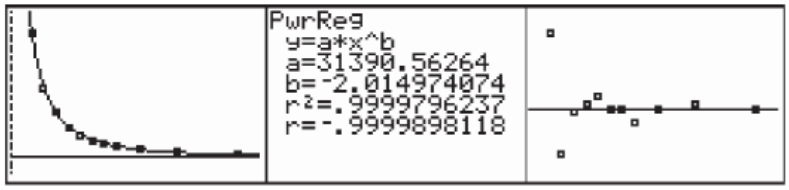
Homework Answers:

32. Brightness.

a) The relationship between brightness and distance is not linear. The scatterplot shows an association that is quite curved.



b) The scatterplot, power regression output, and residuals plot for the model $\widehat{Brightness} = 31391(Distance^{-2.015})$ is provided. There are some larger residuals at short distances, but otherwise the residuals are quite small and appear random.

c) A projector 18 feet from the screen is predicted to have brightness of approximately 93 candlepower.

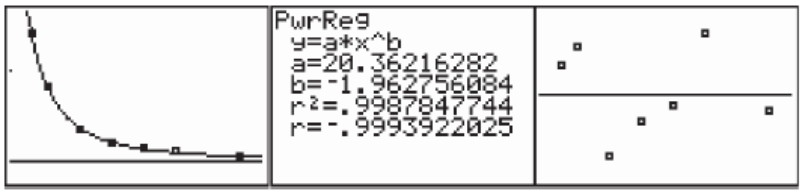
$\widehat{Brightness} = 31391(Distance^{-2.015})$

$\widehat{Brightness} = 31391(18^{-2.015})$

$\widehat{Brightness} \approx 92.78$

d) The model has an exponent very close to -2, suggesting that light intensity follows the inverse square law.

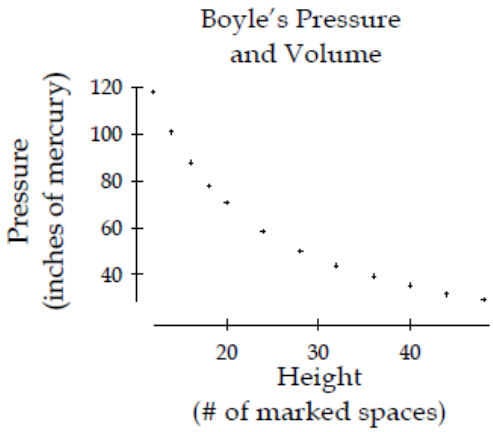
34. Down the drain.



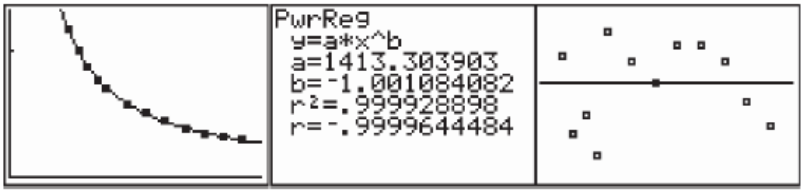
The association between diameter of the drain plug and drain time of this water tank is strong, curved, and negative. Tanks with larger drain plugs have lower drain times. The linear model is not appropriate for the curved association. The scatterplot, power regression output and residuals plot for the model $\widehat{Time} = 20.362(Diameter^{-1.96})$ are provided. The residuals are fairly random, so the model is appropriate.

35. Pressure.

The scatterplot at the right shows a strong, curved, negative association between the height of the cylinder and the pressure inside. Because of the curved nature of the association, a linear model is not appropriate.

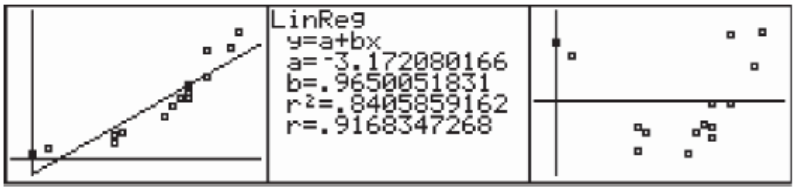


A scatterplot with curve, the power regression output, and the residuals plot for the model $Pressure = 1413.3(Height^{-1.001})$ are shown below. The residuals are small and show reasonable scatter, so the model is appropriate.



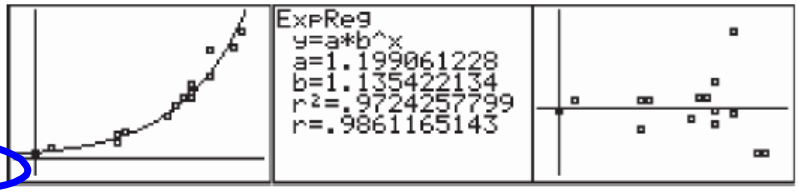
36. Baseball salaries 2005.

a) The scatterplot of year versus highest salary is moderately strong, positive and possibly curved, yet straight enough to try fitting a linear model. The highest salary has generally increased over the years.



b) The linear model, $\widehat{Salary} = -3.172 + 0.965(Year)$ is not an appropriate model. The residuals plot shows a strong bend.

c) A scatterplot , the exponential regression output, and the residuals plot for the model $\widehat{Salary} = 1.2(1.135^{Year})$ are shown. The residuals are small and show reasonable scatter, so the model is appropriate.



What Have We Learned?

- When the Straight Enough Condition fails, we may be able to fit a curved model to the relationship.
  - We can try an exponential or power model.
  - We decide whether the model is appropriate by looking for random scatter in the residuals plot.
- Our models won' be perfect, but may be useful.
  - Some curvature may be okay provided the residuals are very small.
  - Some relationships are too complex to be described by these simple models.

*Name*_____ ***Statistics Chapter 8: Review B***

For each set of data, find the better model (linear, power, or exponential) and the prediction requested. Be sure to be able to justify your choice of model.

1. World Population (United Nations database)
   a) Model

   b) Prediction for year 30? _____

   c) Prediction for 2005? _____

Years since 1949	Population (millions)
1	2526
6	2762
11	3026
16	3329
21	3691
26	4071
31	4449
36	4864
41	5321
46	5742
51	6128
56	6514
61	6916

2. Mortgages (Republic National Bank, founded 1970)
   a) 1970 – 1988 Model (Scale the years somehow…)

   b) Predict total of mortgages for 1992.

years since 1968

	Year	Million $
2	1970	1.2
4	1972	2.5
6	1974	2.9
8	1976	3.1
10	1978	5.8
12	1980	8.3
14	1982	10.8
16	1984	14.7
18	1986	21.8
20	1988	29.7

3. Light Intensity
   a) Model

   b) Intensity at
      1'? _____

      12'? _____

      30'? _____

Distance	Candlepower
2 feet	531.2
5	84.3
8	33.6
10	21.1
15	9.5
20	5.3
25	3.4

4. Write an equation for each context below.

Context	*Equation*
a) Sales tax (T) is 8% on every dollar (D)	$T = 0.08D$
b) The final cost of a taxable item (C) is 108% of its ticket price (P).	
c) The population (P) of a town (current population 2,000) increases by 50 people every year (Y).	
d) The population another town (current population 2,000) increases 50% every year.	
e) After 50 cc of a medicine (M) is ingested, 3.5% will break down in the body each hour (H).	
f) After 50 gallons of water (W) is poured into a barrel. 3.5 gallons will leak out each hour (H).	

Statistics Chapter 8: Review B – KEY

For each set of data, find the better model (linear, power, or exponential) and the prediction requested. Be sure to be able to justify your choice of model.

1. World Population (United Nations database)

a) Model

Population = world population in millions
Years = years since 1949
$\widehat{Population} = 2541.114(1.0174)^{Years}$

Years since 1949	Population (millions)
1	2526
6	2762
11	3026
16	3329
21	3691
26	4071
31	4449
36	4864
41	5321
46	5742
51	6128
56	6514
61	6916

b) Prediction for year 30? _____
4,264,000,000 people

c) Prediction for ~~2015~~ 2005? _____ year = 56
7,935,000,000 people
6,676,690,017 or 6,677,000
(depends on how you rounded)

2. Mortgages (Republic National Bank, founded 1970)

a) 1970 – 1988 Model (Scale the years somehow…)

Mortgage = Mortgages at Republic National Bank in millions of dollars
Years = years since 1968
$\widehat{Mortgage} = 0.996(1.186)^{Years}$

Year	Million $
1970	1.2
1972	2.5
1974	2.9
1976	3.1
1978	5.8
1980	8.3
1982	10.8
1984	14.7
1986	21.8
1988	29.7

b) Predict total of mortgages for 1992.

$59,700,000

3. Light Intensity

a) Model

Distance = distance from the light source in feet
CP = light intensity in candle power
$\widehat{CP} = 2120.87(Distance)^{-2.00}$

Distance	Candlepower
2 feet	531.2
5	84.3
8	33.6
10	21.1
15	9.5
20	5.3
25	3.4

b) Intensity at
1'? 2120.9 cp

12'? 14.8 cp

30'? 2.4 cp

4. Write an equation for each context below.

Context	*Equation*
a) Sales tax (T) is 8% on every dollar (D)	$T = 0.08D$
b) The final cost of a taxable item (C) is 108% of its ticket price (P).	$C = 1.08P$
c) The population (P) of a town (current population 2,000) increases by 50 people every year (Y).	$P = 2000 + 50Y$
d) The population another town (current population 2,000) increases 50% every year.	$P = 2000(1.50)^Y$
e) After 50 cc of a medicine (M) is ingested, 3.5% will break down in the body each hour (H).	$M = 50(0.965)^H$
f) After 50 gallons of water (W) is poured into a barrel. 3.5 gallons will leak out each hour (H).	$W = 50 - 3.5H$