College of Staten Island, Fall 2018

**Intro Stats** (Mth113-D9) Tue 8:00–9:55 Thu 8:00–8:50 (1S-116) Thu 9:05–9:55 (1S-108) (Mth113-D7) Tue12:20–2:15 Thu12:20–1:10 (1S-219) Thu 1:25–2:15 (1S-108)

**Office Hr**  Matthew.Sunderland@csi.cuny.edu  718.982.x3600  Tue Thu 10–11:30 (1S-209)  csi.cuny.edu/campus-directory/matthew-sunderland

**Pre-reqs**
1. Mth20 or placement (SAT 530+, Regents 70+, or EA 57+)
2. *Elementary Statistics* 13e, Triola
   $175 new textbook with MyStatLab access code at csi.bncollege.com or $105 MyStatLab access code with eText at MyStatLab.com (via 6. below)
3. Suggested: TI-83 Plus or TI-84 Plus Calculator $130
4. StatCrunch Lab Manuals www.math.csi.cuny.edu/Courses/MTH113/
5. SLAS account (reset password outside of 1L-109 M-F 9-5, bring any ID)
6. MyStatLab.com: Log in or create account; Enroll with course ID sunderland59355
7. Gradescope.com: Log in or create account; Enroll with entry code M2KYE6
8. Handouts may be sent to your “preferred” email according to home.cunyfirst.cuny.edu > Self Service > Personal Information

**MyStatLab** due Thu: plan for ~20 questions/wk, ~20 min/question, unlimited tries (unless specified)
**StatCrunch** due Thu: will be saving work as PDF and uploading to Gradescope

**Grades** 25% MyMathLab and StatCrunch Labs (paper homework not collected)
15% Exam (ch1–3) 9/25*
15% Exam (ch4–6) 10/23*
15% Exam (ch7–9) 11/20*
30% Final (ch1–11) ~12/21*

*Dates tentative. Use dark pen/pencil.
No phones, notes, formulas, etc.

**Schedule**

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**Lab #**
1  2  3  4  5  6  7  8  9  1-3  4-6  7-9  1-11

**Deadlines**
Add 9/2  Drop 9/16  Withdraw 11/6

**Policy**
1. Attendance is mandatory. Three lates count as one absence.
   Three absences lower your grade by one third letter.
2. Phones must be out of sight and on silent. Food must be out of sight.

**Resources**
Tutoring: Math Dept 1S-214 (x3606), OAS 1L-117 (x4212), SLC 1A-108 (x2412)
Advisement (M-Th 9-4:30): Math Dept 1S-215 (x3600), CAAS 1A-101 (x2280)
Computer Labs (student login) 1S-213 (M-F 9-5), 1L-212 (open every day; x3695)
Health Center 1C-111 (M-Th 9-4 x3113 x3045)
Counseling Center 1A-109 (M-F 9-5 x2391) Accessibility Center 1P-101 (x2510)
Women’s Center 2N-106 (x2871) Veteran’s Center 1C-216 (M-F 9-7:30 x3108)

**Links**
Dept syllabus/topics math.csi.cuny.edu/Courses
Solver WolframAlpha, Symbolab; Grapher GeoGebra, 3D Grapher App
Videos KhanAcademy, StevensStats.com, math.csi.cuny.edu/Students/Tutoring
### Lecture Schedule

Each semester has 42 lecture classes scheduled. The precise timing of the exams varies from section to section to accommodate weekends, holidays, and the lab schedule, and may be impacted by catastrophic weather or other unpredicted emergencies. The reading and pen-and-paper homework is listed here; your instructor will assign additional problems through [MyStatLab](https://media.pearsoncmg.com/aw/aw_triola_elemstats_13_2018/website/stat13t_barrelfold.pdf). For optimal learning, make an attempt at the reading the day before the lecture, attend the lecture, and then start the homework (online or paper) in the hours after the lecture.

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### Formulas and Tables by Mario F. Triola
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<td>( \bar{x} = \frac{\sum x}{n} ) Mean</td>
<td>( P(A \text{ or } B) = P(A) + P(B) ) if ( A, B ) are mutually exclusive</td>
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<tr>
<td>( \bar{x} = \frac{\sum (f \cdot x)}{\sum f} ) Mean (frequency table)</td>
<td>( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) ) if ( A, B ) are not mutually exclusive</td>
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<td>( s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} ) Standard deviation</td>
<td>( P(A \text{ and } B) = P(A) \cdot P(B) ) if ( A, B ) are independent</td>
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<tr>
<td>( s = \sqrt{n(\Sigma x^2) - (\Sigma x)^2} ) Standard deviation (shortcut)</td>
<td>( P(A \text{ and } B) = P(A) \cdot P(B</td>
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<td>( s = \sqrt{n \left( \frac{\sum (f \cdot x^2)}{n} - \left( \frac{\sum (f \cdot x)}{n} \right)^2 \right)} ) Standard deviation (frequency table)</td>
<td>( P(\bar{X}) = 1 - P(A) ) Rule of complements</td>
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<td>variance = ( s^2 )</td>
<td>( #P_r = \frac{n!}{(n-r)!} ) Permutations (no elements alike)</td>
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<td>( \frac{n!}{n_1! \cdot n_2! \cdot \ldots \cdot n_l!} ) Permutations (( n_1 ) alike, ( \ldots ))</td>
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<td>( #C_r = \frac{n!}{n! \cdot (n-r)!} ) Combinations</td>
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<th>Ch. 7: Confidence Intervals (one population)</th>
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<td>( \mu = \Sigma [x \cdot P(x)] ) Mean (prob. dist.)</td>
<td>( \hat{p} - E &lt; p &lt; \hat{p} + E ) Proportion</td>
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<tr>
<td>( \sigma = \sqrt{\Sigma [x^2 \cdot P(x)] - \mu^2} ) Standard deviation (prob. dist.)</td>
<td>where ( E = \frac{z_{\alpha/2}}{\sqrt{n}} )</td>
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<td>( P(x) = \frac{\binom{n}{x} \cdot p^x \cdot q^{n-x}}{n-x} ) Binomial probability</td>
<td>( \overline{x} - E &lt; \mu &lt; \overline{x} + E ) Mean</td>
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<td>( \mu = np ) Mean (binomial)</td>
<td>where ( E = \frac{t_{\alpha/2} \cdot s}{\sqrt{n}} ) (( \sigma ) unknown)</td>
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<td>( \sigma^2 = npq ) Variance (binomial)</td>
<td>or ( E = \frac{z_{\alpha/2} \cdot \sigma}{\sqrt{n}} ) (( \alpha ) known)</td>
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<td>( \sigma^2 = \sqrt{n \cdot p \cdot q} ) Standard deviation (binomial)</td>
<td>( \frac{(n-1)s^2}{\chi^2} &lt; \sigma^2 &lt; \frac{(n-1)s^2}{\chi^2_{1}} ) Variance</td>
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<td>( P(x) = \frac{\mu^x \cdot e^{-\mu}}{x!} ) Poisson distribution where ( e = 2.71828 )</td>
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<td>( z = \frac{x - \mu}{\sigma} ) or ( \frac{x - \bar{x}}{s} ) Standard score</td>
<td>( n = \left[ \frac{z_{\alpha/2}}{E} \right]^2 ) Proportion</td>
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<tr>
<td>( \mu_x = \mu ) Central limit theorem</td>
<td>( n = \left[ \frac{z_{\alpha/2}}{E} \right]^2 ) Proportion (( \hat{p} ) and ( \hat{q} ) are known)</td>
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<tr>
<td>( \sigma_x = \frac{\sigma}{\sqrt{n}} ) Central limit theorem (Standard error)</td>
<td>( n = \left[ \frac{z_{\alpha/2} \cdot \sigma}{E} \right]^2 ) Mean</td>
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<td>( z = \frac{\hat{p} - p}{\sqrt{\frac{pq}{n}}} ) Proportion—population</td>
<td>( z = \frac{\overline{x} - \mu}{\sigma} ) Mean—population (( \sigma ) known)</td>
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<tr>
<td>( t = \frac{\overline{x} - \mu}{s} ) Mean—population (( \sigma ) unknown)</td>
<td>( \chi^2 = \frac{(n-1)s^2}{\sigma^2} ) Standard deviation or variance—population</td>
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<td>( z = \frac{\overline{x} - \mu}{\sqrt{n}} )</td>
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### Ch. 9: Confidence Intervals (two populations)

- **Two means—independent; assumed equal:**
  
  \[
  \bar{x}_1 - \bar{x}_2 - E < (\mu_1 - \mu_2) < (\bar{x}_1 - \bar{x}_2) + E \\
  \text{where } E = z_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}
  \]

- **Two means—independant; assumed unequal:**
  
  \[
  \bar{x}_1 - \bar{x}_2 - E < (\mu_1 - \mu_2) < (\bar{x}_1 - \bar{x}_2) + E \quad \text{(Indep.)}
  \]
  
  \[
  \text{where } E = t_{\alpha/2} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}
  \]

- **Two means—matched pairs (df unknown):**
  
  \[
  \bar{d} - E < \mu_d < \bar{d} + E \quad \text{(Matched pairs)}
  \]

  \[
  \text{where } E = t_{\alpha/2} s_{\bar{d}} / \sqrt{n}
  \]

### Ch. 10: Linear Correlation/Regression

- **Correlation:**
  
  \[
  r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}} \quad \text{or } r = \frac{\Sigma (z_x z_y)}{n-1}
  \]

  \(z_x = \text{z score for } x\)

- **Slope:**
  
  \[
  b_1 = \frac{n \sum xy - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2} \quad \text{or } b_1 = \frac{s_y}{s_x}
  \]

- **y-Intercept:**
  
  \[
  b_0 = \bar{y} - b_1 \bar{x} \quad \text{or } b_0 = \frac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2}
  \]

  \(\hat{y} = b_0 + b_1 x \quad \text{Estimated eq. of regression line}\)

- **r^2:**
  
  \[
  r^2 = \frac{\text{explained variation}}{\text{total variation}}
  \]

\[
\hat{y} - E < y < \hat{y} + E \quad \text{Prediction interval}
\]

\[
\text{where } E = t_{\alpha/2} s_{\hat{y}} \sqrt{1 + \frac{1}{n} + \frac{n(\bar{x_0} - \bar{x})^2}{n(\Sigma x^2) - (\Sigma x)^2}}
\]

### Ch. 11: Goodness-of-Fit and Contingency Tables

- **χ²:**
  
  \[
  \chi^2 = \frac{(O - E)^2}{E} \quad \text{Goodness-of-fit (df = k - 1)}
  \]

  \[
  \chi^2 = \sum \frac{(O - E)^2}{E} \quad \text{Contingency table \{df = (r - 1)(c - 1)\}}
  \]

  \[
  \text{where } E = \frac{\text{row total} \times \text{column total}}{(\text{grand total})}
  \]

- **McNemar’s test for matched pairs (df = 1):**
  
  \[
  \chi^2 = \frac{(b - c)^2}{b + c}
  \]

### Ch. 12: One-Way Analysis of Variance

- **Procedure:**
  
  1. Use software or calculator to obtain results.
  2. Identify the P-value.
  3. Form conclusion:
     - If P-value ≤ α, reject the null hypothesis of equal means.
     - If P-value > α, fail to reject the null hypothesis of equal means.

### Ch. 12: Two-Way Analysis of Variance

- **Procedure:**
  
  1. Use software or a calculator to obtain results.
  2. Test H₀: There is no interaction between the row factor and column factor.
  3. Stop if H₀ from Step 2 is rejected.

  If H₀ from Step 2 is not rejected (so there does not appear to be an interaction effect), proceed with these two tests:

  Test for effects from the row factor.

  Test for effects from the column factor.
StatCrunch is a statistical software package that can be accessed via the internet from any computer. We will use this package to analyze data during computer laboratory sessions in MTH 113. The purpose of this first lab assignment is to provide a brief introduction to StatCrunch and familiarize you with several useful features.

1. You can access StatCrunch by clicking the link found on the left toolbar in MyStatLab.

2. Note, you can either click “data sets from your textbook” to open a version of StatCrunch that enables you to work with data sets from the Triola textbook or “StatCrunch website” to access the more general version. We’ll mainly work with the first option in this course.

3. Once you are within the StatCrunch page (this should open in a separate window), you can begin to analyze data as you wish. In this course, you will be provided with detailed instructions for each lab project.

4. All commands in StatCrunch can be accessed from the menu bar at the top of the page. The StatCrunch menu bar consists of six tabs: StatCrunch, Edit, Data, Stat, Graphics, and Help. When a data set is uploaded, you will also see the name of the file to the right side of the menu bar.

5. We will learn more about each command tab during later labs but in summary: “StatCrunch” allows you to organize the way your data and results are displayed. “Edit” enables you to manipulate the data in various ways. “Data” allows you to bring data into StatCrunch. “Stat” gives you access to all statistical procedures available in StatCrunch that will enable you to invoke the techniques and concepts learned in class. “Graphics” provides several graphical techniques to visualize your data. Lastly, “Help” connects you to the StatCrunch help page to get an overview of all StatCrunch features.

6. The “Options” button in your StatCrunch results area can be used to edit, copy, print, or save your work. You will be able to save your work to either your computer or in your account on the StatCrunch website. We suggest saving your work to the website so you can access it from any computer. Access any saved data or results by clicking on My Data or My Results, respectively in StatCrunch.

7. A few notes of caution about StatCrunch: This is a web-based application so be careful about how you handle your browser window during your session. For instance, you should not use the back button and you should always access other websites in another browser. Otherwise, you will lose all your data and results in your StatCrunch session without any warning!

Here is what you should do today to begin familiarizing yourself with StatCrunch:

1. Let’s first practice loading a data set from the textbook. Click on data set 8, named Alcohol and Tobacco Use in Animated Children’s Movies. Notice, the rows and columns are now filled with data. How many rows and columns are there? Use the scroll bar to check this. What types of variables are included in this data set? Which are quantitative?

2. You can clear data by selecting “Edit” → “Select All” followed by “Edit” → “Cut”. Specific rows or columns can be deleted by selecting “Edit” → “Column” (or Row) → “Delete”. Next click on the name of the column or row you wish to delete and click “Delete”. Try these. You may have to reload the data.

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1 More detailed information can also be found on the StatCrunch website at: www.statcrunch.com
2 See syllabus for instructions on how to access the online course management system, MyStatLab. Access to StatCrunch can also be purchased separately on their website.
3. The first thing you’ll often want to do during data analysis is visualize your data. The **GRAPHICS** tab will assist with this. Click on “Graphics” → “Pie Chart” → “With Data” and then click **Alcohol Use**. Keep clicking next until you get to the end and click “Create Graph”. A pie graph should appear in a separate window (this is the default option, see below for viewing results differently). You will learn about the appropriate graphs to use with which data types next lab.

4. To choose how you view results in StatCrunch, click on the “StatCrunch” tab on the menu bar. Next choose “Session results” → “Display in” → “right half”. Now your work window should be split into two frames. For the remainder of the session, all results will be displayed in the frame on the right. There are other display options that you can choose according to your preference.

5. Most frequently you will want to make a descriptive summary of data. The **STAT** command will allow you to do this. Click on “Stat” → “Summary Stat” → “Columns” to achieve this. Notice only the quantitative variables in the data set are available for selection here. Select each variable, click “Next”, and “Calculate”. A table of summary statistics should appear in your results region. We will discuss how to interpret these values later in the course and revisit this application in Lab 3. Many of the other **STAT** features will also be explored in future labs.

6. Practice saving and reopening your results using the **OPTIONS** Tab in your results window. Click “Options” → “Save” → “to statcrunch.com”. Once you title and save your work, click on the “My Results” tab at the bottom of the page. This should open a new window with a listing of your saved files. Click on the file to open. You can now copy, print, or email your results.

7. Continue to explore StatCrunch. Feel free to try out a new data set! As with any statistical software, you will learn more and become more comfortable the more you utilize StatCrunch.
Computer Lab Project No. 2
Describing, Exploring, and Comparing Data - Graphically

In today’s lab we will explore creating and interpreting graphs such as bar plots, pie graphs, and histograms, as well as frequency tables, in StatCrunch.

**Bar Plots:**
2. Load relevant data into StatCrunch.
3. Click on “Graphics” in the menu bar.
4. Click on “Bar Plot”.
5. Choose the “with data” option to use data consisting of individual outcomes in the data table.
6. Select the column(s) to be displayed.
7. The optional “Group by” column allows you to make side by side bar plots and color code the bars according to chosen category.
8. Click Next to set individual options such as Type (Frequency or Relative Frequency)
9. Click “Create Graph” to construct the bar plot(s)
10. You may have to click the Next button if you have chosen more than one column of data to graph.

**Frequency Tables:**
1. Load Data into StatCrunch.
2. Click on “Stat” in the menu bar.
3. Click on “Tables”.
4. Click on “Frequency”.
5. Select column(s) for which summary statistics are to be computed.
6. Click “Calculate” to compute the frequency table(s)

**Histograms:**
1. Load Data into StatCrunch.
2. Click on “Graphics” in the menu bar.
3. Click on “Histogram”.
4. Select column(s) to be displayed.
5. The optional “Group by” column allows you to color code the bars by specified category.
6. Click Next to set additional options such as “Type” (Frequency or Relative Frequency), number of bins, and bin width.
7. Click Next again to specify an optional density to overlay on the histogram(s).
8. Click “Create Graph” to construct the histogram(s)
9. You may have to click the Next button if you have chosen more than one column of data to graph.
Here is what you should do today:

**Part 1:**

1. Load data set 7 in column 1. This data set consists of a list of measurements from 54 anesthetized wild bears.

2. Use both a pie chart and bar plot to display the weight of the bears. Does one graph give you a better representation of this data? If so, which one?

3. Suppose you wanted to show someone the percentage of male bears measured, what graphical technique would you use to summarize this data? Demonstrate it now.

4. How could you summarize the age of the bears both tabular and graphically?

**Part 2:**

1. Load data set 4 in column 1. It is a sample of weights and body mass index measurements from students taken at the beginning and end of the freshman year.

2. Use StatCrunch to create a frequency table and histogram of the variables "WTSEP" and "WTAPR".

3. What relative frequency of people start their freshman year weighing less than 70 kilograms? How does this compare for men and women? What relative frequency of people end their freshman year weighing less than 70 kilograms?

4. Describe the distributions of these two variables. Are the data Normally distributed?
Computer Lab Project No. 3  
Describing, Exploring, and Comparing Data - Numerically

In today’s lab we will explore obtaining and analyzing numerical summary statistics such as mean and standard deviation in StatCrunch. We will also study boxplots.

**Obtaining Summary Statistics:**
2. Load relevant data into StatCrunch.
3. Click on “Stat” in the menu bar.
4. Click on “Summary Stats”.
5. Identify the column(s) which contain the data of interest.
6. Click “Calculate” to obtain the descriptive statistics.

**Boxplots:**
2. Load relevant data into StatCrunch.
3. Click on “Graphics” in the menu bar.
4. Click on “Boxplot”.
5. The optional “Group by” column can be used to compare boxplots across groups on a single graph.
6. Click “Next” to indicate whether or not to use fences for the boxplots. Note: The five-number summary is used by default.
7. Click “Create Graph” to construct the boxplot(s).

Here is what you should do today:

1. Load data set 17 in column 1. It is a count of the number of words spoken in a day for both men and women, taken in six different samples.
2. First for a bit of preprocessing, let’s combine all of the counts for males in one column and all of the counts for females into another column. This can be accomplished through the following:
   (a) Click on “Data” in the menu bar.
   (b) Select “Stack Columns” and select all the columns with (M) for male. Store the labels in var13 and the data in var14.
   (c) Click “Stack Columns” and verify that your data is now combined on your spreadsheet. You should change the name of the var14 column label to Male.
   (d) Repeat this by putting the female data in columns var15 and var16.
3. Using what you learned in Lab 2, create and compare a histogram of the Male and Female word data. Do they appear to have the same general shape? Would you consider these samples to have come from a population that was Normally distributed?
4. Calculate the summary statistics and use them to comment on the central tendency and variation of the data. Does it appear that women are more talkative than men?
5. Create side-by-side boxplots for both variables. Do these boxplots reinforce the description you gave above? How many outliers are present? Did you notice those outliers earlier?

6. Now repeat the steps above separately for sample 3 (which was taken on students in Mexico) and sample 5. How would you describe and compare these two samples using relevant displays and summary statistics?
Today’s lab will allow us to further explore the concept of probability through the use of simulation.

1. As mentioned in the textbook, calculating probabilities can be difficult but simulation provides an alternative. It is a way to replicate or produce data similar to the way the true procedure would behave. For instance, we can simulate the result of a birth by randomly generating two numbers, one representing a boy and the other representing a girl. Here are the steps to simulate 152 births:
   (a) Click Data → Simulate Data → Discrete Uniform.
   (b) In the pop-up window, put “152” in the text field labelled “Rows”.
   (c) Put “1” in for “Columns”.
   (d) Put “0” in for minimum and “1” in for maximum.
   (e) Click “Simulate”.

   Use your simulation to estimate the probability of having a boy. Is it reasonable to expect at least 127 boys in 152 births? Why or why not?

2. Shaquille O’Neal is a professional basketball star who had a reputation for being a poor free throw shooter with a success rate of 0.528. We can simulate 200 free throws as follows:
   (a) Click Data → Simulate Data → Bernoulli.
   (b) In the pop-up window, put “200” in the text field labelled “Rows”.
   (c) Put “1” in for “Columns”.
   (d) Put “0.528” in for p.
   (e) Click “Simulate”.

   Repeat the simulation of free throws five times and record the number of times that the free throw was made. Is the percentage of successful free throws from the simulation reasonably close to 0.528 in each case? Study the sequences of hits and misses, how long is the longest run of misses? How long is the longest run of hits? Compare this with your classmates.

3. The probability of randomly selecting an adult who recognizes the brand anem of McDonald’s is 0.95. Conduct a simulation of size 10 and record the number of consumers who recognize the brand name of McDonald’s. Is the proportion of those who recognize McDonald’s reasonably close to the 0.95? Try another simulation this time with sample size 75. How do the results compare?

4. Lastly, let’s consider a well know probability example called The Birthday Problem. Similarly to number 1 above, simulate 30 random birthdays(Hint: birthdays are numbers between 1 and 365). You want to select “Use single dynamic seed”. Each number generated will be in decimal form. You can ignore the numbers behind the decimal. Examine your 30 simulated birthdays, how many people have the same birthday? Now perform 10 replications of simulating 30 birthdays, and estimate the probability of getting at least two people sharing the same birthday when you have 30 people. Compare with your classmates.

5. More examples can be found if you refer to the textbook technology project for chapter 4.
Computer Lab Project No. 5
The Normal Distribution

In this project, you are going to explore how to use software in order to calculate probabilities for normal distributions. You won’t need to consult the probability table for the standard normal distribution, and you won’t need to calculate z-scores to find probabilities for nonstandard normal distributions. Here is the procedure for finding probabilities or values (percentiles) for normal distributions using StatCrunch:

2. Click on “Stat” in the menu bar.
3. Click or hover over the menu item “Calculators”.
4. Click “Normal”.
5. In the “Normal Calculator” window that opens, enter the parameters $\mu$ and $\sigma$ of the desired normal distribution in the text fields “Mean” and “Std. Dev.”
6. If you want to find the probability that $X$ (a normally distributed random variable with the specified parameters) is less than (or equal) to a value, enter that value in the text box on the left of the second line.
7. If you know the probability that $X$ is less than (or equal) to an unknown value and you want to find the value, then enter the probability in the textbox on the right of the second line.
8. When you’re done entering the information, click the “Compute” button on the bottom right. The field you left open will be filled with the answer you were looking for.

If you are interested in probabilities of the form $P(X \leq x)$, then you can change the relation symbol on the bottom left by clicking it and choosing the one you want.

Here is what you should do today:

Part 1:
1. Load data set 3 in column 1. It is a sample of body temperatures of healthy adults, in degrees Fahrenheit.
2. Use the “Graphics” menu of StatCrunch to make a histogram of the sample. Leave the window containing the histogram open.
3. Use the “Stat” menu of StatCrunch to calculate a summary of the column statistics (of column 1).
4. Open the normal calculator, as described above. Enter the sample mean as $\mu$ and the sample standard deviation as $\sigma$. These values can be read off the summary statistics. Three decimal places suffice.
5. Use the normal calculator to calculate the (theoretical) probability $P(X \leq 97.85)$, if $X$ is normally distributed with the parameters you entered.
6. In addition to the wanted probability, the normal calculator also displays a graph of the normal distribution with the parameters you entered. Compare it to the histogram. Do you think this normal distribution is a good approximation to the distribution of body temperatures of healthy adults?

\[\text{Instructions can also be found in the textbook on page 325.}\]
7. What percentage of the sample data is less than 97.85? Compare that percentage to the probability you calculated. In order to tell what percentage of the data is less than 97.85, you can order the data (Data → Sort).

8. Find the 80th percentile of the normal distribution with the parameters you entered.

Part 2:

1. Open data set 10. It contains data concerning tar, nicotine and carbon monoxide content of various types of cigarettes.

2. Use the “Stat” menu of StatCrunch to calculate a summary of the column statistics. We’ll be interested in the column titled “FLNic”. It represents the nicotine contents of non-menthol filtered cigarettes.

3. Open the normal calculator, as described above. Enter the sample mean (the average nicotine content of non-menthol filtered cigarettes) as $\mu$ and the sample standard deviation as $\sigma$.

4. Use the normal calculator to calculate the (theoretical) probability $P(0.6 \leq X \leq 0.8)$, if $X$ is normally distributed with the parameters you entered. Assuming the nicotine contents are roughly normally distributed with these parameters, that probability should be close to the relative frequency of scores lying between 0.6 and 0.8 observed in a sample of large size.

5. Look at the graph of the normal distribution displayed in the normal calculator. The maximal value of the curve is larger than 1.5. Discuss how this is possible, considering that probabilities can never be larger than 1.
Computer Lab Project No. 6
Confidence Intervals with known standard deviation

Today we are going to experiment with confidence intervals for the population mean. We are going to use the methods that were developed in class, for estimating the population mean when the population standard deviation is known.

1. Simulate rolling a fair die 100 times, using StatCrunch. You’ll need 3 samples which should be put in columns 1 to 3. Here is how this can be done:
   (a) Click Data→Simulate Data→Discrete Uniform.
   (b) In the popup window, put “100” in the text field labeled “Rows”.
   (c) Put “3” in the text field labeled “Columns”.
   (d) Put “1” as minimum and “6” as maximum.
   (e) You can leave the other settings as they are. Click the “Simulate” button at the bottom right of the window.

2. Consider the experiment of rolling a fair die. Calculate the mean and the standard deviation. The random numbers you generated can be viewed as being samples taken from a population with that mean and standard deviation.

3. Use what you learned in class to calculate confidence intervals for the population mean with confidence level 0.95 based on these samples. Note that even though these samples are realizations of the same distribution (are taken from the same population), the confidence intervals are not the same. The confidence intervals are calculated from, and thus dependent on, the specific sample used. Recall the formula for the confidence interval for the mean at confidence level $\alpha$:

   $$(\bar{x} - E, \bar{x} + E), \text{ where } E = z_{\alpha/2} \frac{\sigma}{\sqrt{n}}.$$ 

   Recall that $z_{\alpha/2}$ is the score such that the area under the normal curve and to the right of the score is $\alpha/2$. In other words, $z_{\alpha/2}$ is the $1 - \frac{\alpha}{2}$-th percentile of the normal distribution. Also, $\alpha$ is 1—the confidence level, so in our case, $\alpha = 0.05$. You can use StatCrunch to calculate $z_{\alpha/2}$, using the normal calculator, as discussed last time.

4. In how many of your samples was the population mean contained in the confidence interval you calculated?

5. Collect all the results obtained in the class. What percentage of confidence intervals calculated by you and your peers contained the population mean?

6. Repeat these steps from the beginning, but this time, calculate confidence intervals at confidence level 0.99.
Computer Lab Project No. 7
Confidence Intervals, continued

In today’s project, you’ll learn how to use software in order to calculate confidence intervals for the mean, using the normal distribution and the *t*-distribution. Here is how it works:

2. If you want to calculate the confidence interval of a sample, then load it into StatCrunch.
3. Click on “Stat” in the menu bar.
4. If you want to use the *t*-distribution for the calculation of the confidence interval, then choose “T statistics” in the submenu, and if you want to use the normal distribution, then choose “Z statistics”.
5. In the next submenu, choose “One sample”.
6. In the following submenu, choose either “with data” or “with summary”. Note that the confidence interval for the mean of a sample at a fixed confidence level depends only on the sample mean, the sample size and the standard deviation (either of the sample or of the population). If you choose “with summary”, you’ll have to enter these values, instead of providing the entire sample.
7. If you chose “with data”, then you’ll have to select the column that contains the data in the next popup window. You can ignore the other text fields and click “Next>”.
   If you chose “with summary”, then you’ll have to enter the measurements of the sample mentioned above in the next popup window.
8. If you wish, you can check the box “Store output in data table”.
9. Choose “Confidence Interval”, and enter the desired confidence level.
10. Click “Compute!”.

Here is what you should do today:

1. Load Data Set 1 (Body measurements Males) into the table by clicking it (on the left hand side of the screen).
2. We’ll only be interested in the pulse column. You can delete all other columns, using the “Edit” item of the menu bar. Rename the “Pulse” column to “Pulse (Male)”. To rename the column, just click on the current column title. You can now edit it with the keyboard.
3. Calculate 90% and 95% confidence intervals for the population mean, using the appropriate method. Don’t add the results to the table.
4. In the window displaying the results, click “Options” and save them to your computer.
5. Now load the second part of Data Set 1 (Body measurements Females) into the table.
6. Proceed as above, renaming the “Pulse” column to “Pulse (Female)” this time.
7. Calculate and save a 90% and 95% confidence interval for the population mean again. Compare the confidence intervals you calculated for the pulses of males and females.
Today’s topic is hypothesis testing. Here is the general procedure, very similar to the calculation of confidence intervals. The built-in hypothesis tests of StatCrunch use the $P$-value method instead of the critical value method.


2. If you want to test a hypothesis concerning a given sample, then load it into StatCrunch.

3. Click on “Stat” in the menu bar.

4. If you want to use the $t$-distribution for the hypothesis test, then choose “T statistics” in the submenu, and if you want to use the normal distribution, then choose “Z statistics”. These choices apply if you want to test hypotheses concerning the mean of a population, with $\sigma$ unknown or known. If you want to test a hypotheses about a proportion of a population, choose “Proportions”.

5. In the next submenu, choose “One sample”, “Two sample” or “Paired” (only in the T-statistics submenu).

6. In the following submenu, choose either “with data” or “with summary”. Note that the test statistic depends only on the sample mean, the sample size and the standard deviation (either of the sample or of the population). If you choose “with summary”, you’ll have to enter these values, instead of providing the entire sample.

7. If you chose “with data”, then you’ll have to select the column(s) that contain(s) the data in the next popup window. You can ignore the other text fields and click “Next”.

8. Choose “Hypothesis Test” (this is the default), enter the desired significance level and the null hypothesis, and choose the relation symbol in the alternative hypothesis.

9. If you wish, you can check the box “Store output in data table”.

10. Click “Compute!”.

Here is what you can work on today. When testing, always use significance level 0.05.

1. Test the claim that a proportion is 0.6, given a data sample of 40 successes among 100 trials, with the alternative hypothesis that the proportion is not 0.6.

2. Load data set 1 (Body measurements (Males)) into the StatCrunch table. Test the claim that the mean body temperature is less than 98.6 degrees.

3. Test the hypothesis that the mean female pulse rate is less than the mean male pulse rate, using two-sample t-statistics. Compare to the confidence intervals for these rates that you calculated last time.

Here is how you can set up the data:

(a) Load data set 1 (Body measurements (Males)) into the StatCrunch table. Mark all the entries of the PULSE column (except the name of the column). Click Edit, Copy.

(b) Load data set 1 (Body measurements (Females)) into the StatCrunch table. Using the Edit menu item, delete all columns except for the PULSE column. Rename that column to “PULSE Female”. Click the first field of the second column, then click Edit→Paste. The entries with the male pulse rates should now be in the second column. Label the second column “PULSE Male”.

Now perform the hypothesis test!
Computer Lab Project No. 9
Goodness-of-Fit, Contingency Tables, Linear Regression

Today’s topics are Goodness-of-Fit, Contingency Tables and Linear Regression. First, here are the general procedures for a **Goodness-of-Fit** analysis:

2. Put the observed frequencies in one column and the hypothesized frequencies in another, so that they line up.
3. Click on Stat→Goodness-of-Fit→Chi-Square test.
4. In the popup-window, put the observed frequencies column in the text field labeled “Observed”, and put the hypothesized/expected frequencies column in the field labeled “Expected”.
5. Click on the “Calculate” button on the bottom right.

**Contingency Tables:**

1. Enter the row labels in a column, then enter the frequencies in separate columns. So the row labels go in the spreadsheet body, unlike column headings.
2. Click on “Stat” in the menu bar.
3. Click on “Tables”, choose “Contingency”, and click the option “with summary”.
4. In the popup-window, under “Select column(s)”, select all columns containing observed frequencies (by ctrl-clicking them in turn), and then in the next box titled “Row labels:”, select the column with the row labels.
5. Make sure under “Hypothesis tests:”, the Chi-Square test for independence is chosen.
6. Click on the “Compute!” button on the bottom right.

Here are the projects concerning goodness of fit and contingency tables you can work on today:

1. Two dice are rolled repeatedly. The frequency distribution of the results are as follows.

Die 1:

<table>
<thead>
<tr>
<th>Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>20</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

Die 2:

<table>
<thead>
<tr>
<th>Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>13</td>
<td>12</td>
<td>8</td>
<td>12</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

For each die, test the hypothesis that it is fair.

2. Refer to your textbook for a discussion of the following data describing the fate of passengers and crew on the Titanic:

<table>
<thead>
<tr>
<th>Survived</th>
<th>Men</th>
<th>Women</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survived</td>
<td>332</td>
<td>318</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>Died</td>
<td>1360</td>
<td>104</td>
<td>35</td>
<td>18</td>
</tr>
</tbody>
</table>

Perform a test for independence between the categories of surviving/dying and passenger type.

Now let’s turn to Linear Regression. The general procedure, using StatCrunch, is as follows:

1. Load the (two-dimensional) data you want to analyze into the StatCrunch table.
2. Click on Stat→Regression, and select the option “Simple Linear”.

3. In the popup window, select the columns you want to analyze as X- and Y-variable.

4. Scroll down until you reach the “Graphs” field. If you want to see the data as a scatter plot, fitted with the regression line, then choose “Fitted line plot”.

5. Click the “Compute!” button on the bottom right. If you chose the graphics option, then you can go back and forth between the numerical linear regression results and the plot using the “Next>” and “<Back” buttons.

Here is what you can work on:

1. Load Data Set 7 into StatCrunch. This data set contains measurements of wild bears such as age, sex, headlength, weight, etc.

2. Use linear regression to analyze the relationship between the age of a bear and at least two of the measurements (other than month or sex). Make plots.

3. Compare with the results of your peers. Which measurement seems to be the most reliable/accurate indicator of the age of a wild bear?

4. If you have time, you can try to analyze the data for male and female wild bears separately. Does this improve the linear approximation? Are there outliers? Can you guess why? If you take away potential outliers, what is the best correlation coefficient you get?
Pearson’s MyLab & Mastering Student Registration Instructions

Go to www.pearsonmylabandmastering.com.

1. Under Register, select Student.
2. Confirm you have the information needed, then select OK! Register now.
3. Enter your instructor’s course ID and continue.
4. Enter your existing Pearson account username and password to Sign In. You have an account if you have used a Pearson product, for example: MyMathLab, MyITLab, MyPsychLab, MySpanishLab or Mastering, such as MasteringBiology. If you don’t have an account, select Create and complete the required fields.
5. Select an access option. Use the access code that came with your textbook or that you purchased separately from the bookstore. Buy access using a credit card or PayPal account. If available, get 14 days temporary access. (The link is near the bottom of the screen.)
6. From the confirmation page, select Go To My Courses.
7. On the My Courses page, select the course tile Test to start your work.

To sign in later:

2. Select Sign In.
3. Enter your Pearson account username and password, and Sign In.
4. Select the course tile to start your work.

To upgrade temporary access to full access:

2. Select Sign In.
3. Enter your Pearson account username and password, and Sign In.
4. Select Upgrade access from the course tile.
5. Enter an access code or purchase access with a credit card or PayPal account.

For a registration overview, go to www.pearsonmylabandmastering.com/students/get-registered. Scroll down to Need a little help? and select a video.
MTH 113: Introduction to Probability and Statistics with Computer Applications

Required Materials:

• *MyStatLab*, Access code for this course management system is packaged with the new textbook from the CSI bookstore or sold separately at [http://www.coursecompass.com](http://www.coursecompass.com). This also provides access to the *StatCrunch* software used in the computer labs.
• *Computer Laboratory Assignments*: The projects can be downloaded at [http://www.math.csi.cuny.edu/Courses/MTH113/](http://www.math.csi.cuny.edu/Courses/MTH113/).
• *TI 83 Plus or TI 84 Plus Calculator*. These two models have functions that do substantial amounts of calculation in exactly the manner needed for this class. The textbook contains purple boxes detailing how to use these models to do computations.

Computer Laboratory Classes:
Each semester has 14 laboratory hours scheduled. The dates will vary by section, as will the use of the Q&A periods, which your instructor may use for exam prep or homework help, or to give you extra time to complete the laboratory assignments.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Date</th>
<th>Topic</th>
<th>Completed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Q &amp; A (period for asking questions, getting caught up on, exam prep, etc)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Lab #1: Getting Started with StatCrunch</td>
<td></td>
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<tr>
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<td>Lab #2: Describing, Exploring and Comparing Data - Graphically</td>
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<td>Lab #3: Describing, Exploring and Comparing Data - Numerically</td>
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<td>Lab #4: Exploring Probabilities</td>
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<td>Lab #5: The Normal Distribution</td>
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<td>Lab #6: Confidence Intervals with known standard deviation</td>
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<td>Lab #7: Confidence Intervals with estimated standard deviation</td>
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<td>Lab #8: Hypothesis Testing</td>
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<td>Lab #9: Goodness-of-Fit, Contingency Tables, Linear Regression</td>
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