

# Stat 312: Lecture 21

## Correlations

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### Concepts

1. The *coefficient of determination*  $r^2 = S_{xy}^2 / S_{xx}S_{yy}$ .
2. The *sample correlation coefficient*  $r$  is defined as  $r = S_{xy} / \sqrt{S_{xx}S_{yy}}$ . In Lecture 20, we showed that  $0 \leq r^2 \leq 1$ . Hence  $-1 \leq r \leq 1$ .
3.  $r = 0$  if and only if paired observations  $(x_j, y_j)$  pass through the same straight line. From Lecture 20 example 2, if  $(x_j, y_j)$  pass through a circle,  $r = 0$ . So  $r$  can be used to measure if the paired observations show linear relationship.
4. *Population correlation coefficient*

$$\rho(X, Y) = \frac{\mathbf{Cov}(X, Y)}{\sqrt{\mathbf{Var}(X)\mathbf{Var}(Y)}}$$

### In-class problems

*Example 1.* Is there any linear relationship between the mathematical achievement test scores ( $x_i$ ) and calculus grades ( $y_i$ ) for 10 college freshmen?

x||39, 43, 21, 64, 57, 47, 28, 75, 34, 52  
y||65, 78, 52, 82, 92, 89, 73, 98, 56, 75

```
> cor(x,y)
[1] 0.8397859
```

*Example 2.* Is there any relationship between the number of times you miss submitting homeworks ( $x_i$ ) and the final grade ( $y_i$ )?

x||03, 04, 01, 02, 01, 00, 00, 07, 08, 05  
y||70, 75, 80, 75, 85, 95, 90, 70, 50, 60

```
> cor(x,y)
[1] -0.8938321
```

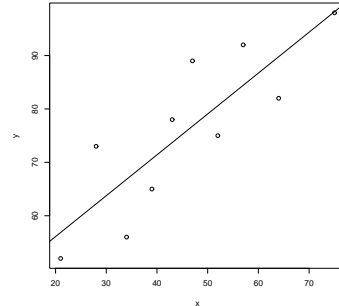


Figure 1: Complete lack of linear fit.

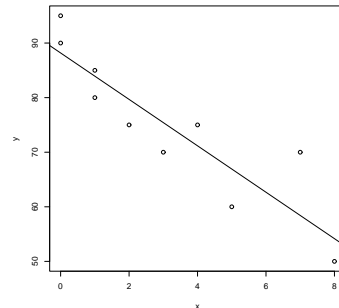


Figure 2: Complete lack of linear fit.

### Self-study problems

Please read P.529. Example 12.14.

### Homework 7

Due April 29. 11:00am.  
12.30., 12.36., 12.58., 12.60., 12.66.