



ON DEPENDENCE AND INDEPENDENCE OF UNCERTAINTIES

Or why we prefer to keep separate things separate.



Orography

2

ATLAS-CONF-2013-034

- As experimental results become more precise, the THU mountains become more clearly visible.

- Effects on gluon-fusion production cross-section is the most visible:
 1. THU from MHO.
 2. THU from PDF.

- **Treating MHO+PDF THU as flat, ATLAS signal strength p-value for $\mu = 1$ goes from 9% to ~40%.**

- Only two ingredients:
 - ▣ Egg yolks.
 - ▣ Sugar.

- Endless variations:
 - ▣ Pudim Abade de Priscos.
 - ▣ Trouxas de ovos.
 - ▣ Ovos moles.
 - ▣ Lampreia de ovos.
 - ▣ ...





~~Gastronomy~~ Cookery

- One thing are the ~~ingredients~~ nuisances:
 - ▣ Different sources of TH uncertainty:
 - Missing higher order in cross-section calculations.
 - PDF fit variety.
 - Parametric dependence on α_s .

- Another thing are the ~~recipes~~ frameworks:
 - ▣ Frequentist profiling of nuisance parameters.
 - ▣ Bayesian marginalization of nuisance variables.

The pre-cooking problem

- Instead of individual THU, provide EXP with one simple combined, pre-cooked, uncertainty.
- Pros:
 - ▣ Ready to eat.
- Cons:
 - ▣ You can't evaluate ingredients individually.
 - ▣ No possible learning.
- **And beware food poisoning.**





How about pre-cooking THUs?

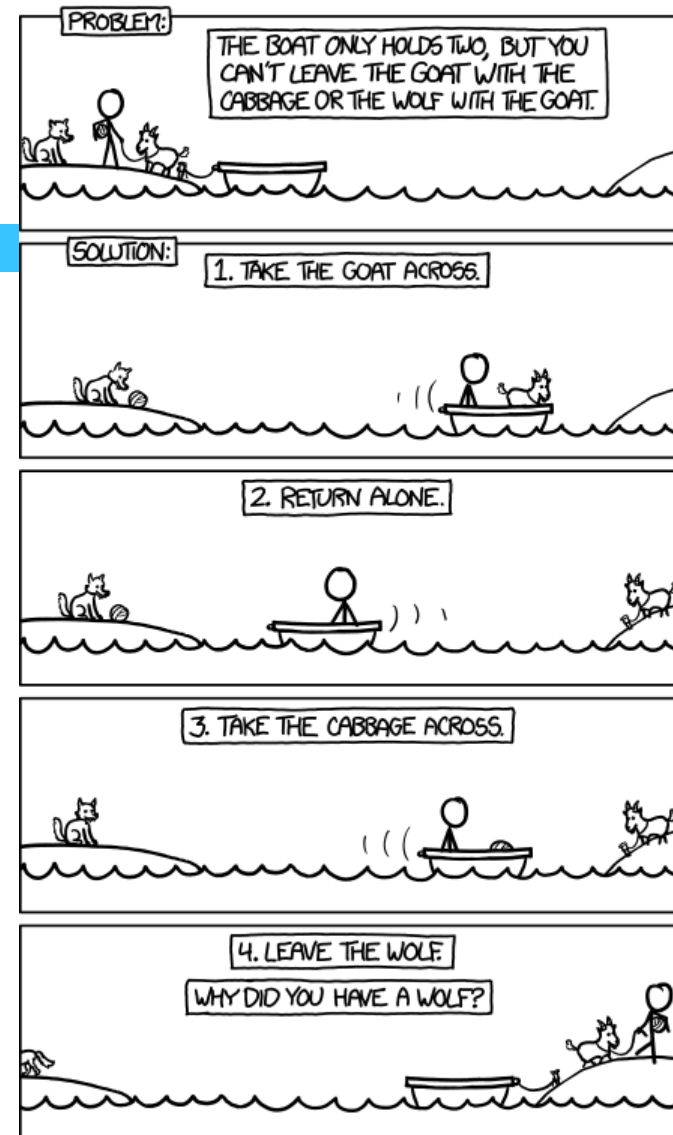
- The actual result the composition of “Flat \oplus Gaussian” depends on the ~~recipe~~ framework:
 - ▣ **Frequentist:** can be done consistently, but results will not be the usual fare (pull to edges).
 - ▣ **Bayesian:** gives something like convolution (via marginalization integral).

- Moreover, you **lose all hope of correlating** the individual THU across production channels.
 - ▣ PDF in ggH & ttH (ditto VH & VBF).
 - ▣ MHO across the board.

The logic boat

<http://xkcd.com/1134/>

- In our view, **each TH uncertainty** should:
 - ▣ Be provided **individually**.
 - ▣ Include the **most accurate shape** (pdf).
 - ▣ Be **part of a correlation matrix** with all other THUs.
- So, yes, we want to keep the cabbage, the goat, **and** the wolf.
- If we agree to cross this river and take the wolf with us we can now discuss:
- **How to statistically treat THUs.**
 - ▣ Statistics experts have been invited to evaluate alternatives.





The statistical treatment of THU

- **Frequentist:** can be done consistently for Flat and Gaussian, but results will not be the usual fare (pull to edges).
 - In the unconditional ensemble the observable associated to the center of the Flat is generated using the Flat itself. Profiling it in the fit usually ends up at the edge.
- **Bayesian:** should give something like a convolution of Flat and Gaussian (via marginalization integral).
 - But how do we choose priors for pseudo-observables (κ , $\mu \equiv \kappa^2$)?
- **Hybrid alternatives?**
 - Using the conditional ensemble where Flat pdf parameters are fixed?
 - Marginalisation of Flats and profiling of Gaussians (in which order)?
 - Anyone with experience/objections/crazy ideas? All are welcome.