

Studio 4

18.05 Spring 2014

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## Studio4.zip

You should download studio4.zip and unzip it into your 18.05 working directory.

It has sample code that will remind you about making histograms and plotting curves.

## Board Question: Problem 1: Covariance and correlation

Jack and Jill are dealers at a casino in Las Vegas.

- Every day during their break, Jack and Jill play roulette 10 times together, each betting one dollar on red each time.
- Jill then plays 5 more times alone, betting one dollar each time.

(In Las Vegas the roulette wheel has 18 red, 18 black and 2 green slots.)

- (a)** What are the expected winnings on a random day for each of them?
- (b)** What is the variance of their winnings on a random day?
- (c)** What is the covariance and correlation between their winnings.

## Problem 1 continued

Suppose Jill and Jack play roulette the same way for 100 days. Let  $JillTotal$  and  $JackTotal$  be their total winnings.

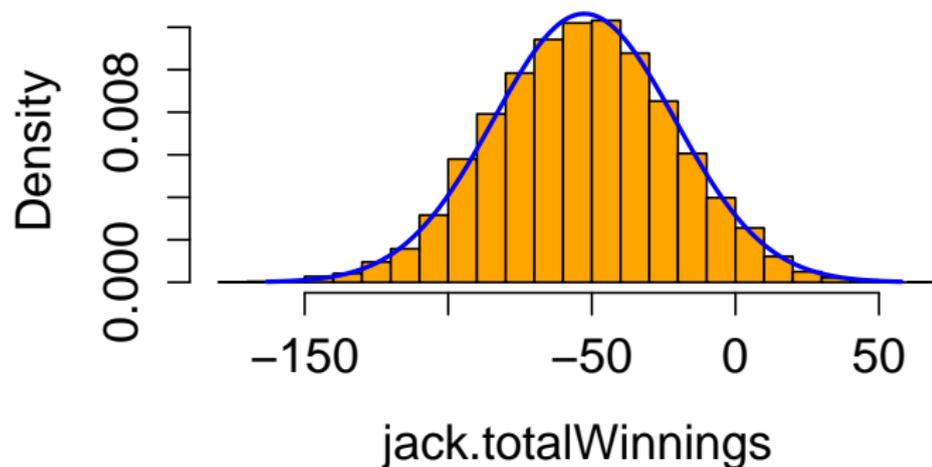
**(d)** What are the expected values, variances, covariance and correlation of these totals?

**(e)** Comment on how each of the quantities depends on the number of days.

## Problem 2: Simulation; Central Limit Theorem

- (a)** Write R code to simulate JackTotal (Jack's total winnings) for 100 days. Run 5000 trials and plot a density histogram of the results. (The code in studio4.r may be helpful.)
- (b)** Why does the central limit theorem apply to approximating JackTotal.
- (c)** What  $\mu$  and  $\sigma$  should be used in  $N(\mu, \sigma^2)$  to approximate JackTotal? Add a graph of the pdf of  $N(\mu, \sigma^2)$  to your histogram in part (a).
- (d)** Using the central limit theorem give a range with about 95% probability of containing JackTotal.
- (e)** What percentage of simulated JackTotal values fall in the range found in part (d).

### Histogram of jack.totalWinnings



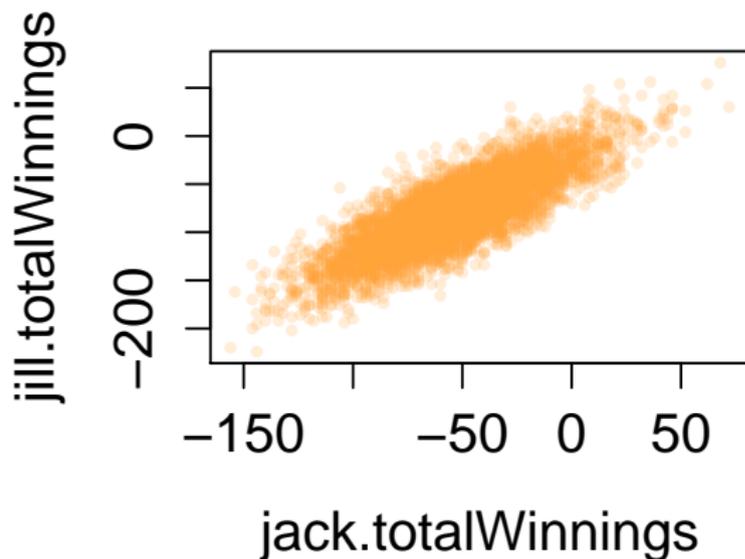
Density histogram and normal pdf for problem 2

## Problem 3: Simulation; covariance and correlation

Extend the simulation from problem 2 to include `JillTotal`, Jill's total winnings over 100 days.

- (a)** Plot `JillTotal` vs. `JackTotal` for the simulation data.
- (b)** Compute the (sample) covariance and correlation of `JackTotal` and `JillTotal` from the simulation.

## Plot for Problem 3



Plot of simulation of JillTotal vs. JackTotal for problem 3

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## 18.05 Introduction to Probability and Statistics

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