

## EE 5324 STATISTICAL ESTIMATION AND DETECTION Spring 2019

- Course Description: (Proposed) Application of statistical decision theory and estimation theory to problems of communication systems, including radar and sonar. Narrowband signals, gaussian derived processes, hypothesis testing, detection of signals, and estimation of signal parameters.
- Background: This is a graduate-level introduction to the principles of detection and estimation using probabilistic models. The material in this course constitutes a common foundation for work in machine learning, signal processing, pattern recognition, computer vision, control, and communication.
- Pre-requisites: Background on probabilities and random processes similar to that provided in provided in EE 5300. We will provide short reviews in the course.
- Prerequisites by Topic:
1. Probability Theory
  2. Random processes
  3. Matrix algebra
  4. Fourier (CTFT, DTFT, and DFT), Laplace, and Z Transforms
  5. Signals and Systems.
  6. Random processes and linear systems (reviewed in class)
- Textbook: L.C. Ludeman, **Random Processes: Filtering, Estimation, and Detection**, John Wiley & Sons, 2003.
- References:
1. H. Van Trees, K.L. Bell, and Z. Thian, **Detection, Estimation, and Modulation Theory**, 2nd Edition, John Wiley 2013. (One of the best books in the subject)
  2. S.M. Kay, **Intuitive Probability and Random Processes using MATLAB**, Springer, 2012. (used in EE 5300)
  3. Kung Yao, Flavio Lorenzelli, Chiao-En Chen, **Detection and estimation for communication and radar systems**, Cambridge University Press, 2013. Available from
  4. J. Shynk, **Probability, Random Variables, and Random Processes: Theory and Signal Processing Applications**, Wiley-Interscience, 2012.
  5. Thomas A. Schonhoff, Arthur A. Giordano, **Detection and estimation theory and its applications**, Prentice Hall, 2006.
  6. M. Barkat, **Signal Detection and Estimation**, Second Edition, Artech House Inc, 2005.
  7. K. Sam Shanmugan, Arthur M. Breipohl, **Random signals: detection, estimation, and data analysis**, Wiley, c1988.
  8. Louis L. Scharf nad Cédric Demeure, **Statistical signal processing : detection, estimation, and time series analysis**, Addison-Wesley Pub. Co., 1991.
  9. H. Stark and J.W. Woods, **Probability, Statistics, and Random Processes for Engineers**, 4th Edition, Prentice Hall, 2011.
  10. B.C. Levy, **Principles of Signal Detection and Parameter Estimation**, Springer, 2008
  11. S.M. Kay, **Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory**, Prentice Hall 1998.
  12. S.M. Kay, **Fundamentals of Statistical Signal Processing, Volume II: Detection Theory**, Prentice Hall, 1998.

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- Office Hours: Mon & Wed 10:00 am to 12:00 pm and by appointment. **I can also answer your questions via e-mail. YOU HAVE TO READ YOUR E-MAIL at utep.edu FOR CLASS ANOUNCEMENTS.**
- Blackboard: We will be using the Blackboard learning management system in the course. Please pay attention to class announcement and all course handouts will be available in electronic format there. I will not hand out hard copies.
- Academic Honesty Group discussions of homework is acceptable. However, you are not allowed to share your code or homework results. The document handed to the professor must only show your work. Copying during an exam is prohibited. You will be allowed to bring a formula sheet to the exams and a basic scientific calculator. You are not allowed to copy code from any sources in computer-based homework. Any code used for any homework problem must be your own. If you are found to be cheating or plagiarizing, you will be subject to disciplinary action, per UTEP catalog policy.
- Grading policy: Your final grade will be based on two to three partial exams (50 %), a final exam (35%), literature review (5%), and homework (10 %).
- Grade assignment:
- |             |   |
|-------------|---|
| At least 90 | A |
| At least 80 | B |
| At least 70 | C |
| At least 65 | D |
| 64 or less  | F |
- There will be a “gray area” between two-letter grades, so that two people getting the same weighted average could get different letter grades. If you are in one of these gray areas, whether you get a higher or lower grade depends primarily on two factors: (a) class participation, attendance, and timeliness of your work; and (b) whether your performance has been improving or declining.
- An **incomplete** grade is given **only** for a valid reason when arrangements have been made with me and, in that case, only if the student was passing the course.
- Classroom Etiquette: Part of being a professional is being on time and being prepared to do your job. This applies to your career as a student as much as it does to your future career as an engineer. You are expected to be in class and prepared to participate at the scheduled start time. Wireless devices (cell phones, PDA’s, MP3 players, Smart phones, etc.) are allowed in the classroom. It is recognized that devices of this sort provide emergency access for your family and loved ones. However, please use professional discretion with these devices. This includes shutting them off or setting them in the silent mode before coming to class. Do not use text messaging or web browser features while you are in class. If you must answer the phone, please do so after discretely leaving the room. You may return to class once your call is finished.

Center for  
Accommodations and  
Support Services  
(CASS):

If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to [cass@utep.edu](mailto:cass@utep.edu), or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at <https://www.utep.edu/student-affairs/cass/>.

**List of Topics (Tentative):**

1. Review of Probabilities
2. Estimation Theory: Static case
3. Parameter Estimation
4. Detection Theory: Static Case
5. Review of Random Processes
6. Review of Linear System Models
7. Estimation of Signal Parameters
8. Estimation of Random Processes
9. Detection of Random Processes

**Computer Usage:** Use of MATLAB in homework to complement class discussions