Web Service for toxicant trigger valuation

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Overview

- Experiment On Models
- Web Service
- Modification
Overview

- BurrliOZ
- NEC
- Web Service
- Extension
- Motivation
Outline

- BurrliOZ
  - Model
  - Experiment
  - Web Service
- NEC
  - Model
  - Experiment
  - Web Service
- Discussion
- Future Work
- Conclusion
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant.
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant

Model

Burr Type III

Original :

Re-rewrite :

\[ F(x; \theta) = 1 + \left( \frac{b x - a}{c} \right)^{k} \]

x > 0, c > 0, k > 0

Original :

Re-rewrite :

\[ F(x; \theta) = 1 - \left( 1 + \frac{x c}{k} \right)^{-1} \]

x > 0, c > 0, k > 0

Graph:

CDF

0.2 0.4 0.6 0.8

1 0.8 0.6 0.4 0.2

0.2 0.4 0.6 0.8
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant.
A statistical software package to help environmental managers to figure out trigger values of toxicant
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant

Features:
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant

Shiny

Number of bins in histogram (approximate):
20

Show Individual observations
Show density estimate

Geyser eruption duration

Density

0.0 0.2 0.4 0.6
1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Duration (minutes)

ui.R
server.R

shinyUI(bootstrapPage(

selectInput(inputId = "n_breaks",
    label = "Number of bins in histogram (approximate):",
    choices = c(10, 20, 30, 50),
    selected = 20),

checkboxInput(inputId = "individual_obs",
    label = strong("Show individual observations"),
    value = FALSE),

checkboxInput(inputId = "density",
    label = strong("Show density estimate"),
    value = FALSE),

plotOutput(outputId = "main_plot", height = "500px"),

Display this only if the density is shown
conditionalPanel(condition = "input.density == true",
    sliderInput(inputId = "bw_adjust",
        label = "Bandwidth adjustment:",
        min = 0.2, max = 2, value = 1, step = 0.2)
)
)

Please see our tutorial to learn more about writing Shiny apps.
A statistical software package to help environmental managers to figure out trigger values of toxicant
**BurrliOZ**

A statistical software package to help environmental managers to figure out trigger values of toxicant.
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant

Web Service

Data Summary

<table>
<thead>
<tr>
<th>Data</th>
<th>Taxonomic group</th>
<th>Type</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>12.0</td>
<td>chronic 5</td>
<td>Ameripenna curvicaudata 1</td>
</tr>
<tr>
<td>2nd Qu</td>
<td>27.0</td>
<td>converted acute 3</td>
<td>Ceratophyllum demersum 1</td>
</tr>
<tr>
<td>Median</td>
<td>32.0</td>
<td></td>
<td>Chlorella sp. 1</td>
</tr>
<tr>
<td>Mean</td>
<td>216.1</td>
<td></td>
<td>Hydra viridissima 1</td>
</tr>
<tr>
<td>3rd Qu</td>
<td>300.8</td>
<td></td>
<td>Lemma aquatica 1</td>
</tr>
<tr>
<td>Max</td>
<td>778.0</td>
<td></td>
<td>Melanotaenia splendidina 1</td>
</tr>
</tbody>
</table>

BurrliOZ
NEC
Discussion
Future Work
Conclusion
BurrliOZ

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BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant

Plot
BurrliOZ

A statistical software package to help environmental managers to figure out trigger values of toxicant
NEC Model

A Bayesian model for the NEC:

\[ Y_i; x_i = \mu = \alpha \exp\left[-\beta x_i - \gamma I\left(x_i - \gamma\right)\right] \]

No effect concentration
A Bayesian model for the NEC:

\[ E(Y_i; x_i) = \mu = \alpha \exp[-\beta(x_i - \gamma)I(x_i - \gamma)] \]

With

\[ I(z) = \begin{cases} 
1, & z \geq 0 \\
0, & z \leq 0 
\end{cases} \]

\( \alpha \) is the response at zero/low-dose concentrations
\( \beta \) controls the rate of decay in the response
\( \gamma \) is the NEC (no effect concentration)
NEC

No effect concentration

BUGS = Bayesian inference Using Gibbs Sampling

WinBUGS

OpenBUGS
No effect concentration
<table>
<thead>
<tr>
<th></th>
<th>WinBUGS</th>
<th>OpenBUGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result Repeatable</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Code Running</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Running on Linux</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Still update</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Same function</td>
<td>Yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
NEC
No effect concentration

User

Shiny

Interface

R code

Server Core

Library

OpenBUGS

Web Service

BurrliOZ  NEC  Discussion  Future Work  Conclusion
No effect concentration
No effect concentration
Discussion

- Cannot repeat the result
- Comparison
- Extension
Possible reason: has not updated for years
Our solution: Using OpenBUGS
### Discussion

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>P2.5</th>
<th>P50</th>
<th>P97.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>0.95</td>
<td>0.01</td>
<td>0.92</td>
<td>0.95</td>
<td>0.97</td>
</tr>
<tr>
<td>Beta</td>
<td>1188</td>
<td>3139</td>
<td>17</td>
<td>107</td>
<td>12350</td>
</tr>
<tr>
<td>Gamma</td>
<td>0.95</td>
<td>0.08</td>
<td>0.01</td>
<td>0.86</td>
<td>1.11</td>
</tr>
</tbody>
</table>

Possible Reasons: Typo Error, Software problem
Solution : continue using OpenBUGS
### Discussion

#### Comparison

<table>
<thead>
<tr>
<th></th>
<th>BurrliOZ</th>
<th>BurrliOZ(WEB)</th>
<th>NEC</th>
<th>NEC(WEB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>OS</td>
<td>Windows</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>Platform</td>
<td>Computer</td>
<td>Computer, mobile device</td>
<td>Computer</td>
<td>Computer, mobile device</td>
</tr>
<tr>
<td>Software</td>
<td>.net library</td>
<td>Web Browser</td>
<td>WinBUGS</td>
<td>Web Browser</td>
</tr>
<tr>
<td>Programming</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>NO</td>
</tr>
</tbody>
</table>

More flexible and accessible usage
## Discussion

### Extension Features

<table>
<thead>
<tr>
<th>Features</th>
<th>BurrliOZ</th>
<th>BurrliOZ(WEB)</th>
<th>NEC</th>
<th>NEC(WEB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading data</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Models</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Priors distribution</td>
<td>NA</td>
<td>NA</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Email</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Output result</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>

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More features and more comparison

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BurrliOZ ➤ NEC ➤ Discussion ➤ Future Work ➤ Conclusion
Future Work

- update the BurrliOZ package;
- improve the performance of BurrliOZ;
- more possible priors distributions in NEC.
- rewriting the front-end by using JavaScript;
- testing new possible models;
- comparing NOEC. vs NEC or other models
- using different tools and packages;
- using the same way in different fields
Revisiting and experimenting Shao’s and Fox’s work, and we find there seems to be different from Fox’s result with ours, we try to explain the difference and give our own solutions;

- implementing BurrliOZ into web service;
- implementing NEC into web service;
- providing figures with published quality
- extending Fox’s work via providing more flexibility in the web service like normal distribution and Weibull distribution
Reference


Thank you !
Q & A