Statistical Research for the Kearny Marsh

Manfred Minimair, Seton Hall University
Juliana Newman, Seton Hall University
STATISTICAL RESEARCH FOR THE KEARNY MARSH

Juliana Newman and Dr. Manfred Minimair
Seton Hall University
Introduction: Kearny Marsh
Data Received - Organization

- Poster
- Treatments Done on Marsh to Contain Pollutants
- Excel Spreadsheets
- Microsoft Access -- relationships
Limitations of Data

- Missing Values
- Not enough values
- Stopped counting chironomids at 500

RESULT -- > we confined our data to 3 species, chironomid, mayfly, scud
Our Questions

1. How does abundance vary by time?

2. How does abundance vary by time and treatment?

3. How does abundance depend on environmental features?
1. How does abundance vary by time?
Comparing Species Means: Dependent \( t \)-test and Wilcoxon signed-rank Test

- The group means of chironomid, scud, and mayfly were compared per year, per pair of seasons that follow each other, and per pair of the same season in different years.

- If the pair being compared was normally distributed, the \( t \)-test was used. If the pair being compared was not normally distributed, the Wilcoxon signed-rank Test was used.
We did not compare the data from 2005 to the data from 2006 because data from 2005 was only collected in the Fall.

On average according to the Wilcoxon test, the mean abundance of chironomids significantly decreased from 2006 ($M=189.79$, $SE=19.72$) to 2007 ($M=142.44$, $SE=18.86$), $t(69)=2.06$, $p<.05$, $r=0.24$. 
Average of chironomid for each season broken down by year.
Scud: Comparing Years

- We did not compare the data from 2005 to the data from 2006 because data from 2005 was only collected in the Fall.

- The mean abundance of scuds was significantly higher in 2006 ($Mdn=19$) than in 2007 ($Mdn=10$), $T=27$, $z=-2.495$, $p<.05$, $r=-.305$, according to the Wilcoxon test.
Average of scud for each Season broken down by Year.
Average of scud for each Year broken down by Season. The marks are labeled by average of scud.
Mayfly: Comparing Years

- We did not compare the data from 2005 to the data from 2006 because data from 2005 was only collected in the Fall.
- According to the Wilcoxon test, the mean abundance of mayflies was significantly higher in 2006 ($Mdn=0$) than in 2007 ($Mdn=0$), $T=5$, $z=-2.509$, $p<0.5$, $r=-.307$. 
The chart represents the average number of mayflies for each year broken down by season. The data shows a significant decrease in mayfly numbers across all seasons from 2006 to 2007.
Result:
1. How does abundance vary by time?

- Most significant changes were decreases as time went on.
- Surprising findings
2. How does abundance vary by time and treatment?
ANOVA – missing values in data

Used Mixed Models analysis to estimate the size of the effect of treatment and year by fitting a linear model to the data

\[ Y_{ij} = \mu + \alpha_i + \beta_j + E_{ij} \]

- **Number of chironomid**: Overall average (SPSS intercept)
- **Effect of treatment**: Effect of treatment \( i=0,2,3 \)
- **Effect of season**: Effect of season \( j=0,1,2,3,4,5 \)
- **Error term**
Sig < 0.05 we can reject assumption that mean is zero, thus there is an effect.
Mixed Models: Summer 2006-2007

Fixed Effects

Type III Tests of Fixed Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Numerator df</th>
<th>Denominator df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1</td>
<td>24.081</td>
<td>109.109</td>
<td>.000</td>
</tr>
<tr>
<td>TimeID</td>
<td>1</td>
<td>26.131</td>
<td>.107</td>
<td>.746</td>
</tr>
<tr>
<td>TreatIgnoreSS</td>
<td>2</td>
<td>22.525</td>
<td>16.848</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Dependent Variable: chironomid.
### Mixed Models: Fall 2006-2007

#### Fixed Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Numerator df</th>
<th>Denominator df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1</td>
<td>25.846</td>
<td>37.017</td>
<td>.000</td>
</tr>
<tr>
<td>TimeID</td>
<td>1</td>
<td>26.740</td>
<td>.547</td>
<td>.466</td>
</tr>
<tr>
<td>TreatIgnoreSS</td>
<td>2</td>
<td>27.423</td>
<td>1.651</td>
<td>.210</td>
</tr>
</tbody>
</table>

a. Dependent Variable: chironomid.
Result:
2. How does abundance vary by time and treatment?

- The treatment had an effect in the Summer, but not in the Fall or the Spring.
- The time had an effect in the Spring, but not in the Summer or in the Fall.
3. How does abundance depend on environmental features?
We looked for linear regression lines between environmental factors, and the number of chironomids, scuds, and mayflies.

The environmental factors used were: Conductivity, Depth, DO, pH, Redox, Salinity, Temp, TSS, and Total w/o Fe (metals). We used SPSS to create scatter plots, and then drew regression lines.

After observing all of the plots, we noticed that they were not significantly linearly related.
Chironomid vs. DO
$R^2 = 0.005$

Chironomid vs. Redox
$R^2 = 0.029$
Scud vs. Total without Fe

Mayfly vs. Depth

There was no feasible regression line drawn.
We observed different clusters, and examined them through colored graphs.
Temperature appears to be clustered by season for chironomid, scud, and mayfly.
Next we looked at salinity by season and year.
Salinity appears to be clustered by season and year for chironomid, scud, and mayfly.
Result:
3. How does abundance depend on environment?

- The abundance varied greatly despite some clusters based on year or season.
- Abundance did not seem to depend on any environmental features that we studied.
As time went on, we saw more decreases in the abundance of different species. The treatment had an effect in the Summer, but not in the Fall or the Spring. The time had an effect in the Spring, but not in the Summer or in the Fall. Abundance of species did not seem to depend on any environmental features that we studied.
Open Questions for Future

• Do any environmental factors influence abundance?

• Does variation depend at all on geography of marsh?

• We have more data about pollution of water and sediment that can be analyzed.
Thank You!

- Dr. Carolyn Bentivegna - Data
- Dr. Manfred Minimair - Advisor
- Clare Boothe Luce Scholarship - Sponsor