**Remember**:

- Include your name and ID in your submission.

- Submit your assignment **online via Canvas** by the due date/time.

1. File `gross.dat` contains gross national product $y$ in real dollars for 26 recent years, $x = 1, 2, \ldots, 26$. Use R expressions to do the followings.

   (a) Read data into R.

   (b) Plot the histogram of $y$.

   (c) Calculate the sample mean, the sample standard deviation[1] and median of $y$.

   (d) The **coding** of a data set refers to the operation of subtracting (or adding) a constant to each observation and then dividing (multiplying) by another constant. The coding by subtracting the sample mean of data and dividing by the sample standard deviation is called *standardization* and the coded data is called *standardized data*. Standardize $y$ and calculate the mean and the variance of the standardized $y$.

2. J.J. Thomson (1856–1940), discovered the electron while investigating the basic nature of cathode rays. In laboratory experiments Thomson isolated negatively charged particles for which he could determine the mass-charge ratio. This ratio appeared to be constant over a wide variety of experimental conditions and to be a characteristic of these new particles. Thomson obtained the following results with two different cathode ray tubes, using air as the gas:

   | Tube 1 | 0.57 | 0.34 | 0.43 | 0.32 | 0.48 | 0.40 | 0.40 |
   |--------|------|------|------|------|------|------|------|
   | Tube 2 | 0.53 | 0.47 | 0.47 | 0.51 | 0.63 | 0.61 | 0.48 |

   (a) Do the two tubes appear to produce consistent results?

3. An orbiting satellite has 3 panels of solar cells, all of which must be active to provide an adequate power output. The panels function independently of one another. The chance that a single panel will fail during the mission is 0.02. What is the probability that there will be adequate power output during the entire mission time? (This probability is called the reliability of the system.)

4. In a study of the coexistence of two types of insects, let $X$ and $Y$ denote the number of type $A$ and type $B$ insects, respectively, that reside on the same plant. From observations of a large number of plants, suppose that the following joint probability distribution is assessed for the insect counts per plant.

   | $\frac{x \to}{y \downarrow}$ | 1 | 2 | 3 | 4 |
   |------|------|------|------|------|
   | 0 | 0 | 0.05 | 0.05 | 0.10 |
   | 1 | 0.08 | 0.15 | 0.10 | 0.10 |
   | 2 | 0.20 | 0.12 | 0.05 | 0 |

   (a) Find the probability that there are more type $B$ insects than type $A$ insects on a plant.

   (b) Compute $\mu_x$, $\mu_y$, $\sigma_x$, $\sigma_y$ and $\mathrm{Cov}(X, Y)$.

5. The medical records of the male diabetic patents reporting to a clinic during one year provide the following percentage:

   | | Light case | | Serious case | |
   |------|------|------|------|------|
   | Age of | Diabetes in parents | | Diabetes in parents | |
   | patient | Yes | No | Yes | No |
   | Bellow 40 | 15 | 10 | 8 | 2 |
   | Above 40 | 15 | 20 | 20 | 10 |

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[1] Recall that the sample standard deviation is the squared root of the sample variance.

Suppose a patient is chosen at random from this group, and the events $A$, $B$ and $C$ are defined

$A$: He has a serious case.

$B$: He is blow 40.

$C$: His parents are diabetic.

(a) Find the probabilities $P(A)$, $P(B)$, $P(A \cap B)$, $P(A \cap B \cap C)$.

(b) Describe the following events verbally and find their probabilities: (i) $A^c \cap B^c$, (ii) $A^c \cup C^c$, (iii) $A^c \cap B \cap C^c$.