9-1 Paired Data

- is there a relationship
- if so, what is the equation
- use the equation for prediction

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9-2 Correlation

- **Correlation**

exists between two variables when one of them is related to the other in some way

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Positive Linear Correlation

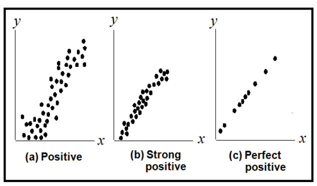
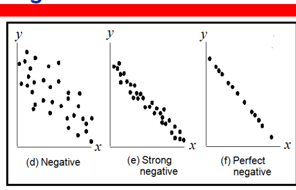


Figure 9-1 Scatter Plots

Negative Linear Correlation



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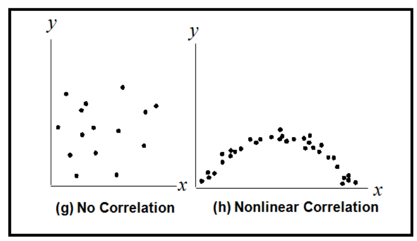
No Linear Correlation



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Ex1) Is there a correlation between the bill amount and the tip you leave? Make a scatterplot for the following data on page 505.

L1	L2
33.46	5.5
50.68	5
87.92	8.08
98.84	17
63.6	12
107.34	16

- enter data in L_1 and L_2
- 2nd y =
- on twice
- select scatterplot for L_1 and L_2
- Zoom
- #9
- Enter

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Linear Correlation Coefficient r

measures **strength** of the linear relationship between paired x and y values in a **sample**

$$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2) - (\Sigma x)^2}\sqrt{n(\Sigma y^2) - (\Sigma y)^2}}$$

Rounding the Linear Correlation Coefficient r

- Round to **three** decimal places so that it can be compared to critical values in Table A-6
- Use calculator or computer if possible

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Interpreting the Linear Correlation Coefficient

- If the absolute value of r exceeds the value in Table A - 6, conclude that there is a significant linear correlation.
- Otherwise, there is not sufficient evidence to support the conclusion of significant linear correlation.

TABLE A-6 Critical Values of the Pearson Correlation Coefficient r

n	$\alpha = .05$	$\alpha = .01$
4	.950	.999
5	.878	.959
6	.811	.917
7	.754	.875
8	.707	.834
9	.666	.798
10	.632	.765
11	.602	.735
12	.576	.708
13	.553	.684
14	.532	.661
15	.514	.641
16	.497	.623
17	.482	.606
18	.468	.590
19	.456	.575
20	.444	.561
25	.396	.505
30	.361	.463
35	.335	.430
40	.312	.402
45	.294	.378
50	.279	.361
60	.254	.330
70	.236	.305
80	.220	.286
90	.207	.269
100	.196	.256

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Properties of the Linear Correlation Coefficient r

1. $-1 \le r \le 1$
2. Value of r does not change if all values of either variable are converted to a different scale.
3. The r is not affected by the choice of x and y. Interchange x and y and the value of r will not change.
4. r measures strength of a linear relationship.

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Common Errors Involving Correlation

1. Causation: It is wrong to conclude that correlation implies causality.
2. Averages: Averages suppress individual variation and may inflate the correlation coefficient.
3. Linearity: There may be some relationship between x and y even when there is no significant linear correlation.

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Formal Hypothesis Test

- To determine whether there is a significant linear correlation between two variables
- Two methods
- Both methods let $H_0: \rho = 0$ (no significant linear correlation)
  $H_1: \rho \ne 0$ (significant linear correlation)

Method 1: Test Statistic is t

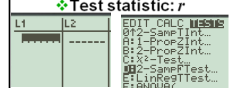
$$t = \frac{r}{\sqrt{\frac{1 - r^2}{n - 2}}}$$

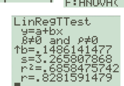
Critical values:

use Table A-3 with degrees of freedom = n - 2

Method 2: Test Statistic is r (uses fewer calculations)

- Test statistic: r





- Critical values:

Refer to Table A-6 (no degrees of freedom)

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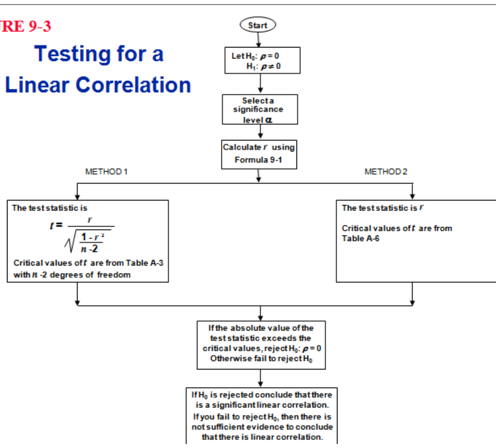
FIGURE 9-3

Testing for a Linear Correlation



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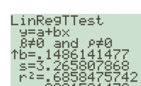
Ex1b)Is there a correlation between the bill amount and the tip you leave? Use $\alpha = .05$

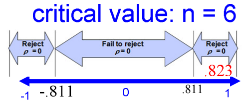
Hypothesis: $H_0: \rho = 0$ (no significant linear correlation)
$H_1: \rho \neq 0$ (significant linear correlation)

test statistic:



critical value: n = 6

n	$\alpha = .05$	$\alpha = .01$
4	.950	.999
5	.878	.959
6	.811	.917
7	.754	.875
8	.707	.834
9	.666	.798



Conclusion: reject H_0. There is a linear relationship.

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Is there a significant linear correlation?

Data from the Garbage Project

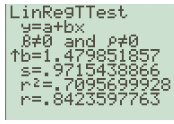
x Plastic (lb)	0.27	1.41	2.19	2.83	2.19	1.81	0.85	3.05
y Household	2	3	3	6	4	2	1	5

$n = 8$ $\alpha = 0.05$ $H_0: \rho = 0$

$H_1: \rho \neq 0$

use calculator - linear regression t test

Test statistic is $r = 0.842$



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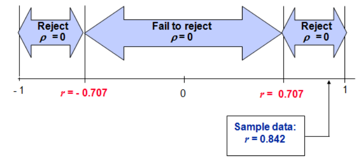
n	$\alpha = .05$	$\alpha = .01$
4	.950	.999
5	.878	.959
6	.811	.917
7	.754	.875
8	.707	.834
9	.666	.798
10	.632	.765

Critical values are r = - 0.707 and 0.707
(Table A-6 with n = 8 and α = 0.05)



0.842 > 0.707, That is the test statistic does fall within the critical region.

Therefore, we REJECT H_0: $\rho = 0$ (no correlation) and conclude there is a significant linear correlation between the weights of discarded plastic and household size.

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