Math 4506 | Brooklyn College
Department of Mathematics
Course Information | Fall 2019

Course Goals and Learning Objectives: This course will teach you to apply your knowledge of probability and statistics to construct models for time-dependent stochastic processes (i.e., time series), to evaluate their adequacy, and to use them for prediction in real-world situations.

Room and Schedule: 330 IA; Monday, Wednesday, 2:15 - 3:55 p.m.

Text: *Time Series Analysis: With Applications in R* (2nd Edition), by Jonathan D. Cryer and Kung-Sik Chan. This text will be complemented by my lecture notes which will be your other main source of material for this course.

Instructor: Christian Beneš; Office: 1119a N; E-mail: `CBenes@brooklyn.cuny.edu`.

Office Hours: Monday, 11:45 a.m. - 12:15 p.m., Tuesday, Wednesday, 11:30 a.m. - 12:15 p.m. No appointment is needed. Feel free to attend as often as you would like.

Prerequisite: If you don't have credit for Math 4501 or an equivalent course, you will not be allowed to take this course.

Work Outside of Class: While coming to class will help you in grasping the material, it will not be sufficient to pass the course. You should expect to spend a substantial number of hours every week working on the course outside of class (how many will depend on your mathematical background and how comfortable you are with the material).

E-mail: I will sometimes share information with you by e-mail. I will do this under the assumption that you check your e-mail at least once a day. I will be using the e-mail address available for you on Webcentral, so make sure you check that e-mail address regularly. You should also feel free to e-mail me with questions you might have but make sure you read the "Golden Rules of E-mail Correspondence" page attached at the end of this syllabus. If you fail to follow these rules, I will most likely not reply to you. Please also make sure e-mail me only with questions to which you have no other means of obtaining an answer.

Homework: Several (no more than 5) assignments will be collected during the semester. The assignments will be given at least 10 days before they are due. They will be a mix of theoretical and applied/computational problems. You are encouraged to work on them in groups (except for work to be done with software) but must turn in your own copy with your own words and writing. Homework sets turned in with identical wording will receive a grade of 0. In order to get credit, you will need to give a clear and rigorous explanation **in your own words**. I will be very demanding with your mathematical syntax and will take off points for logical imprecisions, missing "=" signs, lack of clarity, etc. If I need to read something you write more than twice to understand what you mean, I will disregard it and consider that you haven't written anything. 2-3 problems will be selected on each homework assignment and you will be graded only on these.

Software: One of the goals of this course is to allow you to analyze data sets, some of which may be large. We will be using *R*, a free software available on the web.

Exams: There will be a mid-term exam on Wednesday, October 30 and a final exam, which will probably be a take-home exam involving some modeling, to be due no later than on December 16, 3 p.m. **I will not give a make-up midterm.** If you are forced to miss it due to illness, I need to be notified within 24 hours. When you are healthy again we can discuss reweighing your grades. I will need to see original written documentation in the form of a letter from your doctor.

Grades: Your homework grades will be worth a total of 35% of your final grade. The mid-terms and the final will be worth 30% and 35% of your final grade, respectively. Your letter grade will be determined by the following table:

93+	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	<60
A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

To obtain an A+ for the course, you need a numerical average of 98.0 **before rounding**.

Dropping, Adding, and Withdrawing:

Monday, September 2: Last day to add a course
Thursday, September 5: Conversion Day; Classes follow a Monday Schedule
Monday, September 16: Last day to drop a course without a grade
Tuesday, November 5: Last day to withdraw from a course with a W grade

Website: All necessary course documents, including lecture notes, will be available at

http://userhome.brooklyn.cuny.edu/cbenes/timeseries.html

University's policy on Academic Integrity: The faculty and administration of Brooklyn College support an environment free from cheating and plagiarism. Each student is responsible for being aware of what constitutes cheating and plagiarism and for avoiding both. The complete text of the CUNY Academic Integrity Policy and the Brooklyn College procedure for implementing that policy can be found at this site: `http://www.brooklyn.cuny.edu/bc/policies`. If a faculty member suspects a violation of academic integrity and, upon investigation, confirms that violation, or if the student admits the violation, the faculty member *must* report the violation.

Center for Student Disability Services: In order to receive disability-related academic accommodations students must first be registered with the Center for Student Disability Services. Students who have a documented disability or suspect they may have a disability are invited to set up an appointment with the Director of the Center for Student Disability Services, Ms. Valerie Stewart-Lovell at 718-951-5538. If you have already registered with the Center for Student Disability Services please provide your professor with the course accommodation form and discuss your specific accommodation with him/her.

Math 4506 Lecture and Exam Schedule

This syllabus is intended only as a rough guideline. All topics are subject to changes without notice.

Class#	Date	Chapters	Topics
1	08/28 (W)		Introduction and overview; probability basics
2	09/04 (W)		Multivariate random variables; multivariate normal
3	09/05 (H)	1, 2	Model-building; stationarity
4	09/09 (M)	2, 4	Linear Processes
5	09/11 (W)	4	MA processes
6	09/16 (M)	4	AR processes
7	09/18 (W)	4	Autocovariance of AR processes
8	09/23 (M)	4	Autocovariance of AR processes
9	09/25 (W)	4	Causality and Invertibility
10	10/02 (W)	4	ARMA processes
11	10/07 (M)	4	ACF of ARMA processes
12	10/16 (W)	3	Estimation of ACF and tests for the residual sequence
13	10/21 (M)	3, 8	Estimation of ACF and tests for the residual sequence
14	10/23 (W)	3, 4	Inference; trend and seasonal variation
15	10/28 (M)	5	Differencing
16	10/30 (W)		**MIDTERM EXAM**
17	11/04 (M)	5	Differencing and ARIMA models; logarithmic transformations
18	11/06 (W)	6	Partial autocorrelation function
19	11/11 (M)	6	Yule-Walker estimation
20	11/13 (W)	6, 7	Model fitting and parameter estimation
21	11/18 (M)	9	Forecasting
22	11/20 (W)	8, 9	Forecasting
23	11/25 (M)	7, 9	Maximum likelihood estimation
24	11/27 (W)	8	Model Diagnostics
25	12/02 (M)	9	Forecasting; exponential smoothing
26	12/04 (W)		Additional Topics
27	12/09 (M)		Additional Topics
28	12/11 (W)		Additional Topics

FINAL EXAM: Monday, December 16, 1-3 p.m.

A Suggested Contract

To make sure that we all benefit from this course as much as possible, I am including a "contract" telling you what you can expect from me and what I expect from you.

Your side of the contract

Your main goals as college students should be to become educated citizens and prepare for professional life. It is a privilege to get a higher education, but performing well at a university or college rarely comes without serious effort. The points below give a few suggestions on how to make the best of your experience in the classroom.

- Be responsible! Read the syllabus and know the rules of the course. Read every handout I give you. I choose to spend time preparing them for your benefit, so you should spend time reading them. (In fact, handouts take WAY MORE time to prepare than to read.) It will help you be much more successful in the class.
- Use your time well. If your weekly schedule is tight (as I know it is for many of you), the 3 hours we'll be spending in class together are precious time for you. Make sure you stay focussed and ask whenever something is not clear. As long as we don't run behind, I will try to answer all your questions. If we don't have time to cover them in or after class, come to my office hours or e-mail me.
- Give the material a fair chance. People often dislike mathematics because it's difficult. If you've made it this far, you must find some pleasure in intellectual activities and should be able to find some beauty and stimulation in mathematics (many people do, so there has to be something good about it).
- Be willing to learn from your mistakes. Even the best mathematicians make mistakes all the time. What makes them good thinkers is that they use these mistakes to understand problems better and realize what is the right approach to solve them.
- Be respectful of your peers and of me. If you talk in class, you'll be bothering someone. Don't let your phones ring. Don't type text messages in class. My sharp X-ray eyes will see you doing so, even if you type under your desk.
- Be sure to subscribe to appropriate e-mail etiquette. (See "The Golden Rules of E-mail Correspondence")

My side of the contract

My role as a professor is to present the material to you as clearly as I can, to respect you as students willing to learn, to answer your questions and advise you on how to study better. I am here to assist you in your task of becoming educated citizens. My role is not to simplify the material or give out good grades freely. This would be insulting to you (even if I know some students wouldn't complain). However, my role is to make the material as accessible to you as I can, to point out connections to the real world, to prepare handouts whenever these may be helpful. I have a large number of students and cannot reach out individually to each one. However, if you seek help, I will never turn you down.

- I will prepare a clear syllabus and, whenever I think it may be helpful to you, prepare handouts.
- I will teach with enthusiasm and try not to bore you (but you may also have to try not to be bored by having a positive attitude). I will challenge you and do my best to help you learn the material and, more importantly, help you retain it.
- I will answer your questions (unless the information you seek is on the syllabus or you don't conform to correct e-mail etiquette) about the course material, even if it sometimes requires writing e-mails at 2 a.m. or on a Saturday night. I will listen to your requests to go more extensively over material you didn't understand.
- I won't be disrespectful to you by lowering the level of the course. On one hand, it would be insulting your intelligence. On the other, it is important that Brooklyn College stand up to national standards, so that your degree can be regarded as highly as any other when you look for a job.
- I won't answer my phone in class. I won't interrupt lectures to send text messages to my friends.
- I will use an e-mail address from which you can tell right away who is writing to you. I will sign my e-mails. I will read through my e-mails once I'm done writing them to check that what I wrote makes sense and that there are no spelling mistakes.

The Golden Rules of E-mail Correspondence

- Check your e-mail daily, whenever possible.
- Don't **ever** send me an attachment of more than 500kb without asking for my permission first. If I receive too many large attachments at once, my mailbox might reach its storage limit, causing my account to be blocked.
- Use an appropriate e-mail address. You and I are in a professional relationship and our electronic communications should reflect that. Don't write to me from an address such as "darkangel3472@aol.com" (unless your name really is Dark Angel). Your full name MUST appear in the header of each e-mail you send me. If you don't want to use your Brooklyn College e-mail address, get a gmail account for professional purposes and let your address be "[first name].[last name]@gmail.com". It takes 5 minutes to create such an account.
- When you correspond with your professors or employers, e-mail is a formal means of communication (unlike text messages). The use of simple words such as "please" and "thank you" is strongly encouraged. Do not use abbreviations or slang. Use capital letters, punctuation, greetings, and salutations. Don't start an e-mail with "Hey!" and don't forget to sign it. Don't send me any Linkedin or Facebook invitations. I am not your buddy, even though I'll be happy if we have a friendly interaction.
- Do not e-mail me to let me know you were not in class (I will already know) or to let me know that you will be missing a class. If you must miss several classes due to illness, injury, or serious personal reasons, please do let me know, so that I can try to help you not to fall behind.
- Before sending your e-mail, read it! If you don't check for spelling, grammar, or logical mistakes, you are wasting someone else's time by trying to save yourself a few seconds. Honest mistakes are acceptable (you are not expected to be a proficient speller, but it should be your goal to become one); sloppy mistakes are impolite.

Below are two samples of e-mails that I received from students. These e-mails are unacceptable (even though they provided me with great entertainment). Note that they are slightly modified to preserve the students' privacy.

1. From: sinbad9705@gmail.com

   Subject: can i cum to class tomorro

   Date: November 27, 2007 8:58:37 PM EST

   To: CBENES@brooklyn.cuny.edu

   Hello Prof.

   Its been a long time. How have you bin? I was just wondering if I could attend class tomorrow, since I dont have any classes tmorrow

2. From: sweetangel1342@aol.com

   Subject:

   Date: December 03, 2007 3:12:24 PM EST

   To: CBENES@brooklyn.cuny.edu

   When are your office hours?

Here are a few reasons why these e-mails are inappropriate:

- Neither e-mail was signed. None of the e-mail addresses reflected names of students I had at the time (I checked; no Sweet Angel or hero from the "1001 nights" were in my class). Therefore, I had no way of knowing who they were from and didn't respond.
- Please never ask me if you can come to class. Once you are registered for the class, it is clear that you are welcome to attend. In fact, believe it or not, it is even encouraged. Please never ask me when my office hours are, on what date the next exam is, or when a homework is due. All this information is on the syllabus.
- The first e-mail hasn't been spell-checked. "tmorrow" and "bin" are sloppy typos (I presume Sinbad knows that the words are spelled "tomorrow" and "been") and you don't "cum to class" but "come to class". Both of these mistakes look very bad. If you ever make typos like these in a letter to a future employer, there's a good chance that you won't be invited to an interview, so make sure you raise your standards as early on as you can.
- The second e-mail has no salutation nor subject. I usually don't even open e-mails without a subject since they may be spam (I get dozens of professional e-mails every day and don't have time to filter out spam carefully).