

HOMWORK 2

Hand-in deadline: End of Week 6: Thursday 2nd November 2011

Note: Remember to attach securely all sheets of paper relevant to the problem, and to display your name on your answers. Be sure to do all the things that are asked, and show how you arrived at your answers. Solutions should be placed in the SCM box in the laboratory. Marked solutions will be returned as soon as possible. **The solution and comments on the marking** will be available on the course **website**, and posted on the **notice board** in the laboratory.

You will need to consult tables of integrated Gaussians, as supplied at the end of the lecture notes, in order to answer this question.

A manufacturer is making large, flat sheets of metal absorber for a particle physics detector. An important parameter is their thickness. It is necessary to do quality control and only pass on sheets that are within strictly quoted tolerances. The thickness is supposed to be 4.00 mm. A large sample of production sheets shows that the actual thickness is turning out to have a Gaussian distribution with a mean value of 4.01 mm and a standard deviation of 0.06 mm.

For the most demanding part of the detector it is essential to use sheets with a tolerance of only ± 0.02 mm either side of 4.00 mm. Make a sketch of the frequency distribution of the sheets, with a shaded region showing the ones that can be used for this part of the detector. What percentage of the total production can be used in this part of the detector?

The rest of the detector is less critical, and the physicists decide that the best use of their budget (given the quality of the sheets) is to accept 70% of the total number of sheets produced, that is 70% *including* the percentage used for the most demanding part.

The physicists need to know the tolerance limits of the sheets they will get. The manufacturer wants to know these tolerances ahead of time, so that sheets that are too thin or too thick can be rejected at the point of testing. Assuming that these tolerances will be quoted symmetrically about the mean value of 4.01 mm (so the tolerance limits can be as close together as possible) what limits should be quoted? Illustrate these limits on your sketch graph.