

## CU-Boulder Classroom Utilization

Planning, Budget, and Analysis: Lou McClelland, Fran Costa, Blake Redabaugh, 5/2007

**Request:** Space utilization data for classrooms and instructional laboratories were requested by Teresa Osborne, CU-System Director of Capital Assets, for use in conjunction with this year's review of capital construction budget requests. In addition to the utilization data, President Brown requested information on formal and informal policies about course/room scheduling. Details of planned use from Osborne:

- *For the Regents Sub-committee I want to provide a general overview of each campus and provide them with an average use (both hours and capacity) with specification on whether the data is peak week vs. average.*
- *For program plan review and facilities master plans I will share the data with your facilities folks and we will look at utilization by class size, room equipment, building usage, etc. This, along with the programmatic data, will hopefully give us a better understanding of where and what type of classrooms and instructional labs are needed on each campus.*
- *The Student station PERIOD occupancy along with ASF (facilities will provide) is data we have to provide to CCHE in program plans and facility master plans - again this is data to be used for facilities planning.*

**Data** are in the Excel file posted from <http://www.colorado.edu/pba/course/UCBClassroomUse.htm>. See last section of this document for specifications. The Excel gives a brief definition of each data column plus translations of all codes used. Per the request:

- All data are from SIS. No data are from facilities management systems.
- Rooms listed are in general fund buildings only, with 20 or more hours per week in scheduled instruction. See appendix for detailed counts.
- Cross-listed and combined course sections are counted only once.
- Instruction delivered by continuing education is excluded.
- Hours per week are counted such that MWF (Monday-Wednesday-Friday) 9:00-9:50 counts as 3 hours.
- For Boulder, the "peak" week is in early September. However, there is little variance over weeks because 99% of course sections meet the entire term. Therefore we have reported a "mid-term" or typical week only.

The Excel file also presents the **CCHE/DHE** (Colorado Commission on Higher Education, Department of Higher Education) current **standards for space use**. These may undergo revision in the near future.

**Preview of results:** Below we discuss course sections, rooms and their characteristics, and measures of instructional activity in rooms. Major measures for rooms include number of sections and hours per week scheduled, number of seats available, average enrollment and percentage of seats occupied while scheduled, and two use indices, one for seat use, one for space use.

## Results

- Course sections – In Fall 2006 CU-Boulder taught over 4,500 scheduled course sections in the term:
  - 50% are lecture sections. About 75% of these meet a total of 3 hours per week in two or three class meetings, generally Tuesday-Thursday or Monday-Wednesday-Friday.
  - 20% are recitation sections. 95% of these meet once a week for one hour.
  - 13% are lab or main-lab sections. These generally meet 2-4 hours 1-2 times per week.
  - 12% are seminars. These have widely varying meeting patterns.

- Rooms and room characteristics

- Over 250 classrooms and labs are listed in the Excel. These have 20 or more hours scheduled instruction per week, in over 40 general-fund buildings, each with from one to over 20 rooms listed.
- Sections are scheduled in an additional 150 or so rooms defined to SIS but with other predominant uses (e.g., the music theater) and/or in auxiliary-funded buildings. These include about 20 rooms in auxiliary fund buildings, primarily residence halls.
- The listed rooms cover 85% of scheduled sections, 86% of scheduled hours, and 92% of scheduled enrollments.
- The rooms listed have a “room type” on SIS. Almost 60% are type CLR, classroom. Other types are auditorium (10%), seminar room (7%), lab (13%), studio (4%). The average number of seats varies dramatically with type: 20-30 for seminar rooms, labs, and studios; 40 for classrooms; 190 for auditoria.
- SIS lists the square feet of 180 of the rooms listed. *We have not checked correspondence of these figures to those from facilities management.* Square feet per seat averages 15-16 but ranges from 5 to 38. 80% of rooms listed have 12-20 square feet per seat.
- Caution: SIS-listed square feet data are not always correct. For example, the Excel listing for the Law building (old Law, not Wolf Law) shows the following:

Room	Seats	SIS sq ft	Sq ft/seat	Avg enrollment
102	46	1,015	22.1	36
103	46	1,015	22.1	34
104	77	1,388	18.0	46
154	86	2,878	33.5	51
155	200	1,280	6.4	103
156	86	1,280	14.9	45
157	86	1,280	14.9	50
241	30	522	17.4	25

- Square feet for LAW 154 and LAW 155 have clearly been reversed. They are shaded and noted in the Excel. Other rooms with absurdly low (or high) square feet per seat probably have erroneous square feet on SIS as well. Whereas an incorrect number of seats could also give absurdly low or high square feet per seat, the number of seats is actually used in scheduling so is more likely to be correct on SIS.
- Each room is designated as “centrally scheduled” – scheduled by the registrar’s office – or departmental scheduled. All centrally scheduled rooms are in general fund buildings. This designation is not recorded on SIS directly, but is listed on the Registrar website at [http://registrar.colorado.edu/staff/academic\\_scheduling/pdf/07spring/centrally\\_controlled\\_classrooms.pdf](http://registrar.colorado.edu/staff/academic_scheduling/pdf/07spring/centrally_controlled_classrooms.pdf). Only more generic rooms are centrally scheduled; those with layouts or equipment for a single department (e.g., chemistry) are not. Of the listed rooms, almost all auditoria, 75% of “classrooms,” half of seminar rooms, and no labs or studios are centrally scheduled. In a few instances, rooms noted as centrally scheduled are scheduled by a department for part of each day. See appendix for detailed counts.
- Course sections in rooms – Results are for rooms listed in the Excel except as noted.
  - Sections per week. Rooms are scheduled with 2 to 40 sections per week – median 14. Those with few sections per week generally house labs and studios with two meetings per week of 3-5 hours each. Those with many sections generally house recitation sections each scheduled for only one hour per week.

- Hours per week
  - Rooms are scheduled for up to 70 hours per week of instructional use; those with the highest scheduled use are studios in Architecture and Planning.
  - Listed rooms are scheduled an average of 37 hours per week: 40 in classrooms and auditoria, 36 in seminar rooms, 29 in labs.
  - Labs likely have lower scheduled use for two reasons. First, all have specialized equipment suitable only for classes in one or two departments. Second, students enrolled in scheduled lab sections may opt or be required to use lab equipment outside hours scheduled for instruction. In our study of space use in 2001 we estimated this outside-class use at 0.5 hours per in-class lab hour for most departments, zero for lower-level chemistry and fine arts, and 1-2.5 hours per in-class lab hour for other chemistry, physics, theater/dance, and environmental design. Outside-class use would obviously add considerably to the 29 hours per week scheduled in the labs listed.
  - Over all rooms with scheduled instruction (including those not listed in the Excel), centrally scheduled rooms average 42 hours per week while all others average 19 hours per week. This apparently lower use in the non-centrally-scheduled rooms is a function of several factors:
    - Some of the other rooms have functions other than instruction – they are theaters, lounges, conference rooms, etc.
    - Some are actually scheduled with classes that are specified on SIS only as “see department.”
    - Some are rooms with specialized equipment suitable for only a few classes.
    - Some are at long walking distance from the rest of campus or have other scheduling or use issues.
- Occupancy. Average occupancy is defined as the average enrollment per section as a percentage of the number of seats listed as available on SIS.
  - For listed rooms, average occupancy is just over 71% for centrally scheduled rooms, 76% for labs, and 54% for other rooms not centrally scheduled.
  - Occupancy over 100% occurs when actual enrollment in a section exceeds the listed room capacity. Often this is due to the instructor’s granting special permission for a few students to enroll over the enrollment maximum. Occasionally it is planned, with maximum enrollment set well over room capacity. This happens routinely with courses EBIO1230 and 1240 (general biology labs), where courses are listed for room Ramaley C147 (listed capacity 18) with maximum enrollment up to 72. Students assemble in room C147 once then disperse to nearby labs for the semester. As one consequence, use of the nearby labs is underreported.
  - Occupancy under 100% occurs in several circumstances:
    - When actual enrollment in a section is less than the maximum allowable
    - When the room scheduled has more seats than the maximum allowable enrollment because no smaller room is available
    - When the room scheduled has more seats than the maximum allowable enrollment but is needed for a course for its equipment or facilities (wet lab on Chemistry 140, music theater, etc.)
    - When occupancy comes from activity scheduled on SIS for another room. We think this is rare, but probably does happen at least for the labs near Ramaley C147.

- It's dangerous to look at occupancy alone, or hours alone, because they act *together* to characterize use. In the two use indices presented below, they compensate for one another.
  - In addition, one scheduling situation leads to overstated hours per week and understated occupancy – but to appropriate use indices. This happens when multiple primary sections meet simultaneously in the same room but are counted separately. For example, eight ROTC sections with enrollments of 6-21 students meet for 3.5 hours at the same time on the same day in Duane G1B30. The sections are not cross-listed with one another. Counting these eight sections separately overstates the hours during which the classroom is in use (67 hours vs. proper 42.5 when the enrollments of the eight sections are combined and counted as a single section) and results in an understatement of average occupancy during use (47% vs. proper 68%). Yet the two use indices are the same whether the sections are counted separately or as one. Similar situations occur in dance studio use.
- Use indices. The Excel section “Instructional activity in the term - Additional variables” (columns with buff-colored headers) lists two use indices plus an intermediate variable used in calculation of one index.
  - Examples of each index are shown at the end of this section.
  - The Seat Use Index – developed by Planning, Budget, and Analysis (PBA) – assesses seat use intensity and focuses on occupancy of the seats available in the room irrespective of the size of the room in square feet. For optimal seat use, most or all seats will be filled during scheduled classes (percent occupancy) and the room will be in frequent use (hours per week). The Seat Use Index, therefore, is a function of both percent occupancy and hours/week. It's calculated as the average percentage of classroom seats occupied (average enrollment/number of seats in the room) multiplied by the number of hours per week scheduled. The Seat Use Index is then normalized so that a score of 100 exactly meets the current CCHE/DHE space use standard of 30 hours per week with at least 67% occupancy. Higher numbers indicate more intense use.
  - SSPO, student station period occupancy, is an intermediate variable used in calculation of the CCHE/DHE use index.
    - SSPO is calculated (for a room) as the product of:
      - Average enrollment per section / seats per section = Percent occupancy
      - Hours per week scheduled
      - The number of seats.
    - SSPO is not an index. It is larger for rooms with more seats.
    - *SSPO is weighted by course hours. Sections meeting for more hours in the week count more. When all sections in a room meet for the same number of hrs/week, SSPO and total student contact hours (in the required variables section of the Excel) in a week are equal.*
  - The Space Use Index is the current CCHE standard labeled ASF/SSPO. “Space Use Index” is the PBA name for this quantity.
    - ASF/SSPO is the ratio of assignable square feet to SSPO, or square feet per (percent occupancy \* hours per week scheduled)
    - A classroom meets the CCHE/DHE test for classrooms if it has 30 or more hours of scheduled use per week with at least average 67% occupancy, with no more than 20 square feet per seat. In this case ASF/SSPO calculates to 1.0.  $[20 / (30 * .67) = 1.0]$ . Other combinations with ASF/SSPO less than or equal to 1.0 also meet the standards – for example, higher occupancy with lower hours, or fewer square feet per seat with lower hours.

- Examples, from the Excel, all from the Law (old Law, not Wolf) building

Building and room characteristics				Required variables			Use indices	
	D			F	G	I		
Building, room	N of seats	Sq ft on SIS	Sq ft per seat	Total scheduled hours in a week	Average enrollment per section	Pct occupancy, average over sections	Seat use index, 100 = meets CCHE/DHE standard exactly. Green: Meets test. Pink: Does not.	Space use index from CCHE-DHE, ASF/SSPO. 1=meets DHE standard exactly. Green: Meets test. Pink: Does not
LAW 102	46	1,015	22.1	47	36.2	79%	184	0.60
LAW 103	46	1,015	22.1	41	34.2	74%	150	0.73
LAW 104	77	1,388	18.0	50	45.8	60%	148	0.61
LAW 154	86	2,878	33.5	47	51.1	59%	139	1.20
LAW 155	200	1,280	6.4	36	103.0	52%	92	0.35
LAW 156	86	1,280	14.9	50	45.2	53%	131	0.57
LAW 157	86	1,280	14.9	46	49.7	58%	133	0.56
LAW 241	30	522	17.4	24	24.9	83%	99	0.88

- In the table and in the Excel, seat use indices and space use indices showing more intense use than current CCHE/DHE parameters are shaded green, while those showing less intense use are shaded pink.
- Most of the rooms in the table have seat use indices over 100 (green, relatively intense use) and space use indices under 1.0 (green, relatively intense use). This is true even though none of the rooms shown have more than 30 hours per week and more than 67% occupancy and fewer than 20 square feet per seat. In the use indices, higher hours can compensate for lower occupancy (and vice versa), and higher seat use can compensate for a seating arrangement that requires more square feet per seat (and vice versa).
- Room 155 shows seat use less than 100 but space use in the green range because the 200 seats are listed on SIS as squeezed into 1,280 square feet, for far fewer square feet per seat than usual. As noted above, this square feet figure is almost certainly incorrect.
- Room 154 is the opposite due to its large 33 square feet per seat, also with an incorrect square feet figure.
- Room 241 is almost 100 on the seat use index (its high occupancy compensates for lower hours). With 17 rather than the standard square feet per seat, it then easily meets the space use index standard.
- 180 rooms on the Excel list had sufficient information on SIS to calculate both indices. Results:
  - The seat use index has a median of 133, range 23 to 635 (to 228 without Ramaley C147). 95% of centrally-scheduled rooms and 45% of others have indices at or above 100, the current standard.
  - The space use index (ASF/SSPO) averages .67, range 0.3 to 3.5, with 80% of rooms between .4 and 1.1. 88% have space use indices under 1.0, meeting the current CCHE/DHE test for classrooms; 98% of the centrally-scheduled rooms are at or under 1.0.

- Summary: Indices relative to current CCHE/DHE standards for classrooms.

Seat use	Space use	
	Less intense	More intense
Less intense	20	9
More intense	2	149

- 83% of the rooms listed (149) have more intense seat use and space use than the current standard for classrooms, even though almost 20% of the rooms are labs, studios, and other special purpose rooms with different CCHE/DHE standards.
- Use for two rooms falls below the space use standard but passes the seat use standard. These are both large rooms with relatively few seats.
- Use for nine rooms passes the space use standard but fails the seat use standard. These are relatively small rooms with a very large number of seats. Two (in addition to Law 154) may have erroneous square feet listings on SIS; both show exceptionally small square footage available per seat (LIBR E203 and MCKY 102).
- In 20 instances room use meets neither standard. Six of these rooms have one or both of the room use indicators very close to the current standard. Only four are centrally scheduled. Others are largely in the Engineering center, in Music, and in the new Law building in its first term of operation.
- Other room and use characteristics
  - The Excel section "Instructional activity in the term - Additional variables" (columns with buff-colored headers) lists average per section hours and days per week for each room, plus maximum anticipated enrollment as well as actual. Scheduling must accommodate maximum anticipated enrollment.
  - The Excel also shows the many special feature and special equipment codes listed for over half of the listed rooms, plus "special notes" on scheduling. Many of these impose additional constraints on scheduling.
- The scheduled activity characterized here does NOT include:
  - Non-credit courses
  - SIS-scheduled events associated with courses, such as midterm exams and review sessions
  - SIS-scheduled events not directly related to credit instruction in a single course. E.g., Admissions' Be a CU Student for a Day program, World Affairs Conference
  - Student use of labs outside scheduled class time. In our analysis in 2001 we estimated this at 0.5 hours per in-class lab hour for most departments, zero for lower-level chemistry and fine arts, and 1-2.5 hours per in-class lab hour for other chemistry, physics, theater/dance, and environmental design.
  - Events scheduled by departments in department-controlled rooms, but not shown on SIS. Example: dissertation proposals and orals
  - Maintenance time
  - Courses taught by continuing education
  - Courses taught in non-general fund buildings such as residence halls



**Policies and procedures:** The Academic Scheduling Office, in the Office of the Registrar, schedules and controls approximately 165 classrooms, seminar rooms, and auditoria on the Boulder campus. The academic scheduling coordinators schedule these rooms for *academic* reasons such as courses, review sessions, films, and midterm and final exams. Policies and practices for scheduling centrally-scheduled classrooms have evolved to fit campus needs and to take advantage of the software used for scheduling, through years of collaboration among the Registrar, associate deans, and departments.

- [http://registrar.colorado.edu/staff/academic\\_scheduling.html](http://registrar.colorado.edu/staff/academic_scheduling.html) has an overview of academic scheduling resources and procedures for departments and colleges
- [http://registrar.colorado.edu/staff/academic\\_scheduling/semester\\_info.html](http://registrar.colorado.edu/staff/academic_scheduling/semester_info.html) shows relevant information for each upcoming term

Scheduling is a combination of manual processing and automation using the Student Information System (SIS) database and a standalone computer program called Schedule 25. SIS is the system of record for class and classroom assignments and contains fields that describe the features and capabilities of rooms. SIS also describes the maximum enrollment to be allowed for each course section (without special permission). Data from SIS are fed into Schedule 25, which then attempts to make a best-fit match of rooms needed with rooms available. Schedule 25 can be programmed to consider geographic location as well as room features when making matches. For example, rooms in buildings near the Kittredge residence halls are too far from the main campus to reach in a 10-minute passing period, so must be scheduled separately.

#### Highlights of the policies and procedures

- Timeline – Prior to each academic term, a detailed planning calendar and timeline for classroom scheduling is made available to departmental scheduling liaisons. Over the course of several months, requests for room assignments are processed and updated by iterations of Schedule 25, the software used for assigning classrooms. These iterations follow a specified timetable for requests of large rooms, specific rooms (e.g., labs), rooms for courses with standard meeting patterns, and rooms for courses with non-standard meeting patterns (e.g., recitations, labs). Throughout the process, preliminary schedules are developed and departmental liaisons are urged to check assignments and work with Academic Scheduling to resolve conflicts.
- Courses with enrollment of 90 and over – If a class requires a room with 90 or more seats, a large-room request must be submitted to the Academic Scheduling Office by a specified date. Large-room assignments are based on previous use of the classroom and proper utilization guidelines. Proper utilization for large classrooms is 75% or higher of seats occupied between 9 am and 3 pm, 60% or higher at other hours. There are exceptions to this rule based on equipment needs. For example, Chemistry has first priority for Chemistry 140 and 142 regardless of expected enrollment due to its use of the attached wet lab.
- Requests for smaller courses – The Schedule 25 computer program assigns classrooms using pre-defined building preferences, enrollment limits, and room capacities. Departmental scheduling liaisons enter information about building preferences and enrollment limits on courses into the online program, and Schedule 25 assigns rooms large enough to accommodate expected demand. Schedule 25 also takes into account requests for standard audio-visual equipment, smart classrooms, internet access, tablet arm chairs, and/or seminar-style classrooms that may be required by instructors.

- Special needs – If a course has any of the following special needs, a Specific-Room Request form must be submitted to Academic scheduling: double projection screens; lab supplies that stay in a certain room, necessitating a particular room assignment; accommodation for an instructor with physical limitations; and back-to-back classes (for example, instructor has classes at 10 am and 11 am). A dean's signature is required on Specific-Room Request forms.
- Priority status and informal policies – Some limitations are entered prior to Schedule 25's run; for example, rooms in Ekeley may not be scheduled after 5pm due to risks associated with chemicals stored in or near the rooms. In addition, some room assignments are established prior to Schedule 25's run. In some cases, departmental funds were used for room renovations with the provision that department courses will have priority in booking those spaces, e.g., Department of Philosophy funds were used in part for the last renovation of Hellems 177, and, therefore, Philosophy pre-books this room in advance of Schedule 25. In other cases, pre-existing arrangements exist that are mutually satisfactory to departments. For example, although most departments dislike being assigned to classrooms in the Stadium, the ROTC departments prefer having classes there. Consequently, Academic Scheduling assigns ROTC classes to Stadium classrooms as much as possible. In this and other similar cases, Schedule 25 fills in any unused times for the classrooms in question with courses from other departments.

**Specifications** for the data (L:\ir\reports\cusys\space\gen01/05.sas)

- Fall 2006
- Courses taught on the Boulder campus *excluding*
  - Courses offered by continuing education (academic unit B2 in SIS)
  - Courses with no designated meeting time and place; this excludes virtually all dissertation and independent study courses
- Calculate hours per week from the meeting pattern(s). A course meeting MWF 9:00-9:50 counts as 3 hours.
- Count all sections as 16 weeks. Less than 0.5% of Boulder sections meet less than the full term.
- List in the Excel all rooms with courses in general fund buildings scheduled for 20 or more hours per week, with enrollment and room capacity information from SIS. This includes rooms that are centrally scheduled and rooms that are not.
- Vocabulary
  - Course section, or section: A time/place/instructor combination students enroll in, identified with an 11-digit course ID on SIS. The course ID is comprised of course subject (e.g., HIST), course number (e.g., 1234) and section number (e.g., 100). Cross-listed or combined sections are not counted but their enrollment has been counted with their sponsor section. For example, if HIST4567 and HIST5567 are taught in the same room at the same time by the same instructor, we consider this as only one section with the enrollment of all students from both. Similar examples are of the form ENGL1234 with WMST1234, and section PSYC1001-880 with PSYC1001-100.
  - Meeting pattern: A combination of days of the week (e.g., MWF) and start and end time.
  - Periods: The number of separate meetings for a course section, in a week. A MWF 9-9:50 course has 3 periods.



## Appendix: Room counts with sections, hours of instruction, and enrollments

By on/off the Excel list, in general fund building or not, and centrally scheduled or not

UCB Fall 20067 -- L:\ir\reports\cusys\space\show05

	Rooms	Course sections	Scheduled hours of instruction	Enrollments
All	441	4,574	12,092	150,348
Not on Excel list	164	664	1,723	11,442
On Excel list	277	3,910	10,369	138,906
Not centrally scheduled	275	1,802	5,171	38,478
Centrally scheduled	166	2,772	6,921	111,870
Not general fund bldg	21	138	395	2,664
General fund bldg	420	4,436	11,697	147,684
Not on Excel list				
Not centrally scheduled				
Not general fund bldg	21	138	395	2,664
General fund bldg	139	506	1,283	8,471
Centrally scheduled				
General fund bldg	4	20	45	307
On Excel list				
Not centrally scheduled				
General fund bldg	115	1,158	3,493	27,343
Centrally scheduled				
General fund bldg	162	2,752	6,876	111,563
<b>COLUMN PERCENTAGES</b>				
All	100	100	100	100
Not on Excel list	37	15	14	8
On Excel list	63	85	86	92
Not centrally scheduled	62	39	43	26
Centrally scheduled	38	61	57	74
Not general fund bldg	5	3	3	2
General fund bldg	95	97	97	98
Not on Excel list				
Not centrally scheduled				
Not general fund bldg	5	3	3	2
General fund bldg	32	11	11	6
Centrally scheduled				
General fund bldg	1	0	0	0
On Excel list				
Not centrally scheduled				
General fund bldg	26	25	29	18
Centrally scheduled				
General fund bldg	37	60	57	74