Example Context Elaboration: Binomial Counting

Focus: Applying distributions

Achievement objective S8-4

In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations that require them to:

Investigate situations that involve elements of chance:

A calculating probabilities of independent, combined, and conditional events

B calculating and interpreting expected values and standard deviations of discrete random variables

C applying distributions such as the Poisson, binomial, and normal

Counting Situations

David and Peter spend a lesson counting how many cars enter a petrol station during a five minute period, or how many people approach a money machine during a five minute time interval at a particular time of day, or counting the number of chocolate chips in a cookie, or counting the number of sharks in a fixed area of the ocean on an applet.

They tally their results and plot a bar (column) graph of the results. They notice that the average number of cars arriving in a five minute interval is obvious from the graph, and recognize this value as a rate which would be proportional to the time interval. They calculate the mean and standard deviation of their results, perhaps noting that the standard deviation is approximately the square root of the mean. They compare their experimental probabilities with those calculated using technology or the formula

$$P(X = x) = \frac{e^{-\lambda}\lambda^{x}}{x!}$$

They discuss how the situation they are considering now compares with the Binomial situation, notably that both involving counting, that is they are discrete distributions. They may recognise that there is an upper value to the values that X can take for Binomial but not Poisson and that Poisson deals with a rate, the Binomial does not. The teacher summarises the conditions under which a Poisson distribution can be applied.