Module 5 – Activities & Problems

5.1   (a)   The following formula relates to the binomial distribution.

$$P(X = r) = \binom{n}{r} p^r q^{n-r}$$

        (i)   Describe the type of experiment that results in a random variable that has a binomial distribution.
        (ii)   State what each of the letters p, q, n and r represents in the formula above.

      (b)   In a certain type of archery competition, Laura hits the target with an average of two out of every three shots.
               The shots are independent of each other.
               During one such competition, she has ten shots at the target.
        (i)   Find the probability that Laura hits the target exactly nine times.
                  Give your answer correct to three decimal places.
        (ii)   Find the probability that Laura hits the target fewer than nine times.
                  Give your answer correct to three decimal places.
      [NCCA, Pre Paper, Q5]

5.2   For data that is symmetrically distributed and bell shaped (similar to a normal distribution), approximately what proportion
      of observations lies within one standard deviation of the mean according to the empirical rule?
      What proportion lies within two standard deviations of the mean? What proportion lies within three standard deviations of
      the mean?

5.3   (a)   Using the tables find $P(z \leq 2 \cdot 11)$.
      (b)   Using the tables find $P(z \geq 2 \cdot 43)$.
      (c)   Using the tables find $P(z \leq -1 \cdot 73)$.
      (d)   Using the tables find $P(-1 \cdot 96 \leq z \leq 1 \cdot 96)$.
      (e)   Using the tables find $P(-1 \cdot 44 \leq z \leq 1 \cdot 23)$.

5.4   The distribution of scores in a statistics exam is normally distrubed with a mean of 45 and a standard deviation of 4.
      You receive a mark of 49. What is the probability of someone scoring higher than you?
      What percentage of people score above the mean but lower than you?
      [NCE – MSTL, Example, Pg. 73]

5.5   The average age of a person getting married for the first time in the U.S. is 26 years.
      Assume the ages have a normal distribution with a standard deviation of 4 years.
      (a)   What is the probability that a person getting married is younger than 23 years?
      (b)   90% of people get married before what age?
      [NCE – MSTL, Q5, Pg. 74]

5.6   An athlete finds that in the long jump his distances form a normal distribution with mean 6.1 m and standard
      deviation 0.03 m.
      (a)   Calculate the probability that he will jump more than 6.17m on a given occasion.
      (b)   What distance can he expect to exceed once in 500 jumps.
      [NCE – MSTL, Q8, Pg. 74]

5.7   A survey is carried out on 400 randomly selected students in Munster and the result is that 60% are in favour of Project
      Maths. The confidence level is cited as 95%.
      (i)   Calculate the margin of error.
      (ii)   A similar Survey was carried out in Leinster among 400 randomly selected students to see if there was any
                appreciable difference between support for Project Maths in the Munster and Leinster Area, and the results show
                that 45% of students were in favour of Project Maths. State the Null Hypothesis and would you accept or reject the
                Null Hypothesis according to this survey? Give a reason for your conclusion.