This tutorial comes with a spreadsheet which you can use as a guide to fill out the results of doing each part of the tasks listed.

Task 1. Retrieve your submissions from Homework 5 in Week 9 and compare solutions around the group. For Question 1(b)(ii), how did you calculate the "more than 5" probability? For Question 2(e), how does the standard deviation for A, the mean distance driven over three days, compare to the standard deviation for K_1, the distance on the first day? What about the standard devation of the mean distance driven over five days, ten days, or 100 days?

Task 2. (This is Question 117 from the textbook [Carlton & Devore 2017].)
If the side of a square X is random with the pdf $f_X(x) = x/8$, $0 < x < 4$, and Y is the area of the square, find the pdf of Y.

Task 3. A farm grows apples for sale to distributors. The price of apples depends on their weight and distributors will only take apples of a certain weight range. This year's apples from the farm have weights normally distributed with mean 170g and standard deviation 35g. They are sold to distributors in batches of 500.
Distributor A is looking for apples between 120g and 240g in weight: they check for this by taking a random sample of 10 apples from a batch and will accept the batch if at least 8 are in the target weight range.
Distributor B has a different policy. They are interested in any apples weighing over 100g: to test for this they sample 5 and reject the whole batch if even one of those is underweight.
Which distributor is more likely to accept a batch of apples from this farm?

Task 4. The Normal distribution can be used as an approximation for calculating probabilities from the Binomial distribution. This task explores how well approximations like this work in a simple case.
If $X \sim \text{Binom}(n, p)$ is a discrete random variable counting successes in n trials each with probability p then we have the following approximation.

$$P(X \leq x) \;=\; B(x; n, p) \;\approx\; \Phi\left(\frac{x + 0.5 - np}{\sqrt{npq}}\right) \qquad x \in \{0, 1, \ldots, n\}$$

This is considered a good approximation in practice if $np \geq 10$ and $nq \geq 10$ where $q = (1 - p)$. Here you will look at a situation where both values are much less than 10.

(a) Suppose discrete random variable $X \sim \text{Binom}(4, 0.5)$ counts the number of heads thrown in four tosses of a fair coin: $X \in \{0, 1, 2, 3, 4\}$. What are the mean and standard deviation of the random variable X?

(b) Use the Normal approximation above to estimate the probability that X takes the value 2.

(c) Complete this to draw up a table of estimates for the probability that X takes each of the possible values 0 to 4.

(d) Now compute a table of the PMF for X showing the exact probability that it takes each of these five possible values.

(e) Calculate the table of errors: what percentage variation is there in each estimate compared to the exact value? Which values have the largest error?