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

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

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> # Number of data pairs

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> n := 7 :

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> # Define the data points

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> X := [1, 2, 3, 4, 5, 6, 7];
> Y := [0.5, 2.5, 2, 4, 3.5, 6, 5.5];

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X:= [1, 2, 3, 4, 5, 6, 7]
Y:= [0.5, 2.5, 2, 4, 3.5, 6, 5.5]

```

(1)

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> # Generate the line by the MAPLE command

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> LeastSquares(X, Y, x);
> StandardDeviation(Y);

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0.07142857142857143 + 0.8392857142857143 x
1.945691210268034

```

(2)

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> # Evaluate required summations

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> xt := 0 :
> yt := 0 :
> xiyi := 0 :
> xi2 := 0 :

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

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

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end do:

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> # Arithmetic means

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> xbar :=  $\frac{xt}{n}$  :
> ybar :=  $\frac{yt}{n}$  :

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> # Linear regression coefficients

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> a1 :=  $\frac{(n \cdot xiyi - xt \cdot yt)}{n \cdot xi2 - xt^2}$  ;
> a0 := ybar - a1·xbar,

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a1 := 0.8392857142857143
a0 := 0.071428571428572

```

(3)

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> # Sums needed in error quantification

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> St := 0 :
> Sr := 0 :

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> 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 (4)
=
> # Sum of squares of residuals (relative to regression line)
> Sr,
2.991071428571429 (5)
=
> # Standard deviation
> sy := sqrt( $\frac{St}{n - 1}$ );
sy := 1.945691210268034 (6)
=
> # Standard error of the estimate
> syx := sqrt( $\frac{Sr}{n - 2}$ );
syx := 0.7734431367038470 (7)
=
> # Correlation coefficient
> r := sqrt( $\frac{(St - Sr)}{St}$ );
r := 0.9318356132188194 (8)
=
> # Plot the data and the regression line
> y := a0 + a1 · x;
y := 0.8392857142857143 x + 0.071428571428572 (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} );

```

