PPPA 6002: Research Methods & Applied Statistics

Semester: Fall 2015
- Mondays 6:10 in Corcoran 106 – Section 14
- Wednesdays 12:45 in Old Main 305 – Section 11
- Thursdays 12:45 in Old Main 305 – Section 10
- Thursdays 6:10 in MPA 310 – Section 13

Instructor: Bill Adams (adams@gwu.edu)
Office: MPA Bldg. 601-D Phone: 202-994-7494
Meetings: Wed. 3:30-4:30 & Thursdays 3:30-5:30

SPSS Labs:
Zac Boldon (zsboldon@gwmail.gwu.edu) and Neko Gonnella (nekogonnella@gwmail.gwu.edu)

Textbooks & Software:
- SPSS 22/23 (available in GW computer labs)
- Many other online readings and class handouts.

Class Web Site: gwu6002.com
This web site will include posts of 6002 updates and links to readings. Please subscribe; be sure to check on the weekend and again before the class.

Assignments and Grades:
- Please post weekly worksheets on Blackboard at least one hour before class; no late postings.
- Late SPSS projects are docked a letter grade.
- Class attendance is required; no more than one unexcused absence.
- Overall = final exam (40%). midterm (20%), five SPSS projects (25%), weekly worksheets (15%).
- Like life, the final exam is cumulative.
- Lowest overall grade (no rounding) for an A is 94.00; A− 90.00; B+ 87.00; B 83.00; B− 80.00; C+ 77.00; C 73.00; and C− 70.00.

- For the weekly worksheets, genuine collaboration is encouraged. However, data analyses of the computer output for SPSS projects should be conducted independently.
- If for any reason a class is missed, in whole or in part, please obtain all announcements and assignments (especially those due at the next session), along with class notes and handouts, from your class colleagues before next class.

Learning Objectives:
PPPA 6002 focuses on practical skills for conducting and evaluating empirical and quantitative research, plus a brief look at qualitative methods. The course explores the strengths and weaknesses of experimental (RCT), quasi-experimental, and nonexperimental research; it also covers the widely used SPSS statistical software and the most widely used statistics (univariate statistics, contingency table statistics, chi-square, t-tests, bivariate regression, correlation, and multiple regression).

In particular, the course targets as learning objectives these ten key research skills:

Skill 1: How to conduct and evaluate survey research
Skill 2: How to create an SPSS data set
Skill 3: How to analyze basic univariate statistics
Skill 4: How to analyze basic bivariate statistics
Skill 5: How to conduct and evaluate RCTs
Skill 6: How to conduct and assess quasi-experiments
Skill 7: How to analyze correlation and regression stats
Skill 8: How to conduct and evaluate focus groups
Skill 9: How to conduct and evaluate content analyses
Skill 10: How to conduct and evaluate meta-analyses
<table>
<thead>
<tr>
<th>Session</th>
<th>6002 Session Topics</th>
<th>Lab</th>
<th>SPSS Due</th>
<th>Quiz</th>
<th>Worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1: Aug 31-Sept 3</td>
<td>Univariate descriptive statistics; Univariate inferential statistics</td>
<td>✓ intro</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2: Sept 7-8-10 +12</td>
<td>Conclude univariate statistics; Field trends; Research questions; Literature review; Research ethics</td>
<td>✓ new data set</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 3: Sept 14-17</td>
<td>Question and questionnaire design; Survey sampling systems</td>
<td>✓ univar</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 4: Sept 21-24</td>
<td>Mail, telephone, and e-mail surveys; Measurement validation</td>
<td>[no lab]</td>
<td>1: Dataset and univariate analysis</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 5: Sept 28-Oct 1</td>
<td>Crosstabs (contingency tables); (X^2) (and measures of association)</td>
<td>✓ tables &amp; (X^2)</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 6: Oct 5-8</td>
<td>Causal inference</td>
<td>[no lab]</td>
<td>2: Crosstabs</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 7: Oct 12-15</td>
<td>Mid-term quiz</td>
<td>[no lab]</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Week 8: Oct 19-22</td>
<td>RCT designs</td>
<td>✓ tips</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 9: Oct 26-29</td>
<td>T-tests; NEC group designs</td>
<td>✓ t-test</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 10: Nov 2-5</td>
<td>Time series and correlational designs</td>
<td>[no lab]</td>
<td>3: T-tests</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 11: Nov 9-12</td>
<td>Bivariate regression and correlation</td>
<td>✓ correl.</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 12: Nov 16-19</td>
<td>Multiple regression and correlation</td>
<td>✓ m.reg.</td>
<td>4: Bivariate correlation</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 13: Nov 30-Dec 3</td>
<td>Qualitative analysis; Focus groups</td>
<td>[no lab]</td>
<td>5: Multiple regression</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Week 14: Dec 7-9¹</td>
<td>Content analysis; Meta-analysis Class summary and review for final</td>
<td>[no lab]</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Dec. 11 (3-5p) or Dec. 12 (10-12a)</td>
<td>Final examination (Either date may be selected.)</td>
<td>[no lab]</td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

¹ Note: Last Thursday section meets Tuesday, December 8.
1 Univariate Statistics

Readings:
• Links at class web site and Blackboard
• Wheelan, Chapters 1, 2, 3, and 8
• Adams, Ch. 4 (Blackboard)

Good data analysis requires good data, plus awareness that: all summary statistics are reductionist, context dictates interpretation, small differences should not be exaggerated, correlation does not prove causation, start with univariate analysis before multivariate.

Nominal univariate statistics – percent and mode
Interpretation pitfalls include:
- Misleading pictograms; confusing absolute and relative percent; misinterpreting mode as midpoint; and misleading modal composites

Plurality vs. majority

Measures of central tendency:
- mean and median, plus trimmed mean
Mean symbols: $\bar{x}$ (sample); $\mu$ (mu for population)
Mode (not necessarily a central tendency)

Measures of dispersion:
- standard deviation and interquartile range
Standard deviation symbols:
  - $s$ (sample); $\sigma$ (sigma for population)
Positive skew (high values pull mean above median)
Negative skew (low values pull mean below median)

Normal curve
- $\pm 1$ standard deviation = 68.3% of normal curve
- $\pm 2$ standard deviations = 95.4% of normal curve
- $\pm 3$ standard deviations = 99.7% of normal curve

Value of examining frequency distribution charts
Descriptive vs. inferential statistics
Confidence intervals, sampling error, margin of error

Standard error of the mean (formula optional)
Standard error of the proportion (and formula)
Central limit theorem

Boxplots, stem-and-leaf plots
Histograms, bar charts, pie charts

2 Trends in research methods;
Hypotheses; Research questions;
Literature review; Research ethics

Readings:
• Links at class web site
• Adams, “Internet Research” (Blackboard)

Broad 20th century research trends
“Traditionalism”
Behavioralism / basic research
Classic model of scientific research steps

Theory
Hypothesis
Independent variable (X)
Dependent variable (Y)
Operationalize concepts; operational definition

Applied research / policy analysis
Model of applied research steps

Main goals of literature review
Some tips for the literature review
Basic structure of the written research report:
  - Intro; lit review; methodology; findings; discussion

Principles of research ethics
Institutional Review Board (IRB)

Informed consent
Issues with coercion, privacy, confidentiality, risks, deception, common courtesy, debriefing, and vulnerable populations
3 Survey Research

Readings:
• Links at class web site and Blackboard
• Wheelan, Chapter 10

Principles for designing good individual questions
Ways to filter or minimize "random responses"
Best practices for overall questionnaire flow:
  Short intro; easy start; broader to more detailed;
  sensitive questions later; demographics at the end
Closed-ended vs. open-ended questions
Likert item (strongly agree/agree/disagree/strongly disagree)
Census vs. sample
Random vs. nonrandom samples
Nonrandom (nonprobability) sampling such as
  convenience, snowball, and purposive sampling
Simple random sampling
Systematic random sampling
Stratified random sampling
  (Proportionate vs. nonproportionate)
Probability-proportional-to-size (PPS) sampling
Sampling frame (source/list used to draw sample)

4 Survey Research & Measurement

Readings:
• Links at class web site and Blackboard
• Wheelan, Chapter 7
• Adams, "Semi-Structured Interviews" (Blackboard)

Nonresponse bias vs. response bias
Evaluating response rates; how high is high enough?
Factors for the optimum size of a completed sample
Survey participation as a quick cost-benefit decision
Best practices for improving survey response rates
Benchmark confidence intervals (95% level) for
  n=100 (±10%); 600 (±4%); 1100 (±3%)
Operationalize; operational definition
Measurement reliability & measurement validity
Subjective validity: face validity & content validity
Criterion validity: concurrent & predictive validity
Measurement levels: nominal, ordinal, interval, ratio
Combined interval and ratio = scale or interval
Categorical vs. continuous variable
Unobtrusive measures; multiple measures

5 Crosstabs & Chi Square

Readings:
• Links at class web site and Blackboard

Interpreting crosstabulations (aka: crosstabs or contingency tables) using counts, row percent, column percent, total percent, and marginal

Chi square ($X^2$) test of statistical significance
Interpreting significance levels: .05, .01, .005, .001
Is it acceptable to use .10 as the probability level?

Statistical significance vs. substantive significance
Type I Error vs. Type II Error

Chi square steps:
  State the null hypothesis,
  State the research hypothesis,
  State decision rule (alpha level),
  Examine result to reject or not reject the null

The null is the assumption, but it is never "proven."
Interpretation caveats:
"Statistically significance" does not mean it is important, powerful, strong; it just means odds are good that there is some kind of relationship.
Large samples often show statistical significance for weak, trivial relationships. Conversely, failure to detect a relationship, especially in a small sample, does not mean there is no relationship.

Measures of association (strength) for crosstabs
Gamma (most common measure of association)

RCT’s two essential elements

Pool of Subjects
 Random Assignment of Subjects to Groups
 Random Assignment of X
 Treatment Group
 Control Group
### Causal Inference

**Readings:**
- Links at class web site and Blackboard

Three elements of causal inference...
1) X & Y covary; association; concomitant variation
2) X before Y; direction; time sequence; temporal order
3) Rule out Zs; no plausible alternative; nonspuriousness

Antecedent variables
Intervening variables

Campbell & Stanley's design diagraming system
Single group posttest only
Single group pretest-posttest (aka before-and-after)
Static group design (nonequivalent comparison design)

Threats to internal validity (partial list):
- History
- Maturation
- Practice
- Instrumentation
- Regression to the mean
- Selection
- Intragroup history
- Attrition/Mortality (and how to deal with attrition)

### RCT (Experimental) Designs

**Readings:**
- Links at class web site and Blackboard
- Adams, Ch. 5 (Blackboard)

Randomized, controlled trial (RCT) = true experiment

Elements of a true experiment (RCT):
(1) random assignment of subjects from pool to groups and (2) random assignment of X to groups

Reason for the power of experimental designs:
Comparability of the groups (i.e., only real difference between the groups is X, so X is the best explanation for differences in the groups)

Classic experimental design
(aka pretest-posttest control-group design)

Posttest only experiment
(aka posttest-only control-group design)
Factorial designs (simple or complex)
Dosage/sensitivity designs
Complex X
Multiple Ys

External validity (generalizability)
Random assignment from pool of subjects to groups strengthens internal validity.
Random selection from the relevant population strengthens external validity.

Reactivity
Hawthorne effects
Placebo
Watch out for between-group reactivity as well as other types of reactivity (e.g., with X and staff)

Big four sets of validity issues:
- Construct (measurement) validity
- Internal validity
- Statistical conclusion validity
- External validity

### T-Tests & NEC Designs

**Readings:**
- Links at class web site and Blackboard
- Adams, Chapter 6 (Blackboard)
- Wheelan, Chapter 9

T-tests: significance test for the difference in the means of two randomized groups – either two means from a sample (random selection) or from an experiment (random assignment)

T-test steps:
- State the null hypothesis
- State the research hypothesis
- State the decision rule (alpha)
- Employ the correct F-test step
- Examine result to reject or not reject the null

Usual issues in interpreting statistical significance...
stat. significance vs. substantive significance;
small vs. large samples; careful interpretations if fail to reject null; using the customary .05 criterion
Practical reasons why RCTs may not be conducted
Quasi-experiments (vague term)
Nonequivalent comparison group (NEC) designs
Pretest-posttest nonequivalent comparison design
Posttest only nonequivalent comparison group design

Key threat to internal validity of NEC designs: selection
Retrospective matching design (ex post facto
with nonrandom posttreatment matching)
Causal-comparative (another term for studies that try to
infer causality with groups not randomly assigned)
Natural experiments (strict vs. broad usage of term)

Time Series & Correlation Designs
Readings:
• Links at class web site and Blackboard
• Wheelan, Chapter 13 and Conclusion Ch.
• Adams, Chapter 7(Blackboard)

Time series (aka longitudinal) research
Simple interrupted time series
Reiterative time series
Multiple time series
Panel data (aka "panel-back") vs. cross-sectional data
Deceptive time series charts (truncated base)

Retrospective pretests; proxy pretests
Fallacy of time series inferences from a single survey
Process and logic of correlational designs
Correlational design problems:
Selection threats motivation and self-selection,
plus difficulty in statistically controlling all Zs;
specification error / omitted variable bias;
so findings may vary widely depending on the
availability and choice of control variables
Overall assessment of causal designs:
Lab experiments: strong on internal validity but weak
on external validity
Nonexperimental field studies: strong external but
weak internal validity
Field experiments: strong in both internal and external
validity but often not feasible to conduct
The logic of inferring causality by coupling lab
experiments with nonexperimental field studies
Checklist for conducting and evaluating research

Bivariate Regression & Correlation
Readings:
• Links at class web site and Blackboard
• Wheelan, Chapter 4

r (correlation coefficient)
r² (coefficient of determination)
Scattergram or scatterplot
Positive/direct relationship
Negative/inverse relationship
Linear and curvilinear patterns
Bivariate regression: ŷ = a + bx
ŷ (estimate of y); a (intercept); b (slope)

Analysis of residuals; analysis of outliers
Homoscedasticity and heteroscedasticity
Standard error of the estimate
(alogous to standard deviation)
Ecological fallacy
Aggregate data (units of analysis are groups)

Multiple Regression & Correlation
Readings:
• Links at class web site and Blackboard
• Wheelan, Chapters 11 and 12

Regression-discontinuity design (basic design/logic)
Multiple Regression
Ŷ = a + b₁X₁ + b₂X₂ ... bₙXₙ
Ŷ = β₁X₁ + β₂X₂ ... βₙXₙ

Multiple R = multiple correlation coefficient
Multiple R² = multiple coefficient of determination

Unstandardized partial regression coefficients
(aka: unstandardized partial coefficients;
unstandardized regression coefficients)

Standardized partial regression coefficients
(aka: betas; beta weights; standardized partials;
standardized regression coefficients)

Multicollinearity
Dummy variables
Qualitative Research; Focus Groups

Readings:
• Links at class web site and Blackboard
• Adams, Chapter 8 (Blackboard)
• Adams, “Semi-Structured Interviews” (Blackboard)

Qualitative Research
More exploratory than hypothesis testing
Small, purposive sample, not large random
Extended, intense observations or interviews
Unstructured or semi-structured data gathering
Essay reports with little or no quantitative data
Often explore the researchers’ subjective impact

Focus groups purposes:
Probing attitudes, reaction testing, brainstorming

Focus group: participant recruitment; focus group size; session length and agenda; moderator style; and ideal focus group facilities

Content Analysis; Meta-Analysis

Readings:
• Links at class web site and Blackboard
• Adams, Chapters 3 & 2

Content analysis
Inter-coder reliability testing
Content analysis steps:
  Define scope
  Operationalize variables to code
  Refine and test coding system
  Code content
  Analyze data

Meta-analysis purpose and strengths
Steps in conducting a meta-analysis

Review question for final exam
### “To-Do” checklist for each session

<table>
<thead>
<tr>
<th>To do before this class session →</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Almost every week this semester:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internalize key concepts listed on the syllabus and covered in the prior session to get the most out of the course and prep for the midterm and final exams</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read chapters and supplemental readings listed on the syllabus as accompanying the prior class session.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read the post(s) and linked readings at class web site: gwu6002.blogspot.com</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit weekly worksheet answers via Blackboard (1 hr or more before class)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bring a copy of worksheet questions and your answers to discuss in class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>As scheduled on syllabus:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPSS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Attend SPSS computer lab after class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare a paper copy of your SPSS project to submit in class.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Week</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
</tbody>
</table>

---

**GW Bulletin Course Description** (bulletin.gwu.edu/courses/pppa/)

**PPPA 6002. Research Methods and Applied Statistics**

Development of skills and knowledge for conducting original research and critically evaluating empirical studies. Various research designs and data collection techniques are examined. Focus on computerizing data sets for quantitative analysis, analyzing strength of relationships, selecting appropriate statistical techniques, and testing statistical hypotheses.