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# Human Genetics: Problem Set IV

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## Abstract

This work contains the solutions to the problem set IV of Human Genetics 2015 course at New York University.

### Question 1. Hypothesis Testing I.

**Solution. (a)** Under the null hypothesis of 3 : 1 segregation, the expected counts of inflated and constricted pods are  $1180 \cdot \frac{3}{4} = 885$  and  $1180 \cdot \frac{1}{4} = 295$  respectively.

**(b)** The chi-value for an observed data under a null hypothesis is defined by

$$\chi^2 = \sum \frac{(O - E)^2}{E}.$$

Substituting the given data yields

$$\begin{aligned}\chi^2 &= \frac{(881 - 885)^2}{885} + \frac{(299 - 295)^2}{295} \\ &\approx 0.0723.\end{aligned}$$

Hence, the chi-square value for the observed data under the null hypothesis is approximately 0.0723.

**(c)**

### Question 2. Hypothesis Testing II.

**Solution. (a)** 50 : 50 is a good null hypothesis about the sex ratio of the newborns (girls: boys), because

**(b)** Under the null hypothesis, the exact probability that all 8 children are girls is  $(\frac{1}{2})^8 = \frac{1}{256}$ .

**(c)**

### Question 3. Probability.

**Solution. (a)** Since the dice is fair, the probability that we roll a 5 is  $\frac{1}{6}$ .

**(b)** First of all, if we roll two dices, there are in total  $6^2$  different outcomes with respect to the numbers we see. The cases that we see 11 or greater for the sum of two rolls are exactly (5, 6), (6, 5) and (6, 6), where the tuples denote the outcome of the two dices separately. Hence, the exact probability that the total number rolled will be 11 or greater is  $\frac{3}{36} = \frac{1}{12}$ .

(c) The event that we see the total number 10 or lower is exactly the complement event of the one described in the part (b). Hence, the exact probability that the total number rolled will be 10 or lower is  $1 - \frac{1}{12} = \frac{11}{12}$ .  $\square$