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Bus 274: Further Statistics for Business

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PROBLEM SHEET # 4

Problem 1: Hi-tech underwater lamps are produced in three steps:

- cutting and finishing the case,
- assembling the electronic components on a circuit board,
- mounting the circuit board into the case.

Samples were taken to estimate the total production time of a lamp. A sample of 30 cutting times had mean 23 and standard deviation 7 minutes. Another sample of 50 assembly times had mean 14 and standard deviation 6 minutes, while mounting time is practically always close to one minute. Assume that cutting and assembly times are independent.

a) Estimate the expectation and standard deviation of the time required to produce one lamp.

b) If one working hour costs €33, estimate the expected cost of labour per lamp and its standard deviation.

c) Now assume that the estimate in (a) actually equals the expectation. Considering only the expectation, how many lamps could be produced within one working day (8 hours)?

d) The number of lamps calculated in (c) neglects the variability of production times and hence possible delays. What is the probability that this number of lamps can actually be produced within 8 hours? (Hint: Use the CLT.)

e) How many lamps can be produced within 8 hours with probability at least 0.95?

f) How could the number of lamps in (e) be increased?

Problem 2: This problem is about estimating the parameters of a normal distribution.

a) Simulate (i) $n = 100$, (ii) $n = 1000$ realizations of a normally distributed random variable with $\mu = 10$ and $\sigma^2 = 5$.

b) Use your simulated data to estimate μ and σ^2.

c) What does it mean when we say: $\hat{\mu}$ and $\hat{\sigma}^2$ have a probability distribution? Explain, repeating your simulation several times.