Discussion Questions for Day 1 of Phystat-Nu 2019

Alain's warning:

-- OK to use a parametric fit to a well known problem (v oscillation, Z line shape etc.)
-- It is however not recommended (i.e. should be forbidden really) to fit some data with a convenient but arbitrary or unsure or model-dependent function (i.e. fit looks good) and act as if the error matrix of the fit represents the uncertainty on the fit data. It does not, -- and this can go very wrong!

Comments: Error is in the extrapolation from one sample to another, treating the ad-hoc parameterization as if it were a model of physical interaction. Even smoothing is ad hoc. Unfolding?

Examples abound in neutrino experiments.

We should invite theorists to these workshops!

Louis, quoting someone else:
"Our data are inadequate, so we had to use statistics."

"Our models are inadequate, so we had to..."

Can the ad-hoc terms be useful in the construction of a proper model?
How do we do better?

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What constitutes discovery?

Not just numbers of sigma, but can you discover something by its absence? Pauli and the missing energy/momentum/ angular momentum. Lederman, Schwartz, Steinberger observed.

Tau neutrino – missing energy in W->tauX decays, no tau appearance in numu, nue beam. Is this enough? It was enough to define the null hypothesis before observation of appearance.

GIM and charm

Davis and Solar Neutrinos

Aside: What is an "uncalibrated" 5-sigma result?

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From Yoshi: There is a >4 sigma tension in the LSND/MiniBooNE/MINOS/NOvA/Reactor sector on sterile/exotic neutrinos

How do we handle this?

Best way – do more/better experiments.

What if we are out of money, or the tension comes from a very expensive/large experiment?

LHC – 2 experiments -- cross-checks. LEP: four! Long-baseline experiments can be unique.

Yoshi – "arbitrary scaling of errors was needed" (contentious!)

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Motivated by Costas, Wouter, Nicholas's talks

How can we best communicate the results of neutrino experiments?
- Usefulness to theorists to constrain models
- Usefulness to experimentalists to constrain systematics in future experiments
- Usefulness to Monte Carlo teams to tune detector models.
- Usefulness for future combiners. Can combine data, not results

Past models of distribution of results are inadequate:

- Missing correlations
- Hard to undo the impact of old models and replace with new ones
- How to combine old results with new?

Software solutions: ROOFIT, ROOSTATS, RECAST. How much work is it to make the collider tools useful in neutrino experiments? Is it worth it? Question of software support of resulting system.

Can we agree to share?
- Downsides – credit, spurious results made without vetting, ...

Discussion Questions for Day 1 of Phystat-Nu 2019

Sharing tools and methods.

Is the near-far extrapolation really the same as the joint likelihood
but with the nuisance parameters are the neutrino flux in each bin for each flavor?

How to handle theory uncertainties?

Therorists have opinions about the priors to use, or even the techniques
-- often prefer supremum p-values, or at least flat priors

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What are the criteria for handling systematic uncertainties?

e.g. T2K has a mixture of prior predictive (theta13, systematics) and posterior predictive (theta23, deltamsquared) handling procedures for different systematics within an analysis (Himmel)

This presumably is done for a reason
- Honest accounting of systematics. Expedience should be less of an issue in neutrino experiments.
- Is there an analog of coverage for systematic uncertainties?
- How do we know we're done enumerating systematics? Barlow: penalty for diligence.

Some systematic uncertainties are parameterized with knobs in generators.
Others arise from choosing different models/generators/approaches.
- Does this double count uncertainty?
- Does this undercount uncertainty?
- Ad-hoc procedures in order to handle this (example: PDF uncertainties in colliders are similar)

- HEP inventions – what are the criteria for use? (CLs, Chao: Neyman/Pearson chisquared, Wiener filter smoothing). We are creative in (pre)processing our data! (reconstruction).

Discussion Questions for Day 1 of Phystat-Nu 2019

What are the boundaries between reconstruction, modeling, and statistical interpretation?

Should there be these boundaries? (maybe for tomorrow).

If event selection and energy reconstruction were perfect, we
wouldn't have some complications that appear in the statistical interpretations.

Neutrino energy reconstruction is very difficult!

Invisible/unmeasured particles

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Systematics:
Good, Bad, and Ugly. (Costas)

Cranmer (from memory): Good: Constrainable with auxiliary data
Bad: (Educated) guesses
Ugly: Forgotten, omitted, unknown

What if different results have different mixtures of Good/Bad/Ugly for the same nuisance parameters, if only because they were performed at different times by different people?

Systematics can affect funding decisions and experiment design.

Do not put priors in twice in a Bayesian combination.