1. The diameter in centimeters of a type of bolt has a standard deviation of 0.01 and is assumed to follow a law
normal. The average diameter of a sample of n = 10 bolts is 0.26.

a) Test the null hypothesis that these bolts come from a population of mean 0.25. apply a risk of the first kind (threshold) α of 5%.

b) Calculate the sample size needed to detect a difference in diameter nine times out of ten. A difference of 0.01 diameter compared to the average of 0.25.

2. The melting temperature of an alloy must be 1000 degrees Celsius in order to properly perform a metallurgical operation. Any deviation of at least Δ degrees from 1000 results in an unsuccessful operation and the alloy must be replaced with a new one whose composition is expensive to change. We admit that the melting temperature is a random variable of normal distribution with standard deviation σ = 10. We want to carry out a statistical test by controlling the risks α and β of bad decisions.

Calculate the size n of the sample to be taken for α = 0.05, β ∈ {0.1; 0.05; 0.01} and Δ ∈ {5; 10; 15; 20}. Which of Δ or β seems to have the most influence on the value of n?

3. The professional photo development department is considering replacing its developer. A random sample of 12 color photos is submitted to the current processor. The average development time is 8.1 min with a standard deviation of 1.4 min. A sample
random number of 10 photos is chosen to test the new processor. Time
development mean is 7.3 min with a standard deviation of 0.9 min. (Consider that development time is a normal random variable whose variance is the same from one development to another.)

a) At the 5% threshold, is the average development time shorter with the new developer?

b) Management specifies that we will buy the new developer if we can try that the average time is reduced by at least 2 minutes. Without redo test, determine if the hypothesis $H_0: \mu_{\text{Anc}} - \mu_{\text{Nouv}} = 2$ will be rejected in favor of $H_1: \mu_{\text{Anc}} - \mu_{\text{Nouv}} > 2$.

4. An article from the Journal of Construction Engineering and Management (vol. 125, n ° 1, 1999, p. 39) presents some data on the number of working hours lost per day, in the case of a

construction project, due to problems due to bad weather. Here is the number of hours of work lost over 11 days working days.

8,8	8,8	9,1
12,5	12,2	14,7
5,4	13,3	2,2
12,8	6,9	

In these data, we have Hypothesis tests $\bar{x}$ = 9.7 and s2 = 14.62. Suppose the number of lost work hours is normally distributed.

a) Is there any proof allowing to conclude that the average number of hours lost per day is greater than 8 at the 5% threshold? Clearly state the hypotheses you are testing and H_0's rejection rule.

b) Would the probability of a second kind error (β) Be greater:

i) what if the sample size was 25 instead of 11?
j) if the test threshold of $\alpha = 1\%$ was instead of $\alpha = 5\%$?
k) the average number of hours lost was u_1 = 10 hours or u_1= 12 hours?