Homework n.6

A) A fit with a function $f(x; \gamma)$ on a measured x-distribution yields the result for the parameter γ :

$$\gamma = (-0.34 \pm 0.48\ ) \times 10^{-5}$$

with $\gamma > 0$. Put an upper limit at **90%** C.L. on γ using:

- The classical frequentist approach
- The unified approach (Feldman Cousins) with the mean of the Gaussian constrained to be non-negative
  (see Feldman and Cousins Phys.Rev.D 57 3873 (1998) TABLE X)
- The Bayesian approach (briefly comment the choice of the prior)

B) a counting experiment yields N=S+B=2 event in the signal region with B=5 expected background. Assuming negligible uncertainty on B, evaluate an upper limit for S at **95%** C.L. using:

- The classical frequentist approach
- The unified approach (Feldman Cousins) for a Poisson signal
  (see Feldman and Cousins Phys.Rev.D 57 3873 (1998) TABLES VI-VII)
- The Bayesian approach (briefly comment the choice of the prior)

Homework n.6

C) The parameter $\mu=\sigma/\sigma_{THEORY}$ for the signal strength of a new particle (with predicted cross section σ_{THEORY}) is measured with three different and independent methods yielding:

$\mu_1 = 0.55 \pm 0.30$
$\mu_2 = 0.43 \pm 0.37$
$\mu_3 = 0.99 \pm 0.29$

Assuming gaussian pdfs and errors:

- evaluate the best estimate of the parameter μ and its uncertainty;
- evaluate the corresponding p-value for the fit hypothesis (i.e. a X2 test, consistency of three measurements of the same true value);
- build an expression for the test statistics

  $$q_\mu = -2 \ln \frac{L(\underline{x}|\mu)}{L(\underline{x}|\hat{\mu})}$$

- Evaluate with a toy MC simulation the pdfs $f(q_1|1)$, $f(q_1|0)$, and $f(q_0|0)$. (assuming the same gaussian uncertainties of the measurements).
- Evaluate the p-value of the null hypothesis (μ=0) corresponding to the observed q_0^{obs} .
- Evaluate the p-values CL_{s+b}, CL_b and CL_s corresponding to the observed q_1^{obs} .
- Briefly comment the results.

Homework n.6

D) Repeat all the evaluations of point C) for the following set of measurements
$\mu_1 = 1.55 \pm 0.30$
$\mu_2 = 1.43 \pm 0.37$
$\mu_3 = 0.99 \pm 0.29$