***Due Thursday, September 14, 2023 at 1pm***

The **simulated** data (nanoparticle.csv) for this homework are loosely based on Table 1 in the following article from the Brown Lab.

Alsaleh NB, Minarchick VC, Mendoza RP, Sharma B, Podila R, Brown JM. Silver

nanoparticle immunomodulatory potential in absence of direct cytotoxicity in RAW

264.7 macrophages and MPRO 2.1 neutrophils. J Immunotoxicol. 2019

Dec;16(1):63-73.

In this experiment, they characterized their citrate-coated nanoparticles on several different properties including hydrodynamic size (size\_nm), zeta potential in mV (zeta\_potential), and polydispersity index (poly\_index). Also included in the data set is a variable that indicates whether the nanoparticle formations are spherical in shape (spherical; 1 = yes and 0 = no) and a variable that indicates the quality of nanoparticle on a scale from 1 = poor to 5 = excellent (quality).

1. Based on the *nanoparticle* data set, classify the following variables as interval, ordinal, or nominal: **size\_nm**, **poly\_index**, **zeta\_potential**, **spherical**, and **quality** (3 pts).
2. Create a histogram for **quality** and a histogram, vertical scatter plot, and boxplot for **poly\_index**, (4 plots total). Make an observation about the histogram for **quality** and about the plot of **poly\_index** that you found most helpful. (6 pts)
3. Calculate and compare the mean and median for **size\_nm**. Calculate and compare the mean and median for **poly\_index**. What would a difference between the mean and the median for a variable indicate? (5 pts)
4. Calculate the standard deviation, coefficient of variation, and the three quartiles for **poly\_index**. Which would be the most appropriate measure of scatter for this variable and why? (4 pts)
5. Compare the coefficients of variation for **size\_nm** and **poly\_index** (2 pts).
6. Create a histogram for **poly\_index** that also contains a line for the estimated normal distribution. How well does the line fit the histogram? (2 pts).
7. Calculate the proportion of data points that fall within 1 SD and within 2 SD of the mean for **poly\_index**. How does this compare to proportions predicted for a normal distribution? (3 pts)
8. Calculate the skewness and kurtosis for **poly\_index** and interpret each value. (2 pts)
9. Do you think that **poly\_index** is normally distributed? Give two pieces of evidence for your opinion. (3 pts)