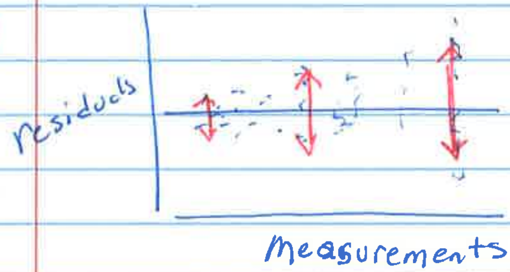
12.1 HW   #'s 1, 4, 6, 8, 9, 11, 13, 17, 19

①



NOTICE THE RESIDUAL INCREASE. THIS INDICATES THE VARIANCES OF THE RESIDUALS INCREASES AS LAB MEASUREMENTS INCREASE THE CONDITION "FOR EQUAL VARIANCES" IS NOT MET

④ CONDITIONS TO CHECK FOR REGRESSION INFERENCE

- UNKNOWN POPULATION STD DEV (σ) – t inference
- RANDOM – THIS WAS A RANDOMIZED EXPERIMENT.
- INDEPENDENT – # OF DRINKS RANDOMLY ASSIGNED
- LINEAR – TO CHECK THIS CONDITION YOU MUST LOOK AT A RESIDUAL PLOT. REVIEWING THE RESIDUAL PLOT, THERE IS NO PATTERN TO THE RESIDUALS CONFIRMING A LINEAR MODEL HAS BEEN CONFIRMED
- NORMAL – TO CHECK THIS CONDITION YOU CAN LOOK AT A HISTOGRAM OR BOX PLOT OF THE RESIDUALS. REVIEWING THE HISTOGRAM, THE SHAPE OF THE RESIDUALS IS APPROXIMATELY SYMMETRIC WITH NO SKEWNESS OR OUTLIERS
- EQUAL VARIANCES – TO CHECK THIS CONDITION YOU CAN LOOK AT A RESIDUAL PLOT OR SCATTER PLOT. REVIEWING THE RESIDUAL PLOT, IT SHOWS ROUGHLY EQUAL SCATTER FOR ALL X VALUES

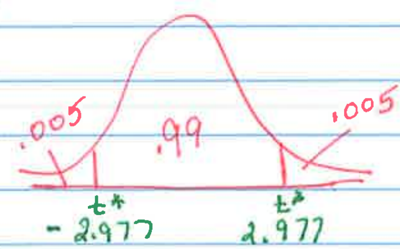
(6) α = y intercept THE Y INTERCEPT IS THE STARTING POINT. IN THIS CASE, IT WOULD MEASURE THE BAC LEVEL IF NO BEERS WERE DRANK. WE WOULD EXPECT IT TO BE ZERO AND IT IS VERY SMALL. The point esimate is $a = -.01$ for α

β = slope IN CONTEXT ... It tells us how much the BAC increases, ON average, WITH EACH ADDITIONAL BEER DRANK. THE ESTIMATE FOR THIS PARAMETER. The point estimate $b = .018$ for β.

σ measures the standard deviation of BAC values about the population regression line. The point estimate is $s = .0204$ for σ.

(8) (A) $SE_b = .0024$ IF WE REPEATED THE EXPERIMENT MANY TIMES, THE SLOPE OF THE SAMPLE REGRESSION LINE WOULD TYPICALLY VARY BY ABOUT .0024 from the true slope of the population regression line for predicting BAC level from the number of beers consumed.

(B)



$df = n - 2 = 16 - 2 = 14$

$t^* = \text{invT}(.005, 14) = -2.977$

$b = .018$

$SE_b = .0024$

$\boxed{\text{T INTERVAL FOR LSRL}}$ ← see Green Sheet for CI formula

$99\%\ CI = b \pm t^* \cdot SE_b$

$.018 \pm 2.977\,(.0024)$ ← SE

$.018 \pm .0071$ ← ME

$\boxed{(.0109, .0251)}$

This is a review of interpreting in context - CONFIDENCE INTERVAL VS CONFIDENCE LEVEL

8 C We are 99% confident that the interval from 0.011 to 0.025 captures the true slope of the population regression line for predicting BAC level from the number of beers consumed

Confidence Interval

D If we were to repeat the experiment many times and compute confidence intervals for the regression slope in each case, about 99% of the resulting intervals would contain the slope of the population regression line.

Confidence Level

(9) TEST: 99% Confidence Interval for β

DEFINE Parameter: β = true slope of the population regression line relating number of stumps to number of clusters of beetle larvae

CONDITIONS: stated conditions were met.

MECHANICS: 99% CI: $b \pm t^* S_b$

$11.894 \pm 2.831(1.136)$

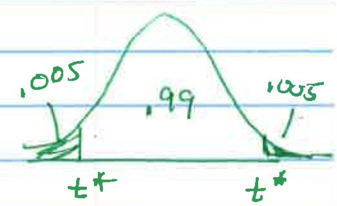
11.894 ± 3.216

$\boxed{(8.678, 15.11)}$

$b = 11.894$

$S_b = 1.136$

$df = 23 - 2 = 21$



$t^* = 2.831$

invT(.005, 21)

CONCLUDE:

WE ARE 99% confident that the interval from 8.678 to 15.11 captures the true slope of the population regression line for predicting clusters of beetle larvae from the number of stumps

(11) (A) $\widehat{\text{LARVAE}} = -1.286 + 11.894 \text{ (STUMPS)}$
$= -1.286 + 11.894(5)$
$= 58.184$ larvae clusters

(B) We would expect our predictions to be off, on average, by about $s = 6.419$ clusters of beetle larvae

(13) [A] SCATTER PLOTS - DESCRIBE STRENGTH, FORM, DIRECTION
DIRECTION - NEGATIVE
FORM - LINEAR
STRENGTH - MODERATE TO WEAK

IN CONTEXT: THE SCATTER PLOT SUGGESTS A SOMEWHAT WEAK/MODERATE, NEGATIVE, LINEAR RELATIONSHIP BETWEEN THE NUMBER OF WEEKS PER METER AND THE CORN YIELD OF THE PLOTS

[B] OPTION 1
USE MEANINGFUL VARIABLE NAMES ⟶ $\widehat{\text{CORN}} = 166.483 - 1.0987\text{(WEEDS)}$

OPTION 2
MUST DEFINE VARIABLES ⟶ $\hat{y} = 166.483 - 1.0987x$
$\hat{y}$ = predicted corn yield
x = number of weeds per meter

[C] y intercept: (starting point) The y intercept says that if there are NO weeds ($x=0$), we would predict a corn yield of about 166.5 bushels
Slope: The slope says that for each additional weed per meter, we can expect the average corn yield to decrease by about 1.10 bushels

13D TEST: One-Sample t-test for β $\alpha = .05$

$H_0: \beta = 0$ ← meaning there is No linear relationship between the 2 variables

$H_A: \beta < 0$

where: β is the true slope of the population regression line relating weeds per meter to corn yield.

must Define β

CONDITIONS UNKNOWN σ → t inference

Random – This was a randomized experiment.

Independent – Due to the random assignment, THE OBSERVATIONS can be viewed as independent

LINEAR – the scatter plot (provided) shows a linear relationship but you must check the residual plot to check the linear model was appropriate

RESIDUAL PLOT

CALC COMMANDS

1. ENTER DATA IN L1 + L2
2. TO POPULATE RESIDUALS

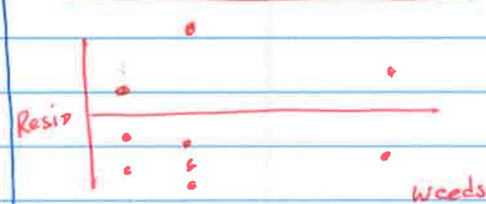
   STAT TESTS F: LINREGTTEST
3. 2ND STAT PLOT ON

   TYPE [scatter icon] Scatter

   ~~X~~LIST RESID ← 2ND LIST 8: RESID

   ~~X~~LIST L2
4. ZOOM 9: STAT PLOT

SKETCH THE RESIDUAL PLOT



The Residual plot shows No pattern therefore the model appears linear

EQUAL VARIANCES – Both the scatter plot (given) and the residual plot above show roughly EQUAL SCATTER FOR ALL X VALUES

You do NOT need to do Both graphs either would be fine

(CONT) →

13D Continued

Conditions (Continued):

NORMAL: SKETCH EITHER HISTOGRAM OR BOX PLOT FOR RESIDUALS

HISTOGRAM OF Residuals

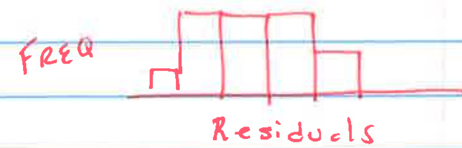
2ND STAT PLOT

TYPE: histogram

XLIST: RESID ← 2ND LIST 8: RESID

ZOOM 9

(1) BASED ON THE HISTOGRAM, THE RESIDUALS ARE APPROX. SYMMETRIC WITH NO OUTLIERS



BOX PLOT OF RESIDUALS

2ND STAT PLOT

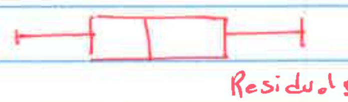
TYPE: box plot

XLIST: RESID ← 2ND LIST 8: RESID

FREQ: 1

ZOOM 9

OR (2) BASED ON THE BOX PLOT THE RESIDUALS APPEAR SYMMETRIC WITH NO OUTLIERS



MECHANICS $t = -1.923$ $df = 14$

STAT TESTS F: LINREGTTEST L1 L2 1 <0

pvalue $= .037$ (NOTICE: Computer output pvalue is .075 because this is a 2 tail test. For a 1 tail test divide $.075/2 = .0375$)

Conclusion: Since the pvalue (.037) is less than .05, we reject the null hypothesis. And conclude that there is convincing evidence of a negative linear relationship between weeds per meter and corn yield.

(17) (a) 99% CI $= b \pm t^* SE_b$

$.79021 \pm 2.977(.07104)$

$.79021 \pm .21147$

$\boxed{(.57874, 1.00168)}$

From Computer Output

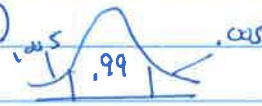
$b = .79021$

$S_b = .07104$

$df = 16 - 2 = 14$

$t^* = 2.977$

invT(.005, 14)



(b) IF ONE METHOD OF MEASURING WEAR GIVES AN INCREASE OF 1 UNIT, WE HOPE THAT THE OTHER WAY OF MEASURING WEAR WOULD ALSO GIVE AN INCREASE OF 1 UNIT, THIS TRANSLATES TO A SLOPE OF 1

(c) Since the confidence interval (.58, 1.00) Contains 1, it suggests that the slope could plausibly be 1. SO WE WOULD NOT reject H_0 and have convincing evidence the slope is 1.

(19) (A) TEST: TTEST FOR β $\alpha = .05$

H_0: $\beta = 0$ β = the true slope of the population regression line relating wine consumption to heart disease death rate

H_a: $\beta < 0$

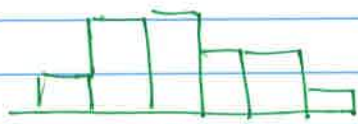
CONDITIONS

Random – the data came from a random sample

Independent – there are more than 10(19) = 190 Countries

Linear – the scatter plot shows approx. linear association

NORMAL – looking at a boxplot OR histogram shows the residuals are approx. Normal



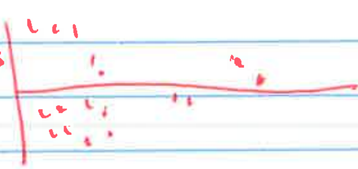
STAT PLOT Box PLOT → Resid

STAT PLOT HISTOGRAM

Residual ← 2ND LIST

8: RESID

EQUAL VARIANCE: LOOKING AT THE RESIDUAL PLOT SHOWS ROUGHLY EQUAL FOR SCATTER OF X VALUES



STAT PLOT Scatter plot

XLIST: L1

YLIST: RESID

MECHANICS DF = 19 − 2 = 17

$t = -6.46$

pvalue = 2.6E−6 ≈ 0

STAT TESTS

F: LINREGTTEST

XLIST: L1

YLIST: L2

<0

19A (continued)

Since the pvalue is very small we reject H_0 and and conclude that there is convincing evidence of a negative linear relationship between wine consumption and death rate due to heart disease.

19B TEST: 95% CI for β

CONDITIONS: CHECK IN TOH (19A)

INTERVAL (-30.47, -15.46)

CONCLUDE: WE ARE 95% confident that the interval -30.47 to -15.46 captures the true slope of the population regression line for predicting heart disease death rate from wine consumption

TEST

G: LINREGTINT

XLIST: L1

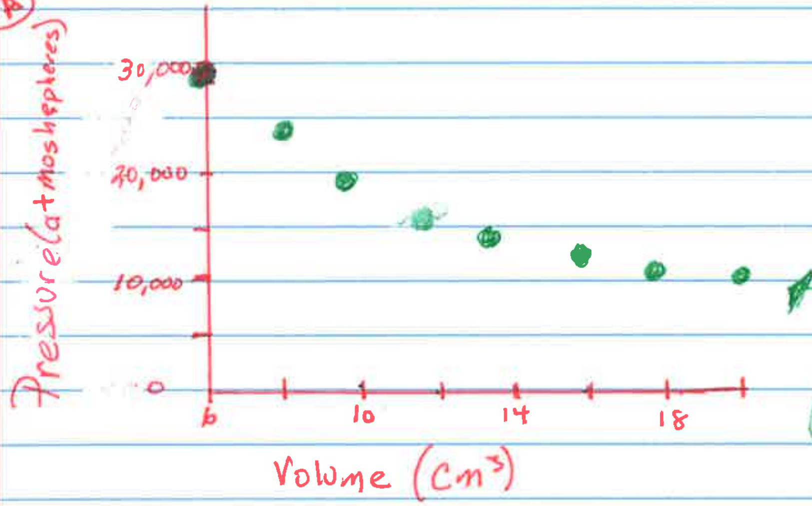
YLIST: L2

FREQ: 1

CLEVEL: .95

12.2 HW #'s 34 + 35

34 A



SetWindow

Xmin: 6 Ymin = 0

Xmax 22 Ymax = 30,000

Xscl = 2 Yscl : 5,000

IF YOU SEE A GRAPH LIKE THIS THE TRANSFORMATION OF X AND 1/Y OR 1/X AND Y

b

$$\frac{PV}{V} = \frac{k}{V}$$

$$P = \frac{1}{V}(K)$$

EXPLANATORY VARIABLE IS RECIPROCAL OF VOLUME $\left(\frac{1}{V}\right)$

RESPONSE VARIABLE IS THE PRESSURE

c

$$\frac{PV}{P} = \frac{K}{P}$$

$$V = \frac{1}{P}(K)$$

EXPLANATORY VARIABLE IS RECIPROCAL OF PRESSURE (1/P)

RESPONSE VARIABLE IS THE VOLUME

TRANSFORMATION 1

35 (A) USING x+y : $\hat{y} = -.08594 + .21\sqrt{x}$

where y = the period, x = the length — must define Variables

remember $\sqrt{x} = x^{1/2}$

recommend using names !!!

$\widehat{\text{period}} = -.08594 + .21(\text{length})^{1/2}$

TRANFORMATION 2

$\widehat{\text{period}^2} = -.155 + .0428(\text{length})$

(B) Predict period when length is 80 cm

TRANSFORMATION 1

$\widehat{\text{period}} = -.08594 + .21\sqrt{80}$

$\boxed{\widehat{\text{period}} = 1.79 \text{ seconds}}$

TRANSFORMATION 2

$\widehat{\text{period}^2} = -.155 + .0428(80)$

$\sqrt{\widehat{\text{period}^2}} = \sqrt{3.269}$

$\boxed{\widehat{\text{period}} = 1.81 \text{ seconds}}$

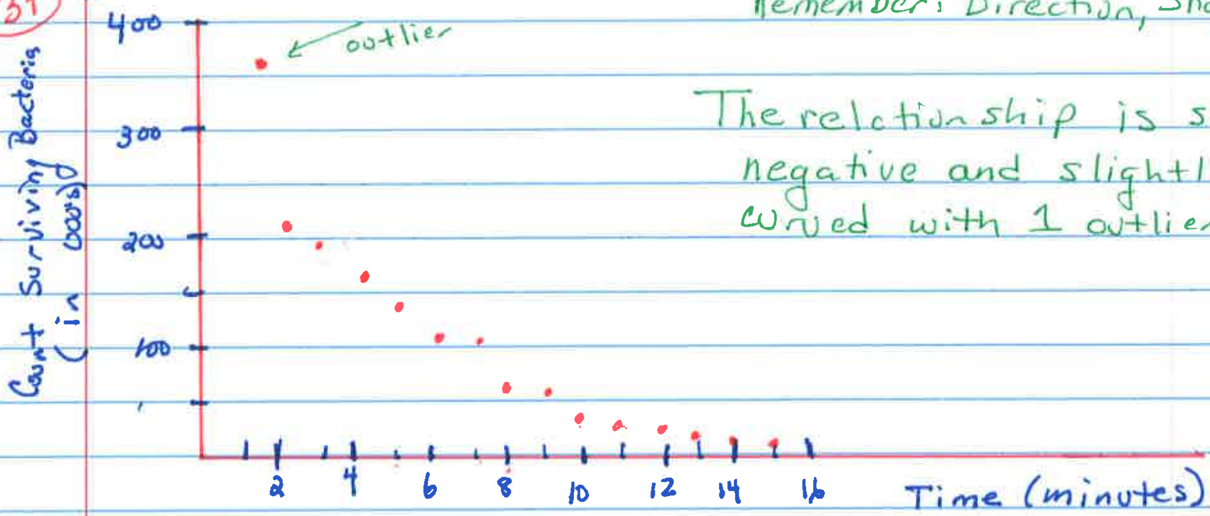
(C) TRANSFORMATION 1 $S = .046 \rightarrow$ The typical distance that a predicted value of the period will be from the actual value is about 0.046 seconds.

TRANSFORMATION 2 $S = .105 \rightarrow$ The typical distance that the SQUARE OF A PREDICTED VALUE OF THE PERIOD WILL BE FROM SQUARE OF THE ACTUAL VALUE IS ABOUT 0.105 seconds SQUARED

12.2 HW #'s 37, 39, 40, 41, 44

37

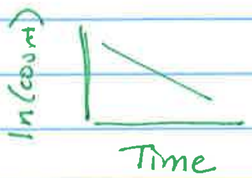
A



Remember: Direction, Shape, Strength

The relationship is strong negative and slightly curved with 1 outlier.

B



Since the graph of the explanatory variable against the natural log of the response variable is fairly linear, an exponential model would be reasonable.

C The LSRL is $\widehat{\ln \text{bacteria}} = 5.973 - 0.218(\text{time})$

D predict bacteria when time is 17 minutes

$\widehat{\ln \text{bacteria}} = 5.973 - 0.218(17)$

$e^{\widehat{\ln \text{bacteria}}} = e^{2.267}$

remember to undo ln raise both to a power of e

$\widehat{\text{bacteria}} = 9.65$ ← 2ND e^x 2.267

$= 965$ bacteria

Since the residual plot shows a random scatter plot around the value 0, we'd expect this predicted value to be about right

(39) $\widehat{\log y} = 1.01 + .72 \log x$

$\widehat{\log \text{brain}} = 1.01 + .72 \log(\text{weight})$ weight = 127 kg

$= 1.01 + .72 \cdot \log(127)$

$\widehat{\log \text{brain}} = 2.525$

$10 \qquad 10$

To undo log's
Use 10 as the base

$\widehat{\text{brain}} = 334.97$

10 ^ 2.525

The predicted brain size for Sasquatch is about 335 grams.

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

$\widehat{\ln \text{biomass}} = -2.00 + 2.42 \cdot \ln(\text{diameter})$ diameter = 30 cm

$= -2.00 + 2.42 \cdot \ln(30)$

$\widehat{\ln \text{biomass}} = 6.231$

$e \qquad e$

2ND e^x 6.231

$\widehat{\text{biomass}} = 508.26$

The predicted total above ground biomass of the tree is about 508 Kg

41 (a) Look at the 2 graphs, the second shows a more linear scatter plot. Therefore the power model would work better with the log (abundance) versus log (body mass)

(b) $\widehat{\log(\text{abundance})} = 1.9503 - 1.04811 \cdot \log(\text{body mass})$

(c) body mass = 92.5 Kg

$\widehat{\log(\text{abundance})} = 1.9503 - 1.04811 \cdot \log(92.5)$

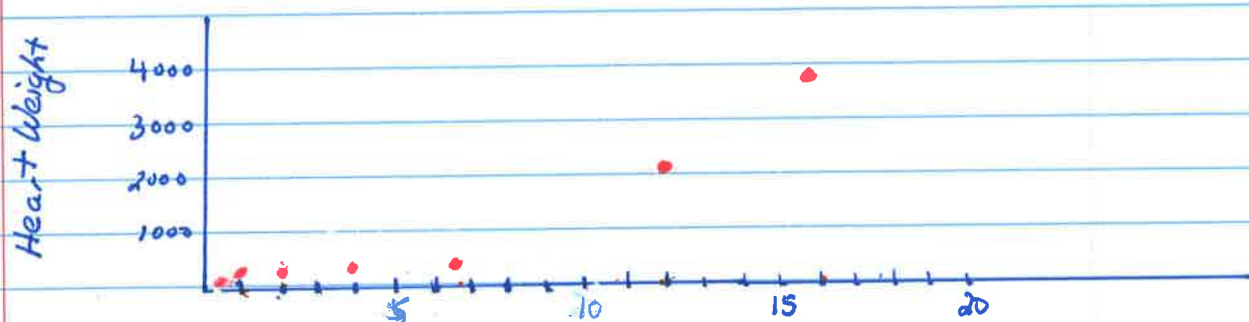
$\widehat{\log(\text{abundance})} = -0.1104$

$10 \qquad 10$

$\widehat{\text{abundance}} = .7755$ per 10,000 Kg of prey

(d) THE TREND IN THE RESIDUAL PLOT SUGGESTS THAT THE RESIDUAL WOULD BE POSITIVE, WHICH MEANS THAT OUR PREDICTION WOULD BE TOO LOW

44A



THERE is A STRONG, POSITIVE, CURVED Relationship

44B

L1	L2	L3	L4
Ventricle	WEIGHT	ln (ventricle)	ln (weight)
		OR	
		* log (Ventricle)	* log (weight)

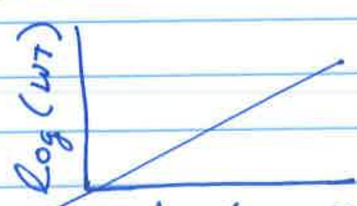
*book solution uses ln
*here is solution with log

1ST. TRY

Scatter plot
XLIST $\boxed{L1}$
YLIST $\boxed{L4}$
ZOOM 9

NOTICE
Graph is still curved when taking log of weight.

2ND TRY



Scatterplot
XLIST $\boxed{L3}$
YLIST $\boxed{L4}$
ZOOM 9

NOTICE!
Graph is linear when taking log of BOTH weight & length of ventricle

44C

STAT CALC

8: LINREG (a+bx)

XLIST | L3

YLIST | L4

⇓

$a = -0.1364$

$b = 3.139$

$r^2 = .9933$

$r = .9967$

LSRL:

$\widehat{\log(WT)} = -.136 + 3.139 \cdot \log(\text{ventricle})$

44D left ventricle = 6.8 cm

$\widehat{\log(WT)} = -.136 + 3.139 \cdot \log(6.8)$

$\widehat{\log(WT)} = 2.4772$

$\cancel{10}^{\cancel{\log}(WT)} = 10^{2.4772}$

$\widehat{WEIGHT} = 300.086$ grams