Graduate Student Handbook

Department of Statistical Science
Baylor University

2022-2023

Department Chair: Dr. James D. Stamey

Graduate Program Director: Dr. Jane L. Harvill

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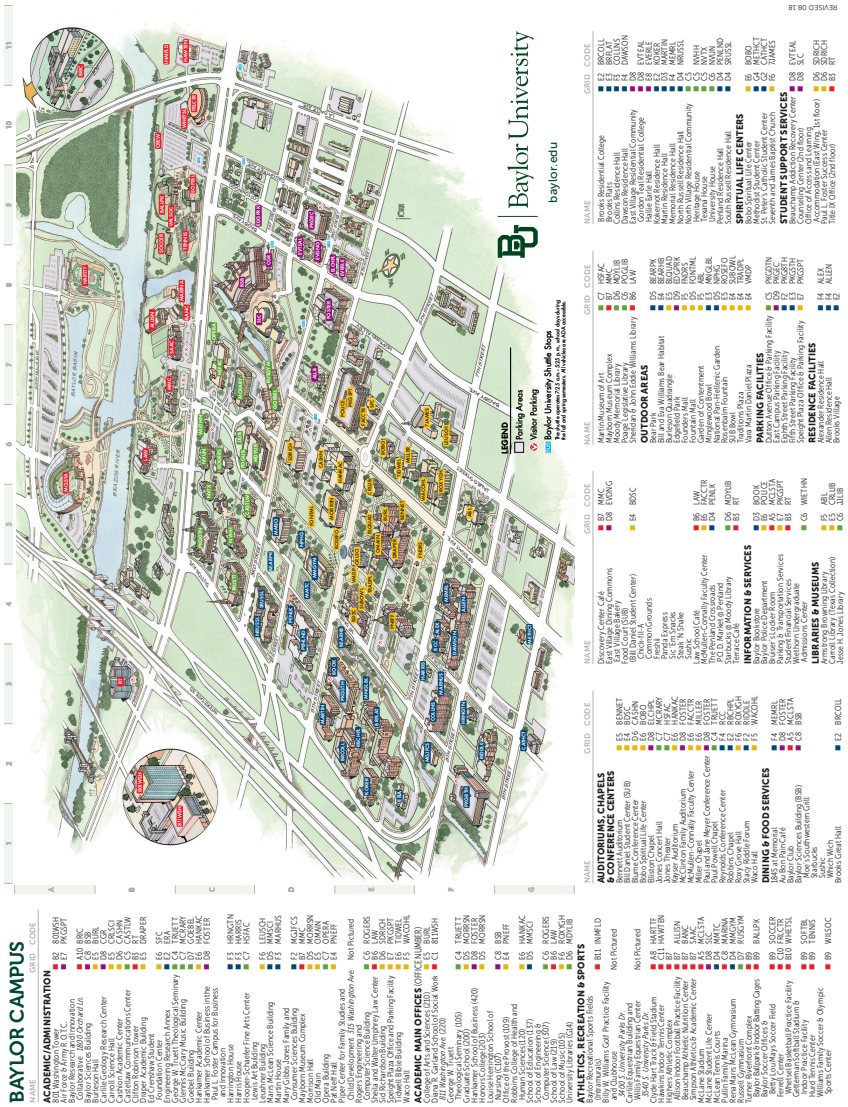

Figure 2: Campus Map.

For an interactive on-line campus map, visit the site `baylor.edu/map/index.php?id=86791`.

Table 1: Department Faculty & Staff Directory.

Name	**Number (254) 710-**	**e-mail @baylor.edu**	**Research Interests**
Dr. James D. Stamey Department Chair	7405	james_stamey	Bayesian analysis Pharmaceutical statistics
Dr. Jane L. Harvill Graduate Program Director	1517	jane_harvill	Time series vector nonlinear & spectral analysis
Dr. Jeanne S. Hill Undergraduate Program Director	4081	jeanne_hill	Statistical inference ranking and selection, reliability
Ms. Tammy Corntassel Office Manager	1699	tammy_corntassel	
Dr. Michael Gallaugher	4079	michael_gallaugher	Model-based clustering and classification, machine learning, multi-way data
Dr. Mandy Hering	1120	mandy_hering	Spatial and space-time modeling, multivariate cluster methods, outlier and anomaly detection
Dr. David Kahle	6102	david_kahle	Statistical computing and graphics, algebraic statistics, bayesian computation
Dr. Rakheon Kim	6174	rakheon_kim	Statistical learning, personalized regression, covariance estimation, biostatistics, actuarial science
Dr. Amy Maddox	6571	amy_maddox	Multivariate analylsis, Sampling, regression, and methodology
Dr. Joshua Patrick	1641	joshua_patrick	Time series analysis spatial data analysis nonparametric regression
Dr. John Seaman, Jr.	6181	john_seaman	Bayesian analysis Pharmaceutical statistics
Dr. Joon-Jin Song	6573	joon_song	Spatial statistics, functional data analysis, bioinformatics
Dr. Rodney Sturdivant	1663	rodney_sturdivant	Biostatistics, data analysis, modeling interdisciplinary research
Dr. Jack Tubbs	7601	jack_tubbs	Pattern recognition ranked data, interdisciplinary research
Dr. Dean Young	6183	dean_young	Mathematical statistics, computational statistics, multivariate analysis, pattern recognition
Dr. Dennis Johnston	Emeritus	dennis_johnston	Biostatistics

1 Introduction

On behalf of the Department of Statistical Science, welcome to Baylor University. We are happy you have chosen to pursue an advanced degree in statistics in our program. This handbook is designed to guide you and to summarize procedures and expectations throughout your graduate work. If you have any questions that are not answered by this handbook, do not hesitate to ask. Our department prides itself on its openness and on the relationships among the faculty and students. We wish you the best of luck during your time at Baylor and beyond!

2 About Baylor

Baylor University has a long, rich history and many fun and inspiring traditions. In 1845, before Texas was a state, Baylor was chartered by the last Congress of the Republic of Texas. Baylor is the oldest continuously operating university in the State of Texas, and is one of the first educational institutions established west of the Mississippi River. Baylor is a private Christian university. Its 1000-acre campus is the largest Baptist university campus in the world. The university currently has twelve degree-granting academic units. Three of these are as designated as colleges, and the others are designated as schools. The Department of Statistical Science is housed in the College of Arts & Sciences. With 25 academic departments, the College of Arts & Sciences is the largest academic unit at Baylor.

2.1 Baylor Traditions

Since the university was founded, many traditions have established. Some are annual, others are symbolized in memorials. In November, 1909 the nation's first homecoming celebration was celebrated at Baylor. The event began as a way to reconnect alumni with current students. It has grown to include the football game, a bonfire, concerts, speeches, receptions, class reunions, pep rallies, and the nation's oldest and longest collegiate parade. In 2012, the Smithsonian declared the Baylor Homecoming event likely to be the first in the nation.

In 1914, the student body elected the American black bear as the university mascot. Three years later, the 10th Engineers, a U.S. Army troop stationed in Waco, gave Baylor its first live bear. Currently the University has two American black bears – sisters Joy and Lady – on campus in a natural habitat enclosure. Dr. Pepper was a main university sponsor, and until the mid-1990s the Baylor bears had a Dr. Pepper often. However, when it was learned the sugar was bad for their teeth, they were not allowed to drink Dr. Pepper any more. The bears were actually in attendance at Baylor football games and on leashes at other campus events. However, in 2010, the USDA informed Baylor they could no longer bring the animals to the games due to safety concerns for the animals and the general public. In May of 2021, the Bill and Eva Williams Bear Habitat at Baylor University announced its approval for accreditation by the Association of Zoos and Aquariums (AZA), the independent international accrediting organization for the best zoos and aquariums. Baylor became the

first university in the world to receive this designation and only one of two in the nation with AZA-accredited zoos on a higher education campus.

On January 22, 1927, a bus carrying the Baylor basketball team collided with the Sunshine Special train in Round Rock, Texas. Ten members of the traveling party were killed and many others were injured in the accident. Associated with the Immortal Ten is the phrase, "For they are the we of us." The story of the Immortal Ten is told each year at Freshman Mass Meeting, where the names of the ten are called out. In 1996, the senior class provided initial funding to create an Immortal Ten statue on campus. Fund raising and planning for the statue continued over the ensuing years. Finally, on June 22, 2007, the statue sculpted by Bruce R. Greene was unveiled. The Immortal Ten memorial was officially dedicated during Homecoming on November 2, 2007 in Traditions Square. The terrible accident prompted Texas politicians to re-examine railway safety. Eight years after the accident, the state's first railroad overpass, Mays Street Bridge, was built over the tracks at Round Rock. In the meantime, many highways were relocated to eliminate railway crossings around the state.

Another Baylor tradition that started in 1953 is Dr. Pepper Hour. Since 1953, students, faculty, and staff come together every Tuesday from 3:00 PM - 4:00 PM in the Barfield Drawing Room for Dr. Pepper floats. Why Dr. Pepper? Well, in 1885, one year before Coke came out of Atlanta, Dr. Pepper was formulated in Morrison's Old Corner Drug Store in Waco, TX! Dr. Pepper is the official soft drink of Baylor University. Interestingly enough, in 1953, the weekly event was called "Coke Hour." Dr. Pepper didn't become the official university soft drink until 1997, when the event received the name it is known by today.

The university's Alma mater is "That Good Old Baylor Line," sung to the tune of "In the Good Old Summer Time." The original humorous lyrics, which has the opposing team wanting to be at home in turpentine, were written in 1906 by a Baylor student. Then in 1931, Mrs. Enid Markham, the wife of a Baylor music professor, did not feel the lyrics were dignified enough for an Alma mater. And so she rewrote the song, resulting in the song's lyrics. In 1948, an original music arrangement was written by Donald I. Moore. And that is the how the Baylor Alma mater came to be the version we know today. The lyrics are

That good old Baylor Line,
That good old Baylor Line.
We'll march forever down the years
as long as stars shall shine.
We'll fling our green and gold afar
to light the ways of time,
And guide us as we onward go,
That good old Baylor Line.
(Sic 'em, Bears!)

There are many more Baylor traditions that aren't included here, like Christmas on 5th Street, or Diadeloso. You can read more about them all online at
`https://www.baylor.edu/about/index.php?id=88779`.

2.2 Bus Information

Baylor University provides a free shuttle bus with a fixed route. Routes for 2021-2022 will be published online in August 2021. The buses run Monday through Friday between 7:25 A.M. and 5:25 P.M. when classes are in session. There is also an after-hours bus route that operates Monday through Thursday between 6:30 P.M. and 12:30 A.M. The Baylor Shuttle also provides a live GPS so that you can know where the bus is at all times. You can download the app for your iPhone or Android and view detailed bus information at `baylor.edu/dps/index.php?id=973233`.

The city of Waco also has a bus system. Although it is not free, they do provide student discounts. More information on the Waco Transit can be found at `waco-texas.com/transit`.

3 About the Department

The mission of the Department of Statistical Science is to provide quality statistics instruction at all levels, to make significant contributions to the discovery and dissemination of statistical knowledge, and to develop, within a Christian environment, ethical scholars, skilled professionals, and educated leaders who are sensitive to the needs of society.

3.1 History of the Department

In 1991, Dr. Thomas Bratcher founded the Institute of Statistics. Dr. Bratcher was the Director of the Institute until 2004, when it became the Department of Statistical Science, housed in the College of Arts & Sciences. Dr. Jack Tubbs became chair of the Department and remained so until 2018. In either the Institute, or the Department, our Baylor graduates have been earning a Doctorate of Philosophy (Ph.D.) and Master of Arts (M.A.), and now Master of Science (M.S.), in statistics since 1991. As of 2019, the program has produced over 90 doctoral students. In 2012, Dr. James Stamey succeeded Dr. Bratcher as Graduate Program Director in 2012. In 2018 Dr. James Stamey became Chair of the Department, and Dr. Jane L. Harvill became the Graduate Program Director. In 2006, our department established an undergraduate program. Dr. Jeanne Hill has served as the Undergraduate Program Director since the program's establishment.

In 2020, two concentrations were added to the Ph.D. The concentration in biostatistics allows students to focus on specific areas related to the analysis of data related to pharma, clinical trials, and other medical applications of statistics. The concentration in data science allows students to focus on specific areas in statistics in data science. More information on both concentrations is in Section 5.

Also in 2020, a new professional masters degree was added to the Department's graduate programs. This degree is considered a terminal degree. In other words, while successful completion of this program will prepare a student to work in business or industry, it is not sufficient to prepare them for a Ph.D. in statistics. More information about this program can be found in Section 7.

3.2 Social Media

The Department of Statistical Science has social media pages on Facebook, Twitter, and Instagram. On Facebook, be sure to like us at `BUStatistics`, follow us on Twitter `@BUStatistics`, and follow us on Instagram `@statisticalscience`.

4 Applying to a Graduate Program, Admission, and Funding

The information in this section is primarily to outline the application procedure for a graduate degree in statistics. More specific information about the application process can be found online at `https://www.baylor.edu/statistics/index.php?id=941990`, and the links contained on that page.

The Department has three graduate programs of study: the Doctorate of Philosophy (Ph.D.), the Master of Science (M.S.), and a professional M.S. in Statistics. Each of these programs are described in more detail below. The Ph.D. program is the main program in the department, and is ideal for those seeking challenging opportunities in industrial, corporate, government, or academic settings. In addition to course work, students may participate in a variety of stipend-supported practicum experiences. The Department offers tuition remission and a graduate teaching assistantship only for those students accepted into the Ph.D. program. To be considered for admission into the program, an applicant must have extremely competitive GRE scores, and be highly proficient in linear algebra and multivariable calculus.

The M.S. in Statistics described in Section 6 is a rigorous masters program which prepares student for jobs in corporate, governmental, and industrial settings, as well as preparing students to continue for the Ph.D. This degree is typically earned by Ph.D. applicants as they pursue their Ph.D., without any loss of time towards obtaining the Ph.D. The Department rarely accepts applicants for this program.

The professional M.S. in Statistics, described in Section 7 is a terminal degree. Like the more traditional M.S., students will be prepared for jobs in a variety of settings. However, this M.S. is considered a terminal degree since upon completion, students will not be sufficiently prepared to pursue a Ph.D. in Statistics. This degree is also the terminal point of the 4+1 B.S./M.S. in Statistics. For more information on the 4+1 program, contact Dr. Jeanne S. Hill.

5 Program of Study: Doctorate of Philosophy (Ph.D.)

The intent of the doctoral program in statistics is to develop our students into excellent statisticians who have the unique expertise to enter positions in industry, government, or academia. The program involves rigorous course work and an original research experience culminating in an approved dissertation. It is expected that the doctoral graduate will be

properly equipped with the knowledge and training needed to independently (1) conduct interdisciplinary research by determining or developing and applying appropriate statistical methods and effectively communicating the methods and findings verbally and in writing, (2) conduct research in the science of statistics, and (3) to teach introductory statistics and advanced topics in their area of specialty.

Students must complete 75 semester hours that include 27 hours of a set of required courses. These courses are referred to as the "Ph.D. Statistics Core." Also required are three hours of a consulting-teaching practicum (STA 5V85), 36 hours of elective courses, and nine hours of dissertation work (STA 6V99). Once a student is eligible to register for dissertation hours, one hour of dissertation credit is considered a a full-time course load. The number of dissertation hours is less than many other graduate programs in statistics. But it allows us to have the same requirements academically, while at the same time reduces our students' financial burden. There is no foreign language requirement.

5.1 Ph.D. Statistics Core

Classes in the Ph.D. Statistics Core are as follows.

- STA 5353 Theory of Statistics II (Spring of first year)
- STA 5380 Methods in Statistics I (Fall of first year)
- STA 5381 Methods in Statistics II (Spring of first year)
- STA 6375 Computational Statistics I (Fall of first year)
- STA 5383 Introduction to Multivariate Analysis (Summer of first year)
- STA 5362 Time Series Analysis (Fall of second year)
- STA 6351 Large Sample Theory (Second or third year)
- STA 6352 Bayesian Theory (Second year)
- STA 6382 Theory of Linear Models (Second or third year)

Course descriptions and prerequisites can be found in Section 11.4 or online at `https://www.baylor.edu/statistics/index.php?id=941989`.

A sample program map for the first two years of study is provided in Figure 5.1[1]. Ph.D. Statistics Core courses are in red. The map in the table is only an example. A full-time load of graduate level courses is typically considered to be nine hours. Terms in the map below that do not specify a full-time course load are those terms where students are able to take elective hours to fulfill the elective hours requirements. Some courses listed in the program map are prerequisites for courses following it. For example STA 5352 is a

Map through Traditional M.S./Ph.D. Program		
Summer 1	**Fall 1**	**Spring 1**
STA 5351	STA 5352 STA 5380 STA 6375 STA 5V85 (1 hour)	STA 5353 STA 5381 STA 6376 STA 5V85 (1 hour)
Summer 2	**Fall 2**	**Spring 2**
STA 5383 STA 5385	STA 5362 STA 6360 STA 6351* STA 5V85 (1 hour)	STA 5377 STA 6352 Elective hours
Summer 3	**Fall 3**	**Spring 3**
STA 6384	STA 6382* STA 5363*/STA 5364*	STA 6380*/STA 5365* STA 6V99 (2 or 3 hours)
Summer 4	**Fall 4**	**Spring 4**
STA 6V99 (2 or 3 hours)	STA 6V99 (2 or 3 hours)	STA 6V99 (2 or 3 hours)

For the M.S., students must complete 36 hours: 15 core curriculum hours, three hours of practicum, and 21 elective hours.
For the Ph.D., students must complete 75 hours: 27 core curriculum hours, three hours of practicum, 36 elective hours, and at least nine hours of STA 6V99.

- Courses in red are core curriculum courses.
- Courses in blue can be used toward the Concentration in Data Science. STA 6353 also can be used.
- Courses in goldenrod can be used toward the Concentration in Biostatistics. Other courses are STA 5367, STA 6384, STA 6366.
- Except for STA 6V99 and STA 5V85, courses not in red can be used for elective hours.
- * - course offered every other year
- One dissertation hour is considered a full-time equivalent. Students can register for as many as four dissertation hours in one semester, if needed, to fulfill graduation requirements.
- At the end of Fall 2, with successful completion of M.S. Oral Exam, students will have earned the traditional M.S. in Statistics.

Courses offered only during even numbered years (in Fall or Spring, as indicated in the table): STA 6351, STA 5364, STA 5363
Courses offered only during odd numbered years (in Fall or Spring, as indicated in the table): STA 6382, STA 5363, STA 6380

*-Courses not listed above: STA 5387, STA 6353, STA 6383

Course descriptions can be found online at https://www.baylor.edu/statistics/index.php?id=941989.

Figure 3: Traditional M.S. and Ph.D. Program Map.

prerequisite for STA 5353. STA 5352 may be used as three hours of credit toward completing the 36 elective course requirement.

Some students may chose to focus their studies and receive recognition through a concentrations. Declaring and working toward completion of a concentration is not a program requirement. Rather the concentration is a formal way to acknowledge a student's focus in a particular area of statistics. The Department offers two concentrations. A concentration cannot be earned if the student does not successfully complete the Ph.D. in Statistics. In other words, students in the Ph.D. program must complete the Ph.D. in Statistics and the appropriate hours for a concentration to be awarded a concentration.

[1] As of the writing of this Handbook, the program map provided has not been finalized.

5.2 Concentration in Biostatistics

The concentration in Biostatistics for the Ph.D. in Statistics allows recognition for those students whose study focused on specific areas in statistics related to the analysis of data related to pharma, clinical trials, and other medical applications of statistics. Students will earn a concentration in Biostatistics by successfully completing of any of the four following courses (12 hours of credit).

- STA 5364 Survival and Reliability Theory
- STA 5365 Design of Experiments and Clinical Trials
- STA 5367 Managerial Epidemiology (cross-listed as HPA 5367)
- STA 5377 Spatial Statistics
- STA 6366 Statistical Bioinformatics
- STA 6384 Analysis of Categorical Data

5.3 Concentration in Data Science

The concentration in Data Science for the Ph.D. in Statistics allows recognition for those students whose study focused on specific areas in statistics related to data science. Students will earn a concentration in Data Science by successfully completing of any of the four following courses (12 hours of credit).

- STA 5363 Advanced Data-Driven Methods
- STA 6376 Computational Statistics II
- STA 6380 Modern Trends in Data Science and Computing
- Other courses outside the Department, if specific approval has been granted by the Graduate Program Director (Dr. Harvill) and the course instructor. Examples of such courses include, but are not limited to CSI 5325 Introduction to Machine Learning, ECL 5396 Deep Learning, or ECO 5352 Data Science II.

5.4 Program Evaluation

In addition to class exams, homework, and projects, etc., there are three program evaluations that a student must successfully complete to earn the Ph.D. Two of the three are really one extended evaluation known as "preliminary exams." The other is the dissertation defense.

1. **Preliminary Exams.** Preliminary exams have two portions. When a student successfully completes both phases of the preliminary exams, they are "admitted to candidacy."

(a) *Written Exams.* The written preliminary exams are taken in August, at the end of the first year of study, usually during the week before Fall classes begin. The exams cover content in the methods, theory, and computational sequences of study. The written portion exams are typically on Tuesday and/or Thursday. Each day consists of a three-hour morning and three-hour afternoon session. Some portions of the exams may be take home exams. On all parts of the exam, students are held to the honor system. Reasonable evidence that a student went against the guidelines provided can result in expulsion from the program.

(b) *Preliminary Project Presentation (PPP).* Students who successfully complete the written portion of the preliminary exam will then work with the Graduate Program Advisor to find a faculty advisor (in the Department) to begin work in the Preliminary Project Presentation (PPP). The PPP is designed to demonstrate that a graduate student can conduct individual research. Work on the PPP with the advisor includes identifying a problem of interest to the student and advisor, working on that project until the advisor feels sufficient progress has been made. When the advisor indicates to the student that progress is sufficient, the student will present their work to the Department. It is often that the PPP will become part of the dissertation. Students are also strongly encouraged to work with their advisor to submit the results of their PPP to a statistics journal for publication, if the advisor believes the work is publishable. From start to finish, the PPP typically requires twelve to eighteen months.

Prior to successful completion of the Preliminary Exams and the PPP students in the Ph.D. program are simply referred to as a "Ph.D. student." Upon successful completion of the Preliminary Exam and the PPP, Ph.D. students are then "admitted to candidacy" and become "Ph.D. candidates."

2. **Dissertation Defense.** Once a student has been admitted to candidacy and is thus a Ph.D. candidate, the student can register for dissertation hours (STA 6V99) with their advisor. To earn the Ph.D., a student must successfully complete nine dissertation hours. Note that one dissertation hour is considered full-time for all students, and is referred to as a "full-time equivalency" course. This is especially important for international students. All students, including international students who are registered for one dissertation hour are considered full-time students. In cooperation with the student's dissertation advisor, the student will complete a research project. When the advisor feels the student has successfully completed the project, the student will present the work to the departmental faculty in a dissertation defense.

5.5 Scheduling the PPP and the Defense

Students may **not** schedule the PPP or the defense without the advisor's direction and consent. The PPP and dissertation are academic, research entities unlike any course. It is impossible to say a student will finish their PPP in 12 months, or that they will finish their

dissertation in 18 months. The completion of these two components is entirely dependent upon the amount of time and work a student puts into them. When the PPP begins, your advisor will schedule regular meetings with you to check on your progress, and help you continue so that you will complete the work, if you do what is required of you. When the work is finished, your advisor will communicate that to you. The same is true for your dissertation. As you progress, you will become more and more aware of what "complete" means in this context, which is unique for each student and each research topic. Our faculty is committed to clear communication and mentoring students through their research. When it is time to schedule the PPP or the defense, your advisor will instruct you to contact Dr. Harvill.

5.6 Grounds for Academic Dismissal or Dismissal Due to Inappropriate Conduct

If a graduate student is not making adequate progress towards his or her degree, the student may be dismissed from the program, according to the guidelines in the *Graduate Catalog*. Examples of such issues include a student's GPA falling below a 3.0 (on a 4.0 scale) or breaking the Baylor Student Conduct Code. Both the *Graduate Catalog* and Baylor Student Conduct Code can be found online.

- The *Graduate Catalog* may be found online at

  `https://www.baylor.edu/graduate/index.php?id=959244`.

- The Baylor Student Conduct Code, along with other student policies and procedures may be found online at

  `https://www.baylor.edu/student_policies/index.php?id=953888`.

Students who are working on their dissertation can also be dismissed if it is determined they are not making sufficient progress towards completion. Dissertation progress is reflected in the grade received from the dissertation advisor each semester.

- **Incomplete grade.** A grade of "I" (incomplete) means that the dissertation is incomplete, but that the student did making satisfactory progress that semester.

- **No credit grades.** A grade of "NCE," (no credit earned) "NCNA," (no credit never attended) or "NCSA" (no credit stopped attending) or "NC" (no credit) means that the student did not make satisfactory progress toward completion.

If a student earns any of the no credit grades on their dissertation at the end of a semester, that student will be on departmental probation for the following semester. The student should have a meeting with his or her dissertation advisor to determine what must be accomplished to any of the no credit grades in following semesters. After the first no credit grade, a second no credit grade (of any type) will result in dismissal from the program.

6 Program of Study: Master of Science in Statistics

The Department's primary graduate degree is the Doctorate of Philosophy in Statistics, and we admit students and fund them with the expectation that they will complete the Ph.D. After two years in that program, students may choose to earn a Master of Science (M.S.) in Statistics. To earn this degree, students must complete 36 semester hours including an M.S. statistics core of 12 hours, three hours of the consulting-teaching practicum, and 21 semester hours of elective courses. There is no foreign language requirement.

6.1 M.S. Statistics Core

Classes in the M.S. Statistics Core are as follows. Descriptions of these, and other courses can be found in Section 11.4 or online at
`https://www.baylor.edu/statistics/index.php?id=941989`.

- STA 5353 Theory of Statistics II
- STA 5380 Methods in Statistics I
- STA 5381 Methods in Statistics II
- STA 5383 Introduction to Multivariate Analysis

The three-hours of statistics practicum (STA 5V85) are distributed one-hour per regular semester through the course of study. Elective courses may include any approved statistics course, or approved courses in mathematics (MTH), computer science (CSI), economics (ECO), quantitative business analysis (QBA), information systems (MIS), biology (BIO), or psychology (PSY).

6.2 Program Evaluation

In addition to class exams, homework, projects, etc., students who desire to earn the M.S. in Statistics as they work toward their Ph.D. must take and pass an oral examination at the end of their second year. The exam is administered by at least three faculty members from the Department of Statistical Science and one faculty member from outside the Department. Options for a faculty member outside the Department can be discussed with your faculty advisor (for the PPP). If you do not have a PPP advisor, you can discuss this option with Dr. Harvill.

7 Program of Study: Master of Science in Statistics (Professional Masters)

In the Fall, 2020 the Department introduced a new M.S. in Statistics that is more geared toward those students who are interested in a terminal masters degree. This degree will

allow students to graduate with an M.S. in Statistics, and to proceed on to employment in corporate, government, industrial careers. However, the level of mathematical rigor is not sufficient to provide a path that will allow the student to proceed towards the Ph.D. in Statistics (which is why the Profession M.S. is called a "terminal degree"). Students were be admitted into this program for the first time in Spring, 2021. Students may apply for this degree upon completion of an undergraduate degree (B.A. or B.S.) in an appropriate field that includes calculus, at least one course in introductory statistical methods, and at least one course in computing. Students may also enter the program through the $4 + 1$ B.S./M.S. in statistics program. For more information about the $4 + 1$ program, contact Dr. Jeanne S. Hill. Students who are accepted into this program will receive no tuition remission and will not be offered any stipend.

The emphasis of the professional masters is in statistical computing and modeling with electives designed to meet individual student goals. The degree requires 36 hours of approved graduate courses, including 15 hours of STA courses, including a capstone project, and 21 hours of approved graduate electives from statistics, mathematics, economics, and management information systems. (Students enrolled in the $4 + 1$ B.S./M.S. will complete a total of 151 hours.)

7.1 Professional M.S. in Statistics Core

Classes in the professional M.S. in Statistics Core are

- STA 5300 Statistical Methods
- STA 5303 Applied Regression Analysis
- STA 5310 Statistical Computing for Data Science
- STA 5384 Multivariate Statistical Methods

In addition to these core statistics courses, students must also complete three hours of a statistics practicum STA 5V85, distributed for three semester, one hour per semester. Finally, students are required to complete STA 5V90 Capstone in Data Analytics. To complete the required 36 hours, the remaining hours are completed using approved graduate electives. A list of courses for this program can be found in Section 11.3 or online at `https://www.baylor.edu/statistics/index.php?id=962029`.

7.2 Program Evaluation

In addition to homework, exams, projects, etc. in the classes, STA 5V90 Capstone in Data Analytics culminates in a project that will allow students to apply their acquired skills in data visualization, data organization, probability, statistical inference, modeling, and prediction to a real-world problem and will be conducted with industry, government, and academic partners.

8 Graduate Assistantships

Graduate assistants (GA) receive a competitive stipend for working for the Department during their time as a graduate student. Not only do GAs receive a paycheck, they also gain valuable experience that will help in their decisions on the type of career they will pursue once they complete their degree. Work in the Department will range from recitation sessions to teaching to consulting and perhaps even assisting with funded research. Dr. Harvill will assign each student to the assistantship duties that best fits the student's academic success and practical experience. Faculty requests are also taken into account when assignments are made. Most GAs have more than one responsibility. Information about the variety of GA work assignments are given in Sections 8.3 through 8.8.

8.1 Payroll

During the fall and spring semesters, GAs work an average of 20 hours per week. Graduate assistants are paid on a monthly basis. Some students who have a paid internship during the summer may not be paid by Baylor during the time they're working on the internship. However, students who do not have an internship, and who are registered for courses during the summer can continue working for the Department for 20 hours per week and will continue to receive monthly pay.

8.2 Insurance

Beginning July 2020, all domestic graduate students under the auspices of the Baylor Graduate School taking three credit hours or more, or at least one hour of a full-time equivalent course must demonstrate proof of active insurance. Students will demonstrate their proof of insurance or enroll in Baylor's student insurance through the AHP (Academic HealthPlans) portal each semester during the open enrollment period. The AHP website can be found here: `https://baylor.myahpcare.com/`. International graduate students are required to maintain insurance coverage through Baylor's student health insurance plan. International students should contact Betty Fornelius for their enrollment. Most fully-funded International students are eligible for the insurance subsidy on their individual student premium if they receive full-tuition remission and a full stipend.

Domestic graduate students will receive an email each semester during the open enrollment period by Academic HealthPlans (AHP) which manages Baylor's student insurance. The email will alert students that the AHP portal is open for enrolling in Baylor's student insurance plan or demonstrating proof of insurance coverage. Graduate students who enroll in Baylor's student insurance plan will have elective coverage options also, including Dental and Vision.

The Department stipend paid to almost all of its graduate assistants is enough that they are eligible to receive an 80% insurance subsidy for the individual student premium. Health coverage is subsidized for 12 months and is renewable as long as the student qualifies. However, students must enroll through the AHP insurance portal each semester to maintain

coverage. Note: Subsidies will be applied to the premium and any remaining balance will be billed to the student's University account. For a full listing of unsubsidized and subsidized student insurance costs for the 2021-2022 academic year, see Table 2.

For more information about health insurance for graduate students, including open enrollment dates, go to
`https://www.baylor.edu/graduate/index.php?id=959184`.

Table 2: Final Premium Rates, 2021-2022

	Fall	Spring	Spring/Summer	Summer
	08/01/2021 through 12/13/2021	01/01/2022 through 05/14/2022	01/01/2022 through 07/31/2022	05/15/2022 through 07/31/2022
Student	$1,362.00	$1,192.00	$1,886.00	$694.00
Spouse	$1,362.00	$1,192.00	$1,886.00	$694.00
Child, 2x Max	$1,362.00	$1,192.00	$1,886.00	$694.00

8.3 Statistics Supplemental Instruction

During the regular school year (Fall and Spring semesters) the Department offers two undergraduate services courses: STA 1380 and STA 2381. Most first-year GAs and some second-year GAs will be responsible for two or three supplemental instruction sessions for one of those two courses. In addition to holding the supplemental instruction sessions, GAs will also be required to attend the section of the course for which they are holding the session.

8.4 STA 1380 and STA 2381

Baylor students enrolled in STA 1380 or STA 2381 make up the vast majority of students who use a recitation session for assistance. Because of this, all first year students, as part of their assistantship duties, must watch STA 1380 videos during their first summer appointment (in the beginning of their first year of study). Then, in the first fall semester, part of their assistantship duties will include attending STA 2381 or watching the STA 2381 videos. The primary reason for this is to help the graduate assistants prepare for their work in the recitation sessions. However, some of our students have found the basic methods course a nice refresher too.

8.5 Grading and Faculty Assistance

All faculty teaching any course have the option to use a graduate assistant to help them with their course responsibilities. These graduate teaching assistants (GTA) may grade

homework, hold additional office hours (in-person or online), help proctor exams, etc. Some faculty will chose to ask for a GTA at the beginning of the semester. Others may only ask for a GTA on an as-needed basis. In either case, the GTA assigned to that job will be contacted by Dr. Harvill. The student is then responsible for contacting the faculty member, and meeting with them to discuss what work is to be done. These hours should not replace work in the recitation sessions, watching STA 1380 videos, attending STA 2381 (or watching STA 2381 videos), or attending departmental meetings or colloquia.

8.6 Consulting

The Department offers statistical consulting services. Dr. Rodney Sturdivant is the professor responsible for organizing and assigning all projects. Graduate students will work under the supervision of Dr. Sturdivant to consult on research projects with people or groups, both within and outside the university.

8.7 Research Assistants

At times, faculty members request assistance on a funded research project, and will request a specific graduate student to work with on that project. The faculty member will discuss this with the Graduate Program Director (Dr. Harvill), and that graduate assistant will be assigned the appropriate number of hours based on those discussions. The graduate research assistant will be contacted by the faculty member and Dr. Harvill.

8.8 Teaching (Teachers of Record)

Once a graduate student has successfully completed 18 hours of graduate-level credit in statistics or a closely-related area, that student is eligible to serve as a teacher of record (TOR). Graduate students who are selected to be a TOR will be the primary instructor for STA 1380. Dr. Amy Maddox is the supervisor for all STA 1380 instructors. On a rare occasion, a graduate student who is a more experienced teacher may be asked to teach STA 2381 or STA 3381. In this case, the remaining duties for that graduate assistant will fall under the discretion of the Graduate Program Director (Dr. Harvill). Graduate students who have passed their preliminary exams may teach QBA 2302 or QBA 2305. Dr. Jonathan Troweris the contact person for graduate students teaching a QBA course. The department increases the stipend for TOR by $1,000 per semester for each semester the graduate assistant is a TOR. Once the graduate assistant ceases to be a TOR, the stipend will return to their pay prior to them becoming a TOR. If there is a raise in stipend during the time a graduate assistant is a TOR, the graduate student will also receive that raise.

8.8.1 Office Hours

Every TOR is required to hold at least three office hours per week. Office hours should be held at your desk in the Department or in the Department Library.

8.8.2 Office of Access and Learning Accommodation (OALA)

At times, teachers of record may have students with learning disabilities. Section 504 of the Americans with Disabilities Act (ADA) states that "no otherwise qualified individual with disabilities in the United States...shall, solely by reason of his/her disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance." The ADA furthered this provision against discrimination by including all institutions private, or otherwise.

The Office of Access and Learning Accommodation (OALA), located in the east wing of the Sid Richardson building, provides these students with the accommodations they require so that Baylor is fully following the guidelines of the ADA. The people who work in OALA will also answer any questions you may have as a teacher of a student with a disability. Students with disabilities register with the Office of Access and Learning Accommodation (OALA). To receive services, the student must provide proof of their disability. If a student is registered with OALA, the instructor is asked to help with whatever accommodations are needed for the specified student. OALA encourages students to contact their teachers and set up a face-to-face meeting to discuss accommodations.

In most cases, such students will receive time-and-a-half on exams, and these exams will be administered at the OALA Testing Center. It is the responsibility of the student to make the appointment at the testing center. Letters of accommodation are housed in Accommodate, an online platform for accommodation management. Students will log into Accommodate, request the letter. When a request occurs, the instructor will receive notification via e-mail, log in to Accommodate, view the letter, and complete the requested signature. Step-by-step instructions are found online at
`https://www.baylor.edu/oala/index.php?id=934763`. That same page has a direct link to log into Accommodate. Instructions for "Test Request Approval Process" are also found on the same page. The Testing Center is used for students who get additional time on their exam, or who have certain accommodations requiring that service. The "Test Request Approval Process" gives you the opportunity to communicate the restrictions and permissions for students taking the exam (for example, closed-book, closed-note, or type of calculator).

If you are not notified within the appropriate time frame before and exam, that is equivalent to the student waiving their OALA rights. In this case, the student must take the exam with the rest of the class (for more information, see
`https://www.baylor.edu/oala/index.php?id=26709#q14`). For more information about OALA as it pertains to you as a teacher of a student with disabilities, see
`https://www.baylor.edu/oala/index.php?id=26125`.

8.8.3 Parent-Faculty Coffee

During Parents' Weekend at Baylor, the University hosts the Parent-Faculty Coffee on Saturday morning. This is an opportunity for the parents of Baylor students (mostly freshmen) to meet their children's instructors. Attendance to this event is not mandatory, but TORs need to inform their classes about their own attendance plans. A breakfast buffet is provided

by the University.

8.8.4 STA 1380 Elementary Statistics

Most TORs within the Department teach a section of STA 1380. Dr. Amy Maddox is the coordinator of all sections of STA 1380. The course is a requirement for any student pursuing a Bachelor of Arts. The textbook for the course is *Introduction to Statistics* by Dr. Maddox. The book is printed in a workbook style, meaning that students will fill in notes within the book throughout the course. TOR are asked to not write in the textbook that they borrow since it will be needed for future courses. Instead the instructor should make photocopies of the pages needed for each class, and write on the copies.

Once a week, instructors of STA 1380 will meet with Dr. Amy Maddox. This meeting will typically address upcoming lesson plans, concerns about specific students or situations, questions concerning the proper way to present material, etc. Instructors are strongly encouraged to inform Dr. Amy Maddox of any issues as soon as they arise – do not wait for the next meeting. All exams need to be approved by Dr. Amy Maddox before the exam is administered to students. At least 48 hours before the exam is to be given to the class, e-mail that exam to Dr. Amy Maddox. Adjustments may be needed before the exam is approved.

At least once a semester, Dr. Amy Maddox will attend a class for each teacher of record. The instructor will be evaluated on his or her ability to (1) motivate and explain the material and (2) control the students in the class. This evaluation is meant to provide constructive criticism to the instructor. If Dr. Maddox's teaching schedule conflicts with the TOR's class, then the Graduate Program Director will evaluate the student.

In STA 1380, when computer software is needed for statistical analysis, the program *JMP* is used. Baylor provides download links for both the software and the licenses. There is no additional cost to the student. If the *JMP* question is about installing *JMP*, students should be referred to Baylor's Help Desk (254-710-HELP).

8.8.5 QBA 2302/2305 Business Data Analysis I & II

Most semesters, one or two graduate students who have previously been a TOR for STA 1380 will be assigned to teach a section of QBA 2302 or QBA 2305 for the Management Information Systems (MIS) Department in the Hankamer School of Business. This course is required for any student pursuing a business degree.

The primary software used in QBA is a *Microsoft Excel* add-in called "MegaStat." It provides a menu-based approach to the built-in statistical functions in *Excel* and produces output which is easy to read and interpret. An *Excel* course is a prerequisite for enrolling in QBA. If you are teaching only a QBA course, no meetings with members of the Information Systems department are necessary, nor do you need to have your exams approved by a faculty member. However, it is highly encouraged that you ask for input on every exam you write. QBA instructors are also encouraged to maintain communication with other members of the Information Systems department. Depending on prior teaching experience, Dr. Amy Maddox or another professor may observe the QBA teachers of record. There are a

number of department functions that are open to those teaching QBA, and attending these functions is a great way to maintain the relationship between the Information Systems and the Statistical Sciences departments.

8.9 Policy for Dismissal from Graduate Assistantship

If a graduate assistant (GA) does not perform their work responsibilities in a satisfactory manner, that student may be dismissed from their assistantship. This dismissal is separate from the GA's academic performance. Dismissal from the assistantship means that the student will no longer receive a stipend, the student will be responsible for paying all of their tuition, and all other benefits of being a graduate assistant will be revoked. The policy and procedure for dismissal because of poor work performance is as follows.

1. If a graduate assistant (GA) is not performing their work duties in a satisfactory manner, their supervisor will notify the Graduate Program Director (GPD) and the GA of the specific deficiencies in writing either by letter or e-mail.

2. The GA, the supervisor, and the GPD will have a meeting to discus the issues. The outcome of that meeting will be a written statement that documents the deficiencies and steps or behaviror that are required to demonstrate improvement.

3. If, within the same semester, the GA's performance does not meet standards a second time, then supervisor will notify the GPD. The GPD, supervisor, and GA will meet again. The GA will be notified in writing (by e-mail or letter) that he or she will be on probation for one semester. During this probationary period,

   (a) the GA will still be on assistantship, but not entitled to any raise in stipend, including the additional $1,000 for being a Teacher of Record (see Section 8.8) that may occur immediately before or during that probationary semester.

   (b) If the GA receives another complaint about the performance of their work responsibilities, at the end of the semester, that GA will be dismissed from their assistantship. The student may continue in their academic pursuits if their academic performance is satisfactory.

   (c) If the GA does not receive another complaint about their performance, they will be removed from probation. They will also receive any raises they did not receive during that time. They will not receive back-pay for those raises.

4. If a GA goes on probation a second time, at the end of the second probationary period, the GA will be dismissed from their assistantship. The student may continue their academic pursuit if their academic performance is satisfactory.

For GAs who are TOR, it is entirely possible that one or more of the students in their class will complain. The TOR should bring that complaint to their supervisor, and the supervisor will work with the student and the TOR to determine how to handle the student's complaint.

Finally, students who fail to follow Baylor student policies and procedures may also be dismissed from their assistantship, as well as the graduate program that they are enrolled in. Baylor student policies and procedures may be found online at
`https://www.baylor.edu/student_policies/index.php?id=953888`.

9 Computing Software

The Department offers plentiful, individual access to computers at student desks, in our department computer lab, and through the Baylor High Performance Computing (HPC) cluster, Kodiak. For more information on Kodiak, see
`https://www.baylor.edu/lib/factech/index.php?id=966458`.

9.1 Software

Baylor University and the Department of Statistical Science offers students free access to a variety of computer software. In addition to anti-virus software, a variety of software for statistical analysis and mathematics is also available. For more information, see `https://www.baylor.edu/its/index.php?id=44606`. Below, some of the more important software for your classwork and your graduate assistantship duties are described. Also included in the description are software packages that are free, open-source packages that will be important in your studies.

9.1.1 Secure Computing: Duo and Global Protect VPN

Baylor protects it most important, widely-accessed university and personal information with *Duo* two-factor authentication. The additional layer of protection provides insurance against threats to personal information, sensitive research data, and other university information and resources stored within a variety of online Baylor platforms. For information on how to obtain and use *Duo*, see `https://www.baylor.edu/its/index.php?id=863033`.

Baylor provides virtual private network (VPN) through Palo Alto Networks *Global Protect*. The VPN allows secure access to Baylor University computing resources from off-campus. For students to have access to *Global Protect*, they require a faculty/staff sponsor. If you are interested in this software, please contact the Graduate Program Director, Dr. Harvill, or discuss it with your dissertation advisor.

9.1.2 *Box* Drive

Baylor provides faculty, staff, and students with secure storage of files that includes mobile access. Online workspace can be easily setup for collaboration and file sharing, with the ability to designate different levels of access. To access your *Box* drive, log in at `http://www.baylor.box.com`. You will need your Baylor ID, password, and *Duo*.

9.1.3 OsoFast

It is physically and fiscally impossible for the Baylor libraries to own every document or information resource needed to support all scholarly activities of Baylor university. Interlibrary Services is a dedicated team of people in the Baylor libraries who try to locate any desired item that is not in any of the Baylor library collections. *OsoFast* is Baylor's interlibrary loan management system. Baylor students, faculty, and staff only need to have a valid Bear ID and password to access *OsoFast*. Once you log into *OsoFast*, you will complete the requested information about the resources you need, and the *OsoFast* staff will search for them and upload them to your *OsoFast* account. You will receive an e-mail notifying you that the documents have been found and added to your account. For more information about *OsoFast*, or to log into *OsoFast*, go to `https://www.baylor.edu/lib/ils/`.

9.1.4 LaTeX

LaTeX, pronounced "lah-tech" or "lay-tech" is a document preparation system for high-quality typesetting. It is not a WYSIWYG (what-you-see-is-what-you-get) word processing program like *Microsoft Word* or *Apple Pages*, neither of which are sufficient for producing high-quality mathematical documents. LaTeX provides a methods for organizing mathematical content in a way that is more elegant and efficient that WYSIWYG programs. LaTeX can be used not only for mathematical documents, but also for presentation. Almost every assignment in every course in the Department is written using LaTeX. All dissertations from the Department must be written in LaTeX using the appropriate (Graduate School approved) format. It is essential that *ALL* graduate students learn how to use LaTeX!

LaTeX requires an editor that can be independent from LaTeX, or which can be part of a program that includes the LaTeX compiler. If you are working on a *Windows* operating system, the preferred LaTeX compiler is *MikTeX*, available for free download from `http://www.miktex.org`. The version of LaTeX available at that site includes a front-loader called *TeXWorks*. There are more sophisticated front loaders, like *TeXNicCenter* (`http://www.texniccenter.org`). If you are working on a *MacOS* platform, *MacTeX* is preferred, and can be found for free download online at `http://tug.org/mactex/`. The download should contain everything you need to get LaTeX running on your machine, including an editor. You can use another editor if you find one you prefer. A reliable site for a list of good LaTeX editors can be found online at `https://beebom.com/best-latex-editors/`. Many students and collaborators like to use *Overleaf*, an online LaTeX editor that comes with hundreds of templates and the ability for online, real time collaboration.

9.1.5 *JMP*

Regardless of your course work or your graduate assistantship assignment each semester, most students end up working with *JMP*. *JMP* is the software used by all students in STA 1380, in some sections of STA 2381, and in STA 5300. It is the best interest of entering graduate students to learn *JMP* as quickly as possible. *JMP* may be downloaded from Baylor's web site for free at

https://www.baylor.edu/its/index.php?id=46507. You will need your Bear ID and password, and Duo to access the site.

Once installation is complete, a window will open informing you that the license has expired. To remedy this, click on the license update from the same page where you downloaded *JMP*. Copy and paste the resulting text into a text file and save it somewhere that will be easy to access (such as your desktop). When you open *JMP*, click on the "Open License" button, and select the text file you just saved. If the license is accepted, you will then be asked to your name and department. If you chose, you can leave both of these blank. *JMP* should then function normally until the time when the license expires again.

9.1.6 *R*

R is a language and environment for statistical computing and graphics. It is a GNU project, is open-source, and is one of the most widely used statistics software by students, teachers, and professional statisticians alike. *R* is an integrated suite of software facilities for data manipulation, calculation, and graphical display. The term "environment" is used to emphasize that *R* is a fully planned, coherent system. *R* is designed around a true computer language, thus allowing the user to add additional functionality by writing their own functions. For computationally intensive tasks, *C*, *C++*, and *FORTRAN* code can be linked and called. *R* can be easily extended via the many packages freely available. For more information about *R*, refer to http://www.r-project.org. To download *R*, the web site address is http://cran.r-project.org/mirrors.html. Some *R* users prefer a more interactive user interface than the interface that is provided with standard *R*. For that, we recommend the freely available *R Studio*, which can be downloaded at https://rstudio.com/products/rstudio/download/.

9.1.7 *SAS*

Though *R* is the most commonly used statistical software in the department, there will be times where a graduate student will need *SAS* (pronounced "sass"). *SAS* – short for "statistical analysis system" – is a statistical analysis software suite developed by the SAS Institute for data management, advanced analytics, multivariate analysis, business intelligence, and many many more tasks. Although there is a graphical user interface for *SAS* users, the primary means of working with *SAS* is through writing a *SAS* program. The numerical results of stable releases of *SAS* are guaranteed to be correct. No other statistical analysis software makes this promise. Because of this promise, *SAS* is widely used in government and industry for statistical analysis. Thus, a well-educated statistician will be proficient in *SAS*.

SAS is not open source, nor is it free. However, Baylor does offer *SAS* to students and faculty without charge. *SAS University Edition* is also free for students and works on all machines. You can download *SAS* from Baylor at
https://www.baylor.edu/its/index.php?id=46525, or go to
www.sas.com/en_us/software/university-edition.html to download the University Edi-

tion. Although *SAS* is not free, there is plenty of free technical support for *SAS* online; in particular, see `http://documentation.sas.com` and `https://support.sas.com/en/documentation.html`.

9.1.8 Other Available Software

This brief list of software is what is most often used for classes and research by faculty and students in the department. It is not an exhaustive list, and is not intended to be. For more information about software available to students at Baylor University, please visit the website at `https://www.baylor.edu/its/index.php?id=44651`.

10 Program and Departmental Rules and Guidelines

10.1 Work Space

As much as is possible, each student is assigned a desk with a computer for their work in the department. Other students are also working in the same area. The environment in the graduate student area should be professional, polite, and conducive to work and study. Students should also plan to be in the department and their work area regularly and often. It is not acceptable to be in the department for only an hour a day. It is expected that students are present. Your assistantship and your classes are your profession. Absenteeism communicates a lack of desire to be a part of the department and to effectively discharge all your responsibilities.

10.2 Computers

In as much as is possible, each graduate student will be assigned a computer in the graduate student work area. That computer is provided so that students can complete homework, work on any of their assistantship duties, do research, and other activities related to their being a student or their work for the Department. **Before any changes are made to the computer, including installing software, or changing the location, you MUST contact the Department Office Manager, Mrs. Tammy Corntassel.** Do **NOT** move your computer from its station. Do **NOT** trade computers with another student. Students are also given access to printing for any of these departmental responsibilities.

11 Department Courses

In the sections that follow, a description of courses offered by the Department is provided. The courses are arranged by program, and then numerically. For a complete listing of all courses, student are encouraged to get the *Graduate Catalog* or visit the Department's web page.

11.1 Course Numbers

Before a list of courses is provided, a few words about the course numbering system are in order. A very, very long time ago, when the numbering system was created, there was a logical system to assign numbers to courses. But as time has passed, some of the logic behind the original intent has eroded. For a variety of very legitimate reasons, changing a course number is not something that is often done at any university.

- The first digit of a course number typically indicates the year of study it is to be taken: a course numbered in the 1000 is a freshman-level course; 5000-level is typically for the first year of graduate study, or indicates an M.S.-level course, and 6000-level is Ph.D.-level course. Over time, this convention has lost some of its meaning. For example, you may notice that STA 6375 is taken the first semester of the first year of graduate study. The course was created many, many years ago, when the topic itself was considered quite advanced. However, as time has passed, with the prevalence of computers in society, this material in this course is fairly common place, and is now a first-year graduate course in most programs around the country.

- The second digit, which sometimes is the letter "V" indicates, the number of hours credit a course is worth. So STA 6365 is a three-hour credit course. If the second digit is the letter "V," then that course is a variable-hour credit course. When you register for STA 5V85, you will register for one-hour per semester for three semesters. STA 5V85 is rarely more than one hour, but sometimes, the flexibility is needed. STA 5V95 is typically (but not always) a three-hour course. Once admitted to candidacy (see more in section 5.4), students will register for STA 6V99 Dissertation. Each semester, the number of hours a student registers for STA 6V99 will be determined by their advisor, in cooperation with the student and Graduate Program Director (Dr. Harvill).

- The last two digits sometimes – but not always – indicate a sequence of courses. Examples of this are (1) STA 5351, STA 5352, and STA 5353 (Theory of Statistics I, II, and III); (2) STA 5380 and STA 5381 (Methods in Statistics I and II), or (3) STA 6375 and STA 6376 (Computational Statistics I and II). A counter example of sequencing are the two courses STA 5383 "Introduction to Multivariate Analysis," which is to be taken by our Ph.D. students, and STA 5384 "Multivariate Statistical Methods," a simpler, less-rigorous course for non-statistics graduate students, and which cannot be taken for credit by our Ph.D. students.

  One thing the last two digits to *not* indicate is the difficulty level of the courses. For most people, the theory sequence is more challenging than the methods sequence, even though the last two digits (51, 52, and 53) of the theory sequence are lower-valued than the last two digits of the methods sequence (80 and 81). Sometimes, the last two digits have no real meaning other than to identify two different courses.

11.2 Undergraduate Courses

The Department offers a wide range of courses in statistics for undergraduate. Some are courses for undergraduate students who are in majors other than statistics; some are taken by students who will earn a statistics minor; and others by students majoring in statistics. A list of the undergraduate courses offered by the Department of Statistical Science follows. At course prefixes are STA.

1301. Statistical Reasoning: A Guide to the Unknown
Prerequisite(s): Freshman standing and consent of statistics undergraduate faculty advisor.
Description: Philosophical, ethical, and sociological issues related to statistical uncertainty and randomness.

1380. Elementary Statistics
Description: Introduction to traditional statistical concepts including descriptive statistics, binomial and normal probability models, tests of hypotheses, linear correlation and regression, two-way contingency tables, and one-way analysis of variance. Credit may not be obtained after receiving credit in STA 2381 or 3381.

IV9R. Research
Pre-requisite(s): Consent of the instructor.
Description: Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

2300. Introduction to Data Science (Cross-listed as CSI 2300)
Description: Principles of data science, including problem workflow, variable types, visualization, modeling, programming, data management and cleaning, reproducibility, and big data.

2381. Introductory Statistical Methods
Prerequisite(s): A grade of C or above in MTH 1321.
Description: Parametric statistical methods. Topics range from descriptive statistics through regression and one-way analysis of variance. Applications are typically from biology and medicine. Computer data analysis is required.

2450. Introduction to Computing for the Mathematical and Statistical Sciences
Description: Computer programming for mathematical scientists with emphasis on designing algorithms, problem solving, and coding practices. Topics include development of programs from specifications; appropriate use of data types; functions; modular program organization; documentation and style; and version control and collaborative programming.

2V9R. Research
Pre-requisite(s): Consent of the instructor.

Description: Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

3381. Probability and Statistics
Prerequisite(s): A grade of C or above in MTH 1322.
Description: Introduction to the fundamentals of probability, random variables, discrete and continuous probability distributions, expectations, sampling distributions, topics of statistical inference such as confidence intervals, tests of hypotheses, and regression.

3386. Regression Analysis
Pre-requisite(s): STA 3381, MTH 2311 and MTH 2321.
Description: A development of regression techniques including simple linear regression, multiple regression, logistic regression and Poisson regression with emphasis on model assumptions, parameter estimation, variable selection and diagnostics.

3V90. Undergraduate Research in Statistics
Pre-requisite(s): Consent of instructor.
Description: Independent study or research in topics not available in other courses. Maximum of four hours will count toward the degree.

3V9R. Research
Pre-requisite(s): Consent of the instructor.
Description: Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

4330. SAS Programming for Statistical Science
Pre-requisite(s): STA 2381 or 3381.
Description: Concepts in SAS programming including methods to establish and transform SAS data sets, perform statistical analyses, and create general customized reports. Methods from both BASE SAS and SAS SQL will be considered.

4350. Statistical Machine Learning
Pre-requisite(s): STA 3386.
Description: Fundamental topics of machine learning including supervised/unsupervised learning, cost function optimization, feature selection and engineering, and bias/variance tradeoff. Learning algorithms including classification methods, support vector machines, decision trees, neural networks, and deep learning are included.

4360. Bayesian Data Analysis
Pre-requisite(s): STA 4385.
Description: An introduction to Bayesian inference emphasizing prior and posterior distributions, estimation, prediction, hierarchical Bayesian analysis, and applications with computer implemented data analysis.

4362. Applied Time Series Analysis
Pre-requisite(s): STA 3386.
Description: Statistical methods of analyzing time series. Model identification, estimation, forecasting, and spectral analysis will be discussed. Applications in a variety of areas including economics and environmental science will be considered.

4370. Sampling Techniques
Prerequisite(s): Three hours of statistical methods.
Description: Planning, execution, and analysis of sampling from finite populations. Simple random, stratified random, ratio, systematic, cluster, sub sampling, regression estimates, and multi-frame techniques are covered.

4371. Data Management and Mining
Prerequisite(s): STA 3381.
Description: Terminology, techniques, and management of Data Mining for biostatisticians.

4372. Introduction to Biostatistics
Prerequisite(s): STA 2381 or STA 3381 or consent of the instructor.
Description: Data Analysis for biostatisticians in the biomedical and pharmaceutical fields.

4373. Computational Methods in Statistics
Prerequisite(s): STA 2381 or STA 3381 or consent of the instructor.
Description: Computational methods using statistical packages and programming.

4374. Statistical Process Control
Prerequisite(s): STA 3381 or equivalent.
Description: Development of statistical concepts and theory underlying procedures used in statistical process control applications and reliability.

4382. Intermediate Statistical Methods
Prerequisite(s): A minimum grade of C in either STA 2381 or STA 3381 and a minimum grade of C in STA 3386.
Description: Development and application of two-sample inferences, analysis of variance, multiple comparison procedures, and nonparametric methods.

4384. Applied Multivariate Methods
Pre-requisite(s): STA 3386.
Description: Numerical and graphical descriptive statistics for multivariate data, principal components and factor analysis, canonical correlation, discriminant analysis, multivariate analysis of variance, multidimensional contingency tables, and cluster analysis.

4385. Mathematical Statistics I
Prerequisite(s): MTH 2321 with minimum grade of C.

Description: Introductions to the fundamentals of probability theory, random variables and their distributions, expectations, transformations of random variables, moment generating functions, special discrete and continuous distributions, multivariate distributions, order statistics, and sampling distributions.

4386. Mathematical Statistics II
Prerequisite(s): STA 4385 with minimum grade of C.
Description. Theory of statistical estimation and hypothesis testing. Topics include point and interval estimation, properties of estimators, properties of test of hypotheses including most powerful and likelihood ratios tests, and decision theory including Bayes and minimax criteria.

4387. Introduction to Probability Methods
Prerequisite(s): STA 4385 with minimum grade of C.
Description: Applications of probability theory to the study of phenomena in such fields as engineering, management science, social and physical sciences, and operations research. Topics include Markov chains, branching processes, Poisson processes, exponential models, and continuous-time Markov chains with applications to queuing systems. Other topics introduced are renewal theory and estimation procedures.

43C9. Capstone Statistics Course
Prerequisite(s): Approval of the statistics undergraduate faculty advisor.
Description: Statistical concepts applied to written and oral reports for consulting. For students majoring in statistics.

4V90. Special Topics in Statistics
Prerequisite(s): STA 2381 or STA 3381.
Description: Topics in probability and/or statistics not covered in other courses. May be repeated for a maximum of 6 hours if the content is different.

4V9R. Research
Prerequisite(s): Consent of the instructor.
Description. Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

11.3 Graduate Courses for Professional M.S. or Electives

The courses listed below may be taken for elective credit by students in majors other than statistics. They may also be taken for credit for the $4 + 1$ BS/MS, or for the Professional Masters described in Section 7. These courses may not be take for credit towards the traditional M.S. program described in Section 6 or the Ph.D. A listing of those courses follows.

5300. Statistical Methods
Description: Introduction to descriptive and inferential statistics. Topics may be selected from the following: descriptive statistics and graphs, probability, regression,

correlation, tests of hypotheses, interval estimation, measurement, reliability, experimental design, analysis of variance, nonparametric methods, and multivariate methods.

5301. Introduction to Experimental Design
Prerequisite(s): Graduate standing.
Description: Simple and complex analysis of variance and analysis of covariance designs. The general linear model approach, including full-rank and less than full-rank models, will be emphasized.

5303. Applied Regression Analysis
Prerequisite(s): STA 5300 or equivalent.
Description: Regression modeling, estimation, and diagnostics with emphasis on applications. Topics include simple linear regression, multiple regression, logistic regression, and Poisson regression. The statistical programming language R is used.

5360. Introduction to Bayesian Analysis
Prerequisite(s): STA 3381 or consent of instructor.
Description: An overview of analytic and computational methods in Bayesian inference beginning with two-sample t-inference procedures and extending through regression, focusing on state-of-the-art software for Bayesian computation.

5361. Applied Time Series Analysis
Prerequisite(s) or Corequisite(s): STA 4385 and STA 3386.
Description: Statistical methods of analyzing time series. Model identification, estimation, forecasting, and spectral analysis will be discussed. Applications in a variety of areas including economics and environmental science will be considered. The R statistical programming language will be used.

5370. Applied Sampling Techniques
Prerequisite(s): Grade of C or better in one of STA 2381 or STA 5300 or equivalent course in statistical methods.
Description: Planning, execution, and analysis of sampling from finite populations. Simple random, stratified random, ratio, systematic, cluster, subsampling, regression estimates and multi-frame techniques are covered. Using computer software for analyzing data collected from designs covered in class.

5371. Methods in Data Mining and Management
Prerequisite(s): STA 3381.
Description: This course introduces the methods and practice of data mining.

5373. Computational Statistical Methods
Prerequisite(s): STA 2381 or STA 3381 or consent of the instructor.
Description: Computational methods using statistical packages and programming.

5376. Methods in Biostatistics
Prerequisite(s): STA 2381 or STA 5300 or an equivalent course in statistical methods.

Description: A survey of methods of data analysis for biostatisticians in the biomedical and pharmaceutical fields. Regression analysis, experimental design, categorical data analysis, clinical trials, longitudinal data, and survival analysis.

5384. Multivariate Statistical Methods
Description: Discriminant analysis, canonical correlation analysis, and multivariate analysis of variance.

11.4 Graduate Courses for M.S. and Ph.D. Statistics Majors

The courses below are taken for credit toward the traditional M.S. described in Section 6 or the Ph.D. The rigor of the courses means that enrollment in the courses is strictly controlled. Graduate students who are not enrolled in the Traditional M.S. or the Ph.D. programs must receive permission from the course instructor and the Statistics Graduate Program Director to enroll in most of these classes. A listing of those courses follows.

5180. SAS Programming for Statistical Analysis
Prerequisite(s): STA 2381 or STA 5300 or equivalent; STA 3381 or equivalent.
Description: Concepts in SAS programming, including methods to establish and transform SAS data set, perform statistical analyses, and create generalized customized reports. Methods from both BASE SAS and SAS SQL are considered. Successful completion of the course prepares students to take the SAS certification exam.

5305. Advanced Experimental Design
Prerequisite(s): STA 5381 or consent of instructor.
Description: The course examines a variety of complex experimental designs that are available to researchers including split-plot factorial designs, confounded factorial designs, fractional factorial designs, incomplete block designs, and analysis of covariance. The designs are examined within the framework of the general linear model. Extensive use is made of computer software.

5351. Introduction to Theory of Statistics
Prerequisite(s): MTH 2321 or equivalent or consent of instructor.
Description: Introduction to mathematics of statistics. Fundamentals of probability theory, convergence concepts, sampling distributions, and matrix algebra.

5352. Theory of Statistics I
Prerequisite(s): MTH 2321 or STA 5351 or consent of instructor.
Corequisite(s): STA 5380.
Description: Theory of random variables, distribution and density functions, statistical estimation, and hypothesis testing. Topics include probability, probability distributions, expectation, point and interval estimation, and sufficiency.

5353. Theory of Statistics II
Prerequisite(s): STA 5352.

Description: Topics include sampling distributions, likelihood and sufficiency principles, point and interval estimation, loss functions, Bayesian analysis, asymptotic convergence, and test of hypothesis.

5362. Time Series Analysis
Prerequisite(s): STA 5352.
Description: Statistical methods of analyzing time series. Topics include autocorrelation function and spectrum, stationary and non-stationary time series, linear filtering, trend elimination, forecasting, general models and auto regressive integrated moving average models with applications in economics and engineering.

5363. Advanced Data-Driven Methods
Prerequisites(s): STA 5381, STA 5383, STA 6376.
Description: Advanced topics and theoretical underpinnings of modern data-driven methods will be presented, including supervised and unsupervised methods from both statistical and machine learning perspectives, uncertainty analysis, model selection and development, and both nonlinear and linear methods.

5364. Survival and Reliability Theory
Prerequisite(s): STA 5352.
Description: Basic concepts of lifetime distributions. Topics include types of censoring, inference procedures for exponential, Weibull, extreme value distributions, parametric and nonparametric estimation of survival function and accelerated life testing.

5365. Design of Experiments and Clinical Trials
Prerequisite(s): Graduate standing.
Description. Traditional designs of experiments are presented within the framework of the general linear model. Also included are the latest designs and analyses for clinical trials and longitudinal studies.

5367. Managerial Epidemiology (Cross-listed as HPA 5367)
Description: This course presents the basic principles of epidemiology with particular emphasis on applications in healthcare management. Topics include specific tools of epidemiology used for purposes of planning, monitoring, and evaluating population health. These include identification and of disease, measures of incidence and prevalence, study designs, confidence intervals, p-values, statistical interaction, causal inference, and survival analysis. Methods for managing the health of populations using an understanding of the factors that influence population health are discussed. Strategies that health care organizations and systems can use to control these factors are also considered.

5377. Spatial Statistics
Prerequisite(s): STA 5353; or consent of instructor.
Description: Exploratory spatial data analysis using both graphical and quantitative descriptions of spatial data including the empirical variogram. Topics include several

theoretical isotropic and anisotropic variogram models and various methods for fitting variogram models such as maximum likelihood, restricted maximum likelihood, and weighted least squares. Techniques for prediction of spatial processes will include simple, ordinary, universal, and Bayesian kriging. Spatial sampling procedures, lattice data, and spatial point processes will also be considered. Existing software and case studies involving data from the environment, geological, and social sciences will be discussed.

5380. Methods in Statistics I
Prerequisite(s): MTH 2311 and MTH 2321.
Corequisite(s): STA 5352.
Description: Descriptive parametric and nonparametric inferential methods for qualitative and quantitative data from a single population. Parametric and nonparametric inferential methods for qualitative and quantitative data from two populations. Linear regression using matrix notation, including topics in multiple regression, modeling diagnostic procedures, and model selection.

5381. Methods in Statistics II
Prerequisite(s): STA 5380 or consent of instructor.
Corequisite(s): STA 5353.
Description: A continuation of STA 5380 with robust regression, quantile regression, and regression trees. K-population descriptive and inferential methods. A matrix approach to one-way analysis of variance and least squares in balanced designs with fixed and random effects. Multiple comparison procedures, power, and sample size. A brief introduction to generalized linear models.

5383. Introduction to Multivariate Analysis
Prerequisite(s): STA 5381 or equivalent.
Description: Statistical models and procedures for describing and analyzing random vector response data. Supporting theoretical topics include matrix algebra, vector geometry, the multivariate normal distribution and inference on multivariate parameters. Various procedures are used to analyze multivariate data sets.

5385. High Dimensional Data Analysis
Prerequisite(s): STA 5383.
Methods for analyzing high-dimensional multivariate data. Topics include matrix computations of summary statistics, graphical techniques for using linear dimension reduction, statistical inference of high-dimensional multivariate parameters, high-dimensional principle component analysis and singular value decompositions, and supervised classification methods for high-dimensional sparse data.

5387. Stochastic Processes
Prerequisite(s): STA 5353.
Description: The study of probability theory as motivated by applications from a variety of subject matters. Topics include: Markov chains, branching processes, Poisson

processes, continuous time Markov chains with applications to queuing systems, and renewal theory.

5388. Seminar in Statistics
Prerequisite(s): Consent of instructor.
Description: Selected topics in Statistics. May be repeated once with change of topic.

5V85. Practice in Statistics
Description: Consulting, research, and teaching in statistics.

5V95. Topics in Statistics
Prerequisite(s): Consent of instructor. Description: Selected topics in statistics. May involve texts, current literature, or an applied data model analysis. This course may be repeated with change of topic.

5V99. Thesis
Description: Supervised research for the master's thesis. A maximum of three semester hours to count for the degree.

6351. Large Sample Theory
Prerequisite(s): STA 5353.
Description: Large sample theory, including convergence concepts, laws of large numbers, central limit theorems, and asymptotic concepts in inference.

6352. Bayesian Theory
Prerequisite(s): STA 5353 or equivalent.
Description: Bayesian statistical inference, including foundations, decision theory, prior construction, Bayesian point and interval estimation, and other inference topics. Comparisons between Bayesian and non-Bayesian methods are emphasized throughout.

6353. Semiparametric Regression Models
Prerequisite(s): STA 5353.
Description: Semiparametric inference, with an emphasis on regression models applicable to a wider class of problems than can be addressed with parametric regression models. Topics include scatterplot smoothing, mixed models, additive models, interaction models, and generalized regression. Models are implemented using various statistical computing packages.

6360. Bayesian Methods for Data Analysis
Prerequisite(s): STA 5353 or equivalent.
Description: Bayesian methods for data analysis. Includes an overview of the Bayesian approach to statistical inference, performance of Bayesian procedures, Bayesian computational issues, model criticism, and model selection. Case studies from a variety of fields are incorporated into the study. Implementation of models using Markov chain Monte Carlo methods is emphasized.

6366. Statistical Bioinformatics
Prerequisite(s): STA 5353 and STA 5383; or consent of instructor.
Description: Critical evaluation of current statistical methodology used for the analysis of genomic and proteomic data.

6375. Computational Statistics I
Prerequisite(s): MTH 2311 and MTH 2321.
Corequisite(s): STA 5352.
Description: A comprehensive introduction to computing for statisticians. Topics range from information technology and fundamentals of scientific computing to computing environments and workflows, statistical document preparation for reproducible research, and programming languages.

6376. Computational Statistics II
Prerequisite(s): STA 6375.
Description: A continuation of 6375 Computational Statistics I with an emphasis on computational and applied mathematics, pseudo-random variate generation, and Monte Carlo methods.

6380. Modern Trends in Data Science Computing.
Prerequisite(s): STA 6375, STA 6376.
Description: A hands-on survey of practical data science technologies and tools used in industry. Topics vary and may include version control systems and collaborative software development, distributed computing, data storage and access, cloud computing, web technologies, applications and dashboards, and workflow and pipelining tools.

6382. Theory of Linear Models
Prerequisite(s): STA 5353 and STA 5381; and knowledge of matrix theory.
Description: Theory of general linear models including regression models, experimental design models, and variance component models. Least squares estimation. Gauss-Markov theorem and less than full rank hypotheses.

6383. Advanced Multivariate Analysis
Prerequisite(s): STA 5383.
Description: Multivariate normal and related distributions. Topics include generalizations of classical test statistics including Wilk's Lambda and Hotelling's T^2, discriminant analysis, canonical variate analysis, and principal component analysis.

6384. Analysis of Categorical Data
Prerequisite(s): STA 5353 and STA 5381 or equivalent.
Description: Theory of generalized linear models including logistic, probit, and log linear models with special application to categorical and ordinal categorical data analysis.

6V99. Dissertation

Description: Supervised research for the doctoral dissertation. Maximum of nine semester hours will count for the degree. A student may register for one to six semester hours in one semester.