Hanford Part #1a

Part 1: The Problem

In an article taken from the Journal of Environmental Health, May-June 1965, Volume 27, Number 6, pages 883-897, author Robert Fadely explains that the Atomic Energy Plant in Hanford, Washington has been a plutonium production facility since the Second World War. Some of the waste have been stored underground in the same area. Radioactive waste has been seeping into the Columbia River, and eight Oregon counties and the city of Portland have been exposed to radioactive contamination. The table below lists the number of cancer deaths per 100,000 residents for Portland and these counties. The table also includes an index of exposure that measures the proximity of the residents to the contamination. The index is based on the assumption that city or county exposure is directly proportional to river frontage and inversely proportional both to the distance from Hanford, WA site and to the square of the county's or city's average distance from the river.

Part 2: Table of Data Displayed

```
In[•]:= List1 := List[2.5, 2.6, 3.4, 1.3, 1.6, 3.8, 11.6, 6.4, 3.8]

In[•]:= List2 := List[147, 130, 130, 114, 138, 162, 208, 178, 210]

In[•]:= CombinedList := List[Transpose[{List1 , List2}]]

In[•]:= TableView[CombinedList]

Out[•]= TableView[{{{2.5, 147}, {2.6, 130}, {3.4, 130},
      {1.3, 114}, {1.6, 138}, {3.8, 162}, {11.6, 208}, {6.4, 178}, {3.8, 210}}}]
```

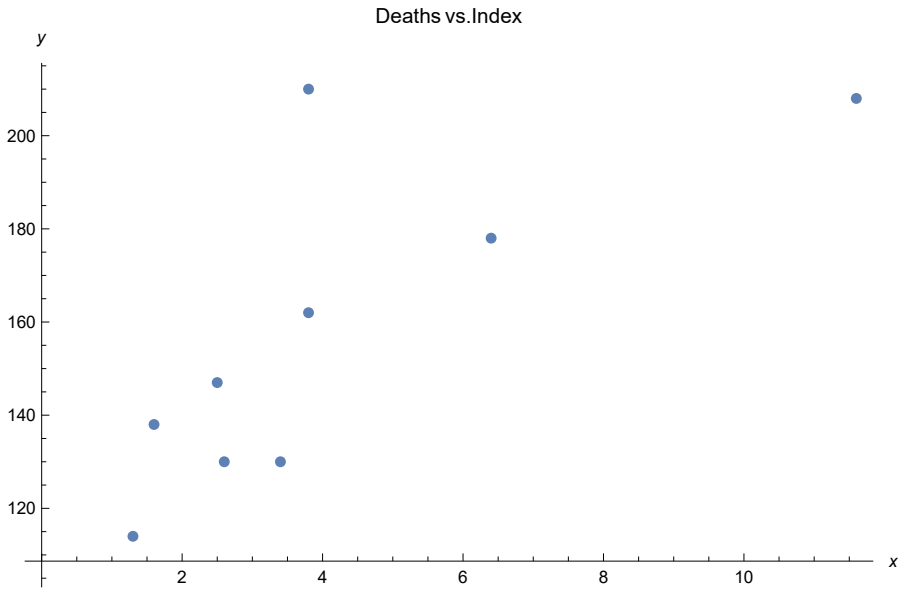
In[ ]:=
```
TableView[{{"Index", "Deaths"}, {2.5, 147}, {2.6, 130}, {3.4, 130},
  {1.3, 114}, {1.6, 138}, {3.8, 162}, {11.6, 208}, {6.4, 178}, {3.8, 210}}]
```

Out[ ]=

	1	2	3	4	5	6
1	Index	Deaths				
2	2.5	147				
3	2.6	130				
4	3.4	130				
5	1.3	114				
6	1.6	138				
7	3.8	162				
8	11.6	208				
9	6.4	178				
10	3.8	210				
11						
12						
13						
14						

In[ ]:=
```
Plot1 := ListPlot[CombinedList]
```

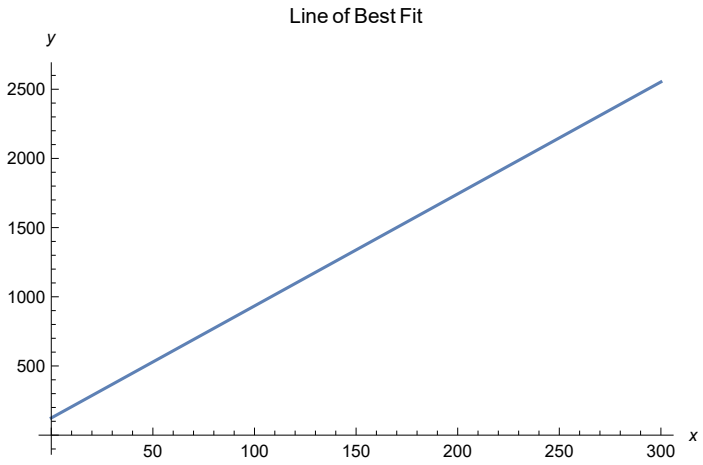
In[ ]:=
```
Show[%26, AxesLabel → {HoldForm[x], HoldForm[y]},
 PlotLabel → HoldForm[Deaths vs.Index], LabelStyle → {GrayLevel[0]}]
```



Part 3: Line of Best Fit

```
In[•]:= Part1 := Total[List1] / 9

In[•]:= Part2 := Total[List2] / 9

In[•]:= Part3 := Total[List1^2] / 9

In[•]:= Part4 := Total[List1 * List2] / 9

In[•]:= Slope := ((Part1 * Part2) - Part4) / ((Part1^2) - Part3)
        ((Part1 * Part2) - Part4) / ((Part1^2) - Part3)
Out[•]= 8.09598

In[•]:= YIntercept := Part2 - (Slope * Part1)
        Part2 - (Slope * Part1)
Out[•]= 124.161

        Plot2 := Plot[(Slope * x) + YIntercept, {x, 0, 300}]

In[•]:= Show[%49, AxesLabel → {HoldForm[x], HoldForm[y]},
         PlotLabel → HoldForm[Line of Best Fit], LabelStyle → {GrayLevel[0]}]
```

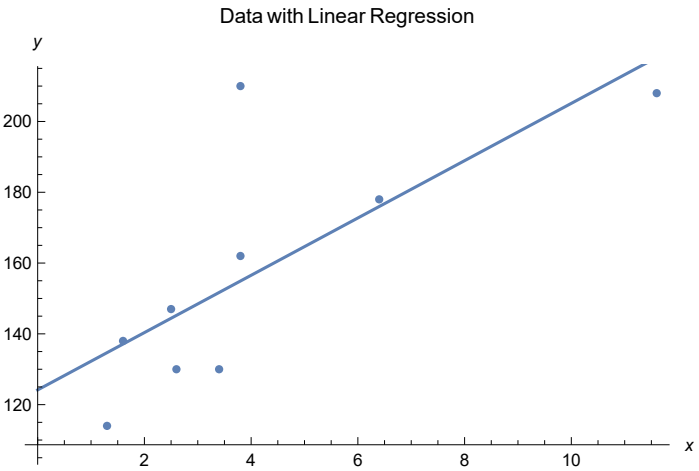
Out[•]=




```
In[•]:= Show[Plot1, Plot2]
```

In[ ]:=
```
Show[%53, AxesLabel → {HoldForm[x], HoldForm[y]},
 PlotLabel → HoldForm[Data with Linear Regression], LabelStyle → {GrayLevel[0]}]
```

Out[ ]=



Part 4: Finding Residuals

In[ ]:=
```
Predicted := (Slope * List1) + YIntercept
```

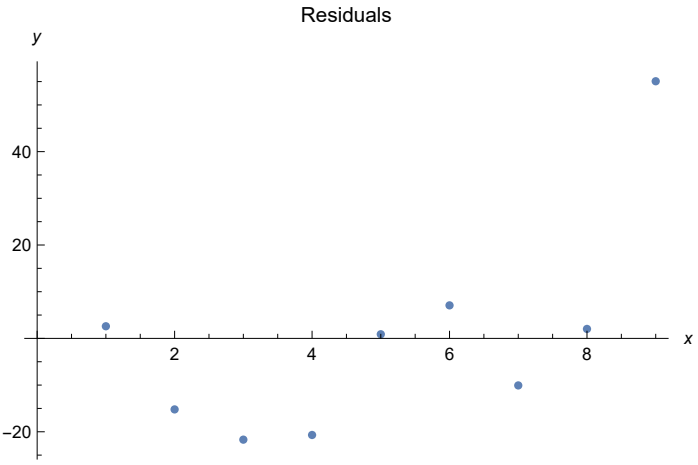
In[ ]:=
```
Residual1 := List2 - Predicted
List2 - Predicted
```

Out[ ]=
```
{2.59907, -15.2105, -21.6873, -20.6858, 0.885449, 7.0743, -10.0743, 2.02477, 55.0743}
```

In[ ]:=
```
ListPlot[Residual1]
```

In[ ]:=
```
Show[%66, AxesLabel → {HoldForm[x], HoldForm[y]},
 PlotLabel → HoldForm[Residuals], LabelStyle → {GrayLevel[0]}]
```

Out[ ]=



In[ ]:=
```
Total[Residual1]
```

Out[ ]=
```
-1.98952 × 10^-13
```

Part 5: Conclusion

The line of best fit, or the least squares line was found to be 8.09598x + 124.161. The sum of the residuals was -1.98952×10^{-13}. The residuals themselves ranged from -21.6873 to 55.0743.