Instructions: Use r to solve the following problems. Do not install any new packages. The problems should be completed using the functions we have learned in chapter 7. When needed provide your answers as the comments in your r-script.

1. (15 points) The article **"Uncertainty Estimation in Railway Track Life-Cycle Cost" (*J. of Rail and Rapid Transit*, 2009)** presented the following data on time to repair

159	120	480	149	270	547	340	43	228	202	240	218

(min) a rail break in the high rail on a curved track of a certain railway line.

a. Create a normal probability plot for the data. Is it plausible that the population distribution of repair time is at least approximately normal?

Use appropriate r-functions (covered in the class) to answer parts b and c.

b. Assume the normality of the distribution of the repair times. Is there compelling evidence for concluding that true average repair time exceeds 200 min?
   - State the hypotheses
   - Carry out the test using significance level $\alpha = 0.05$
   - Write a formal conclusion

c. Using $\sigma = 150$, find the type II error probability of the test used in part b when true average repair time is actually 300 min? What is the power of the test?

2. (5 points) A plan for an executive travelers' club has been developed by an airline on the premise that 5% of its current customers would qualify for membership. A random sample of 500 customers yielded 40 who would qualify.

Use appropriate r-functions (covered in the class) to answer the following questions. Using this data, test at level $\alpha = 0.01$ the null hypothesis that the company's premise is correct against the alternative that it is not correct.

- State the hypotheses
- Carry out the test using significance level $\alpha = 0.05$
- Write a formal conclusion

3. a. (10 points) In math 161A we discussed how to find a $100(1-\alpha)\%$ lower confidence bound and a $100(1-\alpha)\%$ upper confidence bound. Here is a quick summary of the topic.

A **large-sample upper confidence bound for μ** is $\mu < \overline{x} + z_\alpha \cdot \frac{s}{\sqrt{n}}$

and a **large-sample lower confidence bound for μ** is $\mu > \overline{x} - z_\alpha \cdot \frac{s}{\sqrt{n}}$

Write a function that produces upper or lower confidence bounds for a given confidence level. The arguments of your functions should be:
sample (a numeric vector),
conf.level (the confidence level as a decimal between 0 and 1),
type ("lower", "upper" for lower and upper confidence bounds respectively).
Assume that the type of the bound has only two possible values "lower" and "upper".
In other instances, your function should produce an error message "Incorrect type".
The function should return a sentence that looks like as follows (remember it is just an example):

A 95% lower confidence bound is 45.6789.

b. (5 points) Consider the following problem. The concentration of mercury (in ppm) in fresh tuna was collected and recorded in **mercury_concentration.xlsx**. Find a 96% upper confidence bound for μ, the true average concentration of mercury in fresh tuna using the function from part a. Interpret the result in the context of the problem.