CAPACITY BUILDING THROUGH PROJECT BASED LEARNING IN BAYESIAN STATISTICS

SHIRLEE OCAMPO

De La Salle University, Philippines

Bladimir Ocampo

Centro Escolar Las Pinas,Philippines

IASE 2019

DECISION MAKING BASED ON DATA

Location: Sasana Kijang (Bank Negara Malaysia)

AUGUST · 13-16 · 2019,
KUALA LUMPUR, MALAYSIA

*OUTLINE

- Introduction
- Outcomes-Based Education
- Program Outcomes in B.S. Statistics
- Bayesian Statistics
  - Syllabus
  - Learning Outcomes and Outputs
- Project-Based Learning
- Students' Learning Outputs
- Conclusions

Introduction

* The K to 12 educational reforms consequently led to revamps to the baccalaureate Statistics courses.
* Changes in B.S. Statistics curriculum: inclusion of alternative statistical frameworks like Bayesian Statistics.

*

IASE 2019

*Introduction

*Educational reforms include the implementation of Outcomes-Based Education (OBE) system of many higher educational institutions in the Philippines.

*OBE in the Philippines

- Commission on Higher Education (CHED) issued a memorandum order (CMO No. 46, s. 2012) entitled, “Policy-Standard to Enhance Quality Assurance in Philippine Higher Education through an Outcomes-Based and Typology Based QA”.
- Release of Handbook of Typology, Outcomes-Based Education, and Sustainability Assessment in 2014

IASE 2019

Outcomes-Based Education (OBE)

OBE means

- "clearly focusing and organizing everything in an educational system around "what is essential for all students to be able to do successfully at the end of their learning experience."
- "focusing and organizing an institute's entire programs and instructional efforts around the clearly defined outcomes we want all students to demonstrate when they leave institute."

- Spady (1994)

Outcomes-Based Education (OBE)

- Important components of OBE
  - developing a clear set of learning outcomes, and establishing the conditions and opportunities within the system that enable and encourage all students to achieve those essential outcomes (Duradundi and Dipak, 2017)

  - "OBE is a process that focuses on what is to be learned - the outcomes" (Kudlas, 1994)

*Outcomes

- clear, observable demonstrations of student learning that occur after a significant set of learning experiences (Spady and Marshall, 1991)

- reflect real life roles that learners will perform the moment they exit the education system called culminating outcomes” (Spady ,1994)

Outcomes

- Outcomes should reflect

  - (1) What the student knows
  - (2) What the student can actually do with what he or she knows
  - (3) The student's confidence and motivation in carrying out the demonstration.

OBE and Statistics Education

* *Outcome-based education requires statistics education to be structured holistically by allowing the students to work with real life data along with visualization, computation, and learning outputs.*

* SOME PROGRAM OUTCOMES IN STATISTICS

*A graduate of the B.S. Statistics program should be able to

- Exhibit broad and coherent knowledge and understanding of the core areas of statistical theory and statistical modeling.
- Interpret scientific data and make decision based on data.
- Perform basic mathematical and statistical computations and use appropriate technologies in (a) the analysis of data; and (b) In pattern recognition, generalization, abstraction, critical analysis and problem solving.

IASE 2019

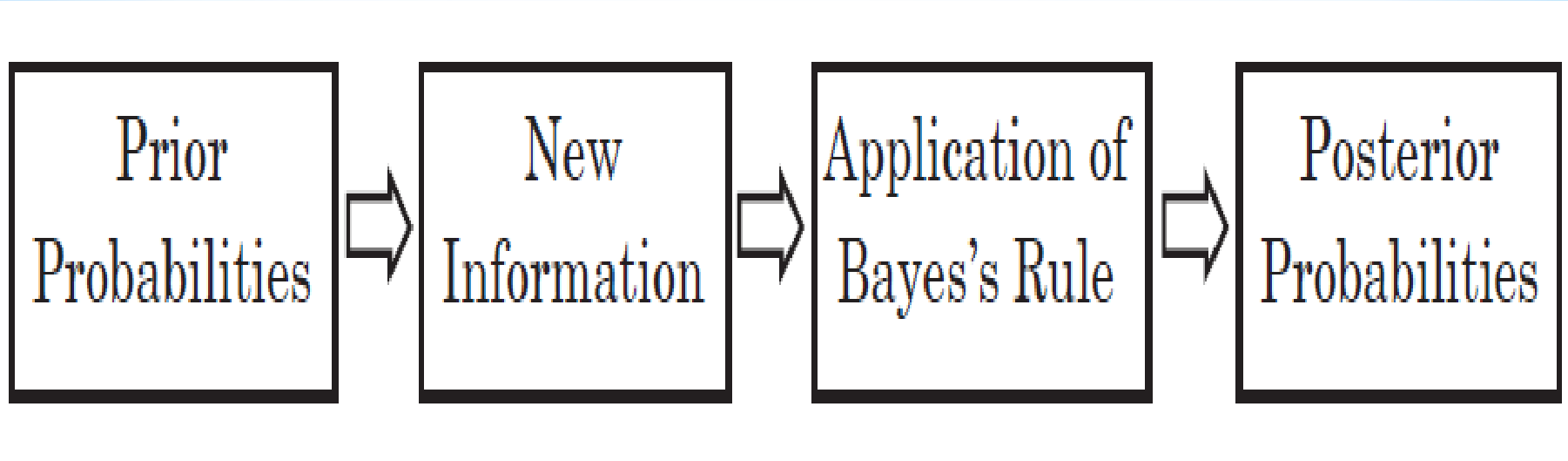
Bayesian Statistics

* "Bayesian Statistics is based on one simple idea. The only satisfactory description of uncertainty is by means of probability. We are, all of us, surrounded by uncertainty. The Bayesian paradigm provides, in probability, a powerful tool for understanding, manipulating, and controlling this pervasive, and often unpleasant, feature of our appreciation of our environment.

  - Dennis V. Lindley

*Bayesian Analysis

- Thomas Bayes (1702-1761)
- English mathematician and Presbyterian minister
- -formulated the Baye's Rule
- -proponent of Bayesian Statistics and Analysis



*Baye's Rule

If the events B_1, B_2, B_3,…B_r,…, B_k constitute a partition of the sample space S such that P(Bi) is not equal to 0 for i= 1, 2, 3, …r,…, k, then for any event A in S such that P(A) is not equal to 0,

$$P(Br \mid A) = \frac{P(B_r \cap A)}{P(A)} = \frac{P(B_r)P(A \mid B_r)}{\sum_{i=1}^{k} P(B_i)P(A \mid B_i)}$$

IASE 2019

*Bayesian Paradigm

- Record some observations, say y.
- It may be reasonable to believe that some hypothetical process yielded y. We call this hypothetical process a statistical model.
- Consider some property (called parameter) θ of the model. Frequentist (non-Bayesian) statistical inference regards θ as an "unknown constant" (fixed) to be estimated.
- In the Bayesian paradigm, $parameter\ \theta$ is regarded as the realized value of some random variable. Parameter θ is unknown and described probabilistically.

*Bayesian Statistics Syllabus

A course dealing with

- Bayesian inference
- Specifying prior distributions
- Posterior distributions
- Bayesian estimation and hypothesis testing
- Predictive distribution and asymptotic
- Bayesian hierarchical models
- Introduction to Empirical Bayes
- Bayesian regression

*use of statistical software

IASE 2019

* Bayesian Statistics
Course Learning Outcome and Output

❖ Learning Outcome

At the end of the course, the student will apply appropriate Bayesian statistical concepts, processes, tools, and technologies in the solutions to various conceptual and real-world problems.

❖ Required Output

Inquiry-based group presentations highlighting the uses of Bayesian statistics in different problem situations encountered in business, health, environment, and other related fields with the use of statistical software.

IASE 2019

CRITERIA	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Formulation of the Research Problem and Objectives (10%)	Research problem and objectives are clearly defined and significant; Demonstrates evidence that the research problem was researched and designed well.	Research problem and objectives are clearly defined and significant.	Research problem is clearly defined but some objectives are insignificant.	Research problem and objectives are vague and insignificant.
Correct Application of the Statistical Concepts (35%)	Statistical analyses are appropriate with correct interpretations and relevant conclusions.	Statistical analyses are appropriate with correct interpretations.	Some statistical analyses are inappropriate.	Statistical analyses are inappropriate
Depth of Analysis (30%)	The analysis convinces the reader about the wisdom of conclusions, implications and consequences on the basis of statistical methods and findings	The analysis engages the reader to appreciate the wisdom of conclusions, implications and consequences on the basis of statistical methods and findings	The analysis have limited ideas that do not explain the wisdom of conclusions, implications and consequences on the basis of statistical methods and findings	The analysis has incorrect ideas and conclusions.
Clarity and Organization of Written Report (10%)	Written report is organized logically and presented clearly with effective transitions.	Written report is organized logically and presented clearly.	Written report is organized and some discussions are not clear.	Written report is not organized.
Oral Presentation (15%)	Overall presentation is creative and well organized with innovative ideas.	Overall presentation is creative and well organized.	Overall presentation is organized	Overall presentation is not organized

*Rubric

*Project Based Learning (PBL)

- an instructional model that involves students in investigations of compelling problems that culminates in authentic products (Intel Teach Program, 2012)
- refers to designing, planning and carrying out an extended project that produces a publicly-exhibited output such as a product, publication, or presentation

*Benefits of PBL

- A growing body of academic research supports the use of PBL in school to engage students, cut absenteeism, boost cooperative learning skills, and improve academic performance (George Lucas Educational Foundation, 2001).
- ✓ Students involved in projects taking greater responsibility for their own learning (Boaler, 1997; SRI, 2000)
- ✓ Opportunities to develop complex skills, such as higher-order thinking, problem-solving, collaborating, and communicating (SRI, 2000)

* PBL transforms!

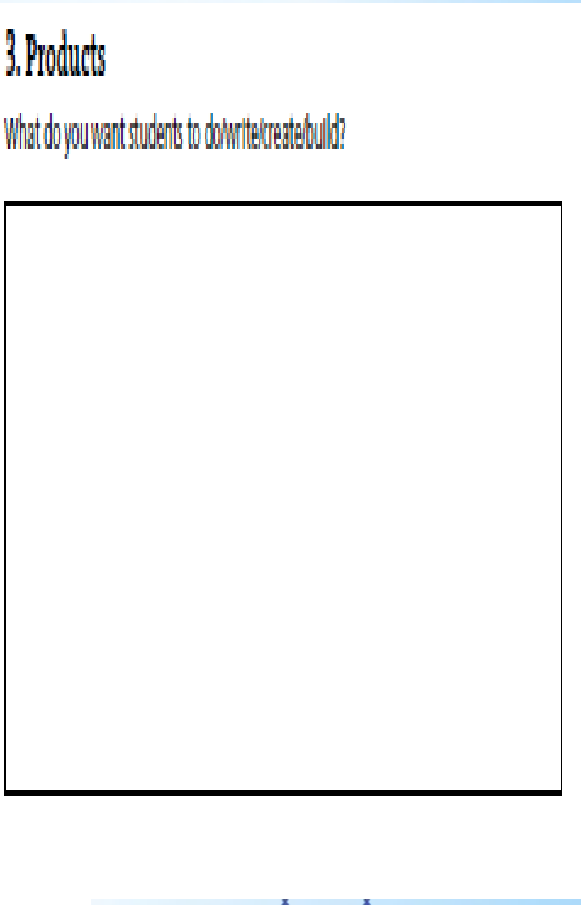
Under PBL,

- There is a problem with no predetermined answer.
- There is an atmosphere that tolerates error and change.
- Students make decisions based on data with a framework.
- Students design the process for reaching a solution.
- Students have a chance to reflect on the activities.
- Assessment takes place continuously.
- A final product results and is evaluated for quality.

*Project Based Learning (PBL)

*PROJECT PLANNER

- ❑ learning outcomes
- ❑ output/product summary
- ❑ timeline
- ❑ presentation/exhibition plan
- ❑ assessment criteria



Project planner

You can use this to help you to design your project, and to help you to explain the project to your colleagues during the project tuning.

PROJECT NAME: .....

TEACHER(S): .....

SUBJECT(S): .....

1. Project summary

What are your students going to do, and why are they doing it?

IASE 2019

*PBL in Bayesian Statistics

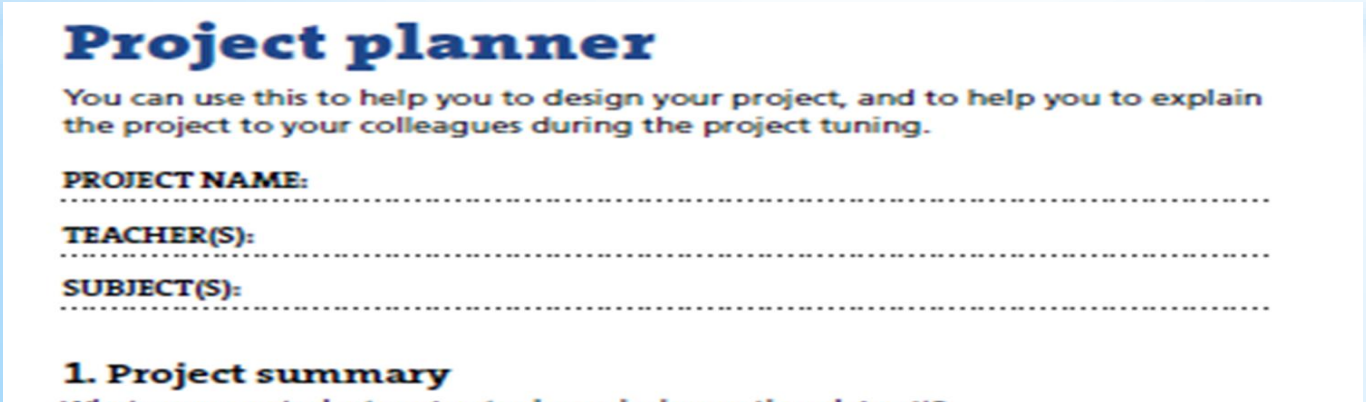
*ADDITIONAL STAGES IN PROJECT PLANNER

- Research on Bayesian Analysis concepts

Hierarchical Bayesian modelling, Markov Chain Monte Carlo (MCMC), Gibbs Sampling, Grid Approximation, Bayesian Regression, Bayesian mapping

- Software

R, SAS, WinBUGS, OpenBUGS, Python



Project planner

You can use this to help you to design your project, and to help you to explain the project to your colleagues during the project tuning.

PROJECT NAME: .....

TEACHER(S): .....

SUBJECT(S): .....

1. Project summary

IASE 2019

*SOME CULMINATING OUTPUTS

A Bayesian Approach to the Interval Estimation of the National Accounts of the Philippines

John Lourenze Poquiz and Shirlee Ocampo

This paper aims to suggest an alternative method for the interval estimation of the Quarterly National Accounts of the Philippines.

This paper explores the use of Bayesian Inference in generating interval estimates for Gross Domestic Product GDP growth.

Methodology: Bayesian Regression

Statistical software: SAS

IASE 2019

BAYESIAN ANALYSIS of INSURGENCY WIDESPREAD PRESENCE in BICOL REGION, PHILIPPINES 2016

Marc Bien Stevens J Deslate and Shirlee R Ocampo

* This paper used Bayesian Hierarchical model (Poisson-Gamma) to generate estimates of the insurgency incidences in Bicol Region.

Methodology: Poisson-gamma hierarchical modelling

Software: WinBUGS OpenBUGS

Poisson-Gamma estimates and direct estimates of insurgency incidences were obtained.

Implication: More developed areas have less insurgency widespread as compared to underdeveloped areas.

* Predicting Gender Representation in Male-Dominated Fields Across Using Grid Approximation

*K.G. Borromeo , C.D. Cresencio, E.G. Cruz , R.W. Gallega , D.P. Lachica, A.C. Lumba, M.C. Ricanor, L.C. Villagantol

*This study focuses on computing the probability of a male being in a particular course and whether it still remains constant throughout the programs and batches of college students .

*Methodology: grid approximation

*Software: Python

IASE 2019

*Sleep Pattern Analysis Using MCMC

*Bayesian Analysis of Mental Health Care Among Southeast Asian Countries”

*CONCLUSIONS

* Educational reforms such as K to 12 curriculum have affected the baccalaureate degree programs
* Alternative statistical framework like Bayesian Statistics is one of the required major courses in new B.S. Statistics program
* The implementation of the OBE have integrated learning outcomes and culminating outputs which are reflected in course syllabi.
* *Project based learning incapacitates the students to do Bayesian statistics research in an organized manner and make decisions based on data.*

IASE 2019

* **REFERENCES**
* Duradandi, S.B. & Dipak, N.M. (2017). An Outcome-Based Education (OBE): An Overview.
* *International Journal in Advanced Research in Education and Technology*. Vol 4(1), 97-100.
* Intel Teach Program (2012). Benefits of Project-Based Learning. *Designing Effective Projects*. Intel
* Corporation, 1-4. Retrieved (May 29, 2019) from https://www.intel.com/content/dam/www/program/education/us/en/documents/project-design/projectdesign/benefits-of-projectbased-learning.pdf.
* Kudlas, J.M. (1994). Implications of OBE: What You Should Know About Outcomes-Based
* Education', *The Science Teacher*, Vol.61 (5), 5-32.
* Poquiz, J.L. and Ocampo, S. (2012). A Bayesian Approach to the Interval Estimation of the National
* Accounts of the Philippines. *Proceeding of DLSU Research Congress 2017*. Retrieved (May 30, 2019) from https://www.dlsu.edu.ph/wp-content/uploads/pdf/conferences/research-congress-proceedings/2017/CENSER/CENSER-III-042.pdf
* Spady, W, &. Marshall, K. (1991). Beyond Traditional Outcomes-Based Education, *Educational*
* *Leadership*, Vol.49 (2), 67-72.
* Spady, W. (1994). *Outcome-based education: Critical issues and answers*. Arlington, VA: American
* Association of School Administrators.
* Spady, W., & Marshall, K. (1991). Beyond Traditional Outcome-Based Education. *Educational Leadership, 49*(2), 67–72.
*

*THANK YOU !

ACKNOWLEDGEMENT:
DLSU and IASE ISI WBTFSCB

IASE 2019