Probability and Random Processes
ECS 315

Asst. Prof. Dr. Prapun Suksompong

(ผศ.ดร.ประพันธ์ สุขสมปอง)

prapun@siit.tu.ac.th

Introduction

Office Hours:
BKD, 6th floor of Sirindhralai building
Wednesday	**13:45–15:15**
Friday	**13:45–15:15**

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Course Website

prapun.com

Asst. Prof. Dr.Prapun Suksompong (ผศ.ดร.ประพันธ์ สุขสมปอง) is currently the Chairperson of Electronics and Communication Engineering (ECS) Curriculum at Sirindhorn International Institute of Technology (SIIT), Thammasat University, Thailand. In 1997, he received the King's Scholarship to study in the School of Electrical and Computer Engineering (ECE) at Cornell university. He topped the Cornell ECE class of 2002, with the highest GPA among all engineering students. He then received the Cornell's fellowship for his graduate study. Prapun joined Prof. Toby Berger's group in 2003 and got his Ph.D. in 2008.

Right after his graduation, he started his teaching career at SIIT. His research interest is in the areas of communication theory, information theory, probability theory, and theoretical neuroscience. In 2012, he (along with two other faculty members in the Wireless Communication Research Group) received the 2011 SIIT Research Award. In 2014, he received the 2013 Outstanding Young Researcher Award (รางวัลนักวิจัยรุ่นใหม่ดีเด่นระดับคณะ ประเภทอาจารย์) from Thammasat University.

Aiam Prapun always highly values the teaching aspect of his career and his life. Many of his notes are available on his personal websites. In 2006, he received the Teaching Assistant of the Year Award from members of the Cornell IEEE Student Branch "for exemplary teaching in ECE". In 2010 and in 2014, he also received the Best Teaching Awards from SIIT.

For more information, here is his CV. (Download pdf version.)

Teaching

- For 1/2017, he teaches
  - ECS315 (Probabilit...
  - ECS332 (Principles...
- For 3/2016, he taught
  - ICT Elementary for communications)
- For 2/2016, he taught
  - ECS452 (Digital C...
  - ECS455 (Mobile C...
- For 1/2016, he taught
  - ECS315 (Probabilit...
  - ECS332 (Principles...

Current version

Last-year version

**Teaching**

- For 1/2017, he teaches
  - ECS315 (Probability and Random Processes)
  - ECS332 (Principles of Communications)
- For 3/2016, he taught
  - ICT Elementary for Embedded Systems (Fourier transform and principles of communications)
- For 2/2016, he taught
  - ECS452 (Digital Communication Systems)
  - ECS455 (Mobile Communications)
- For 1/2016, he taught
  - ECS315 (Probability and Random Processes)
  - ECS332 (Principles of Communications)

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Me?

- Ph.D. from **Cornell** University, USA
- In Electrical and Computer Engineering
- Minor: Mathematics (Probability Theory)
- Ph.D. Research: Neuro-Information Theory
- Current Research: Wireless Communications
- 2009 and 2013 SIIT Best Teaching Awards
- 2011 SIIT Research Award
- 2013 TU Outstanding Young Researcher Award
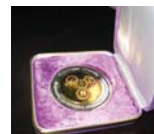
prapun.com

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Getting Info About This Course

- The **syllabus** contains tentative information.

Announcements {

- I will announce **in class** and on the **website** if there is any change.
- You are **responsible** for making sure that you obtain this information.
- Come to classes **on time** and listen carefully for **announcement(s)**.

- For those who want a preview of the class materials, old slides along with the notes and HW from earlier years are available on my web site (**prapun.com**).
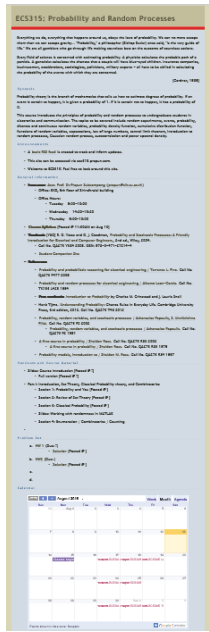
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Course Website

- Announcements
- References
- Handouts (Posted before corresponding lectures)
- Annotated Notes/Slides (Posted after corresponding lectures)
- Calendar
  - Exams
  - HW due dates

Please check the course website regularly.

www2.siit.tu.ac.th/prapun/ecs315/

Course Organization

- **Course Website:**
  http://www2.siit.tu.ac.th/prapun/ecs315/
- **Lectures:**
  - **Tuesday   10:40-12:00   BKD 2601**
  - **Thursday   13:00-14:20   BKD 2401**
- Tutorial/Exercise/Make-up sessions:
  - **Wednesday   09:00-10:20   BKD 2601 (Shared with ECS332)**
- **Textbook:**
  - Probability and stochastic processes: a friendly introduction for electrical and computer engineers
    - By Roy D. Yates and David J. Goodman
    - 2nd Edition
    - ISBN 978-0-471-27214-4
    - Library Call No. QA273 Y384 2005
    - Student Companion Site:
      http://bcs.wiley.com/he-bcs/Books?action=index&itemId=0471272140&bcsId=1991
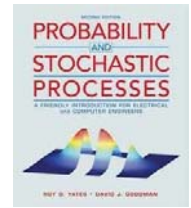
Course Website: Notes & Slides

- Some **PDF notes/slides** will be posted *before* the corresponding lectures.
  - Hard copies can also be purchased from the **copy center**.
- In lectures…
  - PDF notes/slides will be highlighted and annotated with examples / comments.
    - **Put all of your energy into understanding the material**.
  - The slides and annotated notes will be **posted** *after* the corresponding lectures.
- **Remind** (email) me the day after the lecture if the annotated notes/slides from the day before are still not posted on the web.

The Wednesday Sessions

- We will use most of them.
- The first 4-5 sessions will be used for ECS315 **tutorial/review** classes.
  - Chapter 4 of the lecture notes (Enumeration / Combinatorics / Counting)
- Later, we will start using them as tutorial sessions.
  - Will be conducted **in Thai** to help those who have problem with English.
    - Hopefully, you will ask more questions as well.
  - After the midterm, those whose scores are below the median will be required to attend.
- They can also be used for pre-announced in-class exercises as well.

ECS 315: Course Outline

1. Introduction, Set Theory, Classical Probability
2. Combinatorics: Four Principles and Four Kinds of Counting Problems
3. Probability Foundations
4. Event-based Conditional Probability
5. Event-based Independence
6. Random variables, Support, Probability Distribution
7. **MIDTERM: 5 Oct 2017 TIME 15:00 - 17:00**
8. Discrete Random Variables
9. Families of Discrete Random Variables and Introduction to Poisson Processes
10. Real-Valued Functions of a Random Variable
11. Expectation, Moment, Variance, Standard Deviation
12. Continuous Random Variables
13. Families of Continuous Random Variables and Introduction to Poisson Processes
14. Multiple Random Variables
15. Correlation, Covariance, Limiting Theorems
16. Mixed Random Variables, Introduction to Random Vectors and Random processes
17. **FINAL: 12 Dec 2017 TIME 09:00 - 12:00**

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More References (in Thai)

- ความน่าจะเป็นและสถิติสำหรับวิศวกรรมไฟฟ้า
  - ผู้แต่ง: มานพ วงศ์สายสุวรรณ และคณะ
  - ISBN : 9789740324164
- ความน่าจะเป็น :สำหรับวิทยาศาสตร์และวิศวกรรมศาสตร์ (PROBABILITY)
  - ผู้แต่ง : สายชล สินสมบูรณ์ทอง
  - ISBN : 9789740329053
- ทฤษฎีความน่าจะเป็น – Probability Theory
  - ผู้เขียน: ผู้ช่วยศาสตราจารย์วัลลภ เฉลิมสุวิวัฒนาการ
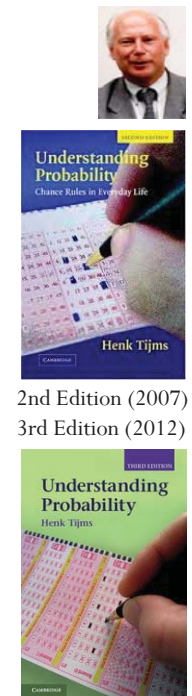 - ISBN 9789749918760

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More references

- Use ones that say probability and random (or stochastic) processes
- If it has the word "statistics" in the title, it may not be rigorous enough for this class
  - Many chapters will overlap our class content. In which case, it provide a nice reading with beautiful/colorful figures.
- If it has the word "measure" or "ergodic" in there, it is probably too advanced.

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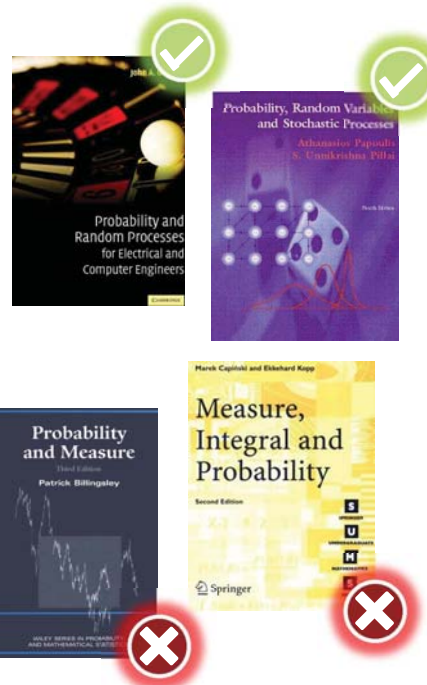
Recommended Reading

- Understanding Probability: Chance Rules in Everyday Life
- By Henk Tijms
- Call No. QA273 T48 2012
- Cambridge University Press
- "Part One" provides many motivating examples and problems from everyday life
- "Part Two" teaches clearly and simply the mathematics of probability theory.
- Sample materials are available at the author's website: http://personal.vu.nl/h.c.tijms/
- http://www.cambridge.org/aus/catalogue/catalogue.asp?isbn=9781107658561&ss=exc

2nd Edition (2007)
3rd Edition (2012)

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Calendar

Tutorials / Make-up

M	T	W	R	F
14-Aug-17	15-Aug-17	16-Aug-17	17-Aug-17	18-Aug-17
21-Aug-17	22-Aug-17	23-Aug-17	24-Aug-17	25-Aug-17
28-Aug-17	29-Aug-17	30-Aug-17	31-Aug-17	1-Sep-17
4-Sep-17	5-Sep-17	6-Sep-17	7-Sep-17	8-Sep-17
11-Sep-17	12-Sep-17	13-Sep-17	14-Sep-1	
18-Sep-17	19-Sep-17	20-Sep-17	21-Sep-17	22-Sep-17
25-Sep-17	26-Sep-17	27-Sep-17	28-Sep-17	29-Sep-17
2-Oct-17	3-Oct-17	4-Oct-17	5-Oct-17	6-Oct-17
9-Oct-17	10-Oct-17	11-Oct-17	12-Oct-17	-Oct-17
16-Oct-17	17-Oct-17	18-Oct-17	19-Oct-17	20-Oct-17
23-Oct-17	24-Oct-17	25-Oct-17	26-Oct-17	27-Oct-17
30-Oct-17	31-Oct-17	1-Nov-17	2-Nov-17	3-Nov-17
6-Nov-17	7-Nov-17	8-Nov-17	9-Nov-17	10-Nov-17
13-Nov-17	14-Nov-17	15-Nov-17	16-Nov-17	17-Nov-17
20-Nov-17	21-Nov-17	22-Nov-17	23-Nov-17	24-Nov-17
27-Nov-17	28-Nov-17	29-Nov-17	30-Nov-17	1-Dec-17
4-Dec-17	5-Dec-17	6-Dec-17	7-Dec-17	8-Dec-17
11-Dec-17	12-Dec-17	13-Dec-17	14-Dec-17	15-Dec-17

Lectures

Exams

Please Double-Check Exam Dates!

Grading System

- Coursework will be weighted as follows:

Assignments	5%
In-Class Exercises	5%
Class Discussion/Participation	10%
Midterm Examination	35%
Final Examination (comprehensive)	45%

- Mark your calendars now!
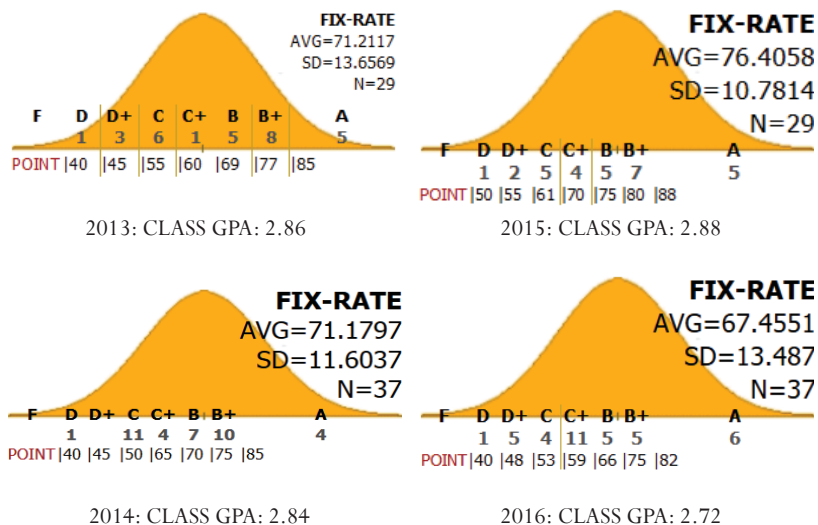- Late HW submission will be rejected.

Please Double-Check Exam Dates!

Calendar (Google)

Available on the course website.

ECS315: Probability and Random Processes

Events shown in time zone: Bangkok

Grading System

FIX-RATE AVG=71.2117 SD=13.6569 N=29

| F | D | D+ | C | C+ | B | B+ | A |
| 1 | 3 | 6 | 1 | 5 | 8 | | 5 |
POINT |40 |45 |55 |60 |69 |77 |85

2013: CLASS GPA: 2.86

FIX-RATE AVG=76.4058 SD=10.7814 N=29

| F | D | D+ | C | C+ | B | B+ | A |
| | 1 | 2 | 5 | 4 | 5 | 7 | 5 |
POINT |50 |55 |61 |70 |75 |80 |88

2015: CLASS GPA: 2.88

FIX-RATE AVG=71.1797 SD=11.6037 N=37

| F | D | D+ | C | C+ | B | B+ | A |
| | 1 | | 11 | 4 | 7 | 10 | 4 |
POINT |40 |45 |50 |65 |70 |75 |85

2014: CLASS GPA: 2.84

FIX-RATE AVG=67.4551 SD=13.487 N=37

| F | D | D+ | C | C+ | B | B+ | A |
| | 1 | 5 | 4 | 11 | 5 | 5 | 6 |
POINT |40 |48 |53 |59 |66 |75 |82

2016: CLASS GPA: 2.72

In-Class Exercises

- Most in-class exercises will occur **without** prior warning or announcement.
  - Focus on the current topic under discussion.
- Done **in group** to **reduce pressure** and provide **opportunity**
  - for those who think they understand the course material to **explain** to their friends and see whether they really know the material under consideration

    and
  - for those who are falling behind to get an **alternative explanation** from their peers
- Note that you **can't be in exactly the same group every time**.
  - Have to change your group members every time.
  - If you are with a friend before, then next time, form a group with someone else.

Class Participation

- NOT the same as class attendance!
- If you come only to **receive**, you will fall **asleep**.
  - Do not simply sit quietly in the class.
- Need **interaction** between lecturer and students.
- **Ask question** when there is something that you don't understand.
  - Don't be shy!
  - It is very likely that your friends don't understand it as well.
- If you already understand what I'm presenting, SHOW ME!
  - Point out the errors/typos.
  - I will raise many issues/questions in class. Try to comment on them.

Class Participation (2)

- Record what you have done.
  - To be submitted right after the midterm and right after the final.

ECS 315: Self-Evaluation 2017

1. The class participation score for this class is judged by how much you actively participate in the class discussion both inside and outside of the classroom.
2. Please honestly answer the following questions. Please provide as much information as possible. Do not include the activities that you have already stated in the first self-evaluation form.

Name

Student ID

How many times have you been absent from the class? Are there any specific reason(s)? Please explain.

How many times have you been late (> 30s) for the class? Are there any specific reason(s)? Please explain.

How many times have you participated (provided comments, asked questions, answered questions, etc) in the lectures? Be specific. Provide some short description for each event. Number alone does not count.

How many times have you correctly informed the instructors the typo or mistake on the whiteboard/slides/hw/etc? Please provide some short description about each of the issues.

How many times have you discussed with the instructor outside of class? (Ask questions, express concerns, etc.) Be specific.

Policy

Based on the clock on my computer. (This should be approx. the same as your phone's and computer's clocks if they are synchronized properly.)

- We will start the class on time and will finish on time.
  - I recommend arriving at least 3 minutes before the start time.
  - Raise your hand and tell me immediately if I go over the time limit.
    - Does NOT mean that I will leave the room immediately after lecture.
    - I will stay and answer questions.
- Mobile phones *must* be turned off or set in silent mode.
- Attendance will be taken/given irregularly and randomly.
- Cheating will not be tolerated.
- Feel free to stop me when I talk too fast or too slow.

Policy (con't)

- I will surely make some **mistakes** in lectures / HW / exams.
  - Some amount of class participation scores will be reserved to reward the **first** student who informs me about each of these mistakes.
    - Grammatical errors are best informed/corrected after class.
- Points on HW / exercises / exams are generally based on your entire solution, not your final answer.
  - You may get full credit even when you have the wrong final answer.
  - You may get **zero** even when you write down a right answer without justification.

Policy (con't)

- Please stop me if I go over the time limit.
- Please stop me if I talk too fast.
- Please stop me if you have any question.

Help and Office Hours

- Get some help!
  - Do not wait until the final exam time or after the grade is out.
  - Right after lecture is always a good time to ask question.
- Office Hours
  - Tentative Time: W,F 13:45-15:15
  - Check Google Calendar on the course website.
  - Appointment can be made.
  - Feel free to come to my office and chat!
  - Don't be shy.

	9.00-10.20	10.40-12.00	13.00-14.20	14.40-16.00	16:00-17:00
MON		Office Hour		JAE MEETING	
TUE		ECS315 BKD 2601		Office Hour	
WED	ECS315/332 BKD 2601	ECS332 BKD 2601	Office Hour		
THU			ECS315 BKD 3401	Office Hour	
	Office Hour	ECS332 BKD 2606	Office Hour		

Asst.Prof.Dr.Prapun Suksompong - 1/2017

Office Hours:
BKD, 6th floor of Sirindhralai building
Wednesday   13:45–15:15
Friday   13:45–15:15

Prerequisite

- Working knowledge of calculus
- Some MATLAB skills for doing HWs and understanding in-class demo
- Frequency domain analysis (Fourier transform)

Soon, we will need to find

$$\int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx = ?$$

Bell curve

$$\mathcal{F}\left\{ \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} \right\} = ?$$

Remarks

- Get as much **legitimate** help as you can
- **Participate actively in class** and outside of class
  - Record what you have done.
- If you feel that the class is very easy, you might overlook something.
- If you feel that the class is very difficult, you are probably not the only one who feel that way.
  - Don't give up. Chat with me.
  - It takes me a long time to feel comfortable with these materials; yet, I still make mistakes.
- My notation can be different from the textbook.
  - Every notation has some advantages and disadvantages.

Easier References

For those who feels that this course is difficult, here are some easier references.
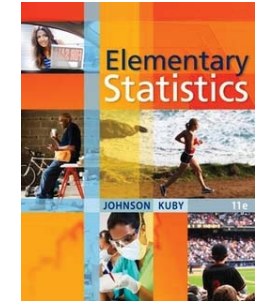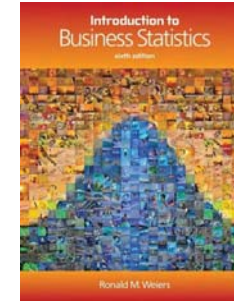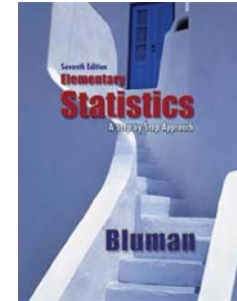
More beautiful pictures. Less technical.
Less applicable for content after the midterm.

Need More Examples or Practice?

- Textbook in the library: Schaum's outline of theory and problems of probability, random variables, and random processes / Hwei P. Hsu. Call No. QA273.25 H78 1997
- Free pdf textbook: Introduction to Probability by Grinstead and Snell
  http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/book.html