

# Analyzing the impact of class scheduling at CSULB on graduation rates

Burkhard Englert & Chung-min Lee

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# Members

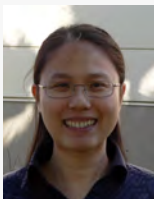
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# Background

Course scheduling aims to minimize, e.g.

- unused time slots for classrooms
- time between classes for students
- time for students to graduate

Scheduling problems

- are computationally difficult, and
- the objectives may be in conflict such as maximizing classroom usage vs. providing course access to students

# Background

Course scheduling in CSULB is handled in departments,

- advantages
  - maximize classroom usage within departments
  - address the individual faculty teaching preferences
- without coordination
  - students with degree required courses in multiple departments may not be able to take courses in the recommended semesters and hence delay progress

# Goals and aims of the study

Investigate the class schedule constraints students face when attempting to graduate in four years

- Following degree roadmaps, do actual class schedules allow FTF students to graduate in four years?
- If yes, what schedule would a FTF student need to complete to graduate?
- What impact would such a schedule have on a student who needs to work to support her/himself?
- Where are the scheduling bottlenecks that affect students progress? How to eliminate them?

# Scope of the study for academic year 2017 – 2018

- Develop a program that utilizes actual course offerings to show scheduling conflicts
- Develop a simulation algorithm that estimates the percentage of the students affected by scheduling conflicts
- Analyze highly impacted Bachelor degree programs

# Class conflict program

We extract from university websites actual course schedules during Fall 2012 to Fall 2016, and build a small local database for analyzing course conflicts.

Subject	Section	Class Nbr	Title	Units	Components	Days	Begin Time	End Time	Facility	Enrollment C	Enrollment A	Waitlist	Unenrolled	Perm	Faculty
2 A/ST 190	1	1002	Tao Primer o	3	LEC					0	0	0	0	0	Closed
3 A/ST 299	1	9422	Directed Study	3	LEC	TBA				0	0	0	0	0	Open Yamada, Terry R
4 A/ST 306	1	9423	Traditional A	3	LEC	Mon	09:30pm	04:45pm	LAS-267	42	33	0	0	0	Open Yamada, Terry R
5 A/ST 307	1	9423	Modern Asia	3	LEC	W	05:00pm	07:45pm	LAS-267	42	33	0	0	0	Open Yamada, Terry R
6 A/ST 393	1	9023	Japan's Herit	3	LEC	M	05:00pm	07:45pm	LAS-267	40	29	0	0	0	Open Tsuchida, John N
7 A/ST 492	1	9024	Proseminar I	3	SEM					0	0	0	0	1	Closed

...

8350 Phvs 1008	15	1	10682 General Phyl	0	LAB					0	0	0	0	0	Closed
8351 Phvs 151	1	1	6684 Mechanics ai	4	SEM	Mon	05:30pm	06:45pm	AS-244	60	62	0	0	0	Closed Iakkumar, Prashu
8352 Phvs 151	2	1	2552 Mechanics ai	4	SEM	Mon	10:00am	10:50am	HSC-100	170	160	0	0	0	Open Pickett, Garen T
8353 Phvs 151	3	1	7949 Mechanics ai	4	SEM	TuTh	08:00am	09:15am	HSC-102	170	112	0	0	0	Open Chung, Kuanwen
8354 Phvs 151	4	1	2553 Mechanics ai	4	SEM	TuTh	09:30pm	04:45pm	Ph-1541	80	84	0	0	0	Closed Nishino, Hiroshi
8355 Phvs 151	5	1	6729 Mechanics ai	0	LAB	M	10:00am	12:45pm	HSC-232	24	23	0	0	0	Open Stankovic, Jasmi
8356 Phvs 151	6	1	2553 Mechanics ai	0	LAB	M	02:00pm	09:45pm	HSC-232	24	24	0	0	0	Closed Kuan, Hanming
8357 Phvs 151	7	1	5862 Mechanics ai	0	LAB	M	04:00pm	06:45pm	HSC-232	24	23	0	0	0	Open Diaz Pinzon, San
8358 Phvs 151	8	1	2554 Mechanics ai	0	LAB	Tu	07:00pm	09:45pm	HSC-232	24	24	0	0	0	Closed Stankovic, Jasmi
8359 Phvs 151	9	1	2555 Mechanics ai	0	LAB	Tu	10:00am	12:45pm	HSC-232	24	23	0	0	0	Closed Sadegh, Hamed
8360 Phvs 151	10	1	5652 Mechanics ai	0	LAB	Tu	01:00pm	09:45pm	HSC-232	24	24	0	0	0	Closed Mollavi, Arabshah
8361 Phvs 151	11	1	2556 Mechanics ai	0	LAB	Tu	04:00pm	06:45pm	HSC-232	24	16	0	0	0	Open Sadegh, Hamed
8362 Phvs 151	12	1	2557 Mechanics ai	0	LAB	W	10:00am	12:45pm	HSC-232	24	15	0	0	0	Open Stankovic, Jasmi
8363 Phvs 151	13	1	2558 Mechanics ai	0	LAB	W	02:00pm	09:45pm	HSC-232	24	23	0	0	0	Open Diaz Pinzon, San
8364 Phvs 151	14	1	5867 Mechanics ai	0	LAB	W	04:00pm	06:45pm	HSC-232	24	25	0	0	0	Closed Yipsh, Ryan E
8365 Phvs 151	15	1	6294 Mechanics ai	0	LAB	Th	04:00am	10:45am	HSC-210	24	14	0	0	0	Open Stankovic, Jasmi

...

# Class conflict program

For example, in Spring 2013 the actually offered courses required for a second semester Computer Engineering are:

**Select College**

College of Engineering

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**URL**

<http://web.csulb.edu/shims/maj/catalog/2012-2013/readmap.html>

---

**Select Course**

Computer Engineering

---

**Semester**

Spring

---

**Year**

2012

---

**Batch Size**

0

---

**Iteration Count**

0

---

Get Conflicts

### Schedule Data With Conflicts (Color)

Subject	Section	Class_Rtr	Title	Units	Color	Components	Days	Begin_Time	End_Time	L_Time
* CECS 105	2	5310	Introduction to CECS	1	Color	SEM	F	10:00am	10:50am	10:00:00
CECS 105	4	6326	Introduction to CECS	1		SEM	M	03:00pm	03:50pm	13:00:00
CECS 105	5	6355	Introduction to CECS	1	Color	SEM	W	03:00pm	03:50pm	13:00:00
CECS 174	1	5268	Intro Prog & Probab...	3	Color	SEM	MW	02:00pm	03:50pm	14:00:00
CECS 174	2	2886	Intro Prog & Probab...	0	Color	LAB	MW	03:00pm	04:15pm	15:00:00
CECS 174	3	5105	Intro Prog & Probab...	3	Color	SEM	TuTh	08:00am	08:50am	08:00:00
CECS 174	4	5106	Intro Prog & Probab...	0	Color	LAB	TuTh	09:00am	10:15am	09:00:00
CECS 174	5	6351	Intro Prog & Probab...	3	Color	SEM	MW	05:00pm	05:50pm	17:00:00
CECS 174	6	6352	Intro Prog & Probab...	0	Color	LAB	MW	06:00pm	07:15pm	18:00:00
CECS 174	7	6325	Intro Prog & Probab...	3	Color	SEM	TuTh	09:30am	10:20am	09:30:00
CECS 174	8	6328	Intro Prog & Probab...	0	Color	LAB	TuTh	10:30am	11:45am	10:30:00
CECS 174	9	7144	Intro Prog & Probab...	3	Color	SEM	TuTh	05:00pm	05:50pm	17:00:00
CECS 174	10	7145	Intro Prog & Probab...	0	Color	LAB	TuTh	06:00pm	07:15pm	18:00:00
CECS 174	11	8376	Intro Prog & Probab...	3	Color	SEM	F	09:00am	10:40am	09:00:00



# Class conflict program

For example, in Spring 2013 the actually offered courses required for a second semester Computer Engineering are:

The screenshot displays the CSULB Smart Scheduler interface. On the left, a sidebar contains filters for 'Select College' (College of Engineering), 'URL' (http://web.csulb.edu/divisions/ce/catalog/2012-2013/roadmaps/ce/), 'Select Course' (Computer Engineering), 'Semester' (Spring), 'Year' (2013), 'Batch Size' (0), and 'Iteration Count' (0). A 'Get Conflicts' button is at the bottom of the sidebar. The main window is titled 'CSULB Smart Scheduler' and features a 'Schedule Date With Conflicts (Color)' button. Below this, a table lists courses and their components. The 'Color' column is highlighted with a red box.

Subject	Section	Class_Nbr	Title	Units	Color	Components	Days	Begin_Time	End_Time	IL_Time
CECS 105	2	5310	Introduction to CECS	1	Color	SEM	F	10:00am	10:50am	10:00:00
CECS 105	4	6336	Introduction to CECS	1	Color	SEM	M	09:00pm	09:50pm	13:00:00
CECS 105	5	6355	Introduction to CECS	1	Color	SEM	W	09:00pm	09:50pm	15:00:00
CECS 174	1	1268	Intro Prog & Prob...	3	Color	SEM	MW	02:00pm	02:50pm	14:00:00
CECS 174	2	2886	Intro Prog & Prob...	0	Color	LAB	MW	03:00pm	04:15pm	15:00:00
CECS 174	3	5105	Intro Prog & Prob...	3	Color	SEM	TuTh	08:00am	08:50am	08:00:00
CECS 174	4	5106	Intro Prog & Prob...	0	Color	LAB	TuTh	09:00am	10:15am	09:00:00
CECS 174	5	6351	Intro Prog & Prob...	3	Color	SEM	MW	05:00pm	05:50pm	17:00:00
CECS 174	6	6352	Intro Prog & Prob...	0	Color	LAB	MW	06:00pm	07:15pm	18:00:00
CECS 174	7	6525	Intro Prog & Prob...	3	Color	SEM	TuTh	09:30am	10:20am	09:30:00
CECS 174	8	6526	Intro Prog & Prob...	0	Color	LAB	TuTh	10:30am	11:45am	10:30:00
CECS 174	9	7144	Intro Prog & Prob...	3	Color	SEM	TuTh	05:00pm	05:50pm	17:00:00
CECS 174	10	7145	Intro Prog & Prob...	0	Color	LAB	TuTh	06:00pm	07:15pm	18:00:00
CECS 174	11	8576	Intro Prog & Prob...	3	Color	SEM	F	09:00am	10:40am	09:00:00

# Class conflict program

For example, in Spring 2013 the actually offered courses required for a second semester Computer Engineering are:

CSULB Smart Scheduler

Schedule Data With Conflicts (Color)

Color	Days	Subject	Section	Class_Nbr	Title	Units	Color	Components	Days	Begin_Time	End_Time	8_Time
Color	W (8 items)											
Color	MW (6 items)											
		CECS 174	1	1268	Intro Prog & Proble...	3	Color	SEM	MW	02:00pm	02:50pm	14:00:00
		CECS 174	2	2886	Intro Prog & Proble...	0	Color	LAB	MW	08:00pm	04:15pm	15:00:00
		CECS 174	5	6351	Intro Prog & Proble...	3	Color	SEM	MW	05:00pm	05:50pm	17:00:00
		CECS 174	6	6352	Intro Prog & Proble...	0	Color	LAB	MW	06:00pm	07:15pm	18:00:00
		MATH 123	10	4457	Calculus II	4	Color	SEM	MW	02:00pm	03:15pm	14:00:00
		MATH 123	31	5194	Calculus II	4	Color	SEM	MW	05:30pm	06:45pm	17:30:00
Color	TuTh (14 items)											
		CECS 174	3	5105	Intro Prog & Proble...	3	Color	SEM	TuTh	08:00am	08:50am	08:00:00
		CECS 174	4	5106	Intro Prog & Proble...	0	Color	LAB	TuTh	09:00am	10:15am	09:00:00
		CECS 174	7	6525	Intro Prog & Proble...	3	Color	SEM	TuTh	09:30am	10:20am	09:30:00
		CECS 174	8	6526	Intro Prog & Proble...	0	Color	LAB	TuTh	10:30am	11:45am	10:30:00
		CECS 174	9	7144	Intro Prog & Proble...	3	Color	SEM	TuTh	05:00pm	05:50pm	17:00:00

# Class conflict program

For example, in Spring 2013 the actually offered courses required for a second semester Computer Engineering are:

CSULB Smart Scheduler

Schedule Data With Conflicts (Color)

Color Days Begin Time

Subject	Section	Class_Nbr	Title	Units	Color	Components	Days	Begin_Time	End_Time	B_Time
Color (47 items)										
Color - F (9 items)										
Color - F - 10:00am (4 items)										
CECS 105	2	5310	Introduction to CECS	1	Color	SEM	F	10:00am	10:50am	10:00:00
ENGR 102	16	7066	Academic Success Sk...	1	Color	SEM	F	10:00am	10:50am	10:00:00
MATH 123	3	8030	Calculus II	0	Color	ACT	F	10:00am	11:50am	10:00:00
MATH 123	21	8032	Calculus II	0	Color	ACT	F	10:00am	11:50am	10:00:00
Color - F - 09:00am (2 items)										
CECS 174	11	8576	Intro Prog & Proble...	3	Color	SEM	F	09:00am	10:40am	09:00:00
ENGR 102	14	5766	Academic Success Sk...	1	Color	SEM	F	09:00am	09:50am	09:00:00
Color - F - 11:00am (1 item)										
CECS 174	12	8577	Intro Prog & Proble...	0	Color	LAB	F	11:00am	01:30pm	11:00:00
Color - F - 08:00am (2 items)										

# Impacts of course conflicts

Science and engineering majors have many course dependencies in beginning years of study. E.g. Computer Engineering (2012-2013 roadmap)

Four Year Plan - 121 Units Required

Course	Units	Course	Units
<b>Semester 1</b>		<b>Semester 2</b>	
ENGR 101 Intro to Engrg Profession (GE-E)	1	ENGR 102 Academic Success Skills (GE-E)	1
MATH 122 Calculus I (GE-B2) *	4	CECS 105 Intro to Comp Eng & Comp Sci (GE-E)	1
CECS 100 Crit Thinking in Dig Info Age (GE-A3)	3	CECS 174 Intro to Prog & Problem Solv <b>CECS 100</b>	3
CECS 201 Computer Logic Design	3	MATH 123 Calculus II (GE Elective-B) * <b>MATH 122</b>	4
Written Communication (GE-A1)	3	CECS 211 Principles of CpE I <b>MATH 122</b>	3
		Oral Communication (GE-A2)	3
<b>Total Units</b>	<b>14</b>	<b>Total Units</b>	<b>15</b>
<b>Semester 3</b>		<b>Semester 4</b>	
CECS 228 Discrete Structures with Comp Applic <b>CECS 174</b>	3	General Education	3
CECS 274 Obj Orient Prog & Data Struct <b>CECS 174</b>	3	CECS 282 C for Embedded Programming <b>CECS 174, MATH 123</b>	3
CECS 301 Computer Logic Design II <b>CECS 174, 201</b>	3	CECS 282 C++ for Java Programmers <b>CECS 274</b>	3
CECS 311 Principles of CpE II <b>CECS 201, 211</b>	3	EE 380 Prob & Stat & Stochastic Modeling <b>MATH 123</b>	3
PHYS 151 Mech & Heat (GE-B1b) * <b>MATH 122</b>	4	EE 210 / 210L Electro-Mag Foundations in EE / Lab <b>PHYS 151</b> (or PHYS 152 Electricity & Magnetism)	4 (4)
<b>Total Units</b>	<b>16</b>	<b>Total Units</b>	<b>16</b>
<b>Semester 5</b>		<b>Semester 6</b>	
General Education	3	GE Capstone course	3
CECS 271 Intro to Numerical Methods <b>CECS 174, MATH 123</b>	3	CECS 326 Operating Systems <b>CECS 282</b>	3
CECS 340 Microprocessors+Controllers I <b>CECS 274</b>	3	CECS 347 Microprocessors+Controllers II <b>CECS 301, 311, 346</b>	3
General Education **	3	CECS 360 IC Design Software	3
MATH or Science Elective	3-4	MATH or Science Elective	3-4
<b>Total Units</b>	<b>15-16</b>	<b>Total Units</b>	<b>15-16</b>
<b>Semester 7</b>		<b>Semester 8</b>	
GE Capstone course	3	GE Capstone course	3

# Impacts of course conflicts

Also Nursing E.g. Registered Nurse 2-year plan, for a student entering with a minimum of 60 transferable units, an Associate Degree, and an RN license (2012-2013 roadmap)

Two Year Plan - 120 Units Required

Course	Units	Course	Units
Semester 1		Semester 2	
CHEM 140 or 302 Biochemistry	5	BIOL 305 Pathophysiology	3
N 309 Dimensions Professional Nsg	2	NRSG 312 Physical Assessment	3
N 451 Leadership and Management	2	Upper Division General Education	6
Statistics (PSY 310 or EDP 419)	4		
<b>Total Units</b>	<b>13</b>	<b>Total Units</b>	<b>12</b>
Semester 3		Semester 4	
		NRSG 450 Nursing Research NRSG 400	3
		NRSG 451 Nursing Leadership NRSG 402	2
NRSG 400 Health Care Delivery System NRSG 309	3	NRSG 452 Adv Nsg in Critical Care	6
NRSG 402 Community Health Nursing NRSG 312	7	Or N 453 Adv Nsg Maternal Child Hlth	
Electives/General Education	3	Or N 454 Adv Nsg Community Mental Hlth	
		Upper Division General Education	3
<b>Total Units</b>	<b>13</b>	<b>Total Units</b>	<b>14</b>

# Impacts of course conflicts

Or for a set of courses that affects a large number of majors. (2012-2013 roadmap) E.g.

- all CBA majors (Accounting, Finance, Management Information System, International Business, Management, Operations and Supply Chain Management, Human Resources Management, Marketing) need to take ECON 100 and STAT 108 in the first semester.
- CNSM majors Chemistry, BioChemistry, Biology; COE majors Chemistry Engineering, Civil Engineering, Mechanical Engineering; all need to take Chem 111A in the first two semesters with other Science or Engineering course requirements.

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# Study class conflict impact

Exact percentage of students affected by scheduling conflict is difficult (computationally costly) to determine.

E.g., Second semester of requirement for Physics majors:

PHYS 152, MATH 123, CHEM 111A

In Spring 2013 schedule:

PHYS 152: 4 seminar sections + 17 lab sections

MATH 123: 12 sections of 1 seminar + 2 activities

CHEM 111A: 3 lecture sections + 22 lab sections

Need  $17 \times 24 \times 22 = 8976$  comparisons of schedules (assuming if a student gets into a lab/activity section can get into a non conflicting seminar/lecture section).



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# Monte Carlo Method

It is a numerical simulation method to estimate underlying distributions.

- Start with a (deterministic) function of a set of parameters
- Input randomly selected values for the parameters (repeat many times)
- Compute the function values for each set of (randomly selected) parameters
- Observe the behavior of the output values (such as the fraction of values with a certain property)

# Monte Carlo Method

## Assumptions:

- capacity of classroom is not an issue
- seminar/lecture courses are the only ones pose conflicts  
(lack of class association database)
- GE can always be satisfied with any schedule
- department courses are scheduled to minimize conflicts for its own majors
- students have equal chances choosing any sections of a course

For a batch of students in a given major at a given semester, simulate the course selections and find how many would have course conflicts.

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For a batch of students in a given major at a given semester, simulate the course selections and find how many would have course conflicts.

It will be an underestimation.

# Impact Examples – one semester

Physics, first semester requirement using Fall 2012 schedule  
 MATH 122 (11 sections of 1 seminar + 2 activities), PHYS 151 (4 seminar sections and 18 lab sections)

The screenshot displays the CSULB Smart Scheduler interface. On the left, a sidebar contains filters for 'Select College' (College of Natural Sciences and Math), 'URL' (https://math.csulb.edu/teachers/bsf/catalog/2012-2013/roadmaps/), 'Select Course' (Physics), 'Semester' (Fall), 'Year' (2012), 'Batch Size' (10), and 'Iteration Count' (1000). A 'Get Conflicts' button is located below these filters. The main window is titled 'Schedule Data With Conflicts (Color)' and shows a table of course sections with columns for Subject, Section, Class, Title, Units, Color, Components, Days, Begin Time, End Time, and N. The table lists sections for MATH 122 and PHYS 151. Below the table, there are buttons for 'Save Students Data' and 'Students Affected'. At the bottom, a table shows the results of the scheduling process, including columns for 'Batch Size', 'Students Affected', and 'No Conflict Students'.

Subject	Section	Class	Title	Units	Color	Components	Days	Begin Time	End Time	N
MATH 122	1	2577	Calculus I	4	Color	SEM	MWF	10:00am	10:50am	10
PHYS 151	2	1085	Mechanics and Heat	4	Color	SEM	SaSu	10:00am	10:50am	10
MATH 122	2	2578	Calculus I	4	Color	ACT	Tu	08:00am	08:50am	08
MATH 122	3	2579	Calculus I	4	Color	ACT	Th	10:00am	10:50am	10
MATH 122	35	11238	Calculus I	4	Color	ACT	Tu	08:00am	08:50am	08
MATH 122	36	11239	Calculus I	4	Color	ACT	Th	10:00am	10:50am	10
PHYS 151	13	4804	Mechanics and Heat	4	Color	LAB	Tu	11:00am	01:40pm	11
PHYS 151	14	4805	Mechanics and Heat	4	Color	LAB	Th	08:00am	08:45am	08
MATH 122	5	2581	Calculus I	4	Color	ACT	Fu	10:00am	10:50am	10
MATH 122	6	2582	Calculus I	4	Color	ACT	Fu	02:00pm	02:50pm	14

Batch	Subject	Year	Batch Size	Students Affected	No Conflict Students
System.Random	Physics	2012	50	0	0
System.Random	Physics	2012	50	0	0
System.Random	Physics	2012	50	0	0
System.Random	Physics	2012	50	0	45
System.Random	Physics	2012	50	0	0
System.Random	Physics	2012	50	0	0
System.Random	Physics	2012	50	0	0
System.Random	Physics	2012	50	0	0

Total students: 155  
 Students Affected: 0

# Impact Examples – one semester

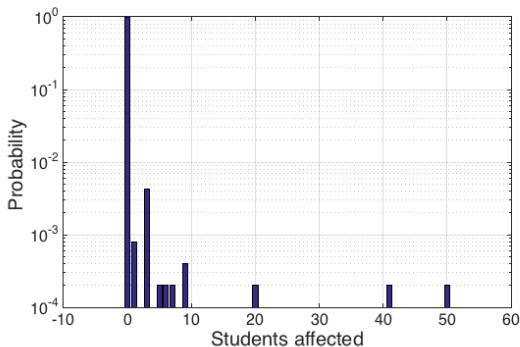
Physics, first semester requirement using Fall 2012 schedule

MATH 122 (11 sections of 1 seminar + 2 activities), PHYS 151 (4 seminar sections and 18 lab sections)

50 students, 5000 simulation runs: Students affected

Mean: 0.0428, Standard deviation 1.0038

**Physics 1st semester (Fall 2012 schedule)**





# Impact Examples – one semester

Civil Engineering, second semester requirement using Spring 2013 schedule  
 ENGR 102 (13 seminar sections), MATH 123 (12 sections of 1 seminar + 2 activities), PHYS 151 (4 seminar sections and 20 lab sections), CE 101, CE 130

CSULB Smart Scheduler

Schedule Date With Conflicts (Fall)

Select College: College of Engineering  
 URL: <http://web.csulb.edu/bsmartsch/schedule/2012-2013/roadmap/ce/>  
 Select Course: Civil Engineering  
 Semester: Spring  
 Year: 2013  
 Batch Size: 30  
 Iteration Count: 5000  
 Get Conflicts

Subject	Section	Class_Nbr	Title	Units	Color	Components	Days	Begin_Time	End_Time	Is_1
By (S) items										
ENGR 102	17	7067	Academic Success Sk...	1	SEM	SEM	Tu	09:00pm	09:50pm	17
MATH 123	8	2076	Calculus I	5	ACT	ACT	Tu	10:00am	11:50am	18
MATH 123	23	5823	Calculus I	5	ACT	ACT	Tu	07:00pm	08:50pm	19
PHYS 151	9	2355	Mechanics and Heat	5	LAB	LAB	Tu	10:00am	12:45pm	20
PHYS 151	10	5852	Mechanics and Heat	5	LAB	LAB	Tu	07:00pm	09:45pm	19
PHYS 151	11	2356	Mechanics and Heat	5	LAB	LAB	Tu	08:00pm	08:45pm	16
PHYS 151	23	9546	Mechanics and Heat	5	LAB	LAB	Tu	07:00pm	08:45pm	19
By (S) items										
ENGR 102	9	5149	Academic Success Sk...	1	SEM	SEM	Th	09:30am	10:20am	09
ENGR 102	10	5304	Academic Success Sk...	1	SEM	SEM	Th	11:00am	11:50am	11
MATH 123	9	2075	Calculus I	5	ACT	ACT	Th	08:00am	09:50am	08
MATH 123	8	2071	Calculus I	5	ACT	ACT	Th	10:00am	11:50am	10
PHYS 151	15	6289	Mechanics and Heat	5	LAB	LAB	Th	08:00am	10:45am	08

See Students Data

Students Affected

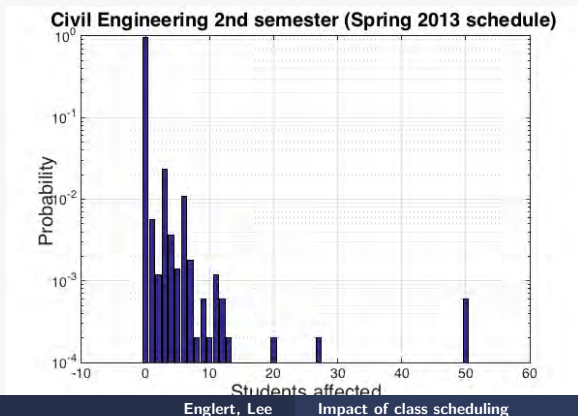
Student	Major	Year	Enrolled	EnrollmentAffected	EnrollmentUnaffected
System.Random	Civil Engineering	2013	30	0	0
System.Random	Civil Engineering	2013	30	3	47
System.Random	Civil Engineering	2013	30	0	0
System.Random	Civil Engineering	2013	30	0	0
System.Random	Civil Engineering	2013	30	0	0
System.Random	Civil Engineering	2013	30	7	43
System.Random	Civil Engineering	2013	30	0	0
System.Random	Civil Engineering	2013	30	4	46

Drag a colored seminar name to group by task reason

Total students: 30  
 Students Affected: 0

# Impact Examples – one semester

Civil Engineering, second semester requirement using Spring 2013 schedule  
ENGR 102 (13 seminar sections), MATH 123 (12 sections of 1 seminar + 2 activities), PHYS 151 (4 seminar sections and 20 lab sections), CE 101, CE 130  
50 students, 5000 simulation runs: Students affected  
Mean: 0.2496, Standard deviation 1.6759



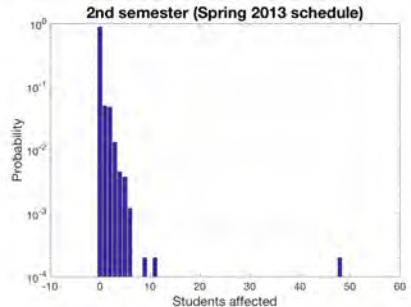
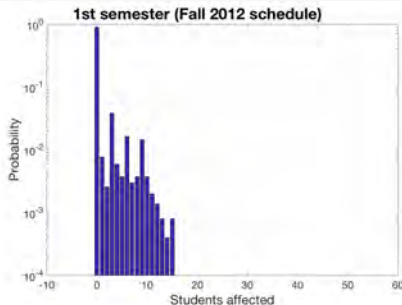
# Impact Example – two semesters

Computer Engineering

first semester: ENGR 101, MATH 122, CECS 100, CECS 201 (Fall 2012)

second semester: ENGR 102, MATH 123, CECS 105, CECS 174, CECS 211  
(Spring 2013 )

1st semester: Mean 0.5528, Std 1.8982; 2nd semester: Mean 0.2426, Std 1.0066



50 students, 5000 simulation runs: Students affected

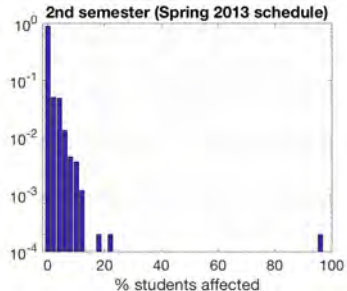
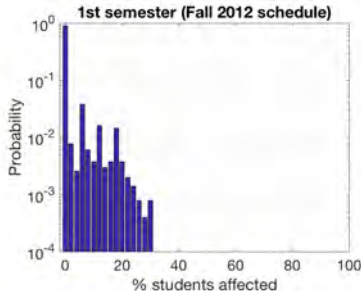
# Impact Example – two semesters

Computer Engineering

first semester: ENGR 101, MATH 122, CECS 100, CECS 201 (Fall 2012)

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(Spring 2013 )

1st semester: Mean 0.5528, Std 1.8982; 2nd semester: Mean 0.2426, Std 1.0066



This is an underestimate.

## Impact Example – two semesters

If there are 4% (2 out of 50) of students affected in each semester, then they cannot be on track for the next semester's courses. After two semesters totally 7.84% of students will not be on track for their 4-year graduation plan.

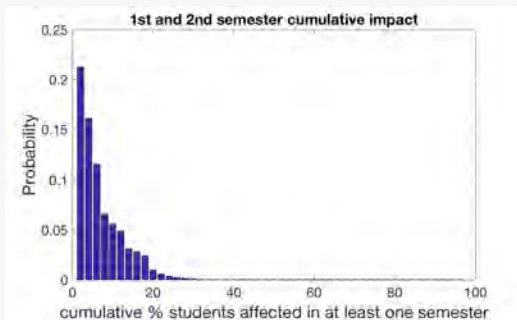
# Impact Example – two semesters

If there are 4% (2 out of 50) of students affected in each semester, then they cannot be on track for the next semester's courses. After two semesters totally 7.84% of students will not be on track for their 4-year graduation plan.

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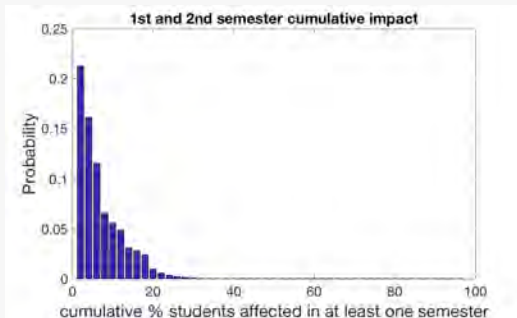


# Impact Example – two semesters

## Computer Engineering

first semester: ENGR 101, MATH 122, CECS 100, CECS 201 (Fall 2012)

second semester: ENGR 102, MATH 123, CECS 105, CECS 174, CECS 211 (Spring 2013 )



at least 2% of students are affected in at least 1 semester: 21% chance

at least 4% of students are affected in at least 1 semester: 16% chance

at least 6% of students are affected in at least 1 semester: 12% chance

# Summary and extension

We developed a program that

- illustrates course schedule conflicts for a given major requirement from actual CSULB schedules, and
- simulates students class choices from the actual schedules.

This allows us to

- estimate the impact of course schedule conflict on students' progress according to degree roadmaps
- possibly adjust course schedules before implementation



# Summary and extension

Recall the impact estimates are likely to be underestimates.

We could

- include the constraints from lab and activity sessions
- incorporate classroom capacity limitations
- impose students time preferences (3-day, 4-day, before 4:00 pm schedules)

for more realistic evaluations.