populations can grow exponentially if not restrained by predators or lack of food. The outbreaks that occasionally devastate the forests of the Northeast illustrate approximate growth. It is easier to count the number of acres defoliated by the moths than to count themselves. Here are data on an outbreak in Massachusetts.

<table>
<thead>
<tr>
<th>Year</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>63,042</td>
</tr>
<tr>
<td>1979</td>
<td>226,260</td>
</tr>
<tr>
<td>1980</td>
<td>907,075</td>
</tr>
<tr>
<td>1981</td>
<td>2,826,095</td>
</tr>
</tbody>
</table>

Plot the number of acres defoliated $y$ against the year $x$.

$\text{Acres vs Year since 1970}$

$\text{y vs x}$

$\text{curved}$

$\text{line is not appropriate}$

\[ \text{year since 1970} \]
that the pattern of growth appears exponential by finding a common ratio.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres</td>
<td>63,042</td>
<td>226,260</td>
<td>907,075</td>
<td>2,826,095</td>
</tr>
</tbody>
</table>

\[
\frac{226,260}{63,042} = 3.59
\]

\[
\frac{907,075}{226,260} = 4.01
\]

\[
\frac{2826095}{907075} = 3.12
\]
The logarithm of the acres and plot the logarithms against the year. What does this not reveal?

\[ \log(\text{acres}) \text{ vs } \text{yr} \]

Stat Plot: Type: 

\[ x\text{List: L1} \]
\[ y\text{List: L3} \]

Zoom 9

\[ \log(\text{Acres}) \text{ vs } \text{yr} \]
\[ \text{is linear} \]

Year since 1970
Find the least-squares regression line for the re-expressed data.

\[
\text{Reg } L_1, L_3
\]

\[
y = 0.3609 + 0.5558 \times (x)
\]

\[
(\text{Acres}) = 0.3609 + 0.5558 \times (\text{yr since 1970})
\]

New:

\[
x: \text{list: } L_1
\]

\[
y: \text{list: } L_3
\]

\[
r = 0.9993
\]

\[
R^2 = 0.9985: 99.85\%
\]
Construct and interpret a residual plot for $\log(acre)$ on year.

Stat, Plot (2nd y=)

1: Type: $\cdot$

X List: L1

Y List: Resid (2nd Stat, Resid)

Zoom 9

\[ \text{Random scatter } \rightarrow \text{ line is appropriate } \]

\[ \text{(logy vs x)} \]
\[ a^{m+n} = a^m \cdot a^n \quad \| \quad a^{mn} = (a^m)^n \]

Inverse transformation to express \( \hat{y} \) as an exponential equation.

\[
\log(\text{Acres}) = 0.3609 + 0.5558 (\text{yr})
\]

\[
\hat{\text{Acres}} = 10^{0.3609 + 0.5558 (\text{yr})}
\]

\[
\hat{\text{Acres}} = (10^{0.3609})(10^{0.5558})^{\text{yr}}
\]

\[
\hat{y} = (a)(b)^x \rightarrow \text{exponential}
\]

```
LC, EXP RE6   L1, L2, Y1
```

```
plot: x: list: l1
     y: list: l2
```
display a scatterplot of the original data with the exponential curve model superimposed. Is your exponential function a satisfactory model for the data?
S. Department of Health and Human Services characterizes adults as “seriously overweight” if they meet a certain weight criterion for their height as shown in the table below (only a portion of the table is reproduced here).

<table>
<thead>
<tr>
<th></th>
<th>58</th>
<th>60</th>
<th>62</th>
<th>64</th>
<th>66</th>
<th>68</th>
<th>72</th>
<th>74</th>
<th>76</th>
<th>78</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbs</td>
<td>138</td>
<td>148</td>
<td>158</td>
<td>169</td>
<td>179</td>
<td>190</td>
<td>213</td>
<td>225</td>
<td>238</td>
<td>250</td>
</tr>
</tbody>
</table>

Weights are given in pounds, without clothes. Height is measured without shoes. There is no distinction between men and women. Despite any reservations you may have about the department’s Body Mass Index standard for both genders, do the following:

Which is the explanatory variable? Make a scatterplot of the data.

8. Lin Reg: L1, L2
   Resid Plots: STAT PLOT
   XLIST: L1
   YLIST: Resid

Ht (in.)
Perform a transformation to linearize the data. Do a least-squares regression on the transformed data and check the correlation coefficient.

\[ \log(L1) \]  
\[ \log(L2) \]

Let \[ x = \log(L3) \]

Let \[ y = \log(L4) \]

Perform linear regression on \[ L3, L4 \]

\[ y = -1.39 + 2(x) \]

\[ \log(h+) = -1.39 + 2(\log h+) \]
Construct a residual plot of the transformed data. Interpret the residual plot.

\[ \text{log } wt \quad \text{vs} \quad \text{log } ht \]

Random scatter line is appropriate

\[ \text{log } wt \quad \text{is} \quad \text{linear} \]
In the inverse transformation and write the equation for your model.

\[
\hat{\log y} = -1.39 + 2 \cdot (\log x)
\]

\[
\log y = -1.39 + \log x^2
\]

\[
\log y - \log x^2 = -1.39
\]

\[
\log \left( \frac{y}{x^2} \right) = -1.39
\]

\[
\frac{y}{x^2} = 10^{-1.39}
\]

\[
\hat{y} = (0.0407) x^2
\]

\[
\hat{\omega} = (0.0407)(h+)^2
\]
model to predict how many pounds a 5’10” adult would have to weigh in order to be considered as “seriously overweight.”

\[ \hat{w}^+ = (0.0407)(h^+)^2 \]

\[ = (0.0407)(70)^2 \]

\[ \hat{w}^+ = 199.43 \text{ lbs} \]

\[ w^+ = -1.39 + 2(\log h^+) \]

\[ = -1.39 + 2(\log 70) \]

\[ \hat{w}^+ = 2.3002 \]

\[ \hat{w}^+ = 102.3002 = 199.62 \text{ lbs} \]