# MECH60017/MECH70041/MECH96014 STATISTICS EXERCISE SHEET 1

**You should attempt to complete exercises marked with a * using both hand calculations and in Python/R.**

A Geiger counter was used to record the number of alpha particles emitted by a radioactive material in 1 minute intervals and the results are displayed below.

You will need to use this dataset for questions 1 and 2.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 25 | 22 | 31 | 25 | 19 | 8 | 24 | 44 | 30 |
| 34 | 12 | 7 | 33 | 19 | 20 | 19 | 42 | 38 | 27 |

**1.** * Construct a suitable histogram plot for the Geiger counter data.

**2.** * Determine the sample mean, the sample variance, the median and the mode of the Geiger counter data.

**3.** A random sample of 60 observations is such that $\sum_i x_i = 377$ and $\sum_i x_i^2 = 2377$.

Starting from the definition of the sample variance:

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

where $\bar{x}$ is the sample mean.

Show that the variance of the sample can be equivalently written as:

$$s^2 = \frac{1}{n-1}\left[\left(\sum_{i=1}^{n} x_i^2\right) - n\bar{x}^2\right]$$

Hence, find the sample mean and standard deviation of this dataset.

**4.** A frequency table for student performances is as follows:

| Class | Dash list | Frequency | Proportion (%) |
|---|---|---|---|
| 19-20 | // | 2 | 3.51 |
| 20-21 | / | 1 | 1.75 |
| 21-22 | ///// //// | 9 | 15.79 |
| 22-23 | ///// ///// ///// // | 17 | 29.82 |
| 23-24 | ///// ///// / | 11 | 19.30 |
| 24-25 | ///// // | 7 | 12.28 |
| 25-26 | ///// | 5 | 8.77 |
| 26-27 | / | 1 | 1.75 |
| 27-28 | /// | 3 | 5.26 |
| 28-29 | / | 1 | 1.75 |
| Sum | | 57 | 99.98 |

(a) Suppose we want to estimate the sample mean of this dataset by assuming that any point in the 19-20 range is taken to have value 19.5, any point in the 20-21 range has value 20.5, etc. Using this approach estimate the sample mean and variance of the strength dataset.

(b) Estimate the minimum and maximum values of the sample mean.