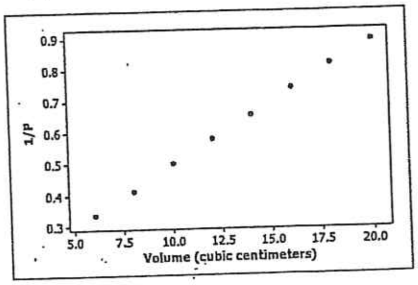
AP STAT Practice

(c) Use the graph below to identify the transformation that was used to linearize the curved pattern in part (a).

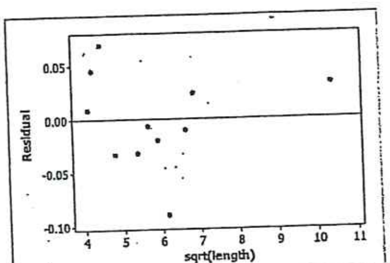


The swinging pendulum Refer to Exercise 33. Here is Minitab output from separate regression analyses of the two sets of transformed pendulum data:

Transformation 1: ($\sqrt{\text{length}}$, period)

ɔdictor	Coef	SE Coef	T	P
ɔstant	−0.08594	0.05046	−1.70	0.123
t ength)	0.209999	0.008322	25.23	0.000

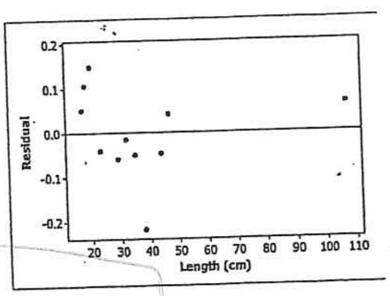
0.0464223 R-Sq = 98.6% R-Sq(adj) = 98.5%



Transformation 2: (length, period²)

ɔdictor	Coef	SE Coef	T	P
ɔstant	−0.15465	0.05802	−2.67	0.026
ɔth (cm)	0.042836	0.001320	32.46	0.000

0.105469 R-Sq = 99.2% R-Sq(adj) = 99.1%



Do each of the following for *both* transformations.

(a) Give the equation of the least-squares regression line. Define any variables you use.

(b) Use the model from part (a) to predict the period of a pendulum with length 80 centimeters. Show your work.

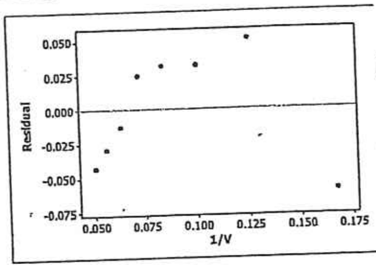
(c) Interpret the value of *s* in context.

36. **Boyle's law** Refer to Exercise 34. Here is Minitab output from separate regression analyses of the two sets of transformed pressure data: ✓ vs-pr.

Transformation 1: $\left(\frac{1}{\text{volume}}, \text{pressure}\right)$

Predictor	Coef	SE Coef	T	P
Constant	0.36774	0.04055	9.07	0.000
1/V	15.8994	0.4190	37.95	0.000

S = 0.044205 R-Sq = 99.6% R-Sq(adj) = 99.5%

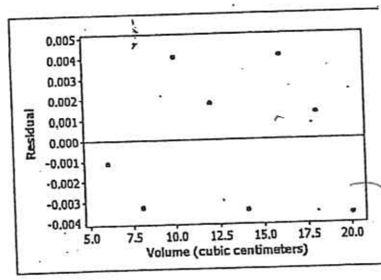


Curve

Transformation 2: $\left(\text{volume}, \frac{1}{\text{pressure}}\right)$ x, $\hat{\frac{1}{y}}$

Predictor	Coef	SE Coef	T	P
Constant	0.100170	0.003779	26.51	0.000
Volume	0.0398119	0.0002741	145.23	0.000

S = 0.003553 R-Sq = 100.0% R-Sq(adj) = 100.0%



Linear

Do each of the following for *both* transformations.

(a) Give the equation of the least-squares regression line. Define any variables you use.

(b) Use the model from part (a) to predict the pressure in the syringe when the volume is 17 cubic centimeters. Show your work.

(c) Interpret the value of *s* in context.

y = press
x = vol

36 (a) $\hat{y} = .3677 + 15.8994\frac{1}{x}$

(b) $\hat{\frac{1}{y}} = .10017 + .03981x$

(b) $\frac{1}{y} = .10017 + .0398119(17)$

$y = 1.287$

$\hat{y} = .36774 + 15.8994\left(\frac{1}{17}\right)$

$\hat{y} = 1.3029$

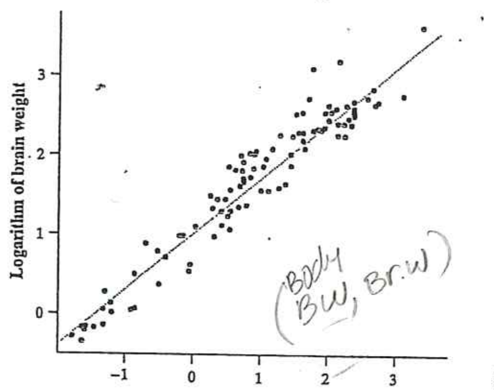
predicted pressure for volume of 17 cm³ approx same in Both cases

Give the equation of the least-squares regression line. Be sure to define any variables you use.

(d) Use your model to predict the light intensity at a depth of 12 meters. The actual light intensity reading at that depth was 16.2 lumens. Does this surprise you? Explain.

39. **Brawn versus brain** How is the weight of an animal's brain related to the weight of its body? Researchers collected data on the brain weight (in grams) and body weight (in kilograms) for 96 species of mammals.[19] The figure below is a scatterplot of the logarithm of brain weight against the logarithm of body weight for all 96 species. The least-squares regression line for the transformed data is

$$\widehat{\log y} = 1.01 + 0.72 \log x$$



Based on footprints and some other sketchy evidence, some people think that a large apelike animal, called Sasquatch or Bigfoot, lives in the Pacific Northwest. His weight is estimated to be about 280 pounds, or 127 kilograms. How big is Bigfoot's brain? Show your method clearly.

40. **Determining tree biomass** It is easy to measure the "diameter at breast height" of a tree. It's hard to measure the total "aboveground biomass" of a tree, because to do this you must cut and weigh the tree. The biomass is important for studies of ecology, so ecologists commonly estimate it using a power model. Combining data on 378 trees in tropical rain forests gives this relationship between biomass y measured in kilograms and diameter x measured in centimeters:[20]

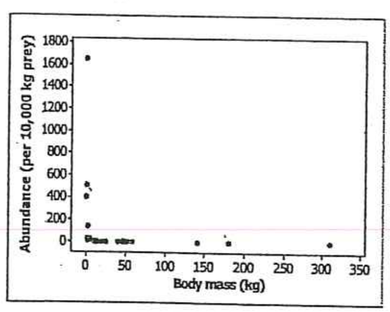
$$\widehat{\ln y} = -2.00 + 2.42 \ln x$$

Use this model to estimate the biomass of a tropical tree 30 centimeters in diameter. Show your work.

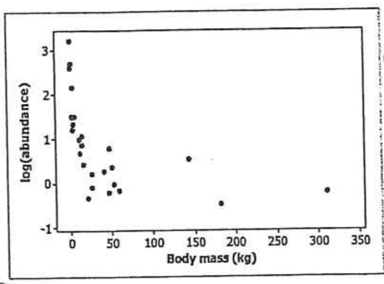
41. **Counting carnivores** Ecologists look at data to learn about nature's patterns. One pattern they have found relates the size of a carnivore (body mass in kilograms) to how many of those carnivores there are in an area. The right measure of "how many" is to count carnivores per 10,000 kilograms (kg) of their prey in the area. The table below gives data for 25 carnivore species.[21]

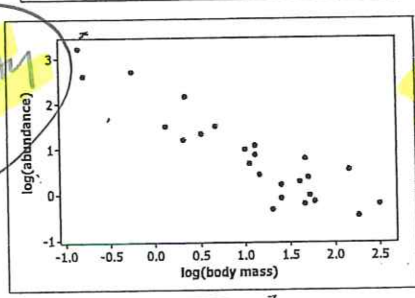
Carnivore species	Body mass (kg)	Abundance (per 10,000 kg of prey)
Least weasel	0.14	1656.49
Ermine	0.16	406.66
Small Indian mongoose	0.55	514.84
Pine marten	1.3	31.84
Kit fox	2.02	15.96
Channel Island fox	2.16	145.94
Arctic fox	3.19	21.63
Red fox	4.6	32.21
Bobcat	10.0	9.75
Canadian lynx	11.2	4.79
European badger	13.0	7.35
Coyote	13.0	11.65
Ethiopian wolf	14.5	2.70
Eurasian lynx	20.0	0.46
Wild dog	25.0	1.61
Dhole	25.0	0.81
Snow leopard	40.0	1.89
Wolf	46.0	0.62
Leopard	46.5	6.17
Cheetah	50.0	2.29
Puma	51.9	0.94
Spotted hyena	58.6	0.68
Lion	142.0	3.40
Tiger	181.0	0.33
Polar bear	310.0	0.60

Here is a scatterplot of the data.



(a) The following graphs show the results of two different transformations of the data. Would an exponential model or a power model provide a better description of the relationship between body mass and abundance? Justify your answer.





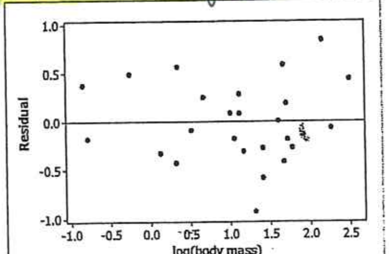
(b) Minitab output from a linear regression analysis on the transformed data of log(abundance) versus log(body mass) is shown below. Give the equation of the least-squares regression line. Be sure to define any variables you use.

```
Predictor    Coef      SE Coef    T       P
Constant     1.9503    0.1342     14.53   0.000
log(body    −1.04811   0.09802   −10.69   0.000
 mass)

S = 0.423352  R-Sq = 83.3%  R-Sq(adj) = 82.5%
```

(c) Use your model from part (b) to predict the abundance of black bears, which have a body mass of 92.5 kilograms. Show your work.

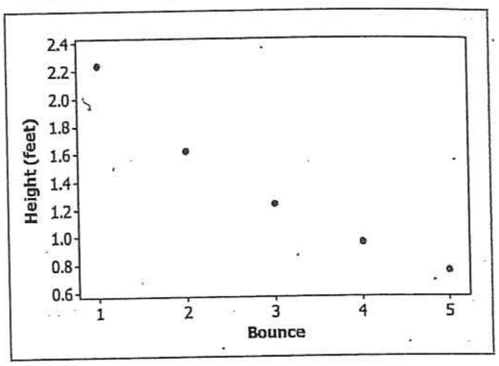
(d) A residual plot for the linear regression in part (b) is shown below. Explain what this graph tells you about how well the model fits the data.



42. **Follow the bouncing ball** Students in Mr. Handford's class dropped a kickball beneath a motion detector. The detector recorded the height of the ball as it bounced up and down several times. Here are the heights of the ball at the highest point on the first five bounces:

Bounce number	Height (feet)
1	2.240
2	1.620
3	1.235
4	0.958
5	0.756

Here is a scatterplot of the data:



(a) The following graphs show the results of two different transformations of the data. Would an exponential model or a power model provide a better description of the relationship between bounce number and height? Justify your answer.