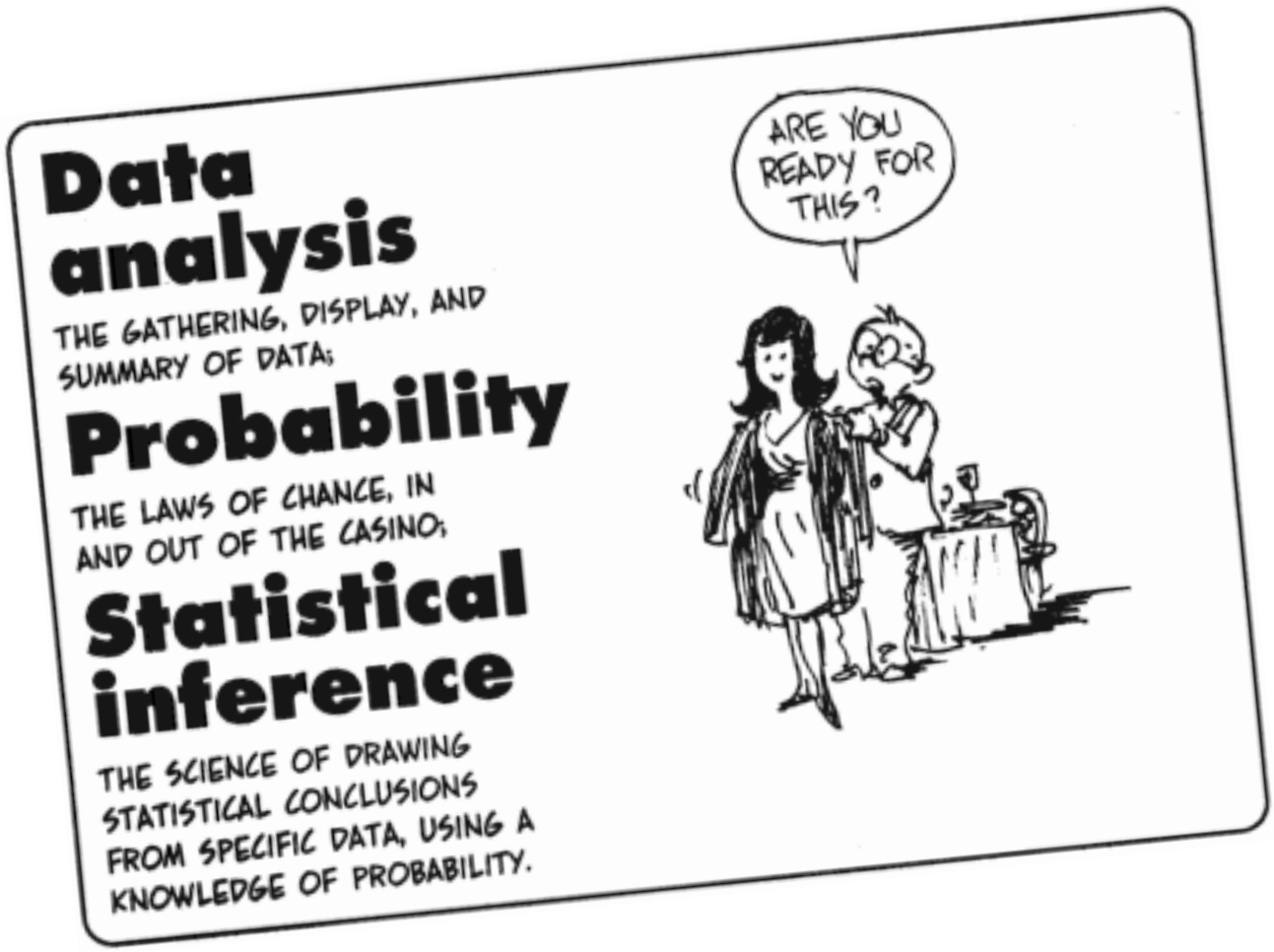
BIOL2006

PROBABILITY AND STATISTICS



PBL - 1

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RIGGED FAULTY

OF DICE AND MEN

How well can we theorise the future? How well can we test these theories? Do we infer, or do we deduce? What is the role of imagination? What is the role of hard work? In this PBL we will use dice to address some philosophical and mathematical questions that will help you understand why we do statistics and why is so important for science.

Goals of PBL

TO UNDERSTAND THE CONNECTION BETWEEN PROBABILITY AND STATISTICS

Probability is a way of thinking, a way to make sense of the world. Probability help us decide from whether to bring an umbrella to the University to understanding the composition of Tropical Rain Forests and Coral reefs.

In this session we will use Dice to understand some basic features about Probability and how it relates to statistics.

I will first introduce the expectations for PBL session. Then, I will discuss today's PBL.

Today, the PBL session will be divided in three main steps:

Step 1: Introduction to Probability - 10min

1) I will provide a quick introduction to probability concepts
2) I will show how to calculate probabilities using coins
3) I will show how to calculate probabilities using dice
4) I will discuss sample size and parameter estimation

Step 2: Activity 1:

Estimating probabilities - 20 min

MATERIALS

1) Set of Dice (Figure 1)
2) Your notebook
3) Your pencils

Figure 1. Each team will have 4 fair dice and 3 modified dice

ACTIVITY 1

1) Write down the probabilities for rolling a 1 to a 6 using a fair, and using an unfair die. Calculate the mean of their sum for each die.
2) Write down the expected probabilities for the possible sums when throwing two fair dice. Compare them to the expected probabilities for the possible sums when throwing one fair and one unfair dice.

FAIR	MODIFIED
Dice 1: 1, 2, 3, 4, 5, 6	Dice 3: 1,2,3,4,5,6,6,6
Dice 2: 1, 2, 3, 4, 5, 6	Dice 4: 1, 2, 3, 4, 5, 6
P(7) = 6/36 Example 1	P(7) = 8/48 Example 2

Table 1. Probability of rolling a seven with two fair dice vs. one fair and one unfair die.

Group Discussion

Draw the probability distribution for two the sum of two fair dice and compare it to the probability distribution for the sum of one fair and one unfair die.

Discuss with your partner the idea of null distribution versus observed distribution.

Step 3: Activity 2:

Sample size - 20 min

ACTIVITY 2

1) Roll 2 fair dice 10 times
2) Record outcomes
3) Count how many times each sum occurs
4) Plot a histogram showing the frequency of each sum.
5) Repeat 1-4 rolling the dice 40 times
6) Compare the two histograms
7) What is the mean value of the observed sums for each experiment?

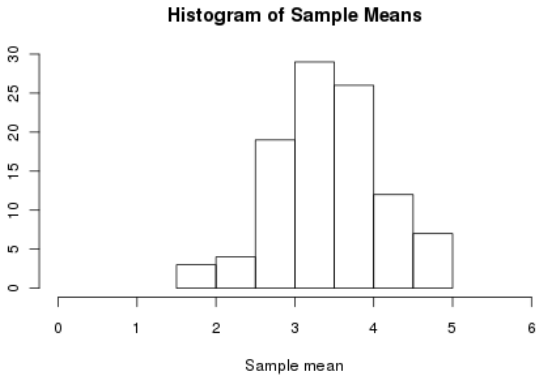


Figure 2. Example of a histogram for the mean value of 10 sets of rolling 1 die 5

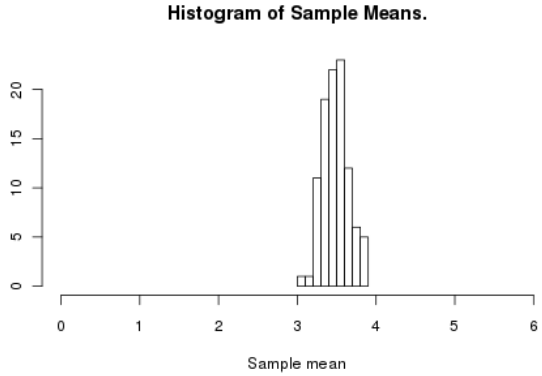


Figure 2. Example of a histogram for the mean value of 100 sets of rolling 1 die 50 times

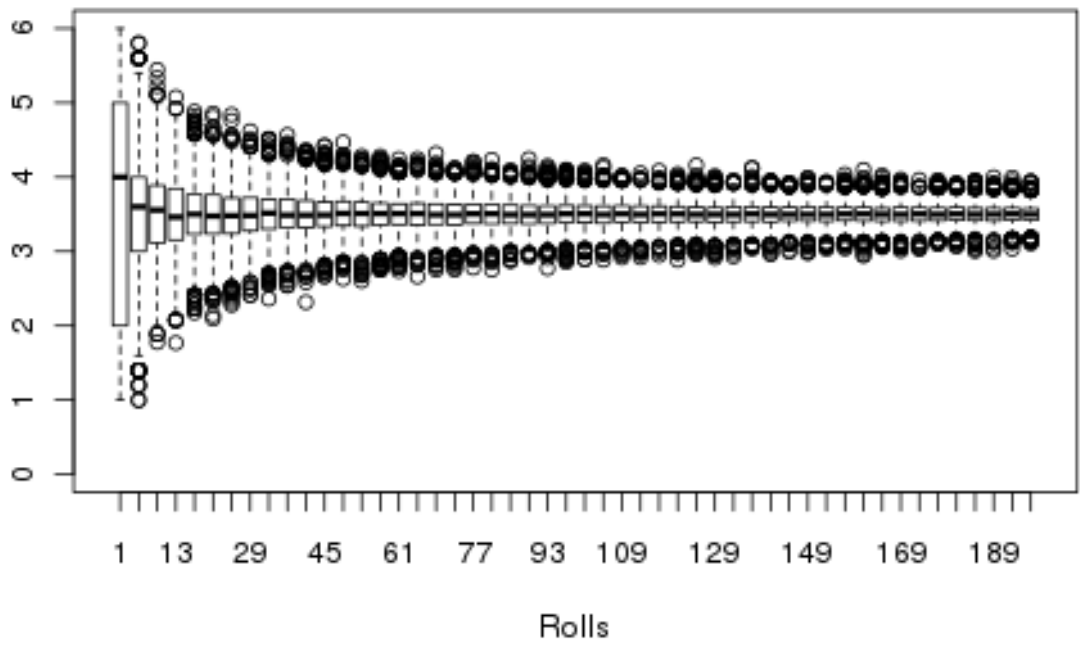
Group Discussion

QUESTION 3

How does the mean value obtained (from rolling dice) change with increasing number of rolls?

QUESTION 4

How does the width of the histogram of the means change with increasing number of rolls?



Step 4: Activity 3:

Game - 20 min

ACTIVITY 3

1) Divide into two teams of 8 per group
2) Each team chooses a pair of dice
3) Each team rolls the dice 30 times for the other team (do not let them see your dice)
4) The other team records the values of the two dice for each of the 30 rolls
5) Exchange roles

Group Discussion

QUESTION 5

Can you tell whether the other team used a modified die?

QUESTION 6

What would you do to test the hypothesis that the other team used a modified die?