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Request for Curriculum Council Action

TO: Lynda Duke, Associate Dean of Curricular and Faculty Development

DATE SUBMITTED: February 1, 2016

(Please submit 1 double-sided copy of your proposal)

FROM: (Name) Seung-Hwan Lee (Department) Mathematics

Email address: slee2@iwu.edu

1. WRITTEN RATIONALES: Attach a written rationale, following the guidelines found in the Curriculum Council Handbook, page 3, at www.iwu.edu/melloncenter/cc2015-16handbook.pdf. Please note that CC will not evaluate incomplete proposals. To expedite consideration of your submission, you must read and follow the guidelines carefully.

2. Proposed Action (Please check all that apply):

	Title	Number	Units
<input checked="" type="checkbox"/> New Course	Mathematical Modeling: Statistics	/ / Math 141	/ 1
<input type="checkbox"/> Gen Ed for Existing Course		/ /	/
<input type="checkbox"/> Deletion		/	/
<input type="checkbox"/> Change title from		/	/
to		/	/
<input type="checkbox"/> Change number from		/	/
to		/	/
<input type="checkbox"/> Change prerequisites from		/	/
to		/	/
<input type="checkbox"/> Special Topic/Experimental		/ /	/
<input type="checkbox"/> May Term Course		/	/
<input type="checkbox"/> New Major/Minor			
<input type="checkbox"/> Revised Major/Minor			
<input type="checkbox"/> Other (please specify)		/	/

3a. If you are requesting General Education unit credit, please check the category:

- Analysis of Values
- The Arts
- Contemporary Social Institutions
- Cultural and Historical Change
- Formal Reasoning
- Gateway Colloquium (see 9b. below)
- Intellectual Traditions
- Literature
- Second Language
- Life Science Issues
- Life Science Lab
- Physical Science Issues
- Physical Science Lab
- Physical Education
- Fitness

3b. Please check the flag(s), if any, you are seeking:

- Writing Intensive
- Global Diversity
- U.S. Diversity

3c. Does this course already carry General Education credit?  Yes  No

if yes, which category/flag? \_\_\_\_\_  
Will the existing category/flag remain?  Yes  No

3d. In what way will you assess how this course has met the goals of the Gen Ed category and/or flag(s) for which you are applying?

- Use the Gen Ed Student Survey (Administered by the Registrar's Office)
- Use a different tool/method (please explain)

4. Please insert here the proposed catalog course description. Course descriptions should be limited to no more than 50 words. The description must include (a) title; (b) prerequisites; (c) General Education category; and (d) when offered, although those four items do not count against the 50-word limit.

141 Math Modeling: Statistics (FR) - This course introduces some basic statistical methods used in practice: organization and description of data, probability, probability distributions, the normal distribution, sampling distributions, inferences from large and small samples, comparing two treatments. Focus will be placed on the derivation of these methods from first principles and its generalization in decision making. Prerequisite: Two years of high school algebra and one year of high school geometry. Offered spring semester of odd-numbered years.

5. Please list any prerequisites: Two years of high school algebra, or the equivalent.

6. When will this course first be offered? (cannot be current or past term) Spring 2017

7. Please indicate how often course is offered. Check only the single item that best describes this course. Because these are the only intervals used in the University Catalog, please do not edit or alter the list to fit a particular course. For example, if your course is offered every third year—an interval that does not appear in the Catalog—you might choose "Offered as needed" or "Offered occasionally" instead. Courses that cannot be offered at least every four years should not be proposed.

- |   |   |
|---|---|
| <input type="checkbox"/> Offered each semester              | <input type="checkbox"/> Offered in alternate years, Fall Term              |
| <input type="checkbox"/> Offered each Fall Term             | <input checked="" type="checkbox"/> Offered in alternate years, Spring Term |
| <input type="checkbox"/> Offered each spring                | <input type="checkbox"/> Offered in alternate years, May Term               |
| <input type="checkbox"/> Offered each May Term              | <input type="checkbox"/> Offered annually                                   |
| <input type="checkbox"/> Offered each semester and May Term | <input type="checkbox"/> Offered every third semester                       |
| <input type="checkbox"/> Offered occasionally               | <input type="checkbox"/> Offered by arrangement                             |
| <input type="checkbox"/> Offered in alternate years         | <input type="checkbox"/> Offered as needed                                  |

8. If your proposal is approved, would you be willing for the Mellon Center to use it as an exemplary submission in the online Curriculum Council Handbook?  Yes  No

9a. Is/are any other department(s) affected in any way by this request (e.g., course is cross-listed, team-taught, required or elective in another major or minor, etc.)?

No.  Yes. In what way? See attached.

\_\_\_\_\_  
Signature of the Head(s) of the Affected Department(s), School(s) or Program(s)

9b. If this proposal is for a Gateway course, does it overlap with any existing courses at IWU?

No.  Yes. In what way? \_\_\_\_\_

\_\_\_\_\_  
Signature of Existing Course Instructor

10. The Curriculum Council assumes that the faculty members of your department have seen and approved of this request. Please sign below if this assumption is correct:

Seyidwan Lew  
Signature of Faculty Member Primarily Responsible for This Proposal

Zahira Min  
Signature of the Head of the Department, School or Program

9a. Is/are any other department(s) affected in any way by this request (e.g., Course is cross-listed, team-taught, required or elective in another major or minor, etc.)?

Some departments have the following courses with statistics content:

1. Biology 209
2. Economics 227, 328
3. Psychology 227
4. Sociology 227

The newly proposed course is developed in line with Formal Reasoning Goals/Criteria. Thus, although there may be overlapping parts with some contents of the above courses, approaches will be distinguished from them. Seung-Hwan Lee is a statistician with expertise in lifetime data analysis.

The proposal for Mathematical Modeling: Statistics has been discussed with me. My department is in agreement with this proposal.

Biology:

Tom Walker

Economics:

Sh Osoil Duhf

Psychology:

Joan L. Kemman

Sociology:

Rebecca Gualbert

**A PROPOSAL FOR A NEW FORMAL REASONING COURSE IN  
MATHEMATICAL MODELING: STATISTICS  
AT ILLINOIS WESLEYAN UNIVERSITY**

By

Seung-Hwan Lee

Statistics, the subject of data analysis and data-based reasoning, is playing an increasingly vital role in all professions. Some familiarity with this subject is an essential component of the college education, especially in an age of Big Data. The course is intended for students who seek to learn important statistical principles, methods and their applications, with basic mathematical and statistical background. Special care will be given to the development of inferential statistical tools that can be used to describe an entire population from some experiment. Thus, in contrast to other statistics courses, an important component of this course will be the derivation of these methods from first principles and its generalization in decision making.

**The proposal:**

This proposal is to create a new formal reasoning course in statistical methods as a regular course. This course contains basic ideas of statistical methods, including organization and description of data, discrete and continuous probability distributions, sampling distribution, large and small sample inferences, etc.

**Addressing the Guidelines:**

**How does this course fit in with your overall program and faculty/student interest?**

Statistics deals with collecting informative data, interpreting these data, and drawing conclusion about a phenomenon under study. Many applications of sciences are based on data. The course will demonstrate many useful methods to analyze the data and draw conclusions. Statistical methods introduced in the course will provide students some extended familiarity with reports on some statistics and a foundation for their further study in specialized area.

**Who will teach the course? How will this course affect department course offerings and staffing?**

Seung-Hwan Lee will teach the course. He is a statistician with specialty in non- and semi-parametric statistical analysis. This course will replace one section of Finite Math. Hence, this course will not affect departmental staffing.

**Are you deleting a course to make space for this one?**

No. This course will replace one section of Finite Mathematics (Math 110), so it does not require any additional resources or staffing.

**Why are you offering the course at this level?**

This course will be offered as a first year course open to anyone who has completed two years of high school algebra. This course should not require any additional resources or staffing. Hence, the course is offered at 100 level.

**If the proposed course unit is more or less than 1, please explain.**

No, the proposed course unit is 1.

**Explain how the library, computer, media or other resources are or are not adequate?**

No library, computer, or media resources will be required.

## **NEW FORMAL REASONING COURSE**

The Department of Mathematics wishes to develop a number of first-year formal reasoning courses that will offer a variety of ways to fulfill the Formal Reasoning requirement in the Illinois Wesleyan general education program. This course will be offered as a first year course open to anyone who has completed two years of high school algebra and one year of high school geometry. Since this course will replace one section of Finite Mathematics (Math 110), it should not require any additional resources or staffing.

## **CATALOG COURSE DESCRIPTION**

**Mathematics 141 Mathematical Modeling: Statistics (FR)** This course introduces some basic statistical methods used in practice: organization and description of data, probability, probability distribution, sampling distributions, inferences from large and small samples, comparing two treatments. Focus will be placed on the derivation of these methods from first principles and its generalization in decision making. Prerequisite: Two years of high school algebra and one year of high school geometry. Offered spring semester of odd-numbered years.

## **RATIONAL FOR FORMAL REASONING CREDIT**

**Formal Reasoning Goal 1:** Familiarize students with one or more formal systems.

**Formal Reasoning Criteria 1:** Courses focus on examining and carefully defining the concepts employed in one or more formal systems and instructing students in the rules used in one or more of these systems.

Statistics as a subject provides a body of principles and methodology for designing the process of data collection, summarizing and interpreting the data, and drawing conclusions or generalities. Statistical principles and methodology taught in the course will be the formal system of interest. In order to familiarize students with the courses' formal system, this class will consist of any combination of the statistical concepts, definitions, theorems and methods which are critical components in tackling sophisticated real-world problems. Development of those enables students to derive plausible generalizations and then assess the extent of uncertainty underlying these generalizations. For example, suppose that the occurrence of an event A is unaffected by the occurrence or nonoccurrence of event B. When this happens we would be inclined to say that events A and B are independent. The notion of independence as a probabilistic concept (in agreement of our everyday usage of the word) is discussed and derived to a set of mathematical/statistical formulas that work for more sophisticated situations. This way, a formal reasoning system on the concept of independence will be well developed/familiarized.

**Formal Reasoning Goal 2:** Promote the understanding of formal systems and their use in identifying, analyzing, and solving problems.

**Formal Reasoning Criteria 2:** Courses instruct students in the use of formal systems to identify, analyze and solve problems. Courses stress critical thinking and reasoning skills and not solely mechanical skills. Courses assist students in writing clear solutions to problems.

In order to help students better understand and apply the formal system to solve a problem, this course will present the key statistical concepts and demonstrate the usage of the most commonly

used applied methods of statistical analysis. For students with a first exposure to the powerful ideas of modern statistics, underlying principles, derivation and application of statistical methods will be performed by the instructor. Students will be required to develop and apply statistical methods that draw valid conclusions for complex statistical problems. For example, in the problem of making an inference of the average height of all students who attend IWU, the theory of estimation for a sample will provide a method for making such an inference about the average height of all students. One possible method to infer would be in terms of the average height of 20 students who take an Applied Analysis course. However, such a single number may lead to an incorrect inference about the true average height. Using an interval would be a better approach. Instructor will show how to derive such an interval, demonstrate how to use it, and finally analyze it. Using a distribution function, students will be required to develop a statistical interval for a numerical characteristic of a population, such as standard deviation. Throughout the course, based on well known statistical methods covered in class, students are required to perform two processes: describing sets of data and drawing conclusions (making estimates, decisions, predictions, etc.) about the data.

**Formal Reasoning Goal 3:** Provide a real-world context for the use of formal reasoning.

**Formal Reasoning Criteria 3:** Courses include exercises in which students use formal reasoning systems to try to solve problems encountered in the real world.

In attempts to understand issues of environmental protection, the state of unemployment, or the performance of competing football teams, numerical facts and figures need to be reviewed, analyzed and interpreted. For example, monthly, as part of the Current Population Survey, the Bureau of Census collects information about employment status from a sample of about 65,000 households. The survey data are analyzed by the Bureau of Labor Statistics which reports monthly unemployment rates. In order for students to be familiar with such real-world applications, they will be required to apply statistical methods to real-world problems for data analysis. Statistical methods involve collecting, classifying, summarizing, organizing, analyzing and interpreting numerical information about data. To deal with real-world applications as part of statistical methods, descriptive statistics (such as average salaries) are used to describe the numerical features of the data in a study, and inferential statistics (such as parameter estimation and hypothesis testing) are used to infer predictions about a population from which a sample is drawn.

**Formal Reasoning Goal 4:** Convey an appreciation of formal systems.

**Formal Reasoning Criteria 4:** Courses include an appreciation of the beauty, symmetry and elegance of formal systems.

A basic premise of this course is that students will come to a deeper understanding/appreciation of the formal reasoning system through the actual application. The statistical concepts and methods covered in this course form the core in all areas of real-world applications. The instructor will present examples drawn from a wide range of applications to help develop an appreciation of various statistical methods and their potential uses. For example, assuming that the probability of a female birth is  $\frac{1}{2}$ , use of binomial distribution will simplify the task of finding probability of there being at least 1 boy and at least 1 girl in a family of 5 children. Without using this distribution, students will have difficulty understanding statistical principles

of this problem and they should take extra time searching for a valid conclusion. Students will also be required to choose an appropriate distribution that works for data in line with their experience in class and judgement, and to interpret results. This kind of statistical analysis can be used for exploring complicated data relevant to the real-world, as well as to make more accurate predictions about future developments.