STAT:1030:0AAA (including sections A01-A16) **Statistics for Business, Fall 2024**

SYLLABUS

Course ICON Site	To access the course site, log into Iowa Courses Online (ICON) https://icon.uiowa.edu/index.shtml using your Hawk ID and password.
Instructor (Course Supervisor)	Professor Joseph B. Lang, 271 SH, joseph-lang@uiowa.edu
Discussion Instructors (TAs)	See ICON course homepage, TA Info.
Lectures **Discussion Sessions**	3:30-4:45, M W, MacBride Hall Auditorium T Th, Times and locations depend on section enrolled
Student Drop-In and Supplemental Instruction Hours	Discussion Instructor (TA): See ICON, TA Info. Instructor: 10:30-12:00 MW, or by appointment, 271 SH Supplemental Instructor (SI): See ICON, Tutoring Info.
Pre-Requisites	None
Approved General Education Course	Quantitative and Formal Reasoning
Department and Course Home	Statistics and Actuarial Science. The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the add and drop deadlines, the "second-grade only" option (SGO), academic misconduct policies, and other undergraduate policies and procedures. Other UI colleges may have different policies.
DEO (Department Chair)	Professor Kung-Sik Chan, 241 SH, 335-0712, kung-sik-chan@uiowa.edu
Department Main Office	241 SH

Required Text: The online text is available on the course ICON site, in Modules 1-11.

Recommended (not required) Text:[1] Sharpe, De Veaux, and Velleman (2023). *Business Statistics*, 4th edition. Pearson.

[1] Supplementary Texts: There are many other free online textbooks available; several include worked examples. For instance, start at https://open.umn.edu/opentextbooks/textbooks/385 for a freely available intro business statistics textbook. See also https://textbookequity.org/Textbooks/introductorystatistics_Vol1.pdf and https://openstax.org/details/books/introductory-statistics. Other non-free books that are very good include Moore, McCabe, Alwan, Craig (2016), *The Practice of Statistics for Business and Economics*, 4th edition, Macmillan; and Moore and Notz (2020), *Statistics: Concepts and Controversies*, 10th edition, Macmillan. There are also many entertaining and informative popular press books available, e.g., *The Art of Statistics: How to Learn from Data*, D. Spiegelhalter, 2021 (see a corresponding presentation at https://www.lse.ac.uk/Events/Events-Assets/PDF/2019/01-LT/20190327-Learning-from-Data.pdf); see Prof Lang for more suggested reading.

Description: This is a one semester undergraduate course in business statistics. All the course material including the required textbook will be made available on ICON. Lectures will introduce the student to statistical and probabilistic (stabilistic) reasoning and will cover introductory topics in descriptive and inferential statistics, with emphasis on business applications (see the appendix for a list of topics and some illustrative examples). Discussions will support lecture material and include a weekly computer lab component where software Excel will be used to carry out data analyses. The material is pitched at a level that should be comfortable to a first-year undergraduate student who has successfully completed high school algebra. This is an approved General Education course (Quantitative and Formal Reasoning).

Objectives: The successful student will leave this course with a basic understanding of many of the fundamentally important ideas of statistical and probabilistic (stabilistic) reasoning. As examples, they will be able to (i) explain statistical concepts, paradoxes, and fallacies to colleagues; (ii) explain the importance of identifying the data production method; (iii) use basic probability rules to measure uncertainty; (iv) carry out predictions, with uncertainty bounds, in the straight-line regression setting; (v) describe univariate and multivariate data, both graphically and numerically; (vi) understand how to describe statistical association and use it to improve prediction; and they will be able to (vii) carry out a variety of statistical inference procedures, after deeming them applicable. They will also be comfortable using Excel to carry out a variety of descriptive and inferential tasks and they will understand how Monte Carlo simulation can be useful for making inferences. *Most importantly, the successful student will learn what questions can be asked (and how to frame them) to improve decision making and predictions when confronted with data and uncertainty.*

Course Organization:

Lectures and Discussions.

Lectures. The 75-minute in-person meetings on M and W will typically be used to introduce important concepts and questions, give a running summary of the material, and to work through examples. We will cover most of the topics from Modules 1-11 in the online textbook. Students will be expected to come prepared and to participate in the worked examples and engagement activities. To be better prepared for lectures, students are strongly encouraged to look over the relevant material before class. The "engagement activities" and "skills building" exercises (see below) will serve as a guide to where we are, and will be, in the material.

Discussion Section. The 50-minute in-person meetings on T and Th will be used to work through examples and practice problems related to the lecture material and skills building exercises. These sessions will also include engagement activities. **Computing:** On either T or Th, depending on the section of your enrollment, discussion will be held in the Myer's Computing Lab in 41 SH. Among other things, in this lab, discussion instructors will help students with the computing aspects of the course. We will primarily use the spreadsheet program Excel to create graphical and numerical summaries of data and to carry out Monte Carlo simulations and basic statistical inferences.

Note: Excel (https://en.wikipedia.org/wiki/Microsoft_Excel) is part of the Microsoft Office suite and is available in all the ITC labs on campus, including the Myers Computing Lab (41 SH).

ABC Work.

All student work in this class will be made up of three components: Engagement **A**ctivities, Skills **B**uilding, and Skills **C**hecks; that is, **A**, **B**, and **C** work.

For planning purposes…Each week you should plan on submitting to ICON a piece of A or B work on Friday by 11:59pm (see the Assignments page in ICON). Skills Checks 1 and 2 (C work) will be turned in on Wednesday evenings (Oct 2 and Nov 6) and Skills Check 3 (the final piece of C work) will be turned in during finals week (Dec 16-20, TBD).

You will be in lecture Monday and Wednesday from 3:30-4:45 and in discussion for two 50-minute periods, one on Tuesday and one on Thursday. **Attendance is required.** During any of these periods, an engagement activity may be carried out and handed in.

Note: Much of your ABC work will be submitted to ICON; each submission must be formatted as a **single PDF file.** For those of us without scanners, there are free apps available for sequentially taking pictures of multiple pages and combining them into a single PDF file—the instructor has had some success with the iOS version of the free *Adobe Scan* app. It is your responsibility to make sure your ICON submission is complete and easily readable.

A. Engagement Activities (A work). Engagement activities will be carried out or assigned regularly (tentatively, around 16-24 over the semester) and will be handed in directly in discussion or lecture, or electronically submitted to ICON. These activities take a variety of forms, including class participation checks, in-class teamwork, short summaries of lectures and discussions, computing work, and self-created exercises with solutions. In-class engagement activities will not be pre-announced. For the activities that will be submitted to ICON (typically on Fridays by 11:59pm), see the Assignments section of ICON. Your lowest 3 activity scores will be dropped without penalty. (There are no make-ups for engagement activities. If you must miss one for any reason, this will be a score that is dropped.)

B. Skills Building (B work). To build the skills necessary to succeed in this course and then later in the workplace, skills building exercises will be assigned regularly (tentatively, around 5-8 over the semester). Your solution sets will be submitted to ICON, in a single pdf file. Details will be posted to the Assignments section of ICON. Due dates will typically be Fridays, at 11:59pm. Your lowest score will be dropped without penalty. (There are no make-ups for skills building exercise sets. If you must miss one for any reason, this will be the score that is dropped.)

C. Skills Checks (C work). There will be three Skills Checks over the semester. The first Skills Check (Wed, 6:30pm-9:30pm, Oct 2) is an out-of-class *work-alone project* that is open book, open computer, and open internet. The last two Skills Checks (Wed, 6:30pm-9:30pm, Nov 6; and TBD, Dec 16-20) may also include in-class components; see the assignments page for forthcoming details. Skills Checks will be based on lecture and discussion material, and on engagement activities, skills building exercises, and practice problems. A Skills Check *work-alone project* is constructed to take between 1.5 and 2 hours to complete, provided you are prepared and know where to find the material; it can be completed anytime over a 3-hour window. As the name implies, you are to work alone. You may not consult with or help any other person and you may not submit any question to a site that has humans responding. (Use of generative AI, e.g., ChatGPT, is okay because no person directly responds.) Details, including dates, will be posted to the Assignments section of ICON.

Course Pace (Tentative):

Modules 1-4:	Intro, Descriptive Stats (Univariate, Bivariate, and Regression)	Weeks 1-5
	Skills Check #1:	W, 6:30pm, Oct 2
Modules 5-9:	Data Production, Linking Data to Inference Targets, Probability and Process Distributions, Named Distributions, Approximations to Process Distributions	Weeks 6-9
	Skills Check #2:	W, 6:30pm, Nov 6
Modules 10-11:	Statistical Inference, Fallacies and Paradoxes	Weeks 10-15
	Skills Check #3:	TBD Dec 16-20

Course-Specific Guidelines and Policies:

Attendance. Attendance is required. Students must attend all lectures and discussion sessions. Just as in the workplace, attendance ("being there") is a critical predictor of success. There will be announced and unannounced Engagement Activities in both lecture and discussion. If you have questions about these expectations, please see your discussion instructor (TA).

Learning Environment. Non-course use of cell phones or any other electronic devices during lectures and discussions is **not permitted**. Take advantage of being in a distraction-free, learning environment. Immerse yourself, challenge yourself, and enjoy the learning process.

Announcements etc. Announcements, assignments, and supplementary material will be posted to ICON. You should check the course ICON site daily for announcements and updates.

Stay Caught Up. It is vitally important that you are self-disciplined enough to stay caught up. You should take note of the due dates of all ABC work and make sure to read and view the online text at least up to that point. You are expected to attend all lectures and discussion sessions.

Effort Expectations. Effort expectations align with the home college's guideline: "for each semester hour of class time, around two hours per week of outside homework and class preparation should be completed by the average student." For example, in a 4-semester-hour course, standard out-of-class effort is 8 hours. Of course, you need to keep in mind that the '8 hours per week' is an average taken over the weeks in the semester. It is also an average taken over a diverse collection of students and courses. Thus, effort amounts will vary from week to week and from student to student. It is fair to say, however, that the more effort you put in, the more you will get out of the course.

Working Alone. You must work *alone* on all three Skills **C**hecks. For example, you may not consult with or help any other person and you may not submit any question to a site that has humans responding. (Use of generative AI, e.g., ChatGPT, is okay because no person directly responds.) Software will be employed to aid in the detection of disallowed consultations and queries.

Working Together. In contrast, unless instructed otherwise, you may work together on the Engagement **A**ctivities and Skills **B**uilding exercises. **However**, **you must write up your own solutions, in your own words**. If you are personally asked to write up your own solutions, but then subsequently turn in material that is obviously in the same words as someone else, the work will be considered plagiarized.

Plagiarism on AB work and disallowed consultations or queries on C work will be dealt with according to the policies of the College of Liberal Arts and Sciences and the University (see additional information on Academic Honesty and Misconduct at the end of this syllabus).

Late Work. Late submissions of Skills Checks (C work) and Engagement Activities (A) are not allowed. Late submissions of any Skills Building (B) work will be penalized by 50% each 24-hour period, for 5 days. After 5 days, no credit can be received on a Skills Building set. For example, if you scored a 7.6 out of 10 on a Skills Building exercise set, but submitted it one hour late, you would receive a score of 3.8 out of 10; and if you submitted it 25 hours late, you would receive a score of 1.9 out of 10.

Questions about Graded Work. Questions about grading **must be asked within one week** of the graded work's return. Reach out directly to your discussion instructor (TA) with any questions.

Grading and Components for Evaluation:

Your final course score S will be computed as

$$S = 0.25\,A + 0.25\,B + 0.25\,C_{(3)} + 0.18\,C_{(2)} + 0.07\,C_{(1)},$$

where $A =$ % credit on Engagement **A**ctivity work, $B =$ % credit on Skills **B**uilding work, and $C_{(3)} \geq C_{(2)} \geq C_{(1)}$ are the highest, median, and lowest of your three Skills **C**heck percentage (%) scores. This scoring scheme dramatically down-weights (i.e., is forgiving of) a low skills check score! See also the engagement activity and skills building sections above for low-score dropping information.

As an example, suppose Janice received a score of 92% on her Engagement **A**ctivity work, 85% on her Skills **B**uilding work, and received Skills **C**heck percentage scores of 87%, 28%, and 95%. Because her highest, median, and lowest skills check scores are $C_{(3)} = 95\%$, $C_{(2)} = 87\%$, and $C_{(1)} = 28\%$, Janice's final score is

$$S = 0.25(92) + 0.25(85) + 0.25(95) + 0.18(87) + 0.07(28) = 85.62.$$

Letter grades (including $+$'s and $-$'s) will be awarded according to a 90-80-70-60 schedule. For example, if $S \geq 90$, then a grade of A$-$ or better will be awarded. These are guaranteed cutoffs, so it is possible, but unlikely, that everyone receives an 'A.' As a rule, A$+$ grades will not be awarded in this class. As an example of a possible exception to this rule, a score of $S \geq 100$, along with outstanding participation, will be considered for an A$+$.

With this grading scheme **you are NOT "graded on a curve,"** so you are not competing with fellow students. Therefore, you are not penalized for working together on engagement activities and skills building exercises (unless instructed otherwise) to better understand concepts. Indeed, helping fellow students with the material is a great way to learn. (Recall: Skills Checks are work-alone projects.)

Miscellaneous Help and Resources:

Help Outside of Class

- TA Office Hours: See ICON for TA information.
- Instructor Office Hours: See top of this syllabus.

- Statistics Tutorial Lab: There is a free statistics tutorial lab (1113 Red, Library Commons, First Floor, Main Library) for students in this course. During available times, a graduate student will be present to assist you. Hours for the lab can be found at https://www.stat.uiowa.edu/resources/tutoring. A list of paid private tutors can be found on this page as well.
- Supplemental Instruction (SI): This course has SI available. SI is an excellent peer facilitated, interactive group study session designed to not only help you learn the material, but also how to learn. See ICON for SI information or go to https://uc.uiowa.edu/student-success/academic-resource-center-arc/si-schedule

Help with Excel

- https://support.microsoft.com/en-us/excel or google any topic for video help

Scanning Apps (for creating images and combining them into a single PDF file)

- The iOS version of the free *Adobe Scan* app seems to work reasonably well.
- CamScanner (https://www.camscanner.com/) is another option.

Below you will find College of Liberal Arts and Sciences and University Policies, and an APPENDIX that includes a list of course topics and illustrative examples …

College of Liberal Arts and Sciences (CLAS) Policies:

Academic Honesty and Misconduct
All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. Graduate academic misconduct must be reported to the Graduate College according to Section F of the Graduate College Manual.

Student Complaints
Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the Director or Chair of the school, department, or program offering the course. Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Associate Dean for Graduate Education and Outreach and Engagement when additional support is needed.

Drop Deadline for this Course
You may drop an individual course before the deadline; after this deadline you will need collegiate approval. You can look up the drop deadline for this course here. When you drop a course, a "W" will appear on your transcript. The mark of "W" is a neutral mark that does not affect your GPA. Directions for adding or dropping a course and other registration changes can be found on the Registrar's website. Undergraduate students can find policies on dropping and withdrawing here**.** Graduate students should adhere to the academic deadlines and policies set by the Graduate College.

Date and Time of the Final Exam (*the 3rd Skills Check in this course*)
The final examination date and time will be announced by the Registrar generally by the fifth week of classes and it will be announced on the course ICON site once it is known. **Do not plan your end of the semester travel plans until the final exam schedule is made public. It is your responsibility to know the date, time, and place of the final exam.** According to Registrar's final exam policy, students **have a maximum of two weeks after the announced final exam schedule** to request a change if an exam conflict exists or if a student has more than two exams in one day (see the policy here).

Communication: UI Email
Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community.

Mental Health Resources and Student Support
Students are encouraged to be mindful of their mental health and seek help as a preventive measure or if feeling overwhelmed and/or struggling to meet course expectations. Students are encouraged to talk to their instructor for assistance with specific class-related concerns. For additional support and counseling, students are encouraged to contact University Counseling Service (UCS). Information about UCS, including resources and how to schedule an appointment, can be found at counseling.uiowa.edu. Find out more about UI mental health services at mentalhealth.uiowa.edu.

Student Care and Assistance provides assistance to University of Iowa students who are experiencing a variety of crisis and emergency situations, including but not limited to medical issues, family emergencies, unexpected challenges, and sourcing basic needs such as food and shelter. More information on the resources related to basic needs can be found at basicneeds.uiowa.edu/resources/. Students are encouraged to contact Student Care & Assistance in the Office of the Dean of Students (Room 135 IMU, dos-assistance@uiowa.edu, or 319-335-1162) for support and assistance with resources.

Select University Policies (links):

Classroom Expectations
Free Speech and Expression
Non-discrimination
Absences for Religious Holy Days
Sexual Harassment/Misconduct and Supportive Measures
Sharing of Class Recordings (if appropriate)

APPENDIX: STAT:1030 Course Topics

Computing: Primarily, the spreadsheet software program Excel will be used in this course.

Module 1 Introduction

Variables (aka Features) and Variable Types
Data, Data Set, Data Base
Sample, Population, and Process (aka Probability) Distributions
Statistics vs. Population and Process Parameters
Descriptive vs. Inferential Statistics
Data Production (All Data are Not Created Equal)
Calculators: Probability and More
Stabilistic (Statistical plus Probabilistic) Reasoning
OPTIONAL: Casino Games and Sports Betting

Module 2 Descriptive Statistics: Univariate Distributions

Graphical Descriptions of Qual and Quant Data
Numerical Descriptions
Relative Standing including Percentile Rank and Z Scores
Comparing Univariate Distributions

Module 3 Descriptive Statistics: Bivariate Distributions

Joint, Marginal, and Conditional Distributions
Association, Correlation, and Causation (Definitions for Qual and Quant Variables)
Two-Way Tables and Scatterplots
Some Measures of Association: Relative Risk, Odds Ratio, Lift, and Correlation
Summaries of Linear Combinations
Why Association is Useful

Module 3 (cont'd) Descriptive Statistics: Change *(Partial Coverage)*

Time Series, Percent Change, Annualized Percent Change, Adjusting for Inflation using CPI
Exponential Model, Compound Interest, Doubling Time, Logarithmic Time Series
Monte Carlo Simulation for Predicting Investment Performance
Quality Control, Control Charts

Module 4 Descriptive Statistics: Regression for Bivariate Description and Prediction

Least Squares (LSQ) Line: Computations and Interpretations
Associative, not Causal, Interpretation of Slope and Predictions
Point Prediction and Prediction Intervals
Regression to the Mean

Module 5 Data Production

Population Sampling Methods (Probability vs. Non-Probability)
Process Sampling Methods (Replication and Sequential)
Two-Stage Selection Sampling and Selection Bias
Observational Study vs. Randomized Designed Experiment

Module 6 Linking Data to Inference Targets

The Fundamental Theorem of Statistics (FTS)
The Law of Large Numbers (LLN)
Empirical Interpretations of Process Parameters

Module 7 Process (aka Probability) Distributions

The 7 Properties of Probability
Bayes Rule
Process Distributions
Summarizing Univariate Processes
Summarizing Bivariate and Multivariate Processes and Linear Combinations
Monte Carlo Simulation for Approximating Process Distributions and Summaries thereof

Module 8 Named Process Distributions

Discrete: Binomial, *Time Permitting*: Geometric, and Poisson Distributions
Continuous: Uniform, Normal, Student's t, Exponential, and Chi-Squared Distributions
Probability Calculators (online and in Excel)

Module 9 Approximations to Process Distributions

Central Limit Theorem
Standardized Mean and Proportion Approximations (StaMA and StaPA)
Studentized Mean and Proportion Approximations (StuMA and StuPA)
Student's t Distributions
Time Permitting: Normal Approximations to the Binomial and Poisson

Module 10 Statistical Inference

One-Sample Univariate Setting
- t and Z procedures for a population or process mean μ;
- Wald and Score procedures for a population proportion or probability p;
- Chi-Squared Test of Goodness of Fit

Two-Sample Univariate Setting
- Welch's and Student's Pooled t procedures for difference bw two population or process means $\mu_1 - \mu_2$;
- Wald and Score inference procedures for difference bw two population proportions or probabilities $p_1 - p_2$

One-Sample Bivariate Setting
- Paired-Difference t for difference bw two population or process means $\mu_1 - \mu_2$;
- Chi-Squared Test of Independence bw two discrete variables;
- Normal Straight-Line Regression (inference about slope β_1, mean $\mu(x)$, and prediction)

Module 11 Paradoxes and Fallacies

Association vs. Causation (including Multiple Testing and Publication Bias Problems)
Simpson's Paradox
Regression Fallacy
Switched Conditionals Fallacy
Time Permitting: Gambler's Fallacies, Statistical Testing and Estimation Fallacies, Sampling Fallacies and Data Snooping Problems

A sample of Illustrative Examples …

- *Utility of Time Series Plots for detecting change patterns and for prediction.*
- *Control Charts*
- *Compound Interest (Optional: Amortization)*
- *Markup Rates and Profit Margins*
- *Market Basket Lift as a measure of association*
- *Portfolio Analysis*
- *Regression for improved prediction of actual (rather than projected) time to job completion.*
- *Size of Sales Force and Sales: On the negative consequences of an incorrect causal interpretation of regression results*
- *Beta Measure of Financial Risk. Regression for assessing sensitivity to overall market swings.*
- *Predicting 10-Year Returns on Investment using Monte Carlo Simulation*
- *Table Waiting. You arrive at a restaurant only to find that you are 4th on the waiting list. How long will you wait? This question can be addressed using Monte Carlo Simulation*
- *Safety Stock Analysis*
- *A realtor found that the LSQ line for predicting the sale price of a home (P) based on the number of toilet paper holders (H) is $P = 120000 + 70000\,H$. Unfortunately, if we add another toilet paper holder to a home, we canNOT expect the price to go up by $\$70000$!*
- *Drug A is better than B overall. But Drug B is better than A for females…AND for males. Huh?*
- *Overall, Airline A has a lower delay rate than Airline B. Sheila has her employees fly with Airline B because there is less chance of delay. Huh?*
- *The Problem with Ranking Hospitals, Awarding Bonuses, Choosing Airlines…(see Simpson's Paradox)*
- *Stock A had return that was 3 std deviations above average this year. The best prediction for its relative standing next year is NOT 3 std deviations above average. A better prediction is closer to average, by the Regression-to-the-Mean phenomenon.*
- *Is there an employee-of-the-month curse? A Sports-Illustrated-cover curse?*
- *Management notes that rewarding high-performing employees typically leads to poorer follow-up performances and punishing low-performing employees typically leads to better follow-up performances. True or False: These data clearly suggest that punishment works better than rewards (i.e., a stick is better than a carrot). False! (see the Regression Fallacy).*
- *A diagnostic test for a rare (1 in 1000) virus is 90% accurate. A randomly selected person tests positive. The chances this person has the virus is NOT 90%; it is only around 0.9%!*
- *Corporate leaders decide to use random drug testing because an inexpensive, 95%-accurate drug test has become available. If the prevalence of drug use by corporate employees is about 1 in 500 and a randomly selected employee tests positive for drug use, then what is the probability this employee actually did use drugs? Answer: The probability of use is just 3.67%, not anywhere near 95%!*

I hope you all have an enjoyable and rewarding semester. Good luck in all your courses. –Professor Lang