Biometrics for Plant Scientists

Pl. Sci 547 ~ Spring 2011

$f(\mu_1, \sigma_1)$
$f(\mu_2, \sigma_2)$
Biometrics for Plant Scientists
Plant Science 547
Spring 2011

Monday, Wednesday & Friday
9:30 to 10:20
Ag. Sci. 141

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Course Objective

Explain the use of biometrical techniques in research with particular emphasis in designing, analyzing and interpreting agricultural and biological experiments.
Course Objective

This course will emphasize the application of statistical methods to biological experiments and outline some of the problems that may be encountered when applying these techniques to biological systems.
Number Systems

Arabic

Roman
Number Systems

1, 2, 3, … 10

I, II, III, … X
Number Systems

- Length, distance.
- Weight.
- Volume
- Speed, direction.
- Temperature.
- Light intensity.
- Earthquake magnitude.
Gambling

✓ Probability of rolling a six and a two on two dice?
✓ Beat a poker hand better than three kings and two aces?
✓ Probability that *Lively Lady* will win the 2007 Derby?
Statistics

- Convert information from events, occurrences, situations, or some process into numerical form.
- Analyze or summarize the numbers collected.
- Make inference or interpret *statistics* and make decisions or recommendations.
Politics
McCain picks Palin as running mate

God, she's hot!
Weather
Products
Sport
Catholics have sex more often, are more playful and enjoy sex more than most Protestants

BY DAVID BRIGGS
Associated Press

You've read the books, seen the movies and heard the stand-up comics describe Catholic sexuality as a procession between the bedroom and the confessional.

Now hear the facts: Catholic sex is not an oxymoron, a prominent sociologist says in a new study.

Catholics have sex more often, approach sex more playfully and are more likely to enjoy sex than non-Catholics, concludes the Rev. Andrew Greeley in a new book "Sex: The Catholic Experience." The book reviews survey data from 1989 to 1991 on Americans' sexual behavior.

In fact, the data suggests those people looking to spend more time making love than falling asleep watching TV on the couch should consider Catholic spouses. In one survey of Protestants, more than 60 percent who were married to Catholic spouses reported having sex once a week or more. In comparison, 54 percent of Protestants married to Protestants and 40 percent of Protestants with Jewish spouses reported having sex with the same frequency.

"They (Catholics) may well be repressed," Greeley said in an interview. "The only point in my book is that they are less repressed than others."

Source: General Social Survey 1989-1991
Collect information on a sample from a population: and based on the results of the sample, make inference on the whole population.

Collect information on events from the past, and use these to predict what will happen in the future.
Statistics

✓ “There are numbers, there are statistics, and there are down right lies!”
✓ Usually there are several factors involved: few things (biological) are simple.
Statistics

Statistics *n. pl.* 1. Numerical facts systematically collected (*statistics of population, crime, VITAL statistics*) 2. usu. treat as *sing.* Science of collecting, classifying and using statistics esp. in or for large quantities of numbers
Biometrics

Biometry *n.* biometrics *n.* *pl.* usu. treated as *singular*. Science of the application of statistical methods to biological facts.
Why do predictions fail?

- Asking the wrong questions.
- Having too small a sample size.
- Using a biased sample.
- Collecting false information.
- Making the wrong inference.
Estimate large-scale agriculture, horticulture, or biological events by examination of a small sample of individual plants or genotypes.
Predict future biological events or situations based on past, and present, information.
What Effects
Performance of Plants

- Biology.
- Environment.
- Agronomic (pre-harvest).
- Agronomic (post-harvest).
- Disease management.
- Pests and insects.
- Weed competition.
- Genotype.
Aim of Biometrics Experiments

✓ Describe. ✓ Optimize.
✓ Estimate. ✓ Explain.
✓ Predict. ✓ Test.

Setting the correct hypothesis
<table>
<thead>
<tr>
<th>Phenotype</th>
<th>=</th>
<th>Genotype + Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>=</td>
<td>Genotype + Phenotype</td>
</tr>
<tr>
<td>Genotype</td>
<td>=</td>
<td>Phenotype + Environment</td>
</tr>
</tbody>
</table>
Why do Experiments fail?

✓ Proposing a wrong hypothesis or asking the wrong question.
✓ Incomplete consideration of the requirements needed to interpret the data.
✓ Ignorance of methods used in analyses.
Potato Yield Trial
(2 irrigations & four plant spacing)

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Spacing</th>
<th>Site A</th>
<th>Site B</th>
<th>Site C</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>50</td>
<td>271</td>
<td>253</td>
<td>177</td>
</tr>
<tr>
<td>High</td>
<td>40</td>
<td>248</td>
<td>251</td>
<td>169</td>
</tr>
<tr>
<td>High</td>
<td>30</td>
<td>199</td>
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<tr>
<td>High</td>
<td>20</td>
<td>192</td>
<td>220</td>
<td>237</td>
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<tr>
<td>Low</td>
<td>50</td>
<td>227</td>
<td>207</td>
<td>121</td>
</tr>
<tr>
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</tr>
<tr>
<td>Low</td>
<td>20</td>
<td>141</td>
<td>164</td>
<td>182</td>
</tr>
</tbody>
</table>
Think Question

- High Irrigation: 200 Yield
- Low Irrigation: 150 Yield
Think Question

![Graph showing yield vs. row spacing]

- Yield values increase with row spacing.
- The trend line suggests a positive correlation.

Questions:
1. What is the relationship between row spacing and yield?
2. How does the yield change as row spacing increases?
Think Question

![Bar chart showing Yield across Sites A, B, and C. Site A has a yield of 200, Site B has a yield of 225, and Site C has a yield of 175.]}
Think Question

![Graph showing yield vs. irrigation and spacing]

- **Yield**
  - High Spacing 20
  - High Spacing 30
  - High Spacing 40
  - High Spacing 50
  - Low Spacing 20
  - Low Spacing 30
  - Low Spacing 40
  - Low Spacing 50

- **Irrigation**
  - High
  - Low
Think Question
Think Question

![Graph showing yield for Sites A, B, and C.](image-url)
Probability and Statistical Parameters