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Sea Levels according to temperature in Reykjaví (Iceland) and Gedser (Denmark)

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PC based Math
Project for High School Students

1 *Description of the Project (introduction)*

Open Close Print

The goal of this project is to show a connection between temperature and sea level in Iceland and Denmark, respectively. To achieve this end, we shall plot two regressions of the collected data from 1986-2006 using *Mathematica*, analyse it, and then make a comparative analysis of the same two regressions.
If we come to the conclusion that there is, in fact, a clear relationship between temperature and sea level we shall make a "forecast": We could, for example examine how much the sea level will change if the temperature rises by two degrees Celsius, provided that the relationship between the two does not change.
Finally, we will discuss our results and if they are valid.

2 *Theory*

Open Close Print

Hypothesis

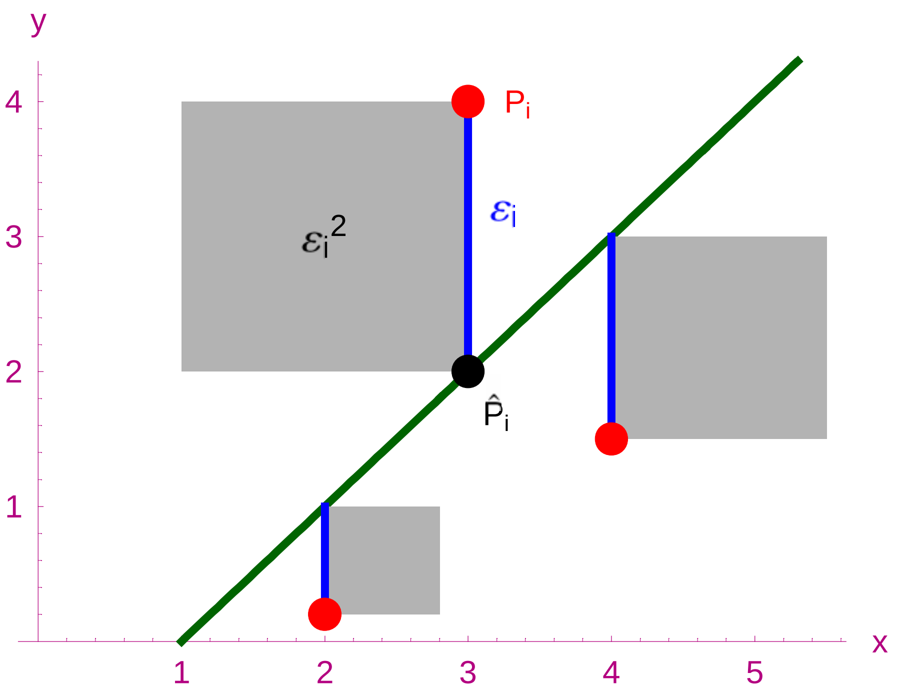
Open Close

Should our project go smoothly, there should be some connection between the temperature and the sea level in either country. Specifically, this means that we should be able to perform a regression of good accuracy on the data if there is a connection.
We expect the change in sea level to be directly proportional to the change in temperature. Thus, we also expect the regression line to be linear and with a postive slope.

In other words, we think that when the Icelandic sea levels rise, the same would happen for the Danish sea levels. In the same way, we think that the lower the temperature, the lower the sea level - this of course because that temperature has an immense affect on the sea levels, e.g. the melting of glaciers, the expansion of water at higher temperatures etc.

Applied Mathematics
Open Close

When analyzing these numbers of temperature and sea levels, we would of course like to be able to have the best model possible - this we could use to predict possible changes in the future. This "best" model is called a regression.
A regression can be performed on any set of data as long as there are more than two points.
The regression line is the graph of the function that best describes the progression of the data. More specifically, this means the line which meets the requirement of the sum of the squared values of the distances between the regression line and each point being smaller than the same value of squared distances for any other possible line of the same type - be it linear, exponential or something else.
The mean point, Pi, is always a point on the regression line.



The regression line is the line whose "boxes" cover the smallest surface possible.

$$r^2 = \frac{\sum(\hat{y}_i - \overline{y})^2}{\sum(y_i - \overline{y})^2}$$

This is the formula for calculating the value of r^2. r^2€]0;1]. The closer this value is to 1, the better the regression; 1 is perfect, and if r^2>0.36, the regression is sufficiently accurate to prove a tendency.

Developing Models

Open Close Print

Icelandic Data

Open Close

These are the data from Iceland 1986-2006.
The x-values show the annual mean temperature in Reykjavik (degrees Celsius) while the y-values show the annual mean sea level in Reykjaví (m). Each point is sorted according to the year in which it has been recorded; the first point is from 1986, the second from 1987 etc.

Input ▷

```
data = {{4.1, 2.16}, {5.4, 2.21}, {4.1, 2.17}, {3.8, 2.16},
   {4.4, 2.25}, {5, 2.12}, {4.2, 2.15}, {4.4, 2.16}, {4.1, 2.17},
   {3.8, 2.16}, {5, 2.21}, {5.1, 2.22}, {4.7, 2.21}, {4.5, 2.19},
   {4.5, 2.19}, {5.2, 2.21}, {5.4, 2.23}, {6.1, 2.27},
   {5.6, 2.25}, {5.1, 2.21}, {5.4, 2.24}}; Add ; data
```

```
{{4.1, 2.16}, {5.4, 2.21}, {4.1, 2.17}, {3.8, 2.16},
 {4.4, 2.25}, {5, 2.12}, {4.2, 2.15}, {4.4, 2.16},
 {4.1, 2.17}, {3.8, 2.16}, {5, 2.21}, {5.1, 2.22}, {4.7, 2.21},
 {4.5, 2.19}, {4.5, 2.19}, {5.2, 2.21}, {5.4, 2.23},
 {6.1, 2.27}, {5.6, 2.25}, {5.1, 2.21}, {5.4, 2.24}}
```

Now we will find the best linear regression line for these data by using the "Regr Line"-button from the "Linear Regression" palette.

Input ▷

```
→ X y ;
Clear[x];
regrLineY[x_] = Fit[data, {1, x}, x]
```

```
1.98862 + 0.0438335 x
```

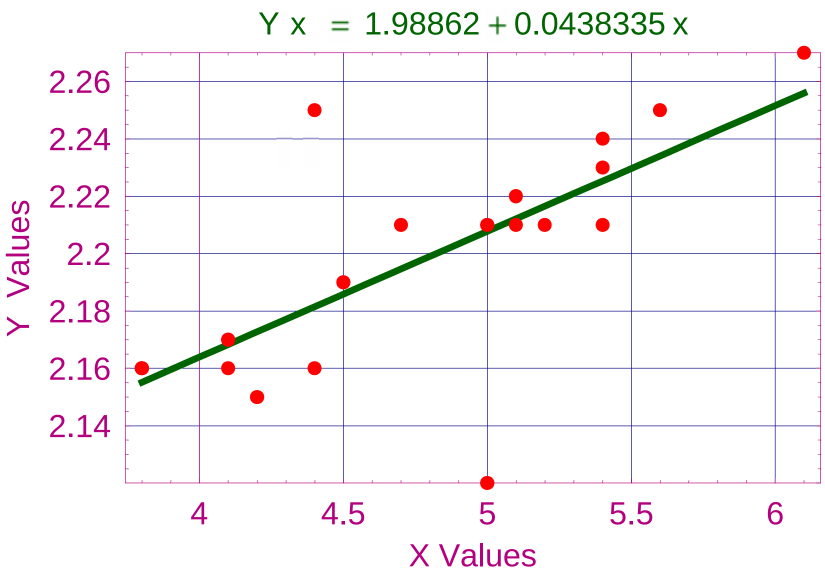
Now that we know the regression to be X[y]=1.98862+0.0438335 x, we are able to plot it to get a feeling for how it actually looks. For this purpose we use "Plot Regr Line" from the "Linear Regression" palette.

Input ▷

```
→ Both Least Squares Lines ;
Clear[x]; regrLineY[x_] = Fit[data, {1, x}, x];

MDSPlotDataRegressionLineY[data, {x, regrLineY[x]},
    Epilog → {Red, PointSize[0.02], Point[data]},
    PlotStyle → {DarkGreen, Thickness[0.01]}]
```

x x y x x y y



At first glance it seems that the regression line describes the location of the points well. However, we want to calculate r^2 to prove this. We find the value using the r r^2 Plot button from the Linear Correlation palette.

Input ▹ `MDSPearsonCoeffReport data`

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}, \bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.716553	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 51. % explained	$\frac{\Sigma x_i}{n}, \frac{\Sigma y_i}{n}$ 4.75714, 2.19714	$\frac{\sum(y_i-\hat{y}_i)^2}{n-2}$ 0.0279144
SS_{xy}	SS_{xx}	SS_{yy}	Data x – range
$\Sigma x_i y_i - \frac{\Sigma x_i \Sigma y_i}{n}$ 0.356429	$\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 8.13143	$\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 0.0304286	x_{min}, x_{max} 3.8, 6.1

From this data box we can see that r^2 equals 0.51. As previously mentioned, this means that the regression is good enough to prove a tendency (since $r^2 > 0.36$). However, if we want a more accurate regression, we can try to investigate the tendency over the last 10 years instead. The process above is repeated to do this.

Input ▹
```
data =  5.1, 2.22 ,  4.7, 2.21 ,  4.5, 2.19 ,
   4.5, 2.19 ,  5.2, 2.21 ,  5.4, 2.23 ,  6.1, 2.27 ,
   5.6, 2.25 ,  5.1, 2.21 ,  5.4, 2.24  ;  Add  ; data
```

```
5.1, 2.22 , 4.7, 2.21 , 4.5, 2.19 , 4.5, 2.19 , 5.2, 2.21 ,
5.4, 2.23 , 6.1, 2.27 , 5.6, 2.25 , {5.1, 2.21 , 5.4, 2.24
```

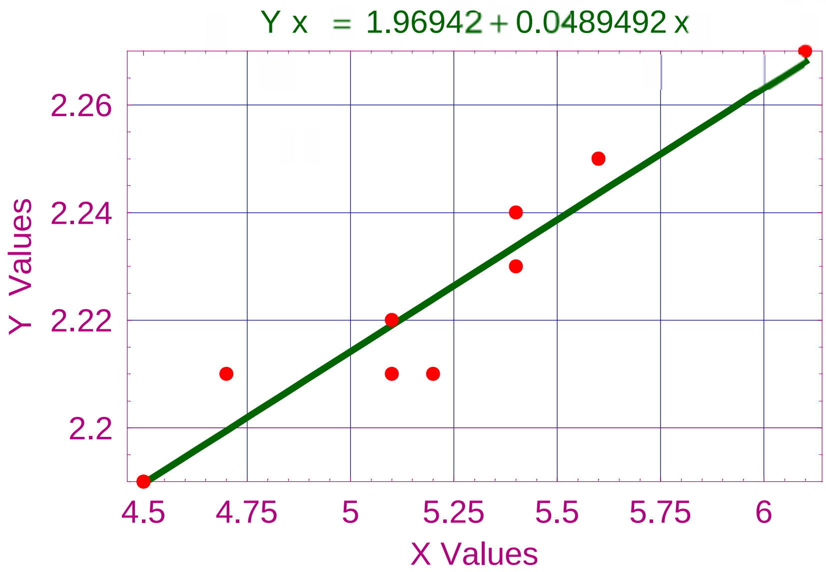
→ X y ;

Input ▹
```
Clear x ;
regrLineY x_ = Fit data, 1, x , x
```
1.96942 + 0.0489492 x

→ Both Least Squares Lines ;

```
Clear x ; regrLineY x_ = Fit data, 1, x , x ;
```

Input ▹
```
MDSPlotDataRegressionLineY data, x, regrLineY x ,
    Epilog → Red, PointSize 0.02 , Point data ,
    PlotStyle → DarkGreen, Thickness 0.01
```



Input ▹
```
MDSPearsonCoeffReport data
```

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}$, $\bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.958232	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 92. % explained	$\frac{\Sigma x_i}{n}$, $\frac{\Sigma y_i}{n}$ 5.16, 2.222	$\frac{\sum(y_i-\hat{y}_i)^2}{n-2}$ 0.00780607
SS_{xy}	SS_{xx}	SS_{yy}	Data x − range
$\Sigma\, x_i\, y_i - \frac{\Sigma x_i\, \Sigma y_i}{n}$ 0.1118	$\Sigma\, x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 2.284	$\Sigma\, y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 0.00596	x_{min}, x_{max} 4.5, 6.1

Now we have an excellent regression line describing a very clear connection between sea level and temperature in Reykjavik over the last ten years: Y[x] = 1.96942 + 0.0489492x

Danish Data

Open Close

These are the Danish data, again from 1986-2006.

Input ▷
```
data = 10.6, 1.03 , 6.2, 1.05 , 8.4, 1.18 , 9.4, 1.68 ,
  9.5, 1.42 , 8.3, 0.71 , 9.2, 1.23 , 7.9, 0.85 , 8.9, 0.85 ,
  8.4, 1.59 , 7.1, 0.54 , 8.8, 1.18 , 8.7, 1.61 ,
  9.3, 1.12 , 9.6, 0.95 , 8.8, 1.31 , 9.5, 1.25 , 9.1, 1 ,
  {9.0, 1.49}, {9.1, 1.12}, {9.9, 0.42} ; Add ; data
```

```
10.6, 1.03}, {6.2, 1.05}, {8.4, 1.18}, {9.4, 1.68},
9.5, 1.42 , 8.3, 0.71 , 9.2, 1.23 , {7.9, 0.85 ,
8.9, 0.85 , 8.4, 1.59 , 7.1, 0.54 , 8.8, 1.18 ,
{8.7, 1.61 , 9.3, 1.12 , 9.6, 0.95 , 8.8, 1.31 ,
{9.5, 1.25}, {9.1, 1 , {9., 1.49 , 9.1, 1.12 , 9.9, 0.42
```

Once again we perform a linear regression on the data as we did above.

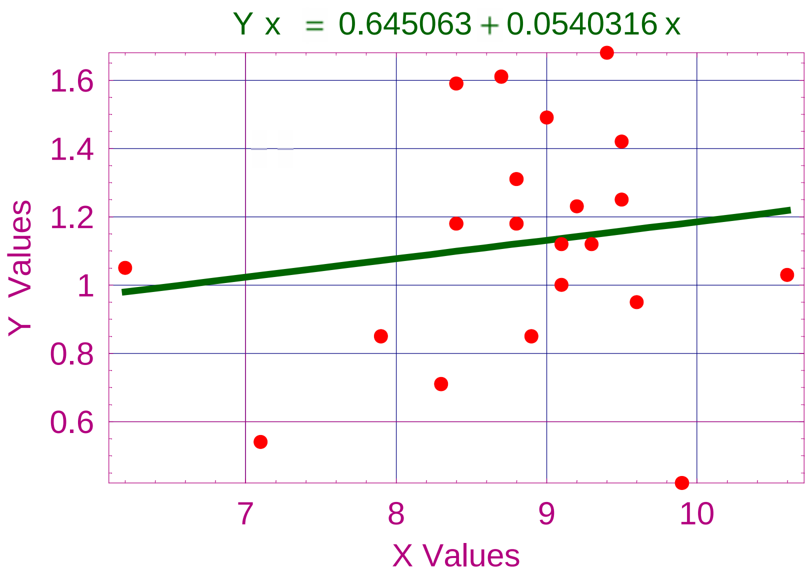
Input ▷
```
→ X y ;
Clear x ;
regrLineY x_ = Fit data, 1, x , x
```

```
0.645063 + 0.0540316 x
```

This graph is then plotted as in the above section.

Input ▷
```
→ Both Least Squares Lines ;
Clear x ; regrLineY x_ = Fit data, 1, x , x ;

MDSPlotDataRegressionLineY data, x, regrLineY x ,
    Epilog → Red, PointSize 0.02 , Point data ,
    PlotStyle → DarkGreen, Thickness 0.01
```



Input ▹ `MDSPearsonCoeffReport data`

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}, \bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.152444	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 2. % explained	$\frac{\Sigma x_i}{n}, \frac{\Sigma y_i}{n}$ 8.84286, 1.12286	$\frac{\sum(y_i-\hat{y}_i)^2}{n-2}$ 0.341627
SS_{xy}	SS_{xx}	SS_{yy}	Data x – range
$\Sigma\, x_i\, y_i - \frac{\Sigma x_i\, \Sigma y_i}{n}$ 0.976429	$\Sigma\, x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 18.0714	$\Sigma\, y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 2.27023	x_{min}, x_{max} 6.2, 10.6

Compared to the Icelandic graph, the accuracy of the Danish one is quite awful. Indeed, there is no clear relationship between sea level and temperature in Denmark during 1986-2006 $r^2 < 0.36$).

The Forecast (Iceland)

Open Close

This is our forecast. We want to find out how high the sea level will be in 2020 (12 years after the last recorded temperature/sea level data). To do so we shall first see if there is a clear tendency between the annual mean temperature and the number of years after 1986. Here, the x-values are the number of years after 1986 and the y-values are the annual mean temperature. NB: We are going to use the Icelandic data in this section because of the poor quality of the Danish regression.

Input ▹
```
data = 0, 4.1 , 1, 5.4 , 2, 4.1 , 3, 3.8 , 4, 4.4 , 5, 5 ,
   6, 4.2 , 7, 4.4 , 8, 4.1 , 9, 3.8 , 10, 5 , 11, 5.1 ,
   12, 4.7 , 13, 4.5 , 14, 4.5 , 15, 5.2 , 16, 5.4 ,
   17, 6.1 , 18, 5.6 , 19, 5.1 , 20, 5.4 ; Add ; data
```

```
0, 4.1 , {1, 5.4 , 2, 4.1 , 3, 3.8 , 4, 4.4 ,
5, 5 , 6, 4.2 , 7, 4.4 , 8, 4.1}, 9, 3.8 , 10, 5 ,
11, 5.1 , 12, 4.7 , 13, 4.5 , 14, 4.5 , 15, 5.2 ,
16, 5.4 , 17, 6.1 , 18, 5.6 , 19, 5.1 , 20, 5.4
```

Now we peform linear regression on the data by using the "Regr Line"-button once again:

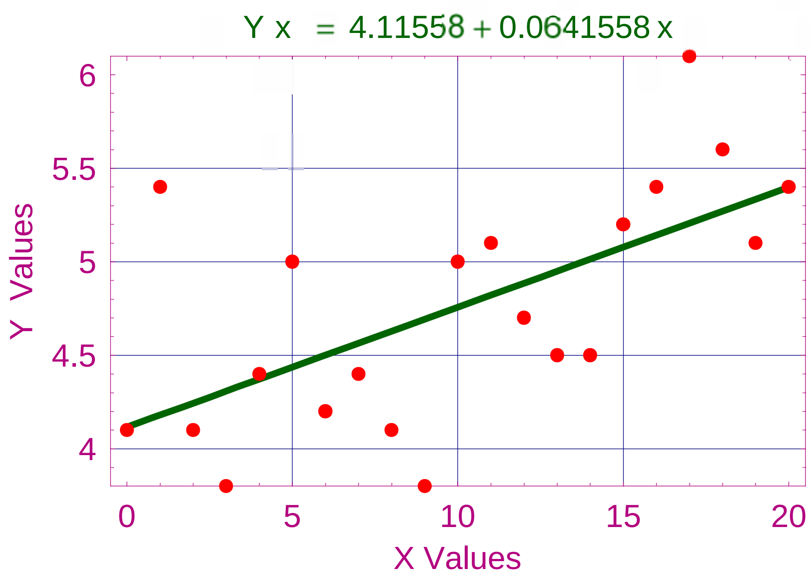
Input ▹
```
→ X y ;
Clear x ;
regrLineY x_ = Fit data, 1, x , x
```

```
4.11558 + 0.0641558 x
```

This function is visualized in a graph:

Input ▹
```
→ Both Least Squares Lines ;
Clear x ; regrLineY x_ = Fit data, 1, x , x ;

MDSPlotDataRegressionLineY data, x, regrLineY x ,
    Epilog → Red, PointSize 0.02 , Point data ,
    PlotStyle → DarkGreen, Thickness 0.01
```



A tendency is hardly present. We will see how r^2 judge it by chossing "r r^2 Box" from the "Linear Correlation"-palette.

Input ▹
```
MDSPearsonCoeffReport data
```

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}$, $\bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.624307	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 39. % explained	$\frac{\Sigma x_i}{n}$, $\frac{\Sigma y_i}{n}$ 10., 4.75714	$\frac{\sum(y_i-\hat{y}_i)^2}{n-2}$ 0.511043
SS_{xy}	SS_{xx}	SS_{yy}	Data x – range
$\Sigma\, x_i y_i - \frac{\Sigma x_i\,\Sigma y_i}{n}$ 49.4	$\Sigma\, x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 770.	$\Sigma\, y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 8.13143	x_{min}, x_{max} 0., 20.

Because our regression is only barely acceptable r^2~0.36), we will perform a new one using the data from 1992-2006 (6-20) to gain a higher level of accuracy.
On the new set of data, x describes the number of years after 1992, and y describes the temperature.

Input ▹
```
data = 0, 4.2 , 1, 4.4 , 2, 4.1 , 3, 3.8 , 4, 5 ,
  5, 5.1 , 6, 4.7 , 7, 4.5 , 8, 4.5 , 9, 5.2 , 10, 5.4 ,
  11, 6.1 , 12, 5.6 , 13, 5.1 , 14, 5.4 ; Add ; data
```

```
0, 4.2 , 1, 4.4 , 2, 4.1 , 3, 3.8 , 4, 5 ,
5, 5.1 , 6, 4.7 , 7, 4.5 , 8, 4.5 , 9, 5.2 ,
10, 5.4 , 11, 6.1 , 12, 5.6 , 13, 5.1 , 14, 5.4
```

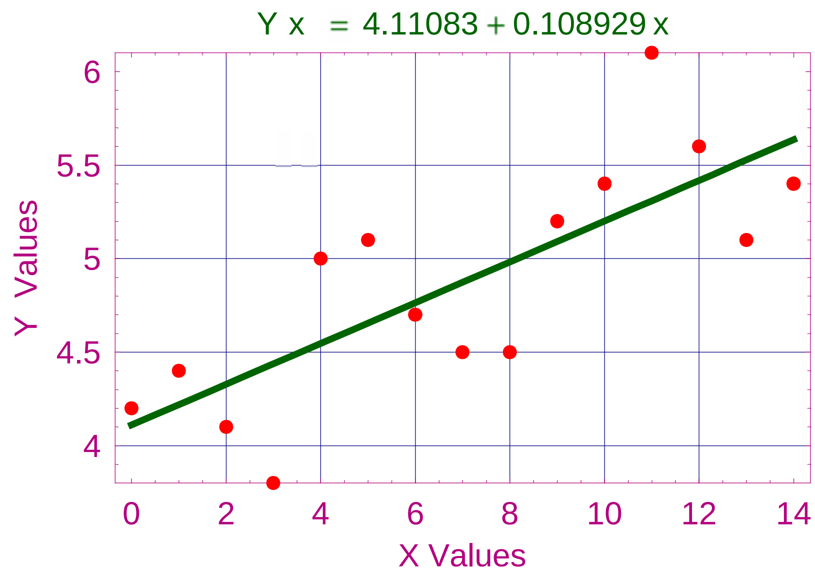
Input ▹
```
→ X y ;
Clear x ;
regrLineY x_ = Fit data, 1, x , x
```

```
4.11083 + 0.108929 x
```

Input ▹
```
→ Both Least Squares Lines ;
Clear x ; regrLineY x_ = Fit data, 1, x , x ;
```

Input ▹
```
MDSPlotDataRegressionLineY data, x, regrLineY x ,
    Epilog → Red, PointSize 0.02 , Point data ,
    PlotStyle → DarkGreen, Thickness 0.01
```

X x y x x y y



Input ▹
```
MDSPearsonCoeffReport data
```

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}$, $\bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.77375	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 60. % explained	$\frac{\Sigma x_i}{n}$, $\frac{\Sigma y_i}{n}$ 7., 4.87333	$\sqrt{\frac{\sum(y_i-\hat{y}_i)^2}{n-2}}$ 0.413894
SS_{xy}	SS_{xx}	SS_{yy}	Data x – range
$\Sigma x_i y_i - \frac{\Sigma x_i \Sigma y_i}{n}$ 30.5	$\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 280.	$\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 5.54933	x_{min}, x_{max} 0., 14.

This regression looks pretty good! r^2 is 0.60, which makes it significantly better than the previous one and easily good enough to prove a tendency (thus, we have proved that it has been getting warmer and warmer during 1992-2006).
Now, we will use this model to predict how warm it will be in 2020 (x = 2020-1992 = 28)

Input ▹
```
→ X y ;
Clear x ;
regrLineY x_ = Fit data, 1, x , x ;
regrLineY 28      x value MUST be in data x-range *
```

7.16083

So, according to our model, the annual mean temperature in Reykjavik will be 7.16 degrees in 2020. Now we want to calculate the annual mean sea level for 2020 by using the final model from the section "Icelandic Data" (Y[x] = 1.96942 + 0.0489492x) with the temperature that we have just found:

Input ▹
```
1.96942 + 0.0489492 * 7.16083
```

2.31994

This means that the sea level will have increased to 2.31994 m in 2020 according to this model.

Another way of making a model is to perform a regression with the time (years after e.g. 1986) on the x-axis and the sea level (m) on the y-axis. The result of this forecast will be compared with the result of the original one (above) in the Result and Summary-section (green section 4).
These are the data as mentioned above. x describes the number of years after 1986.

Input ▷
```
data =  0, 2.16 ,  1, 2.21 ,  2, 2.17 ,  3, 2.16 ,
   4, 2.25 ,  5, 2.12 ,  6, 2.15 ,  7, 2.16 ,  8, 2.17 ,
   9, 2.16 ,  10, 2.21 ,  11, 2.22 ,  12, 2.21 ,  13, 2.19 ,
   14, 2.19 ,  15, 2.21 ,  16, 2.23 ,  17, 2.27 ,
   18, 2.25 ,  19, 2.21 ,  20, 2.24  ;  Add ; data
```

```
 0, 2.16 , {1, 2.21 ,  2, 2.17 ,  3, 2.16 ,  4, 2.25 ,  5, 2.12 ,
 6, 2.15 , {7, 2.16 ,  8, 2.17 ,  9, 2.16 ,  10, 2.21 ,
 11, 2.22 ,  12, 2.21 ,  13, 2.19 ,  14, 2.19 ,  15, 2.21 ,
 16, 2.23 ,  17, 2.27 ,  18, 2.25 ,  19, 2.21 ,  20, 2.24
```

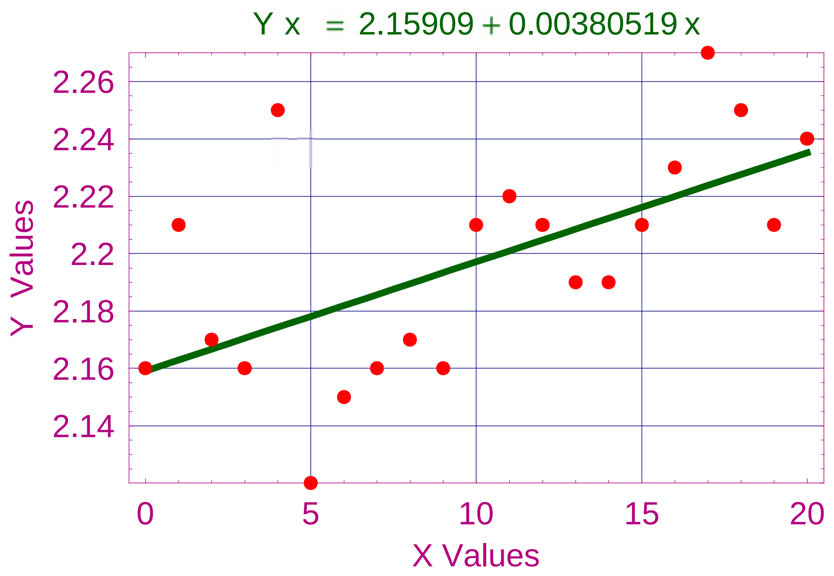
The regression function is determined and the regression line is visualized:

Input ▷
```
 → X y  ;
Clear x ;
regrLineY x_  = Fit data,  1, x , x
```

2.15909 + 0.00380519 x

Input ▷
```
 → Both Least Squares Lines ;
Clear x ; regrLineY x_  = Fit data,  1, x , x ;

MDSPlotDataRegressionLineY data,  x, regrLineY x  ,
    Epilog → Red, PointSize 0.02 , Point  data ,
    PlotStyle →  DarkGreen, Thickness 0.01
```



We determine the accuracy of the regression by the means of r^2:

Input ▹ **MDSPearsonCoeffReport data**

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}, \bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.605315	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 37. % explained	$\frac{\Sigma x_i}{n}, \frac{\Sigma y_i}{n}$ 10., 2.19714	$\frac{\sum(y_i-\hat{y}_i)^2}{n-2}$ 0.0318544
SS_{xy}	SS_{xx}	SS_{yy}	Data x – range
$\Sigma x_i y_i - \frac{\Sigma x_i \Sigma y_i}{n}$ 2.93	$\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 770.	$\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 0.0304286	x_{min}, x_{max} 0., 20.

r^2= 0.37 is closer to 0.36 than to our liking. For this reason, a new regression is peformed, this time on the period of 1992-2006. This time, x is years after 1992 and y is still the sea level in meters.

Input ▹
```
data = {{0, 2.15}, {1, 2.16}, {2, 2.17}, {3, 2.16}, {4, 2.21},
  {5, 2.22}, {6, 2.21}, {7, 2.19}, {8, 2.19}, {9, 2.21}, {10, 2.23},
  {11, 2.27}, {12, 2.25}, {13, 2.21}, {14, 2.24}}; Add ; data
```

```
{{0, 2.15}, {1, 2.16}, {2, 2.17}, {3, 2.16}, {4, 2.21},
 {5, 2.22}, {6, 2.21}, {7, 2.19}, {8, 2.19}, {9, 2.21},
 {10, 2.23}, {11, 2.27}, {12, 2.25}, {13, 2.21}, {14, 2.24}}
```

We perform linear regression as usual:

```
→ X y ;
```

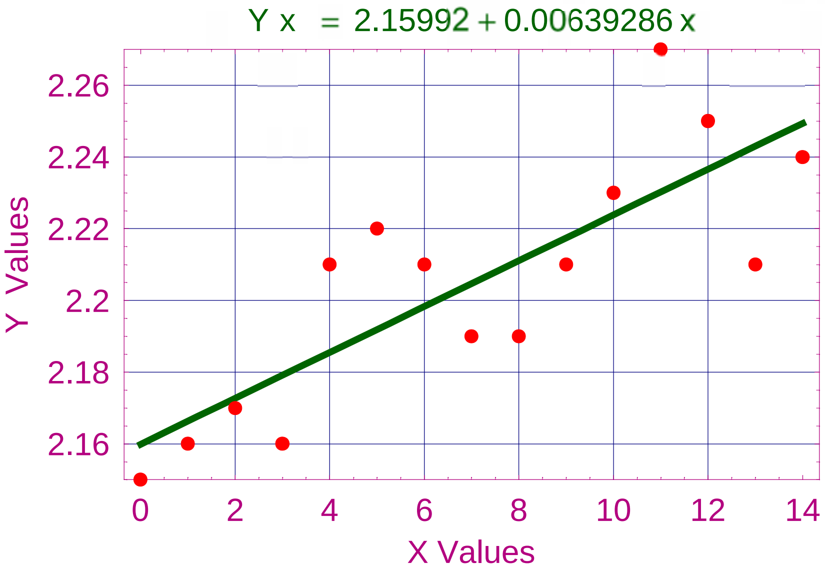
Input ▹
```
Clear x ;
regrLineY x_ = Fit data, 1, x , x
```

2.15992 + 0.00639286 x

The regression is visualized:

```
→ Both Least Squares Lines ;
Clear x ; regrLineY x_ = Fit data, 1, x , x ;
```

Input ▹
```
MDSPlotDataRegressionLineY data, x, regrLineY x ,
    Epilog → Red, PointSize 0.02 , Point data ,
    PlotStyle → DarkGreen, Thickness 0.01
```



This regression seems reasonable. We will ask *Mathematica* to calculate r^2 for us:

Input ▹
```
MDSPearsonCoeffReport data
```

Pearson Coefficient r Report

Pearson r	Determination	$\bar{x}, \bar{y}$	S_e
$\frac{SS_{xy}}{\sqrt{SS_{xx}\,SS_{yy}}}$ 0.816294	$\frac{\sum(\hat{y}_i-\bar{y})^2}{\sum(y_i-\bar{y})^2}$ 67. % explained	$\frac{\Sigma x_i}{n}, \frac{\Sigma y_i}{n}$ 7., 2.20467	$\sqrt{\frac{\sum(y_i-\hat{y}_i)^2}{n-2}}$ 0.0209947
SS_{xy}	SS_{xx}	SS_{yy}	Data x – range
$\Sigma x_i y_i - \frac{\Sigma x_i \Sigma y_i}{n}$ 1.79	$\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}$ 280.	$\Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}$ 0.0171733	x_{min}, x_{max} 0., 14.

r^2>>0.36, which means that Y[x] = 2.15992 + 0.00639286x is, in fact, a good regression. It is even better than the regression on temperature/time (|r^2 =0.60).
According to this model, the sea level in 2020 will be Y[(2020-1992)] = Y[28] =

Input ▹

```
 → X y ;
Clear x ;
regrLineY x_  = Fit data,  1, x , x ;
regrLineY 28      x value MUST be in data x-range *
```

```
2.33892
```

So we have two slightly different results from two different models:
The sea level in 2020 will be 2.31994 or 2.33892. Of course, these numbers are not to be taken too seriously, as we shall now discuss.

4 *Result and Summary*

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Results

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During our project we have found that:
- The connection between the average annual sea level and the yearly mean temperature in Reykjavik can approximately be described as a growing linear function.
- The temperature over the period of 1986-2006 has a linearly growing tendency. In the period of 1992-2006 there is an even more, very clear linear tendency.
- The sea level has evolved similarly to the temperature during the period of 1986-2006. Especially during 1992-2006 there is a clear, linear tendency.
- According to the two models that we have constructed, the sea level in Reykjavik 2020 will be 2.31994 m or 2.33892 m, respectively.

Discussion of Results

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It seems evident that there is, in reality, a general rise in temperature in Reykjavik which in turn will cause the sea level there to rise. These are the general tendencies which we have observed. These can, on a short term, probably be trusted. However, it is much too ambitious to make a forecast resulting in a 5-digit number; one should rather expect to be able to predict another tendency in turn.

In other words, the results we have come up with do not necessarily reflect reality - the factors contributing to the increase in both temperature and sea levels are too great in numbers and complexity to have all been a part of our calculations, thus making it very difficult to actually make an accurate forecast.

Some of the factors affecting the results are:

The water: The water from the melting of glaciers itself has an impact on the sea levels, making the sea levels higher. The reason for this is that the ice from the glacier is on land - this means that the ice from the glacier has not already been a part of the water mass which on the other hand is the case with icebergs. When icebergs melt they do not make the sea levels rise because the iceberg has already been a part of the water mass - this means that the water does not increase the height of the sea levels.

The melting: The glacier looses weight, resulting in rising of the landmasses, thereby having a "counter-impact" on the sea levels.

Salt: When the glaciers melt, the salt levels in the oceans will decrease, resulting in a change of the streams - salty water weighs more than pure water, thereby resulting in a possible dissolve of the Gulf Stream and many others. This could have multiple effects on countries near the streams, in particular Iceland, whose mild climate is mainly caused by same current.

Many other factors come in to play as well, but we shall let the geologists and meteoroligist keep their jobs.

To sum it all up, we have come to the conclusion that we are able to observe and predict certain tendencies, the most important and clear of these being that the temperature *is* in fact increasing and that this *will* result in the sea levels rising.

5 *Our Team*

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Participants

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Impression of Iceland

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We, the Danish group, came to Iceland Saturday afternoon. Our impression of Iceland was fantastic. The nature was more beautiful than the Danish nature in every aspect. The mountains, the wide landscapes with no signs of human interference and the fresh air were all impressions that we will all remember for a long time.

The Icelandic people are very hosbitable, and we felt that from the first moment when we entered our hosts' homes - we simply felt at home right away.

When it comes to the educational part of Iceland, we were all impressed with the fine conditions of the school, which we think beats many Danish schools in terms of both facilities and educational aspects. The students seem focused and willing to learn, and this is noticable almost instantly - and the students also show respect for the school, e.g. when all the students take off their shoes - this would almost never be seen in Denmark.

When that is said, we think that the cultural differences between Danes and Icelandic people are not that great, if noticable at all. The students adress their teachers by first name, a tendency not seen in many other European countries, e.g. Italy, Germany, and so on.

Icelandic impression and overall view on the project

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Over the last two days (9th-10th of November) we have been working on a project that involves the sea level rising and temperature changes around Iceland and Denmark. We had four Danish kids come visit us here in Iceland and we worked together using Mathematica 4, M@th desktop. Our experience working with the Danish kids was both fun and also a little challenging. We started working on the project on Monday and finished on Tuesday. We all had different ideas and options so it was fun mixing together two countries and combining our answers.

New Chapter Cut Last Chapter