Statistics and Probability Theory Assignment

Problem Statement:
The objective of this assignment is to delve into various statistical concepts and probability theory. By answering a series of theoretical and applied questions, students will enhance their understanding of statistical analysis, hypothesis testing, and probability distributions.

Guidelines with Questions:
I. Foundational Knowledge:
- Familiarize yourself with basic statistical concepts such as mean, median, mode, and standard deviation.
- Understand the difference between descriptive and inferential statistics.
- Recognize the importance of probability theory in statistical analysis.

II. Theoretical Questions:
1. Explain the difference between descriptive and inferential statistics. Provide examples of each.
2. Define the Central Limit Theorem and discuss its significance in statistical inference.
3. Discuss the concept of sampling and its role in statistical analysis.
4. Explain the process of hypothesis testing and the key components involved.
5. Describe the T-distribution and how it differs from the normal distribution.

III. Applied Questions:
6. Calculate the mean, median, and standard deviation for the following dataset: [10, 15, 20, 25, 30].
7. A researcher wants to estimate the average height of students in a university. She samples 50 students and finds the mean height to be 65 inches with a standard deviation of 3 inches. Construct a 95% confidence interval for the population mean height.
8. A manufacturer claims that the average lifespan of its light bulbs is 1000 hours. A random sample of 50 light bulbs has a mean lifespan of 980 hours with a standard deviation of 50 hours. Test the manufacturer's claim at a significance level of 0.05 using a right-tailed hypothesis test.
9. A pharmaceutical company is testing a new drug for lowering blood pressure. They want to determine if the drug is effective in reducing blood pressure levels. State the null and alternative hypotheses for this study.
10. A quality control manager at a factory wants to ensure that the average weight of products coming off the production line is 500 grams. She takes a random sample of 30 products and finds the mean weight to be 495 grams with a standard deviation of 10 grams. Test the manager's claim at a significance level of 0.01 using a left-tailed hypothesis test.

Step-by-Step Approach to Answer Questions:

I. Foundational Knowledge:
- Review basic statistical concepts and probability theory.
- Understand the principles of hypothesis testing and confidence intervals.

II. Answering Theoretical Questions:
- Provide clear definitions and explanations for each theoretical concept.
- Include examples or illustrations to elucidate key points.

III. Answering Applied Questions:
- Apply relevant statistical formulas and techniques to solve practical problems.
- Interpret the results in the context of the problem statement.

Submission Guidelines:
- Organize your answers in a structured format, including calculations and explanations.
- Ensure clarity and accuracy in your responses.
- Submit your assignment by the specified deadline.