Water Quality Monitoring of Maryland's Tidal Waterways

UMBC REU Site: Interdisciplinary Program in High Performance Computing

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Overview

Our research determined areas of water quality concern in the Chesapeake Bay and is split into two projects:

Project 1

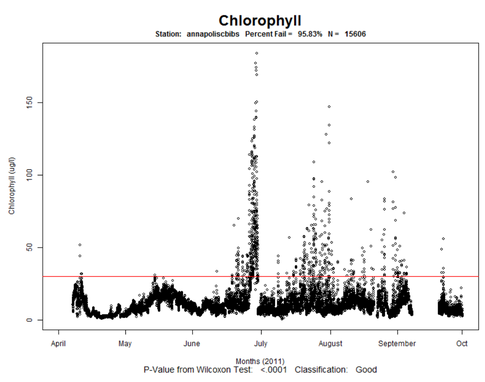
- Compute and compare failure rates for the stations
- Assess stations' statuses using the Wilcoxon Signed-Rank Test
- Preform a simulation to assess the validity of the above test
- Rank the stations using multiple comparison tests

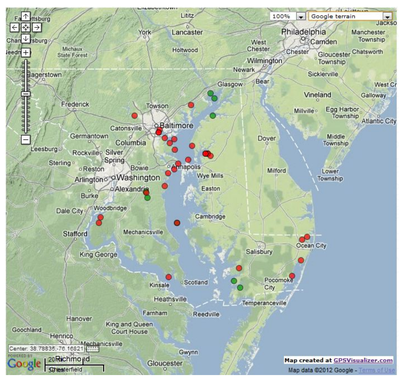
Project 2

- Conducted trend analyses at five stations in the Corsica River

To complement our research, we have developed a data-driven software in R to analyze and display results in a GUI.
This poster covers Project 1.

Stations' Statuses





Left graph serves as an example of the skewed parameters, specifically chlorophyll. Right map shows the stations' statuses utilizing the Wilcoxon test on the log-transformed data with the Benjamini-Hochberg rejection method.

Simulation and Adjustment

- Test Statistic: $\mathsf{S} = \left| \sum_{i=1}^{m} \left[R_i \cdot \mathsf{sign}(x_i - thresh) \right] \right|$

  where $R_i =$ rank of $|x_i - thresh|$

- The Wilcoxon Signed-Rank Test assumes the data is symmetric. For non-symmetric data, the true Type 1 Error may be inflated.
- Our simulation study (using $\Gamma(\alpha, \beta)$ on a range of skewness values) shows that a log-transformation of the data substantially reduces the Type I Error but the error is still large for data with skews in the range we see in our data.

References and Acknowledgments

- Technical report for Project 1 , Project 2, and GUI: HPCF–2012–12 `www.umbc.edu/hpcf` > Publications.
- For more information on the data, visit the Eyes on the Bay website `www.eyesonthebay.net`
- REU Site: `www.umbc.edu/hpcreu`, funded jointly by NSF and NSA
- DNR, UMBC, HPCF, CIRC

Chesapeake Bay

Courtesy - Maryland DNR Eyes on the Bay webpage

- Home to more than 3,600 species of plants and animals
- Valuable commercial and recreational resource
- Maryland Department of Natural Resources (DNR) monitors various parameters such as dissolved oxygen, turbidity and chlorophyll
- We determined areas of water quality concern by assessing parameters against respective DNR-provided threshold levels

Parameter	**Failure Threshold**
Dissolved Oxygen	< 3mg/L
Dissolved Oxygen	< 5mg/L
Chlorophyll	$> 30\mu$g/L
Turbidity	> 7 NTU

Ranking

Oxygen (5mg) — Ranks of monitoring stations with respect to percent failure: the Tukey Test (TT), the Bonferroni Test (Bonf), and the Benjamini–Hochberg Method (BH)

Station Name	**% Fail**	**TT**	**Bonf**	**BH**	
				% Fail	**Mean**
Betterton	0	1	1	1	4
Havre de Grace	0	1	1	1	5
Flats	0.0086	1	1	3	2
⋮	⋮	⋮	⋮	⋮	⋮
Little Monie	80.2075	36	36	36	36
Masonville (bottom)	80.4072	36	36	36	37
Goose (bottom)	89.7545	38	38	38	38

Ranking

- Ranking methods used multiple comparison tests to control for Type I Error
- Bonferonni Adjustment was the most conservative and thus created the largest groupings. Benjamini-Hochberg was the least conservative.