ARIZONA STATE UNIVERSITY

GENERAL STUDIES COURSE PROPOSAL COVER FORM

Course information:

*Copy and paste **current** course information from Class Search/Course Catalog.*

College/School	New College of Interdisciplinary Arts and Scien			Department	**School of Mathematics and Natural Sciences**		
Prefix	**STP**	Number	**280**	Title	Probability and Statistics for Researchers	Units:	3
Is this a cross-listed course?	No	If yes, please identify course(s)					
Is this a shared course?	No	If so, list all academic units offering this course					

*Note- For courses that are crosslisted and/or shared, a letter of support from the chair/director of **each** department that offers the course is required for **each** designation requested. By submitting this letter of support, the chair/director agrees to ensure that all faculty teaching the course are aware of the General Studies designation(s) and will teach the course in a manner that meets the criteria for each approved designation.*

Is this a permanent numbered course with topics? No

If yes, all topics under this permanent numbered course must be taught in a manner that meets the criteria for the approved designation(s). It is the responsibility of the chair/director to ensure that all faculty teaching the course are aware of the General Studies designation(s) and adhere to the above guidelines.

Chair/Director Initials _____ (Required)

Course description: **Methods for data summary, numerical summary measures, probability concepts, discrete and continuous probability distributions, expected values, statistics, sampling distributions, point estimation, and introduction to statistical inference for a single parameter.**

Requested designation: Mathematical Studies–CS

*Note- a **separate** proposal is required for each designation requested*

Eligibility:

Permanent numbered courses must have completed the university's review and approval process.
For the rules governing approval of omnibus courses, contact Phyllis.Lucie@asu.edu or Lauren.Leo@asu.edu.

Submission deadlines dates are as follow:

For Fall 2016 Effective Date: October 6, 2015

For Spring 2017 Effective Date: March 15, 2016

Area(s) proposed course will serve:

A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study.

Checklists for general studies designations:

Complete and attach the appropriate checklist

- Literacy and Critical Inquiry core courses (L)
- Mathematics core courses (MA)
- Computer/statistics/quantitative applications core courses (CS)
- Humanities, Arts and Design core courses (HU)
- Social-Behavioral Sciences core courses (SB)
- Natural Sciences core courses (SQ/SG)
- Cultural Diversity in the United States courses (C)
- Global Awareness courses (G)
- Historical Awareness courses (H)

A complete proposal should include:

- ☒ Signed course proposal cover form
- ☒ Criteria checklist for General Studies designation(s) being requested
- ☒ Course catalog description
- ☒ Sample syllabus for the course
- ☒ Copy of table of contents from the textbook and list of required readings/books

It is respectfully requested that proposals are submitted electronically with all files compiled into one PDF.

Contact information:

Name Jennifer Broatch E-mail jennifer.broatch@asu.edu Phone 602-543-5684

Department Chair/Director approval: *(Required)*

Chair/Director name (Typed): Roger Berger Date: 6/1/15

Chair/Director (Signature): Roger L Berger

Arizona State University Criteria Checklist for

MATHEMATICAL STUDIES [CS]

Rationale and Objectives

The **Mathematical Studies** requirement is intended to ensure that students have skill in basic mathematics, can use mathematical analysis in their chosen fields, and can understand how computers can make mathematical analysis more powerful and efficient. The **Mathematical Studies** requirement is completed by satisfying both the **Mathematics [MA]** requirement and the **Computer/Statistics/Quantitative Applications [CS]** requirement explained below.

The **Mathematics [MA]** requirement, which ensures the acquisition of essential skill in basic mathematics, requires the student to complete a course in College Mathematics, College Algebra, or Pre-calculus; or demonstrate a higher level of skill by completing a mathematics course for which a course in the above three categories is a prerequisite.

The **Computer/Statistics/Quantitative Applications [CS]** requirement, which ensures skill in real world problem solving and analysis, requires the student to complete a course that uses some combination of computers, statistics, and/or mathematics.* Computer usage is encouraged but not required in statistics and quantitative applications courses. At a minimum, such courses should include multiple demonstrations of how computers can be used to perform the analyses more efficiently.

*CS does *not* stand for computer science in this context; the "S" stands for statistics. Courses in computer science must meet the criteria stated for CS courses.

Revised April 2014

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[CS] CRITERIA

A COMPUTER/STATISTICS/QUANTITATIVE APPLICATIONS [CS] COURSE MUST SATISFY ONE OF THE FOLLOWING CRITERIA: 1, 2, OR 3

YES	NO		Identify Documentation Submitted
		1. Computer applications*: courses must satisfy both **a** and **b**:	
☒	☐	**a.** Course involves the use of computer programming languages or software programs for quantitative analysis, algorithmic design, modeling, simulation, animation, or statistics.	Syllabus, Detailed topic list from Course Supplement Document
		b. Course requires students to analyze and implement procedures that are applicable to at least one of the following problem domains **(check those applicable)**:	
☐	☐	i. Spreadsheet analysis, systems analysis and design, and decision support systems.	
☐	☐	ii. Graphic/artistic design using computers.	
☐	☐	iii. Music design using computer software.	
☐	☐	iv. Modeling, making extensive use of computer simulation.	
☒	☐	v. Statistics studies stressing the use of computer software.	Excerpt of in-class examples from course supplement provided in supporting document.
☐	☐	vi. Algorithmic design and computational thinking.	

***The **computer applications** requirement **cannot** be satisfied by a course, the content of which is restricted primarily to word processing or report preparation skills, the study of the social impact of computers, or methodologies to select software packages for specific applications. Courses that emphasize the use of a computer software package are acceptable only if students are required to understand, at an appropriate level, the theoretical principles embodied in the operation of the software and are required to construct, test, and implement procedures that use the software to accomplish tasks in the applicable problem domains. Courses that involve the learning of a computer programming language are acceptable only if they also include a substantial introduction to applications to one of the listed problem domains.

YES	NO		Identify Documentation Submitted
		2. Statistical applications: courses must satisfy **a**, **b,** and **c**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Pre-calculus**,** or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on developing knowledge in statistical inference and include coverage of all of the following:	
☐	☐	i. Design of a statistical study.	
☐	☐	ii. Summarization and interpretation of data.	
☐	☐	iii. Methods of sampling.	
☐	☐	iv. Standard probability models.	
☐	☐	v. Statistical estimation	
☐	☐	vi. Hypothesis testing.	
☐	☐	vii. Regression or correlation analysis.	
☐	☐	**c.** The course must include multiple demonstrations of how computers can be used to perform statistical analysis more efficiently, if use of computers to carry out the analysis is not required. .	

YES	NO		Identify Documentation Submitted
		3. Quantitative applications: courses must satisfy **a**, **b, and c:**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Pre-calculus**,** or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on the use of mathematical models in quantitative analysis and decision making. Examples of such models are:	
☐	☐	i. Linear programming.	
☐	☐	ii. Goal programming.	
☐	☐	iii. Integer programming.	
☐	☐	iv. Inventory models.	
☐	☐	v. Decision theory.	
☐	☐	vi. Simulation and Monte Carlo methods.	
☐	☐	vii. Other (explanation must be attached).	
☐	☐	**c.** The course must include multiple demonstrations of how computers can be used to perform the above applications more efficiently, if use of computers is not required by students.	

Course Prefix	Number	Title	General Studies Designation
STP	280	Probability and Statistics for Researchers	

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
1a	Course uses the open source statistical software R for quantitative analysis, simulation and statistics.	The use of statistical software to effectively complete a statistical analysis is included the in the course objective and learning outcomes (see course syllabus- included supporting documents). Every aspect of the course is taught using R. R requires the user to have some programming skills; however, in this course the syntax is provided so that the students can best utilize the software to more effectively analyze the problem rather than worry about knowing how to "code." Each chapter in the lecture notes' supplement includes a section on the R syntax. The included "Content List" details the topics as well as provides evidence that R is an integral part of the learning in the course. See the last section in each chapter, for example section 1.5, 2.6 etc… of the course lecture content list. Please note that the lecture content corresponds to the textbook, but includes complemetary material and the appropriate methods for software use.
1bv.	This course is an introduction to statistics that also introduces the students to the use of a statistical software package that can effectively analyze a variety of problems.	Every topic covered in the course utilizes statistical software to analyze the problem. This includes using R to: (1) effectively display data and summary statistics, (2) calculate the probabilities from a variety of probability distributions eliminating the need to read antiquated tables, (3) simulate multiple iterations to visualize the theoretical foundation of statistics, (4) calculate and perform basic statistical analyses. Explicit in-class examples are provided in the supporting documents.

STP280: Probability and Statistics Research, Fall 2015
SLN: 77428 MWF: 1:30-2:20 CLCC244

Instructor:	Dr. Jennifer Broatch
Office:	FAB N133
Office Hours:	10:00-11:30 M/W or by appointment
Office Phone:	602-543-5684 * Email is best
Email:	jennifer.broatch@asu.edu
Course Web Page:	Blackboard through my.asu.edu
Textbook:	Probability and Statistics for Engineering and the Sciences, 9th Edition, By: Jay L. Devore (REQUIRED) **Note- this is the required text for STP281 as well.
Prerequisites:	MAT 251, 265, or 270
Calculator :	Basic calculator (NO PHONES) for quizzes and exams. Graphing calculators are not necessary for this class.
Computing Software:	R/R Studio - Downloaded Free from `http://www.r-project.org/` and `http://www.rstudio.com/ide/download/` REQUIRED

Course Description:: Methods for data summary, numerical summary measures, probability concepts, discrete and continuous probability distributions, expected values, statistics, sampling distributions, point estimation, randomization tests and introduction to statistical inference for a single parameter.

Course Objectives:: By the end of this course, students will be able to summarize and critically evaluate information using appropriate statistical methods and software.

Learning Outcomes:: Students will:

- Use graphical displays and numerical measures to summarize data
- Identify various probability distributions and understand when their use is appropriate
- Construct appropriate confidence intervals for a single parameter
- Evaluate and apply hypothesis tests for a single parameter
- Interpret results of a statistical study
- Use statistical software to complete appropriate analysis

Academic Content:: This course will cover chapters 1-8 in the textbook. The remaining topics will be taught in STP281 using the same text. The instructor will provide a "course supplement" available on Blackboard. This extensive supplement is provides an overview of lecture content. This supplement is NOT a substitute for class. Many sections are left blank to be completed during class discussion.

Exams: There will be 2 exams given during the semester, plus a final exam. These exams will involve a mix of mechanical skills and conceptual reasoning. The best possible preparation for the exams is regular attendance and completion of assigned homework. A portion of the exams may be take-home. This will be discussed in class.

Homework & Projects

- Homework will be collected and graded throughout the course, typically weekly. Students are responsible for knowing the assignments. Changes to the assignments will be announced in class. Begin your homework early. **No** late homework will be accepted and all work is collected at the **beginning** of class. If you are late, so is your homework! If you are given prior approval, assignments can be scanned/emailed **prior** to class or placed in my mailbox in N111 during business hours 8:30 AM-4:30PM. You are responsible for the assignments left in the mailroom.

- A project may be assigned during the semester relating to relevant class material.

Attendance Policy & Quizzes: Because class attendance and course grade are positively related, the instructor expects students to attend all class sessions. (See `http://files.eric.ed.gov/fulltext/EJ854856.pdf` for supporting evidence.) Attendance is required and related attendance assessments are worth 10% of the overall grade in this course. Attendance includes participation in course activities, group work and student-instructor interaction. This participation is essential to build the foundation of statistics. On occasion, students may be justifiably absent from classes due to religious observances, illness documented by a physician or other appropriate health care professional, conflicts with university-sanctioned activities documented by an appropriate university administrator, public emergencies, and documented personal or family emergencies. The student is responsible for notifying the instructor in writing via email with as much advance notice as possible. Ultimately, the student is responsible for any content missed during the absence from class, regardless of why the student was absent.

Attendance "quizzes" will be given through the semester. These quizzes will be given (in class or take home) and will reflect content that has recently been discussed in class. To accommodate the occasional absence, **ONE** quiz score will be dropped. **No** makeup quizzes will be given. In addition to attendance quizzes, participation in class discussion and activities will be count as 1-2 quiz grades at the end of the semester. Participation grades will be given at the discretion of the instructor. Participation "quiz" grades will NOT be dropped.

Grades:

- Breakdown:
  20% Homework
  60% Midterms/Final
  10% Quizzes & Class Participation
  10% Reports

- Grading scale: Letter grades will be assigned as follows:

98-100	A+	87-89.99	B+	77-79.99	C+	60-69.99	D
93-97.99	A	83-86.99	B	70-76.99	C	< 60	E
90-92.99	A-	80-82.99	B-				

Important Dates: Calendar

Session C-Important Events:	Dates
Classes Begin:	August 20
Last Day to Register without College Approval:	August 26
Labor Day (no class) :	September 7
Tuition and Fees 100% Refund Deadline	TBD*
Fall Break (no classes):	October 10-13
Course withdrawal deadline*:	November 4
Veteran's Day (no class):	November 11
Thanksgiving (no class):	November 26-27
Complete Session Withdrawal*:	December 4
Last Day of Class:	December 4
Study Days (no class):	December 5-6
Final Exam:	December 7 at 12:10-2:00 AM

*See `https://students.asu.edu/academic-calendar#fall15` for changes/updates.

Withdrawals: The instructor will NOT withdraw students for any reason. Specifically, students should be aware that non-attendance will **NOT** automatically result in their being dropped from the course. Therefore, if a student does not attend class during the first week or for any extended period of time during the semester, they should not presume that they are no longer registered. It is the student's responsibility to be aware of their registration status.

Students are responsible for their registration status!

Any withdrawal transaction must be completed by the deadline date in accordance to the appropriate session at the registrar's office. If not, you will still be officially enrolled and you will receive a grade based on your work completed. *As part of a complete session withdrawal a student must withdraw from all classes in a session. Beginning the first day of classes, undergraduate students are required to work with a Student Retention Coordinator to facilitate the withdrawal process. Please refer to `http://students.asu.edu/StudentRetention`

For additional information about ASU's withdrawal policy and the possible consequences of withdrawing from a class, contact Registration Services or your academic counselor.Any withdrawal transaction must be completed by the deadline date in accordance to the appropriate session at the registrar's office. If not, you will still be officially enrolled and you will receive a grade based on your work completed.

Final Exam Make-up Policy: The final exam schedule listed in the Schedule of Classes will be strictly followed. Exceptions to the schedule and requests for make-up examinations can be granted only by the director of the School of Mathematical and Natural Sciences for one of the following reasons:

1. religious observances
2. the student has more than three exams scheduled on the same day
3. two finals are scheduled to occur at the same time

Make-up exams will NOT be given for reasons of non refundable airline tickets, vacation plans, work schedules, weddings, family reunions, or other such activities. Students should consult the final exam schedule before making end-of-semester travel plans.

If there is a last-minute personal or medical emergency, the student may receive a grade of Incomplete and makeup the final within one calendar month. The student must provide written documentation and be passing the class at the time to receive an Incomplete. A signed "Request for Grade of Incomplete" must be submitted by the student and approved by the student's instructor and the Director of the School of Mathematical and Natural Sciences.

Course/Instructor Evaluation: The course/instructor evaluation for this course will be conducted online 7-10 days before the last official day of classes of each semester or summer session. Your response(s) to the course/instructor are anonymous and will not be returned to your instructor until after grades have been submitted. The use of a course/instructor evaluation is an important process that allows our college to (1) help faculty improve their instruction, (2) help administrators evaluate instructional quality, (3) ensure high standards of teaching, and (4) ultimately improve instruction and student learning over time. Completion of the evaluation is not required for you to pass this class and will not affect your grade, but your cooperation and participation in this process is critical. About two weeks before the class finishes, watch for an e-mail with "NCIAS Course/Instructor Evaluation" in the subject heading. The email will be sent to your official ASU e-mail address.

Grade of Incomplete: A grade of incomplete will be awarded only in the event that a documented emergency or illness prevents a student who is doing acceptable work from completing a small percentage of the course requirements at the end of the semester. The guidelines in the current general ASU catalog regarding a grade of incomplete will be strictly followed. A grade of incomplete will NOT be awarded unless there is documented evidence of extreme personal or immediate family hardship. Changes in work hours, child-care emergencies, or other similar personal problems will not be approved as reasons for awarding incompletes. The Director of the School of Mathematical and Natural Sciences must approve all incomplete grade requests.

Academic Integrity: Academic Integrity and Code of Conduct: As defined in the ASU Student Academic Integrity Policy: `http://provost.asu.edu/academicintegrity`.

Each student has an obligation to act with honesty and integrity, and to respect the rights of others in carrying out all academic assignments. A student may be found to have violated this obligation and to have engaged in academic dishonesty if during or in connection with any academic evaluation, he or she:

- Engages in any form of academic deceit;
- Refers to materials or sources or employs devices (e.g., audio recorders, crib sheets, calculators, solution manuals, or commercial research services) not authorized by the instructor for use during the academic evaluation;
- Possesses, buys, sells, obtains, or uses, without appropriate authorization, a copy of any materials intended to be used for academic evaluation in advance of its administration;
- Acts as a substitute for another person in any academic evaluation;

- Uses a substitute in any academic evaluation;
- Depends on the aid of others to the extent that the work is not representative of the student's abilities, knowing or having good reason to believe that this aid is not authorized by the instructor;
- Provides inappropriate aid to another person, knowing or having good reason to believe the aid is not authorized by the instructor;
- Engages in plagiarism;
- Permits his or her work to be submitted by another person without the instructor's authorization; or
- Attempts to influence or change any academic evaluation or record for reasons having no relevance to class achievement.

STP280 follows the ASU Academic Integrity Policy in the administration of all course examinations and assignments. Violations of the University Academic Integrity policy will not be ignored. Penalties include reduced or no credit for submitted work, a failing grade in the class, a note on your official transcript that shows you were punished for cheating, suspension, expulsion and revocation of already awarded degrees. The university requires that the implementation of any of these penalties for violations of the academic integrity policy be reported to the Dean's office. The Integrity Policy defines the process to be used if the student wishes to appeal this action.

In STP280 you are expected to follow the ASU Student Code of Conduct (`http://students.asu.edu/srr/code`) especially when communicating with your peers, instructors, and teaching assistants. Violations of the student code of conduct may result in withdrawal from the class.

Reasonable Accommodations for Students with Disabilities The Disability Resource Center (DRC) provides information and services to students with any documented disability who are attending ASU West. Individualized program strategies and recommendations are available for each student as well as current information regarding community resources. Students also may have access to specialized equipment and supportive services and should contact the instructor for accommodations that are necessary for course completion. You may contact Disability Service for Students at 602.543.8145 or Email at: `drcwest@asu.edu`. All efforts will be made to ensure that you have equal opportunity to succeed in this course.

Classroom Etiquette : The use of cell phones during class time is not permitted. If you must use your cell phone, you should leave class for the day. It is expected that students not work on material not pertaining to the current lecture (i.e. homework from ANY class) during class time. Any student using the classroom computers for work outside that of the class during class time will be asked to leave. As always, please be considerate of the other students in class.

Policy against Threatening Behavior: In the classroom and out students are required to conduct themselves in a manner that promotes an environment that is safe and conducive to

learning and conducting other university-related business. All incidents and allegations of violent or threatening conduct by an ASU student will be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. Such incidents will be dealt with in accordance with the policies and procedures described in Section 104-02 of the Student Services Manual (`http://www.asu.edu/aad/manuals/ssm/ssm104-02.html`).

Power Outage: In the event of a campus power outage or other event affecting the ability of the University to deliver classes, any decision to cancel classes will be announced using the ASU emergency notification system. For this reason, it is imperative that students register with the ASU emergency notification system at: `https://cfo.asu.edu/emergency-alert`. In cases in which a limited number of buildings are affected, students should check the university website and/or call the School office at (602) 543-6050.

Emergency Evacuation Plan: Students should be aware of the evacuation route posted on the exit door of each classroom. Students who cannot walk down stairs should notify the instructor as early in the course as possible so the instructor can provide information regarding the location of the designated meeting area on each upper floor of the building (marked with a blue sign that states Emergency Evacuation Response Area).

Copyrighted Material: All course content, including lectures, are copyrighted material and students may not sell notes taken during the conduct of the course.

The instructor reserves the right to make changes to this syllabus as needed.

If you find it necessary to leave a note for me, please contact the administrative reception desk of the School of Mathematical and Natural Sciences located at FAB North Level 1 room N101-1.

STP280 Textbook: COVERAGE Chapters 1-8
Probability and Statistics for Engineering and the Sciences, 9th Edition
By: Jay L. Devore **California Polytechnic State University, San Luis Obispo**

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1.5 R Chapter 1 Supplement:

We will be using R computing software to analyze datasets in class and for the homework. R is open source and FREE! You will also use SAS.

1. **Download R:** This can be found at `http://www.r-project.org/`. This site provides links for downloads as well as documentation of manuals, FAQs and many other resources. Follow the "download R" link to select a CRAN mirror for download. I typically choose `http://cran.stat.ucla.edu/` but any mirror in the United States should suffice.

2. Browse the manuals available to familiarize yourself with the software.

3. **Download R Studio:** Although this package is not necessary to use R, this package provides a better user interface.

   Follow the steps to load the R Studio can be found here:
   `http://rstudio.org/download/desktop`

1.5.1 Data input in RStudio- EASY

Open the data file: gradedata.csv in R studio.

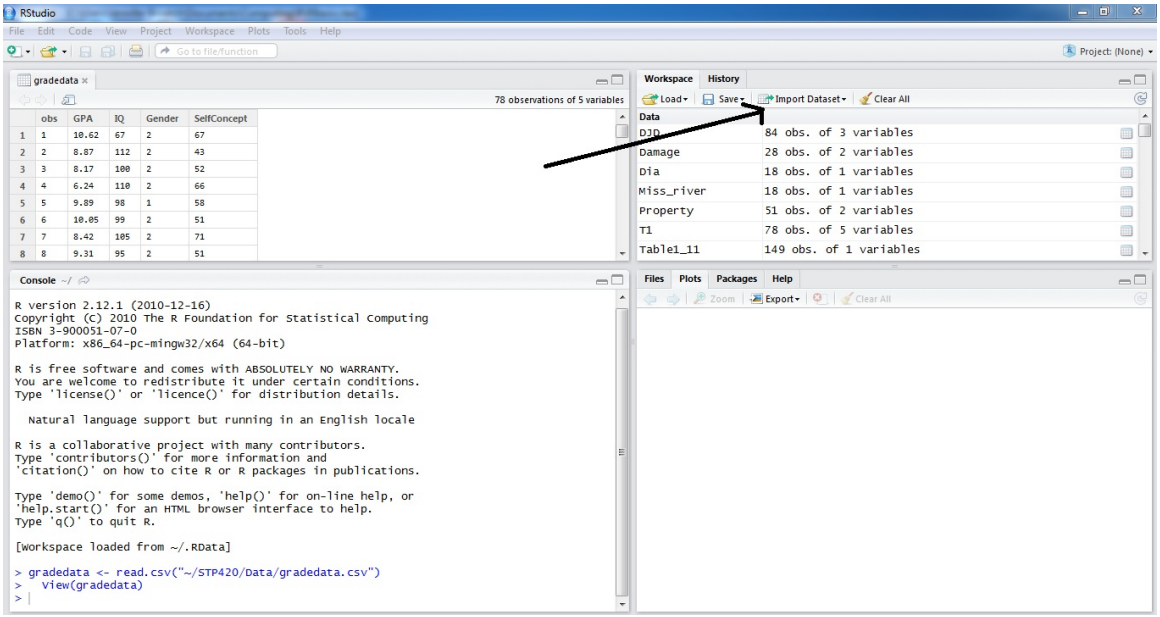


Figure 7: Download data sets!

1.5.2 Data input in R

1. Reading in a data set: Say for example you have a file of grades with 5 columns of data. The data for the first 3 students is found below:

ID	GPA	IQ	Gender	SelfConcept
1	7.940	111	2	67
2	8.292	107	2	43
3	4.643	100	2	52

We will need to load the data from your computer. Save the file as a .csv file (not the only file type!). Enter the following command after the prompt ">"

```
> grades=read.csv(file.choose())
```

- This saves the data in the file to "grades." To see the data simply type grades in command line.
- header=T : tells R that there is a header column in the data set.
- R is case sensitive!!
- Cut and paste commands only! Do not include an additional >.

Note the following:
To see the data set, simply type the name of the data set. R is case sensitive.

```
> grades
```

The result will look like the following: (the first 10 observations were included)

```
> grades
   ID    GPA  IQ Gender SelfConcept
1   1  7.940 111      2          67
2   2  8.292 107      2          43
3   3  4.643 100      2          52
4   4  7.470 107      2          66
5   5  8.882 114      1          58
```

The variable names for example "GPA" is located at the top of the column. To refer to a column in a data set you use "data set name $ variable name". For example, "grades$GPA" refers to the variable GPA in the dataset grades.

1.5.3 Basic plots, measures of central tendency, and variability

1. Create a Stem and Leaf Plot

```
> stem(gradedata$IQ)

  The decimal point is 1 digit(s) to the right of the |

   6 | 78
   7 | 014
   8 | 011133568
   9 | 12233344556667778889999
  10 | 00002344455555677889
  11 | 0011125568
  12 | 0122236888
  13 | 0
```

2. Create a dotplot.

```
> dotPlot(gradedata$IQ, xlab='IQ scores')
```

(a) Install the BHH2 package. *This only needs to be done once!

```
> library(BHH2)
Warning message:
package 'BHH2' was built under R version 2.12.2
```

**If it is the first time installing packages, you will be prompted to select a CRAN mirror. Scroll down and select a CRAN mirror close. (For example, UCLA.)

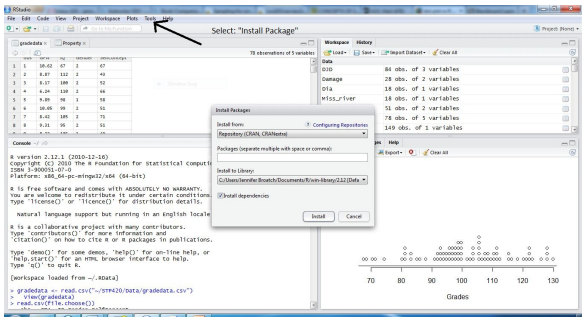


Figure 8: Select "Tools" → "Install Package"

(b) Create the dot plot and label axis.

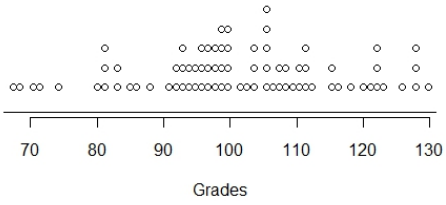


Figure 9: Dot plot for Grade data

3. Create a histogram using counts (frequency).

```
> hist(gradedata$IQ, xlab='IQ Scores', ylab='Frequency', main='Histogram of Grades')
> hist(gradedata$IQ, xlab='IQ Scores', ylab='Frequency',
  main='Histogram of Grades', nclass=14)
```

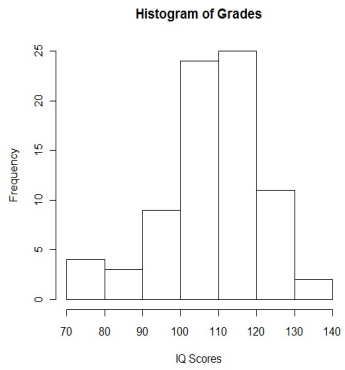


Figure 10: Default number of bins

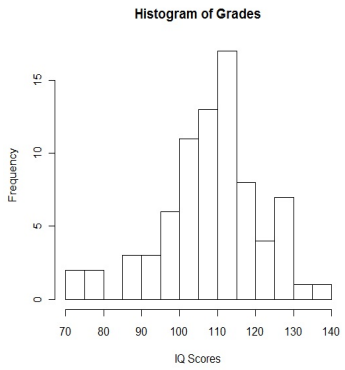


Figure 11: Changes the default

*Note: In R: "gradedata$IQ" indicates the variable IQ from the data table grades.

4. Create a histogram using percentages (Density!).
   The only change needed is to add the option: freq=FALSE. This tells R to use the percentage on the y-axis. It is labeled "density" (name discussed later). The total area under the bars is 1.

```
> hist(gradedata$IQ, xlab='IQ Scores', main='Histogram of Grades', freq=F)
```

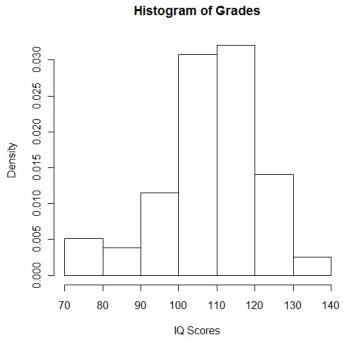


Figure 12: Density Histogram (area under the bars=1)

5. Find the basic summary statistics:

   (a) Mean:

```
> mean(gradedata$IQ)
[1] 101.0897
```

   (b) Median:

```
  > median(gradedata$IQ)
[1] 100
```

   (c) Standard deviation:

```
> sd(gradedata$IQ)
[1] 14.70417
```

(d) Variance:

```
> var(gradedata$IQ)
[1] 216.2126
```

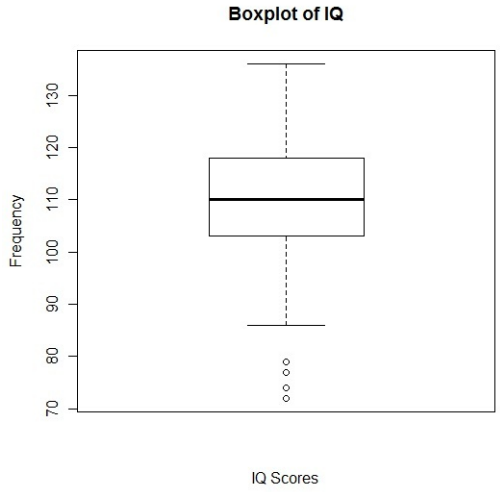
(e) Five number summary:

```
> fivenum(gradedata$IQ)
[1]  67  93 100 110 130
```

6. Create a boxplot for the variable IQ:

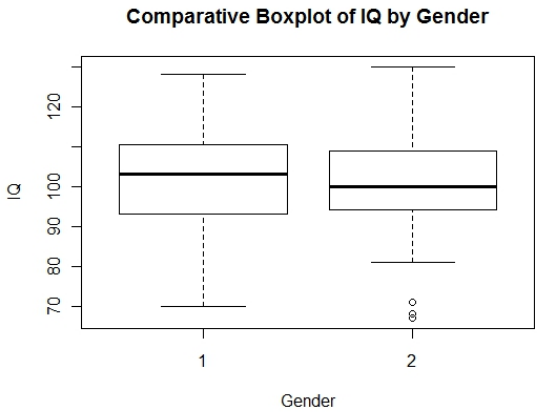
```
> boxplot(gradedata$IQ, xlab='IQ Scores', ylab='Frequency', main='Boxplot of IQ')
```

Output:



7. Create a comparative box plot.

```
>  boxplot(gradedata$IQ~gradedata$Gender, xlab='Gender', ylab='IQ',
          main='Comparative Boxplot of IQ by Gender')
```


Comparative Boxplot of IQ by Gender
IQ
70
80
90
100
120
1
2
Gender

3.7 R Chapter 3 Supplement:

1. Create a cumulative distribution function.

```
> x1=c(0,1,2,3)
> y1=c(0,1/8, 1/2,7/8, 1)
> sf1=stepfun(x1,y1)
> summary(sf1)
Step function with continuity 'f'= 0 ,  4 knots at
[1] 0 1 2 3
  and 5 plateau levels (y) at
[1] 0.000 0.125 0.500 0.875 1.000
> plot(sf1, verticals=F, main='Cummulative Distribution Function: Basketball')
```

2. Binomial Distribution:

   - In general, the command for a pmf for the binomial distribution, $P(X = x)$ is:

     `dbinom(x, n, p)`

     where, "d" calculates the density or pmf.

   - "pbinom" command finds the cdf, $P(X \leq x)$.
     pbinom(x,n,p)

3. Hypergeometric pmf/cdf:
   $P(X = x) = \text{dhyper}(x, M, N - M, n)$
   $P(X \leq x) = \text{phyper}(x, M, N - M, n)$

4. Negative binomial distribution pmf/cdf:
   pmf: $P(X = x) = \text{dnbinom(x,r,p)}$
   cdf: $P(X \leq x) = \text{pnbinom(x,r,p)}$

5. Poisson Distribution example:

   - Find $P(X = 5)$ given $X \sim \text{Poi}(\mu = 8)$: (Directly and using distribution)

```
> exp(-8)*8^5/factorial(5)
[1] 0.09160366
> dpois(5,8)
[1] 0.09160366
```

   - Find $P(X \geq 3)$ given $X \sim \text{Poi}(\mu = 8)$: (Using distribution)

```
 > 1 - ppois(2, 8)
[1] 0.986246
> 1  - dpois(0,8) -  dpois(1,8)- dpois(2,8)
[1] 0.986246
```

     where $P(X < 3) = P(X \leq 2) = \text{ppois}(2, 8)$.

5.6 R Chapter 5 Supplement:

1. CLT Exploration: Sampling from a Normal Distribution

```
normsims <- function(N,n,mu,sd){
  #N is the number of repetitions, n the sample size,
  #mu the mean, and sd the standard deviation for the population.
  results <- c()  # initialize results
  for (i in 1:N){
    results <- c(results, mean(rnorm(n,mu,sd)))}
  results}

par(mfrow=c(2,2))
samp1=normsims(N=1000,n=5,mu=0, sd=1)
hist(samp1, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=5",
      xlab='Sample Means')
samp2=normsims(N=1000,n=20,mu=0, sd=1)
hist(samp2, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=20",
     xlab='Sample Means')
samp3=normsims(N=1000,n=50,mu=0, sd=1)
hist(samp3, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=50",
     xlab='Sample Means')
samp4=normsims(N=1000,n=100,mu=0, sd=1)
hist(samp4, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=100",
     xlab='Sample Means')
```

2. CLT Explorations: Sampling from an Exponential Distribution

```
expsims <- function(N,n,lam){
  #N is the number of repetitions, n the sample size,
  #lam is the parameter
  results <- c()  # initialize results
  for (i in 1:N){
    results <- c(results, mean(rexp(n,lam)))}
  results}

par(mfrow=c(2,2))
samp1=expsims(N=1000,n=5,lam=3)
hist(samp1, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=5",
      xlab='Sample Means')
samp2=expsims(N=1000,n=20,lam=3)
hist(samp2, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=20",
     xlab='Sample Means')
samp3=expsims(N=1000,n=50,lam=3)
hist(samp3, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=50",
     xlab='Sample Means')
samp4=expsims(N=1000,n=100,lam=3)
hist(samp4, xlim=c(min(samp1), max(samp1)), main="Histogram Sample Means n=100",
      xlab='Sample Means')
```

```
Compare=c(mean(samp1),mean(samp2),mean(samp3),mean(samp4) )
Compare;
```