


**Write what? I thought this was a Math class.**  
**Incorporating real data analyses with written assignments to improve Business Statistics application.**

Amy Luginbuhl Phelps, PhD  
 phelpsa@duq.edu



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**Three Educational Forces**

- ▶ Three major educational forces were coming together in the late 1990's
  - Experiential learning
  - Service-Learning
  - Statistical Reform producing the GAISE guidelines: ASA, 2005

<http://www.amstat.org/education/gaaise/GAISECollege.htm>

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**Experiential learning**

- ▶ Angelo and Cross, 1993
  - Students learn more when they take an **active** role
- ▶ Newmann, 1992
  - "Psychological Investment":
  - Combining traits of **purpose and caring give students ownership** and connection to real world

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**General Public Plea for SL**

- Campus Compact formed in 1985
  - ✦ Followed scattered activities of 60's and 70's
  - ✦ Initiated by Brown and Georgetown, now has more than 1,100 membership
- Bok, 1990 (Former Harvard President)
  - ✦ Universities failing to teach students to respond to pressing social issues
- National & Community Service Act 1990
  - ✦ \$275 million allocated for SL from K thru higher education

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**GAISE Guidelines**

1. Emphasize **statistical literacy** and develop **statistical thinking**.
2. Use **real data**.
3. Stress **conceptual understanding** rather than mere knowledge of procedures.
4. Foster **active learning** in the classroom.
5. **Use technology** for developing concepts and analyzing data.
6. Use assessments to **improve** and **evaluate** student learning.

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**Classroom activities/Assessments**

- ▶ How many times per semester do you
  - Use REAL data, not 'real' datasets from textbook
    - Generated by current research
    - Generated by the student(s)
  - Grade student generated
    - Graphs
    - Excel/software analyses?
  - Grade written interpretation/summary statements with business applications

→ They have to DO statistics with technology  
 → They need to be held accountable (graded)

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## Communication

- ▶ Written
  - Students have to write
    - summary paragraphs
    - Inference and applications to business problems
- ▶ Oral
  - Be able to present to a general audience
- ▶ Technical
  - How to tell technology what you want
  - Communication with Excel/statistical software

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## Business Statistics I

- ▶ Study/survey design
- ▶ Data collection
- ▶ Graphical and numerical summary
- ▶ One sample inference
  - Confidence Intervals
  - Hypothesis testing
- ▶ Communication (written/technological)skills
  - Through bi-weekly lab assignments
  - Interpretations Excel/StatCrunch outputs on quizzes and exams

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## Business Statistics II

- ▶ Modeling and relationships
- ▶ Two-sample t-test
- ▶ Chi-square test of independence
- ▶ ANOVA
- ▶ SLR and MLR
- ▶ Introduction to time-series, non-parametrics and/or data mining (Instructor choice)
- ▶ Verbal and written communication
  - Addition of student generated research projects presented the last week of class

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## Lab reports

- ▶ **Text:**
  - Business Statistics, 2nd Sharpe, DeVeaux, Velleman
- ▶ **Plan-Do-Report style**
  - Get them used to what actions/plans/purpose for collecting the data.
  - Graphical numerical summary and analysis
    - start small, add and grow with each Lab
    - cumulative and repetitive
      - each subsequent lab uses techniques from previous lab
- ▶ **Work in pairs**
  - Helps reduce grading time

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## Biweekly Labs (Stat I)

- ▶ Descriptive Statistics
  - One and two-way pivot tables
    - Bar/pie charts
    - Row/column percent → joint, marginal, conditional
  - Histograms, scatterplots
    - Mean and sd
    - Median and Q1-Q3 → boxplots
    - Trendline/linear model
- ▶ Sampling activity to collect own data (or SL)
  - Use own data to
    - Construct CI
    - Hypothesis testing

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## Assessments

- ▶ Provides Excel/StatCrunch outputs
  - These include summary stats, graphs etc...
- ▶ Emphasize business interpretations and applications of results
- ▶ Exams
  - I allow the students to generate their own formula (cheat) sheets.
  - I provide practice exams
  - I write my own questions

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## Projects

- ▶ Stat I – Labs 4/5 combined using data we collect ourselves ('capstone' for stat I)
  - Thanksgiving data
  - Tangrams (S. Kuipers)
    - (NSF 2011 Grant "Playing games with a Purpose")
  - Service-learning projects
- ▶ Stat II ('capstone' for stat II)
  - Either student generated
  - Or Service-learning project

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## Service-Learning Projects

- ▶ Meet with CP 2–3 times
  - Understand organization and needs
  - Determine what activities class can do to emphasize learning goals and assist the organization (reciprocity)
- ▶ Proposal– Briefly outline
  - what is expected of instructor, students, CP
  - Tentative timeline of when tasks will be done (align with student project tasks)
- ▶ <http://www.amstat.org/publications/jse/v20n3/phelps.pdf>

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## Class Activities

- ▶ Meet the CP and organization
  - ▶ Get HIPAA certification if necessary
  - ▶ Embed service project in classroom activities
    - Create survey, data collection design
    - Schedule data collection and data entry
    - Use real-time data collection to emphasize concepts in class
    - Final presentations and reports
- I accomplish some of these activities through bi-weekly lab assignments

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## Too Much work!?

- ▶ Perhaps, but the benefits are
  - It feels like the right thing to do to
  - Help students learn and
  - Get excited about statistics (... well, maybe?)

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## More benefits

- Doing something REAL and they can see its importance in real time
- It helps me to stay ORGANIZED and on track.
- I have readily usable data they understand to use classroom resources to present
  - data problems we have to deal with
  - new statistical techniques
  - use for classroom quizzes, exams, ...

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## Student Oral Presentations

- Student research projects
  - Forces students to be accountable for material they need to learn
- SL projects
  - Provides the opportunity to present data to real professionals and
  - Field questions from real professionals

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### SL project example

- ▶ By the end of a two-semester SL project
- ▶ Two Programs for county foster teens
  - Residential
  - Community-based educational
- ▶ 600 cases
  - ~300 client applications
  - ~200 accepted in residential program
  - ~100 community-based educational program
- ▶ 86 variables

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### Student Presentations

- ▶ Wow! It truly all came together
- ▶ The students presented to the executive directors of the organization
- ▶ They answered questions
- ▶ Fall semester
  - The students presented preliminary descriptives and potential trends thus fielding questions for future analyses
- ▶ Spring semester
  - Answered some key questions

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### Executive Director Quote

*"...based on the results presented by the students, Ward Home has made changes in how they operate and how they compile and store their records."*

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*Although we are just students learning, I feel we all came together to give Ward Home, Inc some really valuable statistical information...*

*...when we told them the results, they were surprised things were different than they thought and it can help them improve their organization*

*My time in this class and especially on the project feels like a complete success. One day I hope I can be as helpful to other organizations.*

*The project definitely tested the abilities I learned this semester*

*..it is wonderful that we were able to give back while learning valuable information ourselves*

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