Evaluating the soundness of statistical methods for optical atomic clock comparisons.

1. Introduction:
   1. Basics of optical atomic clocks: basic operation, use in timing and modern-day applications.
   2. Comparison of optical atomic clocks: why we compare optical atomic clocks, and how those comparisons are used for redefinition of the second, clock characterization, and tests of fundamental physics.
   3. The role of analysis in clock data.
2. Statistical tools in the analysis of clock measurement data:
   1. Traditional statistical tools, their application to clock measurement analysis, and their limitations.
   2. How data analysis can lead to biases or analysis inconsistencies in clock ratio evaluations.
      1. Interpolation and imputation.
      2. Data filtering.
         1. Flagging good and bad data.
         2. If two people start with the same data set, but filtering causes one set to differ in length by 5%, 10%, or 20%, by how much can we expect variations in the mean?
         3. Deglitching vs the island filter.
         4. What deglitch level makes sense 2-sigma, 3-sigma, 5-sigma?
   3. Stability analysis and for estimating noise sources and for assigning in-day statistical uncertainty.
      1. Challenges associated with dead time, non-Gaussian frequency noise and data scatter.
      2. Allan deviation (when it works, when it doesn’t)
      3. Spectral analysis (comparison with the adev method, computational challenges, analysis benefits and limitations)
      4. Noise aliasing method (PTB analysis) – ask Jeff!
   4. Calculating the clock frequency ratio mean and total measurement uncertainty.
      1. Weighted mean vs Bayesian analysis: agreement, pros and cons regarding the assessment of dark uncertainty.
      2. What makes most sense for evaluating the total statistical uncertainty: Spectral analysis applied to the entire (point-by-point multiday) data set vs analysis applied to a short time record of in-day measurements with error bars.
      3. What other methods should be explored?
3. Conclusions:
   1. Summary of the problem
   2. Recommendations
   3. Challenges as clocks move toward 10^-19!