

***Statistical Methods for 2010 and Future  
Directions for Analysis***

*Steven Earnest*



# Statement of the Issue

- Ambient water samples are generally comprised of grab samples that measure the quality of water at a discrete moment in time.
- Samples are collected repeatedly in an attempt to represent average conditions over time.
- The frequency at which single samples in a data set exceed a given parameter criteria determine the percentage of time a water body is impaired.



# Statement of the Issue

- Numerous statistical methods have been attempted to describe this impairment status. These include:
- **Raw Score** = the ratio of exceedances to sample size = % impairment.
- **Binomial** = controlling for Type-I error rate to generate a probability that a water body is impaired for a certain percentage of samples in a data set (i.e. Type-I not greater than 20% for determining impairment).
- **Confidence interval analysis** = attempts to control for the magnitude of exceedances in a given data set (does not work well with widely variable data).
- Does not apply to criteria expressed as an long term average (i.e. TDS)



# Guidance for 2008 and 2010 IR

- Implemented SAS Assessment Enhancement Tools in 2008
- Created new output table in SAS for summarizing the statistical results of sample sets (Samples, exceedances, Binomial error, raw score, CIP, and accompanied details)
- Uses Binomial method of determining impairment status (**Type-I error** is the chance of listing erroneously if listing with a particular exceedance/sample combination at a predetermined exceedance rate).

For example -

10% impairment:	3 exceedances of 10 samples = 7% Type-I
	3 exceedances of 15 samples = 18% Type-I
25% impairment:	5 exceedances of 10 samples = 8% Type-I
	6 exceedances of 15 samples = 15% Type-I



# Guidance for 2010 IR, cont...

- 303(d) Listing:

- Conventional - DO, pH, Temp requires 10% exceedance rate to list as Not-Supporting, 8% exceedance to list as a concern (Type-I = 20%)
- Recreational – Bacteria requires 25% to list as Not-Supporting, 20% exceedance to list as a concern (Type-I = 20%)



## Guidance for 2010 IR, cont...

- **Delisting:**

Delisting occurs when a previously listed water body is determined to be Fully-Supporting a given use (Aquatic Life Use – Dissolved Oxygen)

- Various circumstances may cause delisting of a water body. In general, this occurs with two fewer exceedances than were required for listing and/or one fewer exceedance than required for a concern. This is often double-checked with a review of the raw score ratio.
- Type-II error (the chance of missing an impairment when not listing with the sample number of exceedances/samples) does not play a major decision role due to the need for much larger data sets. In general, balancing Type-I with Type-II error rates is impractical due to a small datasets at most monitoring sites.



## Future Directions (Beyond 2010)

- Future efforts:
  - Create a new SWQM statistics work group
  - Further examine ways to incorporate magnitude into our impairment decisions
  - Examine methods of normalizing highly variable datasets (i.e. bacteria)
  - Incorporate stakeholder input, where appropriate, into guidance procedures for impairment and delisting decision processes (Does anyone have any better ideas?)
  
- Questions/Comments ?

