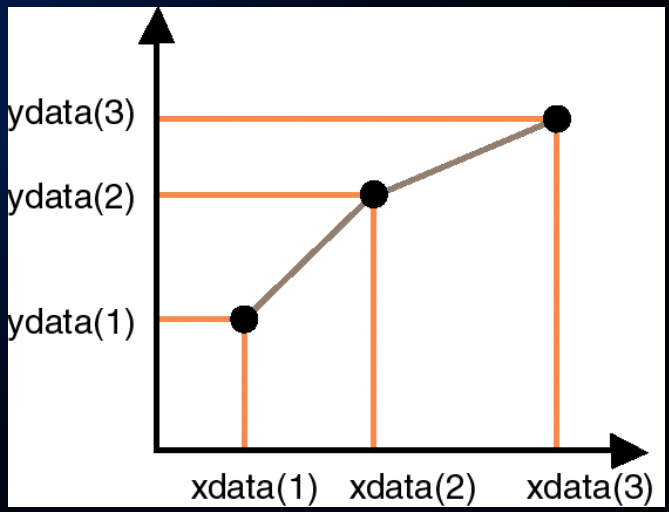
Interpolation Topics

- 1D Interpolation
- Interp1 Command
- Spline Command
- 2D Interpolation
- Interp2 Command

1-D Interpolation

- The command **`interp1`** is used for One Dimensional Interpolation
- Given xdata and ydata



- Want to estimate the values of the function:

```
xi=[xi(1) xi(2) … ]' % values of x
```

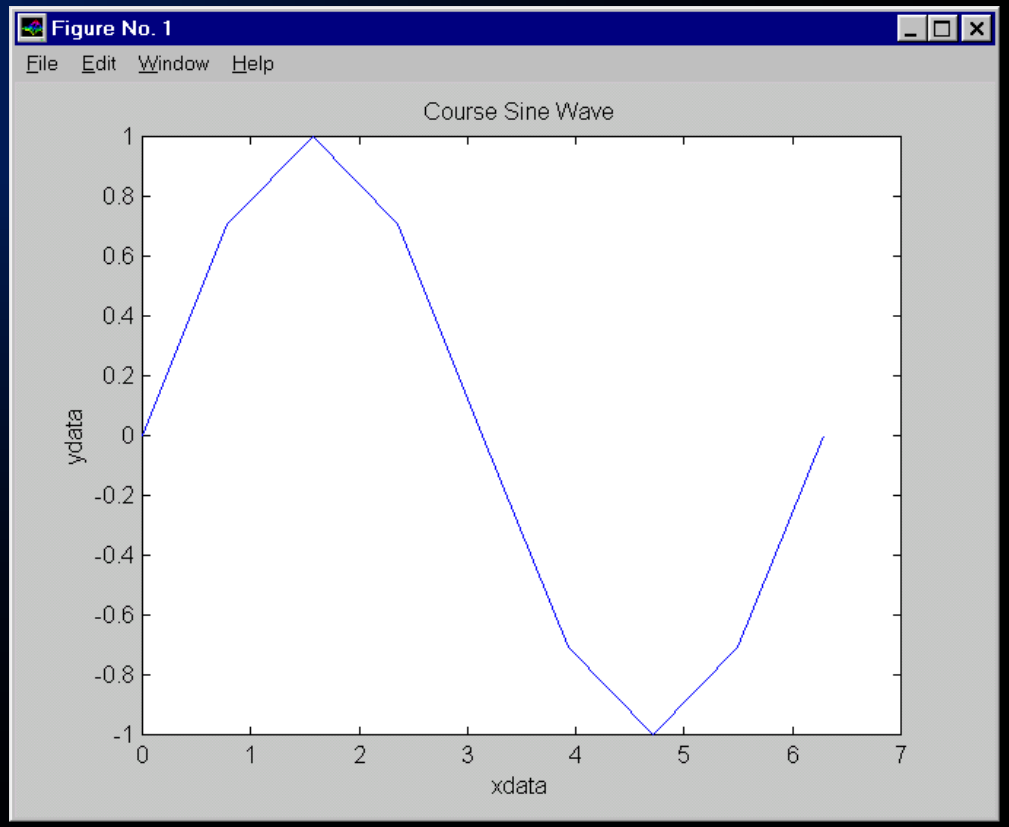
interp1 Command

```
yi=interp1(xdata,ydata,xi,method)
```

- Where the **`method`** of interpolation can be:
  - **`'linear'`** for linear interpolation
  - **`'spline'`** for Spline Interpolation
  - **`'cubic'`** for Cubic Interpolation

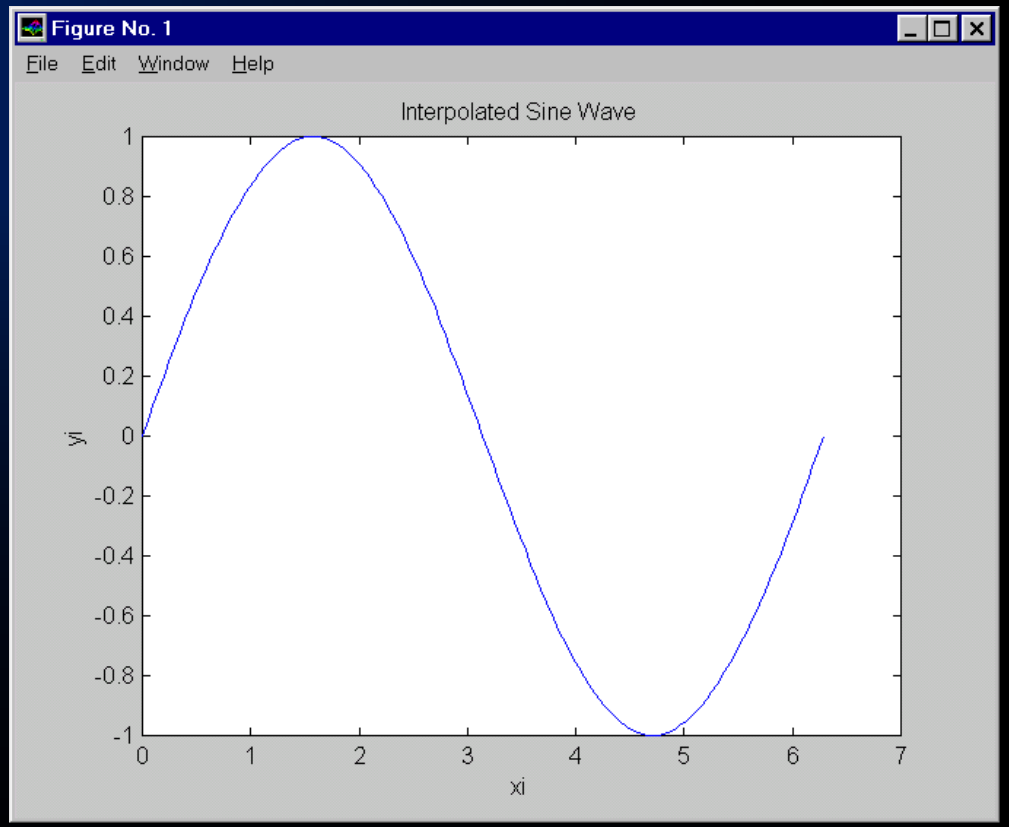
A Coarse Sine Wave

```
» xdata=[0:pi/4:2*pi]';
» ydata=sin(xdata);
» plot(xdata,ydata);
» title('Course
        Sine Wave');
» xlabel('xdata');
» ylabel('ydata');
```



Interpolated Sine Wave

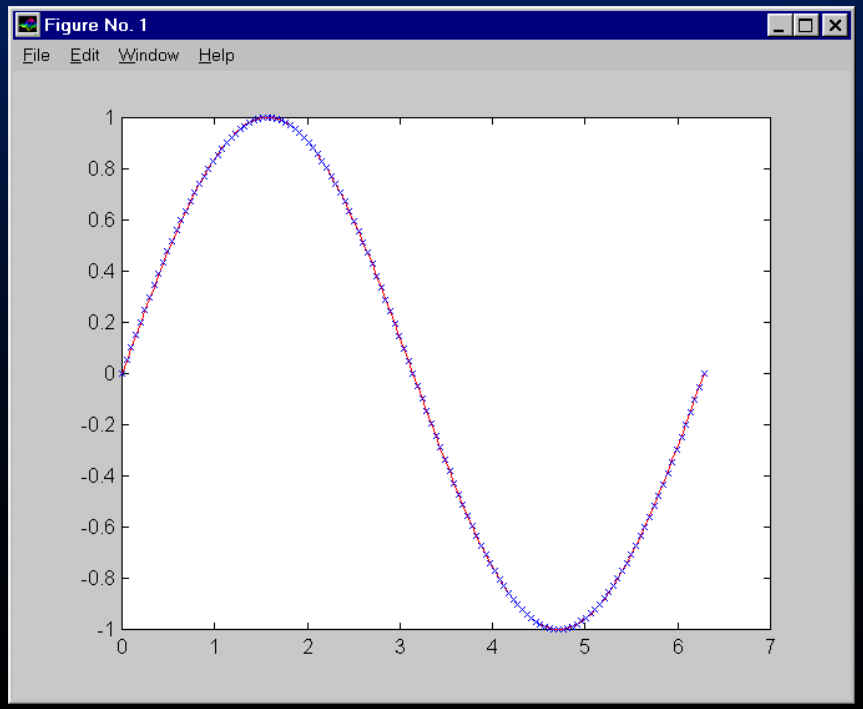
```
» xi=[0:pi/64:2*pi]';
» yi=interp1(xdata,
    ydata,xi,'spline');
» plot(xi,yi)
» title('Interpolated
    Sine Wave');
» xlabel('xi');
» ylabel('yi');
```



Good Fit & Error

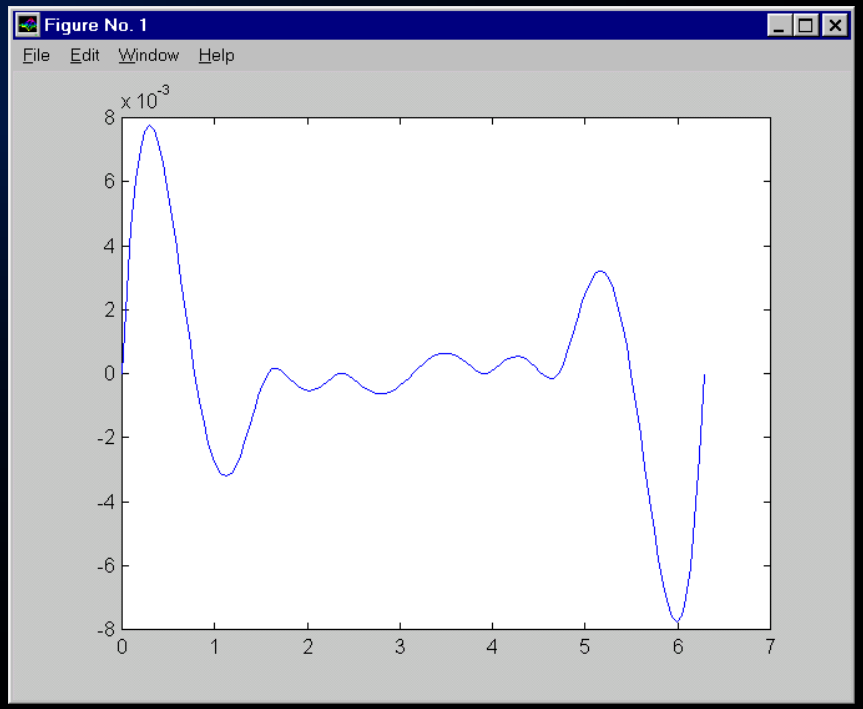
- *Check for Good Fit*

```
» plot(xi,sin(xi),'r',xi,yi,'x');
```



- *Check For Error*

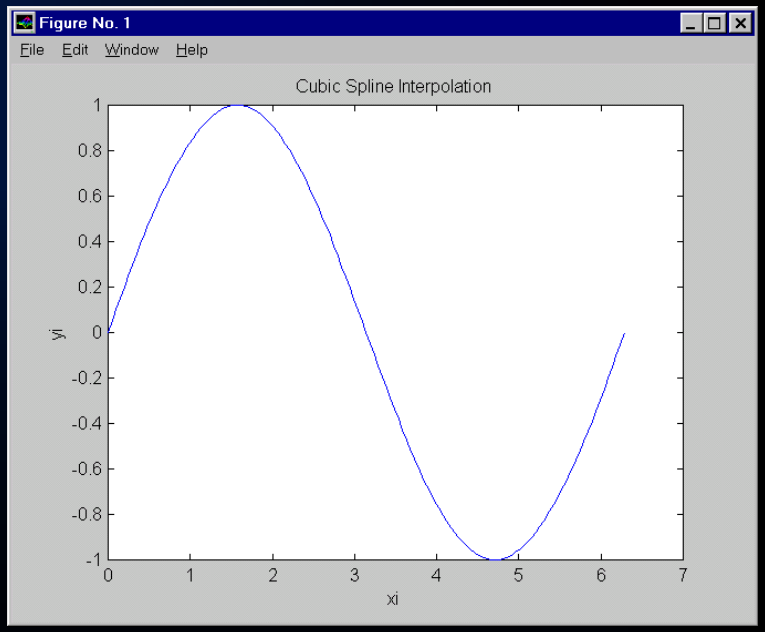
```
» plot(xi,(yi-sin(xi)));
```



Spline

- Use **`spline`** for a cubic spline interpolation method

```
» yi=spline(xdata,ydata,xi);
» plot(xi,yi);
» title('Cubic Spline
          Interpolation');
» xlabel('xi');
» ylabel('yi');
```



2-D Interpolation

- Consider the following sheet of metal with the following temperatures at different points:

	1	2	3	4	5	x
1	82°	81°	80°	82°	84°	
2	79°	63°	61°	65°	81°	
3	84°	84°	82°	85°	86°	
y						

- We will estimate the temperatures on a finer scale

Plot Original Mesh

- Set up Matrices in Matlab

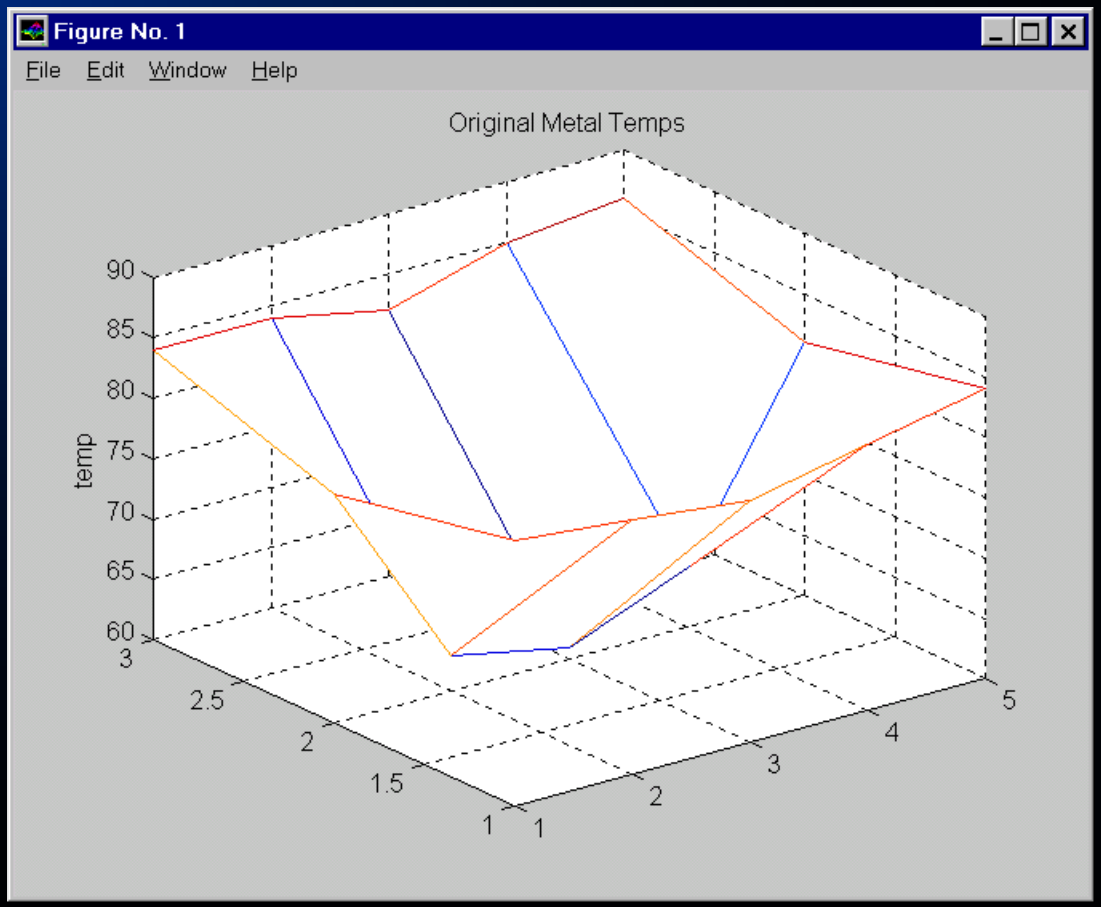
```
» z=[82 81 80 82 84
     79 63 61 65 81
     84 84 82 85 86];
» xdata =[1:5];
» ydata=[1:3]';
```

- Plot the Original Mesh

```
» mesh(xdata,ydata,z);
» title('Original Metal Temps');
» zlabel('temp');
```

Original Mesh

- Coarse
- Concave



Finer 2-D Interpolation

- Estimate Temperature Surface to a finer scale using the **`interp2`** command

```
» xi=[1:0.1:5];
» yi=[1:0.2:3]';
» zi=interp2(xdata,ydata,z,xi,yi,'cubic');
                % or ‘linear’ or ‘spline’

» mesh(xi,yi,zi);
» title('2D Interp Metal Temps');
» zlabel('temp');
```

2-D Interpolated Mesh

- Smooth
- Concave