Statistics and Error and Data Analysis for Particle and Nuclear Physics – Parameter fitting and hypothesis testing

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Everything that glitters is Gold!

Carl Friedrich was going to conduct a physics experiment in which he needed 100 thin Gold foils weighing 10 g each. He ordered the foils from his local manufacturer*) and after delivery he weighed each foil on his highly accurate scales only to conclude that the manufacturer was trying to cheat him. He therefore returned the shipment together with an angry letter in which he threatened the manufacturer with legal consequences if he didn't stop cheating the customers.

Within a few days Carl Friedrich got a new shipment of 100 foils together with a letter explaining what had gone wrong, reassuring him that this time he would be satisfied. Carl Friedrich again weighed each foil and after analyzing the data he came to the conclusion that the manufacturer indeed was a scoundrel.

The two series of measurements are included below. A text-file containing the data can be found at http://www.hep.lu.se/staff/stenlund/Gold.txt

Weights (g): first series			
9.885	9.787	9.822	9.930
9.981	9.853	10.114	9.893
9.995	9.901	9.925	9.984
10.013	9.782	9.797	9.938
9.913	10.035	9.986	10.004
9.865	9.957	9.983	10.009
9.917	9.863	9.916	9.880
9.958	9.829	10.017	9.812
9.866	9.958	9.845	9.849
9.997	9.799	9.862	9.833
9.942	9.925	9.832	9.975
9.867	10.030	9.819	9.864
9.716	9.916	9.916	9.917
9.842	9.930	10.019	9.723
9.965	9.778	9.893	9.893
9.967	9.856	9.955	9.931
9.805	9.947	9.909	9.824
9.907	10.093	9.941	9.801
9.907	9.984	9.792	9.909
9.885	9.973	9.961	9.910
9.894	10.003	9.972	9.984
9.933	9.775	9.932	9.988
9.830	10.036	9.871	9.982
9.915	9.935	10.037	9.759
9.785	9.999	9.840	9.994

Weights (g): second series			
9.969	9.992	10.001	10.129
10.007	10.059	9.972	10.054
9.997	9.982	9.976	9.990
9.978	10.004	10.069	9.954
10.051	9.968	10.043	10.009
9.961	9.982	10.015	9.956
9.976	9.978	9.970	9.998
9.984	9.957	10.021	10.031
9.985	9.951	9.991	9.990
10.026	9.951	10.077	10.081
10.044	9.989	9.999	9.990
9.963	9.972	10.022	9.961
10.034	10.031	9.956	10.001
9.958	10.020	9.985	9.977
9.973	9.953	10.003	10.083
9.981	10.025	9.987	10.030
9.951	10.003	9.971	10.013
9.986	9.985	10.001	9.991
9.951	10.015	9.995	9.962
9.993	10.039	9.959	9.996
10.039	9.999	9.956	10.016
10.034	9.983	10.072	10.114
10.082	10.026	10.072	10.012
9.969	10.048	10.017	10.032
10.143	10.051	9.977	10.077

*) Thin Gold Foils Ltd.® is the worlds largest supplier of thin Gold foils weighing 10 g and produces several thousands such foils every day to be shipped to customers world wide.

Litterature:
Statistics for nuclear and particle physicists / Louis Lyons (Cambridge: Cambridge U.P., 1989)
Statistics / Evert Stenlund, http://www.hep.lu.se/staff/stenlund/Somethings.ppt
(lecture given during the cycle; included as a PowerPoint file and a .pdf file)

Aims:
The aims of this cycle is to give the students a general idea of how statistical methods are applied to the specific problems they may encounter in there future attempts trying to evaluate experimental results.
The problem given in the scenario consists of two data sets, and the idea is that the students should analyze those. The first set is a Gaussian distribution with mean around 9.9 and a standard deviation around 0.1, i.e. the distribution does not have the nominal mean of 10.0 (as stated by the manufacturer).
The second distribution is the same Gaussian truncated at 9.95, so that the mean now is close to 10.0.
During the cycle the students are supposed to figure this out.