14-79
AP-9/30/14
Senate Info : 11/4/14

Undergraduate Distance Education Review Form

(Required for all courses taught by distance education for more than one-third of teaching contact hours.)

Existing and Special Topics Course

Course: MATH 214 Probability and Statistics for Business Majors

Instructor(s) of Record: John Zhang

Phone: 724-357-4061 **Email:** zhang@iup.edu

Step Two: Departmental/Dean Approval

Recommendation: ☑ Positive (The objectives of this course can be met via distance education)

☐ Negative

Signature of Department Designee — Date: 9/24/14

Endorsed: Signature of College Dean — Date: 9/25/14

Forward form and supporting materials to Liberal Studies Office for consideration by the University-wide Undergraduate Curriculum Committee. Dual-level courses also require review by the University-wide Graduate Committee for graduate-level section.

Step Three: University-wide Undergraduate Curriculum Committee Approval

Recommendation: ☒ Positive (The objectives of this course can be met via distance education)

☐ Negative

Gail S Sechrist — Signature of Committee Co-Chair — Date: 10/1/14

Forward form and supporting materials to the Provost within 30 calendar days after received by committee.

Step Four: Provost Approval

☑ Approved as distance education course ☐ Rejected as distance education course

Signature of Provost — Date: 10/10/14

Forward form and supporting materials to Associate Provost.

IUP PROVOST'S ASSOCIATE OFFICE RECEIVED OCT 7 2014

Received SEP 25 2014 Liberal Studies

Proposal for MATH 214 Probability and Statistics for Business majors Online Course

John Zhang

Background

MATH 214 Probability and Statistics for Business majors is a service course for business majors offered by the mathematics department. It is the first of a sequence of two courses. The second course, QBUS 215, is offered by the Eberly College of Business. QBUS 215 has an online version and the Eberly College of Business has requested that the mathematics department offer an online version of MATH 214 to accommodate their students. This proposal is our attempt to meet the needs of business majors.

One textbook is used for both courses in this sequence. There is a textbook selection agreement between the two parties. Every two years, one party chooses three textbooks for the sequence and the other party selects one from the three as the textbook. The roles alternate every two years. Because of this arrangement, it is not feasible for this proposal to tide one particular textbook with online resources. Instead, the applicant uses more general online resources such as Mathematics Association of America's WebWork to assign students HWs in this application. Additional online material and resources related to a particular textbook will be utilized in the actual teaching of the course.

Brief Narrative Rationale for A1-A5

1. How is/are the instructor(s) qualified in the distance education delivery method as well as the discipline?

   The instructor has a Ph.D. in statistics and has been teaching statistics courses at IUP for about twenty years. The instructor has also created an online course for MATH 217 Probability and Statistics and has taught this online course for over 10 years. MATH 217 is similar to MATH 214 except for application emphases. MATH 217 uses examples from social sciences and many other disciplines, but MATH 214 focuses on business applications.

   For the MATH 217 online course, the instructor has develops videos to teach content material, to show detailed steps in working out many practice problems using technology such as Excel. The teaching materials and videos are delivered to students using Moodle. Additional software and online platforms are also utilized. For example, homeworks and exams are delivered through the Hawkeslearing system.

2. How will each objective in the course be met using distance education technologies?

   The course objectives as stipulated by the departmental syllabus of record are as follows:
   a) Create and interpret the basic graphical representations of data
   b) Calculate and interpret basic numerical descriptions of data.
   c) Understand basic random discrete and continuous variables and their probability distributions. Calculate and interpret point and interval estimates for population parameters. Understand the concept of sampling distribution and the Central Limit Theorem and its applications. Interpret a confidence interval.

d) Understand and apply the concepts of hypothesis testing and writing appropriate conclusions.

For a), the instructor will create video lectures to teach the content materials. The videos will be delivered by Moodle. Excel will be used to create the graphical displays and videos on how to use Excel to create these graphs will be created and stored in Moodle for student access. Videos on solving practice problems and additional example will also be created.

For b), the instructor will create video lectures to teach the content materials. The videos will be delivered by Moodle. Excel will be used to carry out statistics computations. Videos using Excel to carry out computations for different examples will be created and delivered by Moodle.

For c), the instructor will create video lectures to teach the content materials. The videos will be delivered by Moodle. Probability topics require more critical thinking and understanding. Therefore, the video lectures for probability topics will be more detailed and use many examples (the sample lecture is on probability issues). For confidence interval topics, Excel templates that help with the computation will be created for students' download through Moodle. The emphases will be on the interpretations.

For d), the instructor will create video lectures to teach the content materials. The videos will be delivered by Moodle. Again, Excel templates that help with the computation will be created for students' download through Moodle. The emphases will be on the interpretations.

3. How will instructor-student and student-student, if applicable, interaction take place?

Instructor-student and student-student interaction will take place mostly on Moodle's discussion forum and chatroom. Email communications will also be used as an important communication tool.

4. How will academic honesty for tests and assignments be addressed?

HWs will be assigned weekly in a regular semester format and will be assigned daily in a summer or winter session format. HWs will assigned using WebWork and be counted for about 20% of a student's final grade. Four exams will be assigned (in a semester or summer session format) and will be counted for 80% of the grade. HWs and exams will be delivered online. An individualized exam delivery system will be used (such as Hawkeslearning system) so that the order of the problems and numbers in the problem will be changed from student to student.

An honor statement will be stated in the syllabus. The current statement that I have used is "You must finish the exams **on your own**. Absolutely no collaborations! I consider any collaboration as cheating and if discovered, you will automatically receive an F score for the course."

Part II. Description of Curriculum Change

1. New Syllabus of Record

I. Catalog Description

MATH 214 Probability & Statistics for Business Majors 3c-0l-3cr

Prerequisites: None

(Catalog statement needs to be inserted here)

II. Course Outcomes

Upon successful completion of this course, students will be able to:

1. Create and interpret the basic graphical representations of data
2. Calculate and interpret basic numerical descriptions of data.
3. Understand basic random discrete and continuous variables and their probability distributions.
4. Calculate and interpret point and interval estimates for population parameters.
5. Understand the concept of sampling distribution and the Central Limit Theorem and its applications.
6. Interpret a confidence interval.
7. Understand and apply the concepts of hypothesis testing and writing appropriate conclusions.

III. Course Outline

1. Data Collection and different types of data. (3 hours)
2. Descriptive Statistics and graphical summaries. (2 hours)
3. Basic probability. (5 hours)
4. The Normal Probability Distribution. (3 hours)
5. Sampling Distributions for the mean and proportion. (5 hours)
6. Confidence Intervals for a single population mean and proportion. (6 hours)
7. Hypothesis Testing for a single population mean and (6 hours)

proportion.

8. Inference on two population means. (5 hours)

This syllabus leaves 7 hours for tests and other optional topics etc..

IV. Evaluation Methods

The final grade for the course will be determined by elements such as tests, quizzes, projects, and homework assignments. A substantial proportion of the course grade should be determined by tests.

V. Example Grading Scale

90% - 100%	A
80% - 89%	B
70%-79%	C
60% - 69%	D
Below 60%	F

VI. Undergraduate Course Attendance Policy

Although there is no formal attendance policy for this class, student learning is enhanced by regular attendance and participation in class discussions. The University expects all students to attend class.

[Note: It is recommended that an attendance policy be developed by individual faculty and included in student syllabi. (See undergraduate catalog for Undergraduate Course Attendance Policy.)]

VII. Required Textbooks, Supplemental Books and Readings

Anderson, David R.; Sweeney, Dennis J & Williams, Thomas A (2008), *Statistics for Business and Economics* (10th ed.), Thomson.

VIII. Special Resources Requirements

Calculator with statistical capabilities.

IX. Bibliography

Anderson, David R.; Sweeney, Dennis J & Williams, Thomas A (2008), *Statistics for Business and Economics* (10th ed.), Thomson.

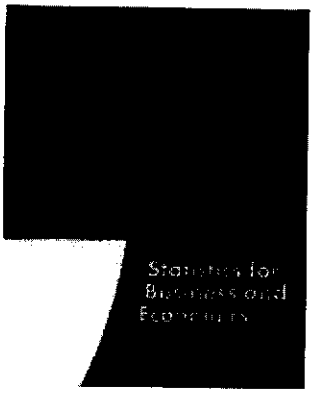
2. Summary of proposed revisions

This is a new version of the MATH 214 syllabus of record.

3. Justification

No recent changes have been to MATH 214. So, a syllabus of record does not exist.

4. Old syllabus



MATH 214 PROBABILITY & STATISTICS FOR BUSINESS MAJORS

JOHN ZHANG

Please Read All Information in This Letter Carefully!!

Course: MATH214 online Section (Probability and Statistics for Business Majors)

Instructor: Dr. John Zhang

Office: 313 Stright Hall

Office Hrs: Five office hours will be listed here for a semester section; for a summer or winter section, no office hours will be list except for meetings by appointments

Tel: 724-357-4061(O), 724-375-2608 (math office)

email: zhang@ iup.edu

Add and drop deadline:
Withdraw deadline:

Textbook:

Statistics for Business & Economics
Cengage Learning
Author: David Anderson
ISBN: 9780538481649
Edition: 11th

Exams:

Four exams will be given. All exams will be open book and open notes and will be delivered through HLS software (if the Hawkeslearning software will be used, if not, another platform will be used). Please also note that:

- Since exams will be scheduled using the HLS software, please check the exam days through Hawkeslearning software and make sure that you have enough time to take the exams before deadlines.
- Four sample exams are also scheduled and assigned. All sample exams are about the same length as the real exam. You can earn up to 1% extra credit (of your final grade)

by completing each of the sample exams. So, please take advantage of these extra credits. In addition to the assigned sample exams, you can also generate sample exams on your own and practice on them prior to taking the real exam (you will not receive extra credits by doing the sample exams that you generate by yourself). I have created a video showing you how to generate sample exam.

Note: Any cheating on Exams will result automatically an F score for the course and further disciplinary action may follow.

HWs: HWs will be assigned using the WebWork platform. Videos on how to use WebWork is available on Moodle.

Teaching: This is an online course. So, there will be no face-to-face lectures. Teaching videos for all materials can be accessed on Moodle. You are assigned to view these videos and a chatroom discussion of the material for each of the topics is also scheduled. Please make sure that you will view the videos before deadline and participate in the chatroom discussions.

Discussions: Please use the Moodle forum to start a discussion with other students. Post your questions/discussion topics there to the class and me.

Course Description: This course is designed for business majors. The course introduces the study of elementary data analysis, elementary probability theory, discrete and continuous random variables and their probability distributions, the concept of statistical inference, interval estimation, hypothesis testing and simple linear regression.

Overview: Statistics might be defined as the science of numerical reasoning from data. Its purpose is to aid people in making decisions based on the analysis of numerical information. Data and numerical arguments abound not only in science and social science disciplines but in almost every field of academic inquiry. In addition to most people encounter statistical reasoning in everyday life, business decisions are increasingly depending on statistical analysis. It is therefore exceedingly appropriate and important for all business majors to undertake study of fundamental principles and methods of statistics.

Course Principles: I try to keep in mind the following principles as I teach this course:

1. Statistics is not number-crunching. Contrary to its popular perception as a black box collection of arcane magic tricks, statistics involves much more than numerical computations. The emphasis of the course will be on understanding statistical concepts and on interpreting and communicating the results of statistical analyses. In other words, you will be expected to learn to construct and analyze numerical arguments. In contrast to most mathematics courses, we will be using phrases such as "there is strong evidence that ..." and "the data suggest that ..." rather than "the exact answer is ..." and "it is therefore proven that ..." To alleviate the computational burden, we will **use Excel to perform calculations** and produce visual displays.
2. Statistics involves the analysis of genuine data. You will analyze genuine data from a wide variety of applications in business.

Prerequisites: There are no formal prerequisites for this course. Certainly, no prior knowledge of statistics is expected. The mathematical level of the course is that of high school algebra. Although we will use computers, you need not to have prior familiarity with them. What you do need to bring to the course are an open mind for tackling numerical questions in a conceptual manner and a willingness think using comment sense.

Attendance: No class attendance requirement.

Changes and/or additions to any items will be announced by email and on Moodle. Students are responsible for all such changes and/or additions, and excuses such as "I did not check my email" carry no weight.

Grading: Your course grade will be based on four exams and quizzes. The weights assigned to these are as follows:

		Curve:	
Four exams:	20% each	90-100%	A
HWs:	20%	80-89%	B
Sample Exams (extra credit)	1% each	70-79%	C
		60-69%	D
		Less than 60%	F

Sample Lecture (introduction to probability)

Video (Chapter 4 is divided into two classes; this video is for the first class):

mms://avs.iup.edu/emp/zhang/IUPOnly/Chapter 4 Part A.wmv

Teaching Notes:

Introduction to Probability

Uncertainties - Managers often base their decisions on an analysis of uncertainties such as the following:

- What are the *chances* that sales will decrease if we increase prices?
- What is the *likelihood* a new assembly method will increase productivity?
- What are the *odds* that a new investment will be profitable?

Facts about Probability:

- Probability is a numerical measure of the likelihood that an event will occur
- Probability values are always assigned on a scale from 0 to 1.
- A probability near zero indicates an event is quite unlikely to occur.
- A probability near one indicates an event is almost certain to occur.

Example:

- If the event is very unlikely to occur, P=
- If the occurrence of the event is just as likely as it is unlikely, P=
- If the event is almost certain to occur, P =

What is statistical Experiment?

- In statistics, the notion of an experiment differs somewhat from that of an experiment in the physical sciences
- In statistical experiments, probability determines outcomes
- Even though the experiment is repeated in exactly the same way, an entirely different outcome may occur
- For this reason, statistical experiments are sometimes called *random experiments*
- An experiment is any process that generates well-defined outcomes
- The sample space for an experiment is the set of all experimental outcomes
- An experimental outcome is also called a sample point

Experiment	**Experiment Outcomes**
Toss a coin	Head, tail
Inspection a part	Defective, non-defective
Conduct a sales call	Purchase, no purchase
Roll a die	1, 2, 3, 4, 5, 6

Play a football game	Win, lose, tie

Example: Bradley has invested in two stocks, Markley Oil and Collins Mining. Bradley has determined that the possible outcomes of these investments three months from now are as follows

Markley Oil: 10, 5, 0, -20

Collins Mining: 8, 2

Tree Diagram for outcomes:

A Counting Rule for Multiple-Step Experiments:

- If an experiment consists of a sequence of k steps in which there are n_1 possible results for the first step, n_2 possible results for the second step, and so on, then the total number of experimental outcomes is given by $(n_1)(n_2) \ldots (n_k)$

Example: In the previous example, K=?, n_1=?, n_2=?

Counting Rule for Combinations:

Number of Combinations of N Objects, Taken n at a Time

Number of Permutations of N Objects, Taken n at a Time

Basic Requirements for Assigning Probabilities

1. The probability assigned to each experimental outcome must be between 0 and 1, inclusively

2. The sum of the probabilities for all experimental outcomes must equal 1

Different ways of assigning probability

- Classical Method
  - Assigning probabilities based on the assumption of equally likely outcomes
- Relative Frequency Method
  - Assigning probabilities based on experimentation or historical data
- Subjective Method
  - Assigning probabilities based on judgment

Example: Rolling a die

If an experiment has n possible outcomes, the classical method would assign a probability of $1/n$ to each outcome

- Sample Space: $S = \{1, 2, 3, 4, 5, 6\}$
- Probabilities: Each sample point has a 1/6 chance of occurring

Example: Lucas Tool Rental would like to assign probabilities to the number of car polishers it rents each day. Office records show the following frequencies of daily rentals for the last 40 days.

Number of Polisher Rented	Number of Days	Probability
0	4	
1	6	
2	18	
3	10	
4	2	

Subjective method

- When economic conditions and a company's circumstances change rapidly it might be inappropriate to assign probabilities based solely on historical data

- We can use any data available as well as our experience and intuition, but ultimately a probability value should express our degree of belief that the experimental outcome will occur
- The best probability estimates often are obtained by combining the estimates from the classical or relative frequency approach with the subjective estimate

Example: for the Bradley Investments, An analyst made the following probability estimates

Exper. Outcome	Net Gain or Loss	Probability
(10, 8)	**$18,000 Gain**	**0.2**
(10, -2)	**$8,000 Gain**	**0.08**
(5, 8)	**$13,000 Gain**	**0.16**
(5, -2)	**$3,000 Gain**	**0.26**
(0, 8)	**$8,000 Gain**	**0.1**
(0, -2)	**$2,000 Loss**	**0.12**
(-20, 8)	**$12,000 Loss**	**0.02**
(-20, -2)	**$22,000 Loss**	**0.06**

Events and Their Probabilities

- An event is a collection of sample points
- The probability of any event is equal to the sum of the probabilities of the sample points in the event
- If we can identify all the sample points of an experiment and assign a probability to each, we can compute the probability of an event

Example: Bradley Investments, suppose Event M = Markley Oil Profitable and

$M = \{(10, 8), (10, -2), (5, 8), (5, -2)\}$

$P(M) = P(10, 8) + P(10, -2) + P(5, 8) + P(5, -2) =$

Do it in class

Event C = Collins Mining Profitable

$C = \{(10, 8), (5, 8), (0, 8), (-20, 8)\}$

P(c) =

Some Basic Relationships of Probability

There are some basic probability relationships that can be used to compute the probability of an event without knowledge of all the sample point probabilities

- Complement of an Event
  - The complement of event A is defined to be the event consisting of all sample points that are not in A
  - The complement of A is denoted by A^c
- Union of Two Events
  - The union of events A and B is the event containing all sample points that are in A or B or both
  - The union of events A and B is denoted by AUB
- Intersection of Two Events
  - The intersection of events A and B is the set of all sample points that are in both A and B
  - The intersection of events A and B is denoted by $A \cap B$
- Mutually Exclusive Events
  - Two events are said to be mutually exclusive if the events have no sample points in common
  - Two events are mutually exclusive if, when one event occurs, the other cannot occur

Example: Continue from the previous example, let

Event M = Markley Oil Profitable

Event C = Collins Mining Profitable

$M \cup C$ = Markley Oil Profitable or Collins Mining Profitable (or both)

$M \cup C$ = {(10, 8), (10, -2), (5, 8), (5, -2), (0, 8), (-20, 8)}

$P(M \cup C) = P(10, 8) + P(10, -2) + P(5, 8) + P(5, -2) + P(0, 8) + P(-20, 8)$

$M \cap C$ = Markley Oil Profitable and Collins Mining Profitable

M and C = {(10, 8), (5, 8)}

$P(M \text{ and } C) =$

Addition Rule

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Example: Compute P(M or C) by the addition rule

Conditional Probability

- The probability of an event given that another event has occurred is called a conditional probability
- The conditional probability of *A* given *B* is denoted by $P(A|B)$
- A conditional probability is computed as follows:

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

Example: For the previous example, find

P(C|M)= P(Collins Mining Profitable given Markley Oil Profitable)

Multiplication Law

- The multiplication law provides a way to compute the probability of the intersection of two events
- $P(A \cap B) = P(B)P(A|B)$

Example: use the multiplication rule to fine P(M and C)

Independent Events

If the probability of event A is not changed by the existence of event B, we would say that events A and B are independent

Two events A and B are independent if:

$$P(A|B) = P(A) \quad \text{or} \quad P(B|A) = P(B)$$

Multiplication Law for Independent Events

- The multiplication law also can be used as a test to see if two events are independent
- The law is written as: $P(A \text{ and } B) = P(A)P(B)$

Example: For the previous example, are M and C independent?

Note: Do not confuse the notion of mutually exclusive events with that of independent events

- Two events with nonzero probabilities cannot be both mutually exclusive and independent
- If one mutually exclusive event is known to occur, the other cannot occur; thus, the probability of the other event occurring is reduced to zero (and they are therefore dependent)
- Two events that are not mutually exclusive, might or might not be independent

Bayes' Theorem

- Often we begin probability analysis with initial or prior probabilities
- Then, from a sample, special report, or a product test we obtain some additional information
- Given this information, we calculate revised or posterior probabilities
- Bayes' theorem provides the means for revising the prior probabilities

Example: L. S. Clothiers

- A proposed shopping center will provide strong competition for downtown businesses like L. S. Clothiers. If the shopping center is built, the owner of L. S. Clothiers feels it would be best to relocate to the shopping center
- The shopping center cannot be built unless a zoning change is approved by the town council. The planning board must first make a recommendation, for or against the zoning change, to the council

Let: A_1 = town council approves the zoning change

A_2 = town council disapproves the change

Using subjective judgment: $P(A_1) = .7$, $P(A_2) = .3$

Suppose that: The planning board has recommended against the zoning change. Let B denote the event of a negative recommendation by the planning board;

Given that B has occurred, should L. S. Clothiers revise the probabilities that the town council will approve or disapprove the zoning change?

- Past history with the planning board and the town council indicates the following:
  - $P(B|A_1) = .2$
  - $P(B|A_2) = .9$
- Therefore:
  - $P(B^C|A_1) = .8$
  - $P(B^C|A_2) = .1$

A tree Diagram:

Town Council Planning Board Experimental Outcomes

To find the posterior probability that event A_i will occur given that event B has occurred, we apply Bayes' theorem

$$P(A_i|B) = \frac{P(A_i)P(B|A_i)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2) + \ldots + P(A_n)P(B|A_n)}$$

Bayes' theorem is applicable when the events for which we want to compute posterior probabilities are mutually exclusive and their union is the entire sample space.

Given the planning board's recommendation not to approve the zoning change, we revise the prior probabilities as follows:

$$P(A_1|B) = \frac{P(A_1)P(B|A_1)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2)}$$

The planning board's recommendation is good news for L. S. Clothiers. The posterior probability of the town council approving the zoning change is .34 compared to a prior probability of .70.

Steps:

- Prepare the following three columns:
  - Column 1 - The mutually exclusive events for which posterior probabilities are desired
  - Column 2 - The prior probabilities for the events
  - Column 3 - The conditional probabilities of the new information *given* each event

Events Ai	**Prior Probability P(Ai)**	Cond. Prob. P(B|Ai)
A1	0.7	**0.2**
A2	0.3	**0.9**

- Prepare the fourth column:
  - Compute the joint probabilities for each event and the new information *B* by using the multiplication law

Events Ai	**Prior Probability P(Ai)**	Cond. Prob. P(B|Ai)	Joint Prob. P(Ai and B)
A1	0.7	**0.2**	0.14
A2	0.3	**0.9**	0.27

  - We see that there is a .14 probability of the town council approving the zoning change and a negative recommendation by the planning board;
  - There is a .27 probability of the town council disapproving the zoning change and a negative recommendation by the planning board
- Sum the joint probabilities in Column 4. The sum is the probability of the new information, $P(B)$. The sum .14 + .27 shows an overall probability of .41 of a negative recommendation by the planning board;
- Compute the posterior probabilities using the basic relationship of conditional probability

Events Ai	**Prior Probability P(Ai)**	Cond. Prob. P(B|Ai)	Joint Prob. P(Ai and B)	Posterior Prob. P(Ai|B)
A1	0.7	**0.2**	0.14	0.34
A2	0.3	**0.9**	0.27	0.66
Total	1		0.41	1