SIMULATION

AND

STATISTICAL EDUCATION.

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OUTLINE:

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*** Motivation, Introduction and Background**

*** Problems in Using Simulation in Teaching.**

*** Simulation Approaches to Teaching Stats.**

*** Monte Carlo Simulation in Education.**

*** GPSS Simulation Example.**

*** Summary and Conclusions.**

I. INTRODUCTION AND BACKGROUND:

*** Need: Reach the Students**

*** Pedagogical Changes Advocated in:**

- ASA Workshops and Conferences

- ASA Educational Section

- Electronic and Hard Copy Journals

*** Less is More.**

- Less Theoretical Concepts

- More Statistical Methods

- Selection/Priorities/Trade-offs

- Real Life Examples

- More Case Studies

- Inter-Disciplinary Applications

- More Undergraduate Statistics

II. SIMULATION IN TEACHING

*** Teaching Approaches:**

- lecturing

- Physical Experimentation

- Simulation

*** Problems with Lecturing:**

- Boring and Dry

- Lack of Data Collection

- Lack of Group Learning

*** Problems With Physical Experimentation:**

- Expensive in Time/Resources

- Personal Risks Involved

*** Advantages of Simulation:**

- Retains uncertainty of outcomes

- Data Collection and Manipulation

- Less Time Consuming

- More Time for Case Studies

*** Discrete Event Simulation**

- Seldom Used for Teaching in Past

- Difficult to Program in HOL

- Simulation Languages in Main Frame

- At Present, SW Available in PC's

- Comes With Simulation Textbooks

- Easy to obtain, learn, operate

*** Present Experience Stems from:**

- Teaching Applied Statistics

- Teaching Simulation Modelling

- Teaching Statistics With Simulation

- Workshop for Faculty

III. SIMULATION APPROACHES

*** THREE Approaches:**

- Independent Course

- Companion Lab

- Embedded in Course

*** Independent Course (Applications):**

- Complementary but Required

- Data Analysis and Methods

- Real Life/Inter-Disciplinary

*** Companion Laboratory:**

- Staff with Intermediate Simulation

- Understanding/Operating GPSS

- Weekly Lab Follows Lecture

- Alternative to Physical Experiments

- Group Learning (Seed)

- Individual Accountability (Seed)

- Different/Contradictory Results

- Lively Discussions

- Control Over Model/Variables

- Model Assumption Violations

- Realistic/Inter-Disciplinary Examples

- Flexibility in Constructing Examples

- Final Report: Summarization Skills

- Presentations: Communications Skills

- Less Drudgery for Faculty/Students

*** Embedded Simulation:**

- Staff with Minimal Simulation

- Running/Operating GPSS

- Focal Point Faculty

- Class Examples and Homeworks

- Course Final Proyects

- Individual/Group Work (Seed)

- Different/Contradictory Results

- Easy Example Modifications

- Different Problem Responses

- Model Assumption Violations

- Student Discussions/Interactions

*** Stat Methodology Reviewed:**

- GOF/Transformations

- Simple/Multiple Regressions

- ANOVA and ANCOVA

- Response Surface Methodology

- *Experimental Design*

- *Multivariate Analysis*

- *Non Parametrics*

- *Time Series Analysis*

- *Quality Control*

- *Exploratory Data Analysis*

- *Use of Statistical Packages*

IV. MONTE CARLO SIMULATION

* As A Teaching Tool:

- *In-Class Examples*

- *Final Proyects*

- *Generation of r.v.*

- *GOF Tests*

- *Hypothesis Testing*

- *Test Assumption Violations/Transformations*

- *Statistical Alternatives*

- *Performance Measures: Power*

- *Approximations of the Distribution*

- *Multi-Dimensionality Problems*

V. GPSS SIMULATION EXAMPLE

* Analysis of a System of Small Dams

VI. CONCLUSIONS

*** Simulation has used Statistics**

*** Statisticians Can Now Use Simulation**

*** This is No Longer a Problem**

- Software (GPSS) Easy to Get

- Easy to Learn and to Run

- Saves Programming Time

*** Very Flexible/Easy to Modify**

*** Allows Group Learning/Interaction**

*** Maintains Individual Accountability**

*** Relatively Small Faculty Training**

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