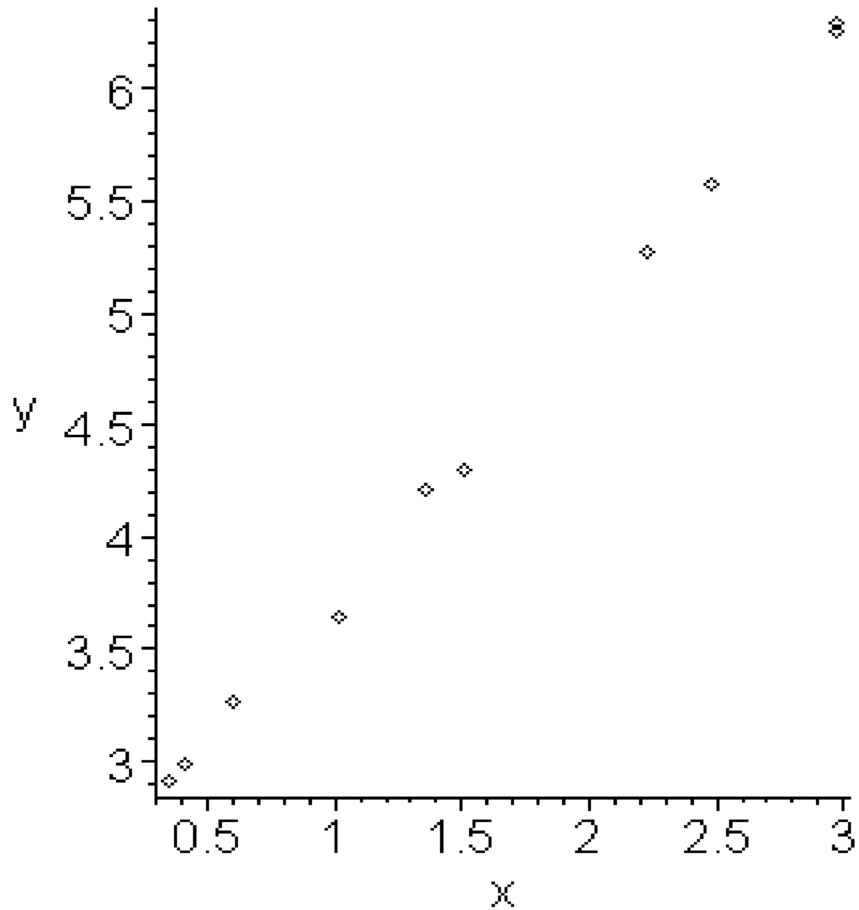
MATLAB Fitting

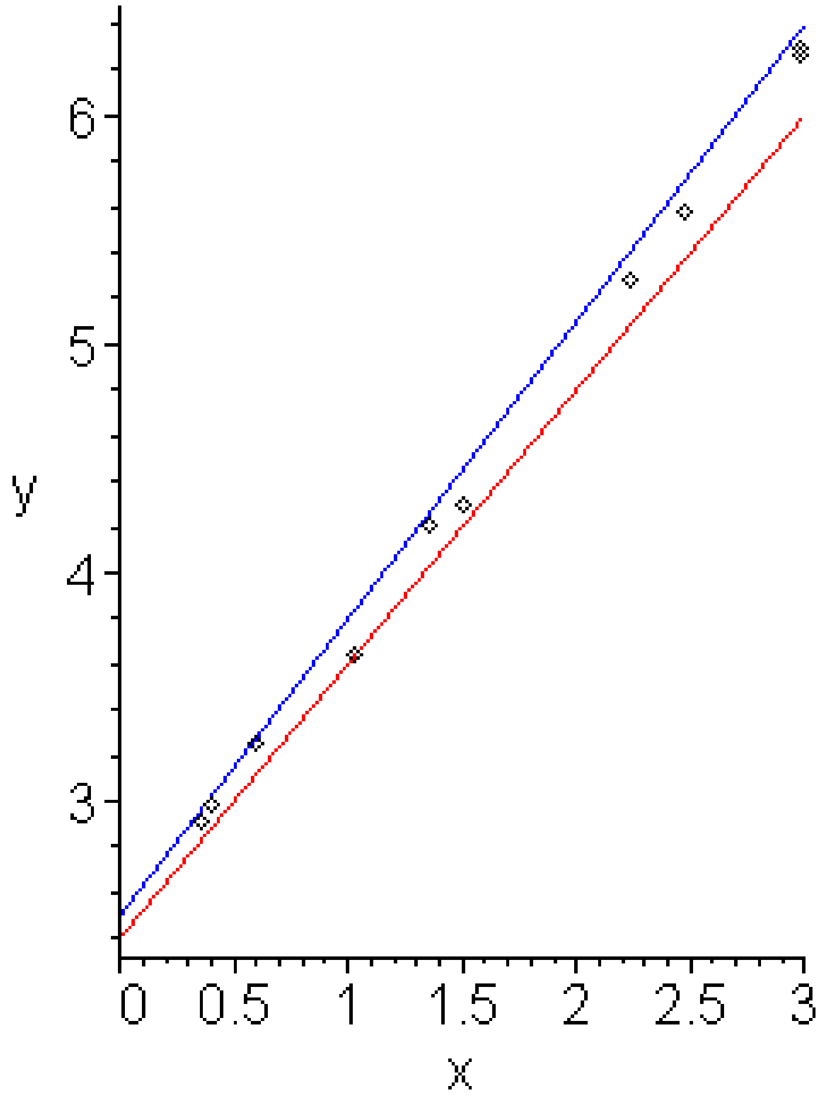
Linear Regression

Consider the points (x_i, y_i) shown in Figure

It looks like the points appear to lie in a straight line, something of the form
$y(x) = ax + b$
where a and b are unknown real values.



The question is, how can we find the best values for *a* and *b*.



Linear Regression in MATLAB

Fitting a least-squares linear regression is easily accomplished in MATLAB using the backslash operator: **'\'**. In linear algebra, matrices may by multiplied like this:

output = input * coefficients

The backslash in MATLAB allows the programmer to effectively "divide" the output by the input to get the linear coefficients. This process will be illustrated by the following examples:

EX: Y = a X + b Find the amount of x and b for this linear equation .

```
%% input data with a linear relationship (as columns )
x=[0 2 5 6]';
y=[3 16 22 27]';
b =x\y  ;                   %% divide the output by the input to get the linear coefficients
b = [ones(length(x),1) x] \ y    %% Append a column of ones before dividing to include an intercept
```

In this case, the first number is the intercept and the second is the coefficient.

Polynomials and Curve Fitting

About Polynomial Models

Polynomial models for curves are given by

$$y = \sum_{i=1}^{n+1} p_i x^{n+1-i}$$

where $n + 1$ is the *order* of the polynomial, n is the *degree* of the polynomial, and $1 \leq n \leq 9$. The order gives the number of coefficients to be fit, and the degree gives the highest power of the predictor variable.

In this guide, polynomials are described in terms of their degree. For example, a third-degree (cubic) polynomial is given by

$$y=p_1x^3+p_2x^2+p_3x+p_4$$

p = polyfit(x,y,n) returns the coefficients for a polynomial p(x) of degree n that is a best fit (in a least-squares sense) for the data in y. The coefficients in p are in descending powers, and the length of p is n+1

EX: Using polynomial method to find equation form

$$y = a\,x^2 + b\,x + c$$

```
x=[0 1 2 3];
y=[-1 4 15 32];
p = polyfit(x,y,2)  % this equation 2nd degree
```

Exponential Fitting

Exponentials are often used when the rate of change of a quantity is proportional to the initial amount of the quantity. If the coefficient associated with *b* and/or *d* is negative, *y* represents exponential decay. If the coefficient is positive, *y* represents exponential growth.

$$y = a\,e^{bx}$$

we can use fit(x,y,'exp1'); where x and y are our set of points.

This example shows how to fit an exponential model to data using the fit function .

Δ T (K)	10	20	30	40
Q (w/m²)	250	450	600	850

```
x=[10 20 30 40]';
y=[250 450 600 850]';
cf = fit(x,y,'exp1')
```

MATLAB Fitting

Power Fitting

Power series models describe a variety of data. For example, the rate at which reactants are consumed in a chemical reaction is generally proportional to the concentration of the reactant raised to some power.

$$y = a\, x^{b}$$

we can use fit(x,y,'power1'); where x and y are our set of points.

This example shows how to use the fit function to fit power series models to data.

x	0.01	1	2	3
y	2	5.5	16	42

```
x=[0.01 1 2 3]';
y=[2 5.5 16 42]';
f = fit(x,y,'power1')
```