

STAT 1150 Section A01

Winter 2022

Time MW 2:30-3:45 pm
Location Zoom
CRN 55911

Instructor Jenna G. Tichon
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Email: jenna.tichon@umanitoba.ca

Office Hours: Thurs: 10:30 a.m. - 11:30 a.m.
During Home Video Lecture Periods

Web Pages UMLearn: <http://umanitoba.ca/umlearn>
Statistics: <https://www.sci.umanitoba.ca/statistics/>
R Studio Cloud login: <https://rstudio.cloud>
MyStatLab: <http://www.pearsonmylabandmastering.com>

If the above times are not convenient for you, please email me to arrange an alternate time to meet. I will do my best to return all emails within 24 hours on weekdays and by noon Monday for emails sent after the end of the workday on Fridays.

Calendar Description

(Lab required) This course is recommended for students in mathematically rich disciplines, including Statistics, Mathematics, Actuarial Science, Computer Science, and related interdisciplinary programs. Topics to be covered include: summarizing and displaying large datasets, sampling, estimation and significance tests, probability calculations, random variables and probability distributions, introduction to regression and correlation analysis, statistical software.

Not to be held with STAT 1000, STAT 1001, STAT 2000, STAT 2001 and STAT 2220.

Prerequisite: Minimum of 70% in Pre-calculus Mathematics 40S or a grade of B or better in Mathematical Skills (MSKL 100) offered by Extended Education or equivalent.

Course Goals

By the end of the course we would like students to:

- Be able to make appropriate choices for numerical and graphical summaries for a wide variety of data sets.
- Formulate statistical hypotheses and perform the appropriate tests for common one-sample and two-sample data problems.
- Identify statistical questions in real world examples and think critically about data sources and assumptions made in studies.
- Be able to effectively communicate basic statistical ideas and concepts to non-statisticians.
- Use R to create graphical and numerical summaries as well as carry out all learned statistical tests.

STAT 1150 is designed to help prepare students for further study in statistics by giving a broad summary of important ideas in probability and inference. There is an emphasis on understanding the underlying principles behind the methods used so that the students can make judicious choices in their further studies what method should be applied. This course will introduce students to the use of statistical computing software to not only apply methods but explore the mechanics through simulations.

Textbook, Readings, and Course Materials

Required Textbook: *Statistics: 13th Edition* by James T. McClave and Terry T Sincich
ISBN-13: 9780134080215

The textbook is available as an e-text through the purchase of MyStatPortal which is required for the course. Paper copies of the textbook are available through the bookstore if students would like a hard copy as well. An access code to the textbook and MyStatPortal is available for purchase through the University of Manitoba Bookstore.

Supplementary Readings: Occasionally I will assign supplementary readings in the form of short articles or website URLs to complement the lectures. These will be made available through the course website on UMLearn under the course content for the appropriate unit or on the class discussion forum.

Required Materials: All students will be required to have access to a scientific non-programmable calculator. It will also be required for all non-computing and non-reflection assessments in the course.

Using Copyrighted Material

Please be mindful and respect copyright throughout this course. All course notes, assignments, tests, exams, practice exams, and solutions are either my own intellectual property or that of the Department of Statistics. If I use any copyrighted material in my lectures I will properly source and follow copyright guidelines and I expect you to do the same. The copyrighted works are made available for your personal use and study and must not be distributed in any format without express permission.

You do not have permission to upload any course notes, tests, assignments, or handouts to any note sharing websites. Please see the following site for more information: https://umanitoba.ca/admin/vp_admin/ofp/copyright/media/Note_sharing_Web_sites.pdf

Recordings of the lectures are available for your own personal use only. You may not upload or edit any of the videos or materials I produce.

Course Technology

Respectful Behaviour in an Online Classroom: All live components of this course will be conducted over UMZoom. It is expected that you conduct yourself professionally and do not distract your fellow students with unnecessary or inappropriate chat messages, sounds, or images if you are ever on web camera. If you appear on web camera, it is expected that you will be dressed appropriately for a classroom environment and that your background does not contain distracting or offensive materials.

R Studio: In this class we will be making use of the statistical software R. While you may download R from <http://cran.utstat.utoronto.ca/> and the R Studio program from <https://www.rstudio.com/products/rstudio/download/>, in this class we will be making use of R Studio Cloud through a web browser. It is required that you can access the course and files through R Studio Cloud to work on course work and submit assignments. The second class of term we will get everyone set up with R Studio Cloud. It is very important that you attend this class.

Throughout the course I will demonstrate how to carry out many of the calculations using R and the labs will make extensive use of R for doing demonstrations and simulations.

UMLearn: All course material as well as class reflections for marks will be posted on UMLearn. All important dates can be found on the calendar and I will make class announcements through the news feed on the course website and by email. All grades will be posted in the UMLearn Gradebook

In addition, there will also be discussion forums available. For each class I will open up a discussion forum where I will post the material covered that class, any announcements, and suggestions for preparation for the next class. Please be in the habit of checking it after every class. If you have questions about anything during the lecture or any announcements, you can ask directly on the forum for the relevant class. There will also be a discussion forums opened up for general class/technology questions, for questions on assignments/projects, and

a student forum.

All discussion will be monitored closely by me. Please be courteous in posing questions and replying to questions on the board. Your best effort should be made to make clear questions in complete English sentences.

Crowdmark: Some of the assessments will be marked using the Crowdmark software, an online grading tool. These assessments will be written by you on paper or on a tablet and then scanned and uploaded through a link you will be provided over email. While you may take a photo of your paper, due to the high quality of most camera phones, it is recommended that you use the app Cam Scanner (or something similar) to take the photos of your work. There will be a trial run of the software prior to the first assessment that uses it. Upon completion of the marking, an electronically marked copy of your assessment will be emailed to your UManitoba e-mail address. I will send out an email when the marked copies have been sent. Please check your spam folders if you do not see it in your inbox.

Notice Regarding Collection, Use, and Disclosure of Personal Information by the University: Your personal information is being collected under the authority of the *University of Manitoba Act*. It will be used for the purposes of grading papers and providing feedback to students. Personal information will not be used or disclosed for other purposes, unless permitted by *The Freedom of Information and Protection of Privacy Act* (FIPPA). The University of Manitoba has taken steps to ensure that its agreement with Crowdmark, Inc. for services provided by the Crowdmark application in compliance with FIPPA. Please be aware that information held by Crowdmark Inc. may be transmitted to and stored on servers outside of the University of Manitoba, or Canada. The University of Manitoba cannot and does not guarantee protection against the possible disclosure of your data including, without limitation, against possible secret disclosures of data to a foreign authority in accordance with the laws of another jurisdiction. If you have any questions about the collection of personal information, contact the Access and Privacy Office (tel. 204-474-9462), The University of Manitoba, 233 Elizabeth Dafoe Library, Winnipeg, Manitoba, Canada, R3T 2N2.

MyStatLab: This class will make use of the learning management system, MyStatLab.

To access MyStatLab you will need to buy an access code from the University of Manitoba bookstore. You should then go to <http://www.pearsonmylabandmastering.com> and under **Register** select **Student**. When prompted to enter your instructor's course ID, type **tichon96108** and click **Continue**. You will then need to create a Pearson account if you do not have one from another class. Use the access code purchased from the bookstore to complete the registration. From the **You're Done!** page, select **Go To My Courses** and select my class. If you are unsure if you will remain in the course, you can use a free temporary access code for the first few weeks. You can also find these instructions posted on UMLearn.

To login in the future, go to <http://www.pearsonmylabandmastering.com> or use the

link in UMLearn in the Content Browser.

In MyStatLab you will have access to the class textbook, the short mastery quizzes based on the pre-recorded lectures which are worth 10% of your final grade, and other videos and supplementary instructional material.

Expectations: I Expect You To

In my class I expect you to:

- Attend lectures as much as you are able and watch the recordings within 24 hours when you are not.
- Make use of the chat function over UMZoom to ask questions of myself and provide answers to class discussions.
- Behave professionally in our online learning environment.
- Have paper, a writing utensil, a computer/tablet and access to a scanner or cell phone capable of taking photos during Crowdmark assessments.
- Ask questions during my lecture as needed and answer questions asked of you.
- Be mindful of my time outside of class and allow me sufficient time to answer emails or look in to your concerns.
- Make use of the discussion forums as much as you are able for your course questions.
- Follow all policies in the syllabus and consult it as needed.
- Come to me with any constructive feedback that would improve the running of the course.

Academic Dishonesty: It is important that you understand what constitutes academic dishonesty and that you are familiar with the very serious consequences. Links to resources that describe academic dishonesty (including plagiarism, cheating, inappropriate collaboration and examination impersonation, as well as typical penalties) can be found at:

http://www.umanitoba.ca/student/resource/student_advocacy/academicintegrity/students/a-to-i-what-is-academic-integrity.html#cheating-on-exams

http://www.umanitoba.ca/student/resource/student_advocacy/academicintegrity/students/student-academic-misconduct-faq.html

<https://www.sci.umanitoba.ca/students/undergraduate-students/academic-resources/academic-integrity-2/>

Whether this course be done in person or through remote learning, I expect students to hold themselves to the highest standards of academic integrity. Impersonation, cheating for hire websites, and using unauthorized materials are very serious offences and are no less serious in an online environment. I expect you to be honest, conduct yourself with integrity, actively encourage your peers to conduct themselves with integrity, and uphold the value of what a degree from the University of Manitoba means. When you are in doubt, always consult with your instructor. My virtual door is always open for discussions on the boundaries of what is and what is not allowed. Asking is a sign of integrity, not a signal that you might think of cheating. Always bear in mind that what is considered a violation of academic integrity can vary from course to course (even with the same instructor) so it is always important to ask and clarify. Ignorance is not an acceptable excuse for academic misconduct.

Recording of Class Lectures

Your instructor and the University of Manitoba hold copyright over the course materials, presentations and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission from your instructor.

Class Communication: The University requires all students to activate an official University email account. Please note that all communication between your instructor and you as a student must comply with the Electronic Communication with Students Policy. Please see http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html

You are required to obtain and use your U of M email account for all communication between yourself and the university.

E-mail: To schedule an appointment outside of office hours or to ask a question that would not be suitable for the discussion forums (it involves your personal information or the answer would not be of interest to other students) you may email me at my university email address. Please note that if your question is answered on the course outline (which will be posted on UMLearn) I will simply direct you to find the answer yourself. The subject line of your emails should contain "STAT 1150 A01". All emails should start with an opening salutation, be written in complete English sentences and be signed with your name and student number. Please note that I will not divulge grades over email. All emails received during the work week will be replied to within 24 hours. While I will generally check my work emails over the weekend in case there is an emergency, you can expect a reply to non-urgent matters received over the weekend by Monday at noon.

Office Hours: My office hours are listed at the top of the course outline. There is one hour of dedicated STAT 1150 office hours that will be scheduled over UMZoom as a drop-in session as well as the lecture period for any days designated for watching videos by yourself. Weeks without a video session I will add an extra office hour and notify the class in advance of its time. You do not need to make an appointment and may just show up to ask any

questions that you may have. If you can not make my scheduled office hours, please email me to make an appointment. Should we return to in-person learning, my office hours may be adjusted. This is the perfect time to ask questions about course material, your assignment, review your coursework, or receive help with R.

Student Accessibility Services: If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

<http://umanitoba.ca/student/saa/accessibility/>
520 University Centre
204-474-7423
Student_accessibility@umanitoba.ca

Expectations: You Can Expect Me To

As your instructor you can expect me to:

- Treat you with respect inside and outside of the classroom.
- Begin the class video stream 5-10 minutes prior to the start of class and remain for a few minutes afterwards to answer questions after the lecture.
- Come prepared to my lectures.
- Be available during my office hours and make my best attempt to provide sufficient notice if an office hour needs to be moved or canceled.
- Answer your questions thoughtfully and follow up if needed.
- Listen to your feedback/concerns and do my best to take reasonable requests in to account.
- Monitor my markers and ensure assessments are returned in a reasonable time period.
- Set assessments that are reasonable and contain questions that match the learning objectives for the course.
- Be passionate about my subject and what I teach.
- Be flexible in the face of any technological issues that may arise as we navigate remote learning together.

Course Delivery

The class will be run mostly using a flipped class model. With some adjustments for tests or holidays, the class will largely run as Wednesday's lectures being self study on your own

time by watching a series of videos I will post on UMLearn that contain roughly a week's worth of material for a 3 credit hour course. This is where I will teach major content and formulas. When you have completed the videos, there will be a short approximately 3 question basic comprehension test to take on MyStatLab. These will be simple questions that are mainly just to gauge if you paid attention to the videos and should take you about 10/15 minutes to complete. The following class (generally Mondays) will be a live lecture streamed over Zoom (or live in a classroom should we return to in-person) where I will do demonstrations, talk through more complicated/interesting examples, or talk about case studies/news articles. Attendance at the live lectures, while we are remote, is encouraged but not mandatory. You are, however, expected to watch the recording within 24 hours and respond to a short reflective question that will be available on UMLearn. Should we return to in person, reflective questions will switch to happening live during the class period. Please see the class schedule for the exact details of when there are live lectures, pre-recorded videos, or tests. On days with pre-recorded videos, I will have live office hours over UMZoom during the class time slot.

Course Schedule and Evaluation

Please see the course calendar in a separate file (available on UMLearn) for a schedule of all classes, labs, and assessments. Please note that dates for live content coverage in these schedules are approximate and subject to minor changes. All classes marked as LIVE will be held live over Zoom while remote or in person should we return to campus. All classes marked as VIDEO are comprised of videos available through UMLearn that are to be watched on your own time that day.

* All assessments due prior to the Add/Drop date will be accepted through Feb 11th at 11:59 pm. However, for all of these assessments, the intention is that you would complete them on schedule.

Lab Expectations: This course comes with a mandatory lab component. The lab will be run by the professor and graduate students from the Department of Statistics with previous lab demonstrating experience.

Seven labs will contain additional instruction, mostly relating to using R to explore concepts taught in class. The material covered is testable and is not necessarily also covered during the lecture section so it is important that you attend. You may wish to have another monitor or tablet open to follow along with the R code. You can find the lab schedule on the course calendar in a separate document.

Three labs will be replaced by quizzes with short answer questions that require you to show your work. They will become available at the start of the Tuesday lab period (3:30 p.m.) and be due at 3:30 p.m. on Thursday (at the end of the Thursday lab period). You will receive an email over Crowdmark notifying you that the quiz is available and it can be retrieved through the link. You are to take a photo of your solutions (separately for each question) or create separate pdf documents and upload them to the Crowdmark website by the due date. Note that this is an individual quiz and you are not allowed to consult other people. The only acceptable resource is materials on MyStatLab, and materials that I make available through UMLearn. You are not to consult outside websites or your classmates. Inappropriate collaboration, plagiarism, or contract cheating of any kind will be dealt with severely and forwarded to the appropriate disciplinary committee.

Please note that all dates for content coverage in these schedules are approximate and subject to minor changes.

Grading:

The following will compromise your course mark that will earn you a grade out of 100:

Reflective Q's	/5
MyStatLab Quizzes	/10
R Assignments (2)	/10
Quizzes (3)	/15
Tests (3)	/60

Marks for i►clicker sessions, assignments, quizzes and the midterm test will be posted on the gradebook in UMLearn.

Subject to the caveat in the paragraph below, the following are the minimum percentage grades required to receive each of the various letter grades: A⁺ (90%), A (80%), B⁺ (75%), B (70%), C⁺ (65%), C (60%), D (50%).

Midterm Info: There will be three midterms for this course and no final exam. The first two midterms will occur during the regular class period on Monday, March 14th and Monday, April 4th respectively. If we are remote, at 2:25 an assessment will appear on UMLearn under Assessments > Quizzes. You can begin the midterm at any point between 2:25 - 2:45 and will have 80 minutes to complete the assessment which will be a mix of multiple choice, long and short answer questions. The same procedure will occur for the third midterm but at a time scheduled by the registrar's office. If we are in-person, the midterms will be written live in the classroom. If you miss one of the first two midterms for an acceptable reason, a deferred midterm will be scheduled by the instructor within a reasonable time frame. Should you miss the third midterm, you will need to apply for a deferred exam through your home faculty. If you are ill and unable to write a midterm, you are to fill out the university's self-declaration form prior to the start of the midterm and turn it in to your instructor within 48 hours of the missed assessment.

Midterm 1 will cover units 1-3, midterm 2 will cover units 4-5, and midterm 3 will cover units 6-7. While the midterms are not cumulative, you cannot forget skills from previous units. You will just not be asked questions that solely come from previous units. To complete them, you will need access to a scientific non-graphing calculator and a booklet of tables provided on UMLearn. If we are remote, up until the start of the assessment, you can submit a formula sheet/study guide to a dropbox on UMLearn to receive a bonus 5% on your midterm. If we are in person, you can bring with you one 8.5x11 sheet of paper to the exam with anything you would like written on it. You may turn it in with your midterm for a bonus 5% if the instructor deems that it contains a good faith effort to include all of the formulas from the units covered. Note that the midterms themselves are individual assessments and, if they are written remotely, you are not allowed to consult other people or web sources outside of UMLearn, your formula sheet, and the textbook. All other resources

and communication with other individuals is strictly prohibited. Inappropriate collaboration, plagiarism, or contract cheating of any kind will be dealt with severely and forwarded to the appropriate disciplinary committee.

Lab Quiz Info: Three labs will be replaced by quizzes with short answer questions that require you to show your work. They will become available at the start of the Tuesday lab period (3:30 p.m.) and be due at 3:30 pm on Thursday. You will receive an email over Crowdmark notifying you that the quiz is available and it can be retrieved through the link. You are to take a photo of your solutions (separately for each question) or create separate pdf documents and upload it to the Crowdmark website by the due date. Note that this is an individual quiz and you are not allowed to consult other people. The only acceptable resource is materials on MyStatLab, and materials that I make available through UMLearn. All other resources and communication with other individuals is strictly prohibited. Inappropriate collaboration, plagiarism, or contract cheating of any kind will be dealt with severely and forwarded to the appropriate disciplinary committee.

Lab quizzes account for 15% of your final grade. They will be graded within one week and marks will be posted on the Gradebook. There will be no make-up quizzes. If you are severely ill in a way that prevents you from writing your quiz during the approximate two day span that it is open, you should fill out the university's self declaration form prior to the Thursday deadline and email it to the professor within 48 hours. The weight of the quiz will be transferred to the midterm that covers that unit's material.

MyStatLab Quizzes: After each pre-recorded lecture, there will be a short assessment on MyStatLab found under Assignments. It will be 2-3 very basic questions on the video coverage to assess if you were watching the videos and understood the first-level skills. They should take approximately 10-15 minutes to complete if you understand and have practiced the material. They will become available at the start of the regular class period and be due at 2:30 p.m. the following Monday*. You will have 2-3 attempts per question depending on the question type (multiple choice vs short answer). It is acceptable to work with your peers on these assignments and consult any source that you wish. As these are graded by a computer, if you made a "silly" mistake such as putting a comma instead of a period or it was overly harsh with rounding, you may email me to request a manual adjustment if I agree you did the work correctly. There are no MyStatLab quizzes for the last pre-recorded lecture. (*For all assessments due before the add/drop deadline, the deadline will be set as 11:59 p.m. on February 11th. It is, however, the expectation that students registered in the course will still complete the responses for each class within 24 hours.) Your lowest quiz will be dropped from your final grade. If you miss a quiz due to an extended illness, it will be dropped automatically without need to provide the self declaration form.

Reflective Questions: After each live lecture, there will be a short reflective question available on UMLearn under Assessments>Quizzes. While we are remote, it will be available from the end of the class period until 6:00 the following day. Should we return to in-person, these will be done live at the end of the lecture period on a slip of paper. These are meant to

be thinking questions about how concepts we talk about in class work or applications of the concepts to real life. These are meant to take approximately 2-5 minutes to complete and should be answered thoughtfully in one or two fully reasoned sentences. For the first class this will be a Getting to Know You Survey but following that it will be a prompt for a short 1-2 sentence written response. Each question will be marked out of 2. A score of 0 is for an entirely irrelevant answer. A score of 1 is for an answer that is relevant but incomplete (e.g. it asks for 2 examples and you give 1 or it asks you to explain why and you give a one word answer.) A score of 2 is for any answer that makes a genuine attempt at giving a complete answer to the question (regardless of whether it is correct or not). You may work with up to one other person and submit the same answer but you both must identify in your answer the full name and student ID number of the person you worked with. The answers must be in your own words (the exception being two people working together and identifying that they are submitting the same answer) and direct copying from the notes, text, or the internet is considered plagiarism and will be submitted for academic dishonesty. (*For all assessments due before the add/drop deadline, the deadline will be set as 11:59 p.m. on February 11th. It is, however, the expectation that students registered in the course will still complete the responses for each class within 24 hours.) The lowest reflective question will be dropped from your grade. If you miss a reflection due to illness, it will be dropped automatically without need to provide the self declaration form.

R Assignments: Throughout the term there will be two assignments to be completed by making an R Markdown document using my template and answering the contained questions. Each student will have a unique dataset to work with that is determined by their student ID number. The assignment will be available on R Studio Cloud and students are to submit their completed PDF to the dropbox on UMLearn under Assessments > Assignments. Further instructions will be provided at the time of the assignments. A practice assignment that will count towards the reflection marks will be assigned in January to ensure students can properly make the required R Markdown documents for the assignments.

Assessment Tokens: For each student in the class, I will maintain a spreadsheet for two assessment tokens. These are used for 48 hour no questions asked extensions on one-minute papers (only while remote), R assignments, and MyStatLab quizzes. They can also be used for an extension until 11:59 p.m. for a lab quiz. To use a token, simply email me with a request to extend the deadline, specify that you are using a token, and tell me which assessment you are requesting an extension for. Note that if you request the extension after the due date has already passed, you will have to wait for me to receive your email and manually extend your assessment before submitting or accessing it depending on the submission type. This will not extend the 48 hour window. The 48 hours is from when the assessment was due, not when I extended the assessment. I highly suggest that you request the extension **before** the due date. You do not need to justify why you are using the token but you do need to tell me that you are using one. You do not need to use your tokens and there is no reward for not using them.

Practice Questions: Through out the course I will provide extra practice problems in pdf form and suggest questions from the textbook. These are not for marks but you should complete them for the extra practice. The pdf questions in particular will be helpful as they were written by me and will reflect the way I ask questions on the quizzes and tests. You

will also find additional practice problems on the MyStatLab portal under the study plan or the quizzes tab.

Voluntary Withdrawal

The voluntary withdrawal date is **April 8** (by which time you will have received your marks for your first two midterms, two quizzes, one R assignment, and numerous reflective questions and MyStatLab Quizzes).

ROASS Schedule A

Schedule A of the Responsibilities of Academic Staff with regards to Students (ROASS) policies of the University of Manitoba lists resources and policies for students. It is important that you familiarize yourself with these resources and policies. Schedule A will be posted on your instructor's UMLearn page.

Course Topics

Unit 1 – Examining Data

- obtaining data: samples, types of variables
- representative samples and data quality
- displaying data: frequency distributions, histograms
- describing data with numbers: mean, weighted mean, median, quartiles, interquartile range, range, variance and standard deviation
- five-number summary and boxplots
- the $1.5 \times \text{IQR}$ rule for suspected outliers, outlier boxplots
- resistant measures
- Introduction to R with descriptive statistics

Unit 2 – Random Variables and Probability Distributions

- randomness, the language of probability
- long term proportion
- discrete random variables and probability distributions
- continuous random variables, density curves
- uniform distribution
- statistics vs parameters
- normal distribution

Unit 3 – Sampling Distributions

- simple random samples
- sampling distribution of a sample mean
- bias and variability
- Central Limit Theorem
- sampling distributions for proportions

Unit 4 – Confidence Intervals for a Single Population Mean

- confidence intervals for σ known
- selecting samples sizes
- introduction to the t-distribution
- confidence intervals for σ unknown
- confidence intervals for \hat{p}

Unit 5 – Tests of Significance for Single Populations

- tests of significance for a single population mean (σ known and unknown)
- test of significance for population proportions

Unit 6 – Inference for the Means of Two Populations

- matched pairs t procedure
- inference when population variances are equal
- inference when population variances are unequal

Unit 7 – Regression

- association versus causation
 - response variable, explanatory variable
 - scatterplots
 - correlation
 - least-squares criterion, least squares regression line and r^2
 - residuals, outliers, influential observations
 - lurking variables
 - extrapolation
 - inference on β_0 and ρ
 - analysis of residuals
 - confidence intervals for μ_Y
-