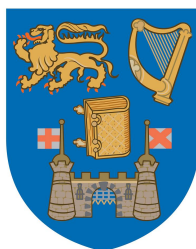


# UNIVERSITY OF DUBLIN, TRINITY COLLEGE



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## DICE INVESTIGATION

### ST2004 & ST2353 ASSESSMENT 1

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**1 q1i**

Q1i

## 2 Q1ii: Probability Distributions

### 2.1 Permutation

Three dice can be rolled in a variety of 216 ways ( $6*6*6$ ) over a probability distribution shown above in fig x.x. The possible combinations for each die results in varied probabilities for each number, where a greater number of combinations results in a higher probabilistic outcome, and thus over the long run, results in a variance of probabilities for each dice combination. The probability of each number rolled tends from the value of the number of combinations that can be possibly formed for that combination, with respect to the total number of combinations possible for n dice.

Expected value is defined as the product of given value with respect to the probabilistic outcome of that value, as a summation of all the possible values within that set for a randomly distributed variable X:

$$E[X_n] = x_n p_n$$
$$E[X] = \sum_i^n x_n p_n$$

Given the probability distribution, the expected value is calculated as such:

$$E[X] = 1 * \frac{1}{6} + 1 * \frac{2}{6} + 1 * \frac{3}{6} + 1 * \frac{4}{6} + 1 * \frac{5}{6} + 1 * \frac{6}{6} = 3.5$$

In the case of having three dice, this method can be extended to encapsulate a wider range of values over two additional dice:

$$E[X] = 3 * \frac{1}{216} + 4 * \frac{3}{216} + 5 * \frac{6}{216} + 6 * \frac{10}{216} + 7 * \frac{15}{216} + 8 * \frac{21}{216} + 9 * \frac{25}{216} + 10 * \frac{27}{216} +$$
$$11 * \frac{27}{216} + 12 * \frac{25}{216} + 13 * \frac{21}{216} + 14 * \frac{15}{216} + 15 * \frac{10}{216} + 16 * \frac{6}{216} + 17 * \frac{3}{216} + 18 * \frac{1}{216}$$

The rolling of dice in such a way is denoted as an independent event, as the dice rolls in the future are not dependent on previous rolls and do not affect the outcome of values, where essentially the expected outcome of the event

is given by:

$$E[X + Y + Z] = E[X] + E[Y] + E[Z]$$

Given the independence of each die roll, the expected value for three rolls is given by:

$$E[X + Y + Z] = 3.5 + 3.5 + 3.5 + 3.5$$

## **2.2   graphs**

### **3 q1iii**

Q1iii

4 q2

Q2