Hanford Part #1

Krishna Purimetla
Due: November 24th, 2021

Question:

In[ ]:= In an article taken from the Journal of Environmental Health, 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 . Radio active 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 one thousand 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

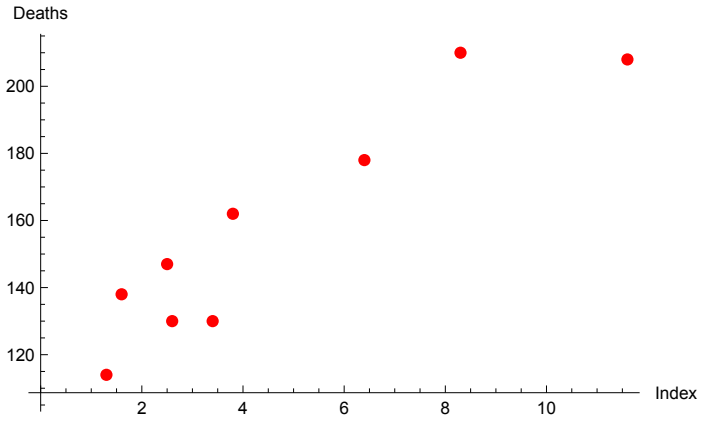
Table:

Out[ ]=

Location	Umatilla	Morrow	Gilliam	Sherman	Wasco	Hood River	Portland	Columbia	Clatsop
Index	2.5	2.6	3.4	1.3	1.6	3.8	11.6	6.4	8.3
Deaths	147	130	130	114	138	162	208	178	210

Graph:

Out[ ]=



Line Of Best Fit:

In[•]:=
```
n = Length[Index]
```

In[•]:=
```
Asum = Sum[Deaths[[i]]^2, {i, n}]
```

In[•]:=
```
Bsum = Sum[Index[[i]]^2, {i, n}]
```

In[•]:=
```
Csum = Sum[Index[[i]], {i, n}]
```

In[•]:=
```
Dsum = Sum[Deaths[[i]] * Index[[i]], {i, n}]
```

In[•]:=
```
Esum = Sum[Deaths[[i]], {i, n}]
```

y = m*x+b

m = (Dsum - b * Csum)/(Bsum)
b = (Esum - m * Csum)/(n)

m = (Dsum - ((Esum - m * Csum)/n)*Csum)/(Bsum)
m = (Dsum * n - Esum * Csum + m * Csum^2)/(n * Bsum)

With a little bit of rearranging:
m = (Dsum*n - Esum * Csum)/(Bsum * n - Csum^2)

In[•]:=
```
m = (Dsum * n - Esum * Csum) / (Bsum * n - Csum^2)
```

Out[•]=
```
9.27386
```

Slope of the Line of Best Fit

9.27386

b = (Esum - m * Csum)/(n)
m = (Dsum - b * Csum)/(Bsum)

b = (Esum - ((Dsum - b * Csum)/(Bsum))*Csum)/(n)
b = (Esum*Bsum - Dsum*Csum + b * Csum^2)/(n)

With a little bit of rearranging:
b = (Esum*Bsum - Dsum * Csum)/(Bsum * n - Csum^2)

In[•]:=
```
b = (Esum * Bsum - Dsum * Csum) / (Bsum * n - (Csum)^2)
```

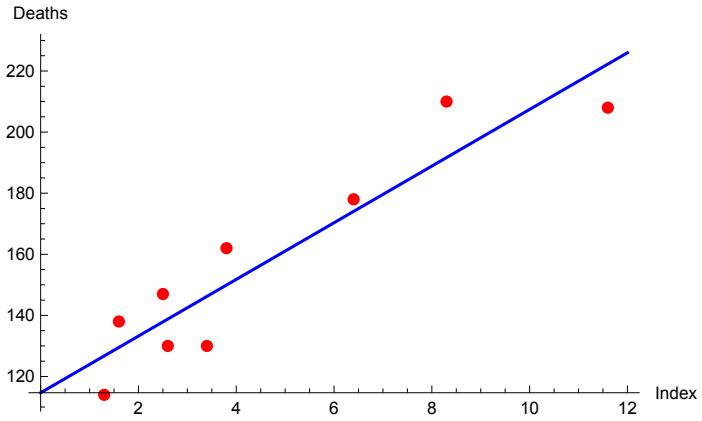
Out[•]=
```
114.682
```

Y- Intercept of the Line of Best Fit

114.682

y=mx+b
y=9.27386*x+114.682

In[ ]:=



Out[ ]=

Check:

Out[ ]= 114.682 + 9.27386 x

Residuals

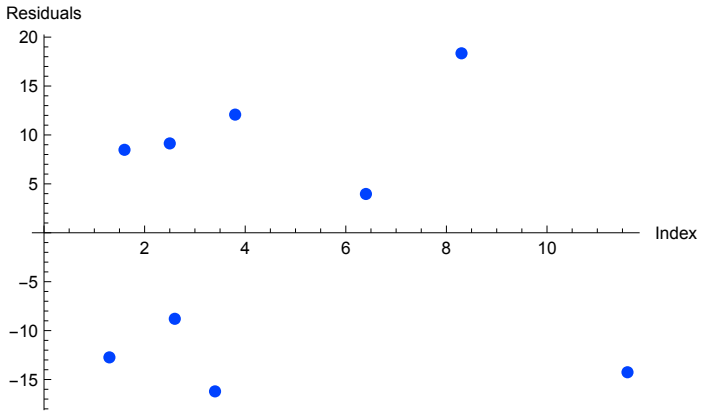
In[ ]:=
```
bestFit[x_] := m * x + b
bestFitVals := {}
For[i = 1, i ≤ Length[Index], i++, AppendTo[bestFitVals, bestFit[Index[[i]]]]]
```

In[ ]:=
```
Residuals = Deaths - bestFitVals
```

Out[ ]= {9.13371, -8.79367, -16.2128, -12.7376, 8.48019, 12.0777, -14.2585, 3.96564, 18.3453}

In[ ]:=

In[ ]:=
```
ListPlot[Transpose[{Index, Residuals}],
 PlotStyle → {RGBColor[0, 0.26, 1], PointSize[0.02]},
 AxesLabel → {HoldForm[Index], HoldForm[Residuals]},
 PlotLabel → None, LabelStyle → {GrayLevel[0]}]
```



Out[ ]=

In[•]:=

Minimum Value of The Sum of the Residuals (Basically Zero):

In[•]:= `Total[Residuals]`

Out[•]= 1.84741×10^{-13}