

```

> # Prof. Dr. Serkan Dağ
# ME 310 Numerical Methods
# File 8.1
# Linear Regression
# Finds coefficients of linear approximation  $y = a_0 + a_1 x$ 

> restart :
Digits := 16:
with(CurveFitting):
with(Statistics):

> # Number of data pairs
> n := 7:

> # Define the data points
> X := [1, 2, 3, 4, 5, 6, 7];
Y := [0.5, 2.5, 2, 4, 3.5, 6, 5.5];
X := [1, 2, 3, 4, 5, 6, 7]
Y := [0.5, 2.5, 2, 4, 3.5, 6, 5.5] (1)

> # Generate the line by the MAPLE command
> LeastSquares(X, Y, x);
StandardDeviation(Y);
0.07142857142857143 + 0.8392857142857143 x
1.945691210268034 (2)

> # Evaluate required summations
> xt := 0:
yt := 0:
xiyi := 0:
xi2 := 0:

> for i from 1 by 1 to n
while true do

xt := xt + X[i]:
yt := yt + Y[i]:
xiyi := xiyi + X[i]·Y[i]:
xi2 := xi2 + X[i]^2:

end do:
> # Arithmetic means
> xbar :=  $\frac{xt}{n}$ :
ybar :=  $\frac{yt}{n}$ :

> # Linear regression coefficients
> a1 :=  $\frac{(n \cdot xiyi - xt \cdot yt)}{n \cdot xi2 - xt^2}$ :
a0 := ybar - a1 · xbar;
a1 := 0.8392857142857143
a0 := 0.071428571428572 (3)

> # Sums needed in error quantification
> St := 0:
Sr := 0:

```

```
> for i from 1 by 1 to n  
  while true do
```

$$St := St + (Y[i] - ybar)^2 :  
Sr := Sr + (Y[i] - a0 - a1 \cdot X[i])^2 :$$

```
end do:
```

```
> # Sum of squares of residuals (relative to mean)
```

```
> St;
```

$$22.71428571428572 \quad (4)$$

```
> # Sum of squares of residuals (relative to regression line)
```

```
> Sr;
```

$$2.991071428571429 \quad (5)$$

```
> # Standard deviation
```

```
> sy := sqrt\left(\frac{St}{n - 1}\right);
```

$$sy := 1.945691210268034 \quad (6)$$

```
> # Standard error of the estimate
```

```
> syx := sqrt\left(\frac{Sr}{n - 2}\right);
```

$$syx := 0.7734431367038470 \quad (7)$$

```
> # Correlation coefficient
```

```
> r := sqrt\left(\frac{(St - Sr)}{St}\right);
```

$$r := 0.9318356132188194 \quad (8)$$

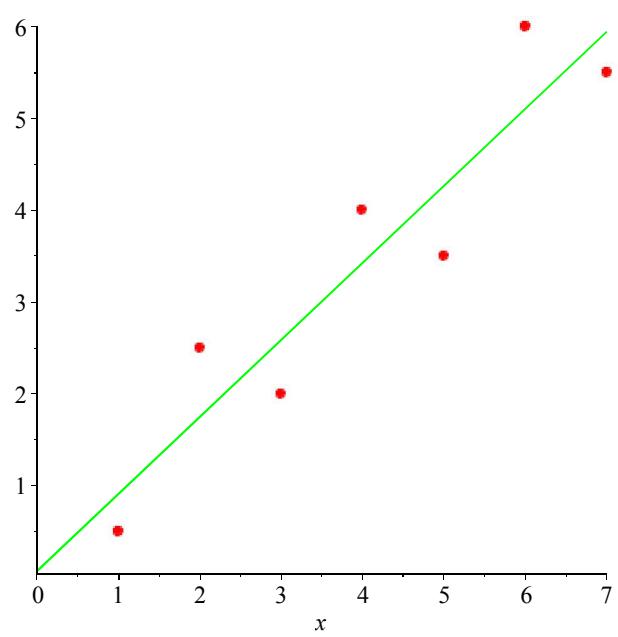
```
> # Plot the data and the regression line
```

```
> y := a0 + a1 \cdot x;
```

$$y := 0.8392857142857143 x + 0.071428571428572 \quad (9)$$

```
> with(plots) :
```

$$p1 := plot(X, Y, style = point, color = red, symbol = solidcircle, symbolsize = 12) :  
p2 := plot(y, x = 0 .. 7, color = green) :  
display(\{p1, p2\});$$



➤