Biostatistics Questions & Database Basics

Dan Eastwood, MS, Program Manager/Biostatistician
Medical College of Wisconsin, Division of Biostatistics

Friday, October 4, 2013
12:00-1:00 pm
Clinical Cancer Center-Room K
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Hours of Participation for Allied Health Professionals
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Financial Disclosure

- In accordance with the ACCME® standard for Commercial Support Number 6, all in control of content disclosed any relevant financial relationships. The following in control of content had **no** relevant financial relationships to disclose.

<table>
<thead>
<tr>
<th>Name</th>
<th>Role in Meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwang Woo Ahn, PhD</td>
<td>Activity Director</td>
</tr>
<tr>
<td>Haley Montsma, BBA</td>
<td>Planning Committee</td>
</tr>
<tr>
<td>Dan Eastwood, MS</td>
<td>Presenter</td>
</tr>
</tbody>
</table>
Evaluation Forms

Your opinion matters!
Help us plan future meetings, by completing and submitting your evaluation forms.

Thank you.
Learning Objectives

• Discover the capabilities and resources available within the Biostatistics Consulting Service

• Transition your research idea into a testable hypothesis

• Effectively organize research data

• Common data problems to avoid
Biostatistics Questions

Dan Eastwood, MS
Understanding Statistics

I used to think correlation implied causation.

Then I took a statistics class. Now I don't.

Sounds like the class helped. Well, maybe.

http://xkcd.com/552/
Why Biostatistics Consulting?

• Shared experience
• Discuss your study
• Consider alternate views
• Formulate ideas into hypotheses
Why Biostatistics Consulting?

Why might you need help?
Why Biostatistics Consulting?

Why might you need help?

• “I’ve got this research idea about ...”
• ...
• ...
• ...
• “The reviewers asked me to ...”
Why Biostatistics Consulting?

Why might you need help?

• “I’ve got this research idea about ...”
• “How large should my sample be?”
• ...
• ...
• “A significant result! What does it mean?”
• “The reviewers asked me to ...”
Why Biostatistics Consulting?

Why might you need help?

• “I’ve got this research idea about …”
• “How large should my sample be?”
• “I need help organizing my data.”
• “How do I perform a Chi-square test?”
• “A significant result! What does it mean?”
• “The reviewers asked me to …”
Questions for the Investigator

• What is your hypothesis?
• What is the design?
• What data are available?
• What is the plan for analysis?
Questions for the Investigator

What makes a good hypothesis? (1)

• A simple sentence. Null and alternate hypothesis should be evident
• Difference, equivalence, or agreement?
• No hypothesis? - a descriptive study
• Feasible design
Questions for the Investigator

What makes a good hypothesis? (2)

• The alternate hypothesis should be reasonable (power and clinical effect)
• Related factors (confounders)
• Preliminary data
## It Never Hurts to Ask

<table>
<thead>
<tr>
<th>Independent Samples</th>
<th>Sleep difficulty, Medication X?</th>
<th>Sleep difficulty, Medication Y?</th>
<th>Total</th>
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<tbody>
<tr>
<td>“No”</td>
<td>48</td>
<td>78</td>
<td>126</td>
</tr>
<tr>
<td>“Yes”</td>
<td>136</td>
<td>106</td>
<td>242</td>
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<tr>
<td>Total</td>
<td>184</td>
<td>184</td>
<td>368</td>
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</table>

Chi-Square test, \(p=0.0010\), Medication X 58%, Medication Y 74%
It Never Hurts to Ask

<table>
<thead>
<tr>
<th>Paired Data</th>
<th>Med Y, No difficulties</th>
<th>Med Y, Sleep difficulties</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Med X, No difficulties</td>
<td>34</td>
<td>44</td>
<td>78</td>
</tr>
<tr>
<td>Med X, Sleep difficulties</td>
<td>14</td>
<td>92</td>
<td>106</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>136</td>
<td>184</td>
</tr>
</tbody>
</table>

McNemar’s Test, p=0.0001, paired data odds ratio $= \frac{44}{14} = 3.14$
Questions for the Investigator

What data resources are available?

• Understand your data
• Clinical data and public databases
• Data management

• Good data = good research
The Answers

What is the plan for analysis?

• Best methods for the available data
• Best data for the available methods
• Potential for other analyses
Biostatistics Consulting Service

How to find us:
• Schedule a meeting.
• Just “Drop-In”.
• Special Sessions.
• Ask Us.
Consulting Services Faculty

• Prakash Laud, PhD, Professor & Acting Director
  • Injury Research Center, Center for Patient Care and Outcomes Research, Bayesian statistical methodology

• Aniko Szabo, PhD, Associate Professor & BCS Director
  • Cancer statistics, genetics, clinical trials

• Sergey Tarima, PhD, Assistant Professor
  • Missing data problems, health service research

• Tao Wang, PhD, Associate Professor
  • Statistical genetics

• Jessica Pruszynski, PhD, Assistant Professor
  • Logistic regression, Cancer studies
Consulting Services Staff

• Dan Eastwood, MS, BCS Manager
  • Cancer studies, general biostatistics
• Alexis Visotcky, MS, Biostatistician
  • VA databases, REDCap
• Qun (Katelyn) Xiang, MS, Biostatistician
  • Large databases, pediatric data
• Shi (Heather) Zhao, MS, Biostatistician
  • Nutrition, Obstetric studies
• Haley Montsma, BBA, Administrator
What should you bring to a meeting?

- Ideas
- Protocol?
- Example of your data
- Electronic copy of your data?
- “The boss”
Services

Data entry (fee service).
Help with:
• Design
• Analysis
• Grant Preparation
• Reading Papers
• Reports
• Graphics
• Assistance with Public Databases
• Advice on Methods
Biostatistics Consulting Service

• We are now supported by the Medical College’s *Clinical and Translational Science Institute* (CTSI)

• Biostatistics key function

• Monthly Lecture Series (more stats!):
  www.mcw.edu/biostatistics/LectureSeries.htm

• **DATUM** newsletter:
  www.mcw.edu/biostatistics/datum.htm
Biostatistics Consulting Service

CTSI services available to faculty, staff, and students working on Clinical and Translational Science Research at:

• MCW
• VA Medical Center
• Blood Center
• UW-Milwaukee
• Marquette
• Milwaukee School of Engineering
Free Drop-in Consulting

• **Medical College of Wisconsin:**
  Tuesdays and Thursdays  
  Time: 1:00 PM—3:00 PM  
  Building: Health Research Center  
  Room: H2400 Biostatistics

• **MCW Cancer Center**
  Wednesdays 10:00 AM—12:00 PM  
  Fridays 1:00 PM—3:00 PM  
  Building: MCW Clinical Cancer Center  
  Room: Clinical Trials Support Room  
  CLCC: 3236 (Enter through C3233)

• **Froedtert Pavilion:**
  Mondays & Wednesdays  
  Time: 1:00 PM—3:00 PM  
  Building: Froedtert Pavilion  
  Room: TRU Conference Room L742

• **Clement J. Zablocki VA Medical Center:**
  1st & 3rd Monday of the month  
  Time: 9:00 AM—11:00 AM  
  Building: 111, 5th Floor B-wing  
  Room: 5423

• **Marquette University:**
  Every Tuesday  
  Time: 8:30 AM—10:30 AM  
  Building: School of Nursing, Clark Hall  
  Room: Office of Research and Scholarship: 112D  
  Contact: [Jessica Pruszynski, PhD](mailto:jessica.pruszynski@marquette.edu) to make an appointment  
  Please note: Priority given to MU Nursing and Dental School personnel
Contact

- Haley Montsma
  - (414) 955-7439
  - hmontsma@mcw.edu
  - consult@mcw.edu
- Dan Eastwood, MS
  - (414) 955-4855
  - eastwood@mcw.edu
  - consult@mcw.edu

www.mcw.edu/biostatsconsult.htm
Database Basics

Dan Eastwood, MS
What is a Database?

• An organized collection of data

• Accessible in a computer

• Accessible in various ways
  • sortable
  • searchable
  • indexed
What is a Database?

- Well organized data enables good research
- Complex studies require careful organization
- Simple studies benefit from good organization
Is a spreadsheet a database?

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
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<td>Ethnicity</td>
<td>IBD</td>
<td>BMI (kg/m²)</td>
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<td>Age at Surgery</td>
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</table>
Spreadsheet vs. Database

• Spreadsheets have few or no rules

• Databases have strict rules

• Rules make spreadsheets more like a database
Spreadsheet vs. Database

• Use a database program to enforce rules

• Additional capability of databases

• A simple database can be viewed in a “flat” or “table” form (a single spreadsheet)
Spreadsheet vs. Database

• Spreadsheets are prone to copy/paste, partial sorting, and other entry errors
  • Errors may be uncorrectable
  • Errors may be undetectable
• Changes to databases are generally reversible
  • Queries display data in different ways
  • Revert to original
  • Errors are more easily detected
What goes into a database?

- Type of data, formatting
- The “bad” list
- Factors and variables
- Sample units or observations?
- Multiple tables and linked tables
Statistical Qualities of Data

Data Types

- Categorical
- Ordinal
- Interval
- Ratio

Qualitative

Quantitative
Computational Qualities of Data

Data Types, Part 2

- Character (text)
- Numeric (numbers)
- Dates
  - (Missing or Censored)
The List of Bad Things

• More than one value in a single cell
• Mixed character and numbers
• Merged cells
• Color coding
• UPPER and lower case text are different
• Confused coding or formats
• “Prettifying” is generally unhelpful
• Identifying information (try to minimize)
<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th>Age</th>
<th>Race</th>
<th>Angio</th>
<th>Location of stenosis</th>
<th>QUALITY</th>
<th>Location of stenosis</th>
<th>QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>43</td>
<td>white non-hispanic</td>
<td>7/23/2002 MRA Head</td>
<td>3</td>
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<tr>
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<td></td>
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<td>4</td>
<td>1</td>
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<tr>
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<td>3</td>
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Better now?

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<th>L</th>
<th>M</th>
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<td>Location Angio 1</td>
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<td>Location Angio 2</td>
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<td>Angio</td>
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<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>
Variables

• Short yet meaningful names
  • Top row of spreadsheet
  • Longer description or labels elsewhere

• Create a “key” to formatted values
  • ex: 1=‘yes’, 2=‘no’ :: 1=‘treatment’, 0=‘control’
  • Usually on a different sheet
Factors & Variables

• A factor is a complete description of one contributing element in the analysis

• A variable is a representation of a factor, or part of a factor, as used in the analysis

• A factor may be described by several variables (ie: dummy variables)
Factors & Variables

<table>
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<tr>
<th></th>
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<th>Factor ABC</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>A</td>
<td>B</td>
<td>C</td>
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<td>Y</td>
<td>N</td>
<td>N</td>
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<td>3</td>
<td>B only</td>
<td>N</td>
<td>Y</td>
<td>N</td>
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<td>A and C</td>
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<tr>
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<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>A, B, and C</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Sample Units & Observations

• Depends on Study Design
• Usually one row of data per sample unit
  • ie: one row per patient
  • “wide” layout
  • side-to-side scrolling problems
• Sometimes one row per observation
  • “long” layout
  • wasted space with demographics
## Wide Layout

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<th>Study ID</th>
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<th>Group</th>
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<th>DBP1</th>
<th>SBP2</th>
<th>DBP2</th>
<th>SBP3</th>
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<td>2</td>
<td>F</td>
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<td>Placebo</td>
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<td>DBP</td>
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<td>1</td>
<td>M</td>
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Database Programs

- **Microsoft Access**
  - Everybody has it
  - Nobody uses it
Database Programs

- REDCap
  - web based
  - secure server
  - survey package (no more Survey Monkey)
  - 267 institutional partners
  - 20K+ studies, 30K+ end users
  - project-redcap.org

- Contact for more information:
  - Mark Oium, moium@mcw.edu, 805-2051
Concluding Remarks

• Have a plan for your data
• You can “pilot” a database at the same time you gather pilot data for a study
• Good data leads to good research
Questions?