

Undergraduate Course Access and Courses with “Bottleneck” Features

Initiatives to improve the undergraduate experience and increase the efficiency of degree production often include proposals to address course “bottlenecks”. The term “bottleneck” lacks a shared definition and meaning, complicating identification of courses and analyses of related issues. In this analysis, we experiment with a methodology to operationalize the term “bottleneck” for analytic purposes.

Courses with bottleneck features have the potential to cause course access problems for students unless departments have the support and resources to address their challenges. Identification of courses with bottleneck features is intended to recognize and support the need for allocation of additional resources for these courses, rather than criticize the efforts of departments that are already working on multiple fronts to address the features that may lead to course bottlenecks.

Based on the most cited features of bottleneck courses, we identified three main features of course bottlenecks and operationalized each of them. These features include:

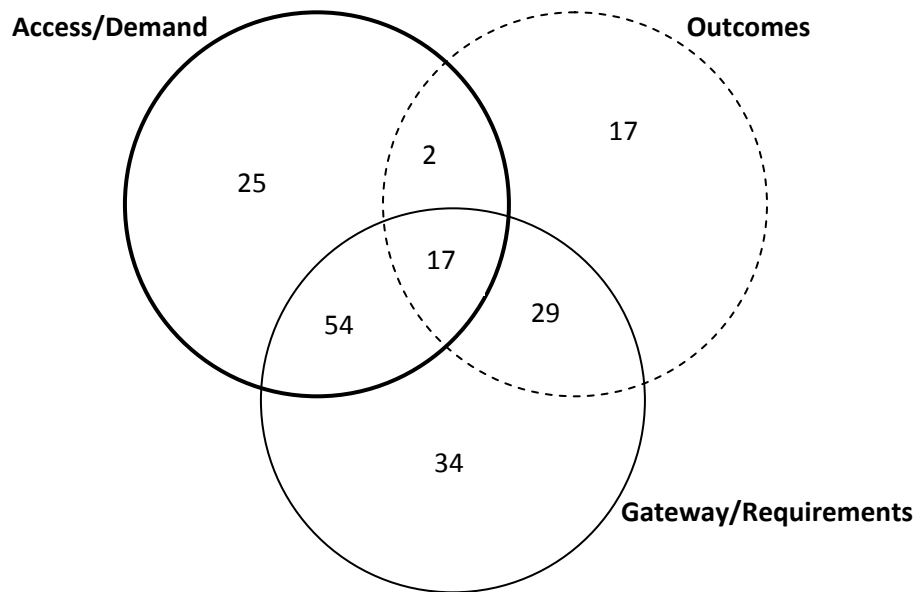
1. Features related to course **access/demand**. These courses are large, serve a high percentage of new students, and/or have more students who want to enroll than can be accommodated. Some of these courses are affected by physical space limitations and room capacity issues. For example, enrollments in some lab science courses cannot be expanded beyond the available lab space. For this analysis, we operationalize identification of courses with access/demand features to be a) courses that enroll 700 or more undergraduates per year and/or b) courses that had more than 15 students left on a course waitlist at the end of recent semester enrollment periods.
2. Features related to course **outcomes**. These courses serve a relatively large number of undergraduates and a relatively high proportion of enrolled students do not have a successful course outcome (grade). Lack of success in these courses contributes to high course repeat rates (a factor in access/demand issues). Students who do not complete these courses may need to reconsider their intended major or career plans. For this analysis, we operationalize identification of courses with outcomes features to be courses that enroll at least 100 undergraduates annually and have a D/F/Drop rate (proportion of enrolled students whose final grade is a D or F or who dropped the course after the 10th day of class) of 20% or higher overall or for any measured subgroup.
3. Features related to **“gateway/requirements”** courses. These courses are ones that many students need to get through, or choose to use to get through, in order to meet general education requirements, to progress to upper level courses, to enter a major and complete degree requirements, and/or to prepare for post-baccalaureate professional positions. For this analysis, we operationalize identification of courses with gateway/requirements features to be courses that are a) commonly used to meet general education competency requirements (Comm A and B, QRA and B, ethnic studies), b) are courses at the lower end of common multi-course sequences, and/or c) are courses required for all students in one or more medium to large majors.

This analysis is based on these features as they apply to courses in recent semesters. Adding to the complexity of identifying courses with bottleneck features is the fact that course bottlenecks are not

static. Shifts in student demographics, changes to degree requirements, fluctuations in enrollments, and changes in student majors and career interest can change (increase or reduce) course demand rapidly.

Based on courses offered in recent semesters, there were 178 courses that had one or more of the three main features of bottleneck courses, with significant overlap. Of these 178 courses with bottleneck features, 102 meet more than 1 of the main features. Figure 1 shows the number of courses with each of the bottleneck features and how much overlap there is in the features.

Figure 1: Number of Courses in Each Bottleneck Feature Category



Overall there are 17 courses that have all three course bottleneck features. These courses are in 13 different subjects/departments. Three departments, Economics, Mathematics and Zoology (home of the Biology and Zoology subject listings), have more than one course on this list. These courses include:

- Accounting and Information Systems 100
- Astronomy 103
- Biology 151 (managed in Zoology)
- Chemistry 343
- Computer Sciences 302
- Curriculum and Instruction 277
- Economics 101 and 301
- Engineering Mechanics & Astronautics 201
- Mathematics 112, 211, 222, and 320
- Philosophy 211
- Psychology 202
- Statistics 301
- Zoology 101

Eighty-five other courses have two of the three bottleneck features. These include:

- 2 courses with **access/demand** and **outcomes** bottleneck features
- 54 courses with **access/demand** and **gateway/requirements** bottleneck features
- 29 courses with **outcomes** and **gateway/requirements** bottleneck features

An additional 76 courses have a single feature of a bottleneck course as defined for this analysis, including:

- 25 courses with the **access/demand** bottleneck feature
- 17 courses with the **outcomes** bottleneck feature
- 34 courses with the **gateway/requirements** feature

When the list of 178 courses is sorted by subject/department, a listing of departments with a high number courses with bottleneck features becomes evident. Fourteen subjects/departments have four or more courses with bottleneck features. These departments include:

- Mathematics – 17 courses, including 4 courses with all three types of bottleneck features
- Computer Sciences – 12 courses
- Chemistry – 8 courses
- Economics – 8 courses, including 2 courses with all three types of bottleneck features
- English – 8 courses, including 2 English as a Second Language (ESL) courses
- Physics – 8 courses
- Psychology – 8 courses
- Sociology – 8 courses
- Zoology (Biology and Zoology subject listings) – 5 courses
- Communication Arts – 4 courses
- Gender and Women’s Studies – 4 courses
- Journalism and Mass Communication – 4 courses
- Philosophy – 4 courses
- Statistics – 4 courses

We noticed that many of the courses with bottleneck features are recommended for pre-health students as part of a curriculum planning guide for admission to M.D. programs or other health professions. Because so many of our incoming students indicate pre-health interest, the demand for some of these courses may be driven by this factor.

Note: This analysis is based on courses that were offered in fall and/or spring 2012-13 and are based on the enrollments in these courses, the number of students on waitlists in these courses, and the final grade distributions in these courses. Identification of courses that meet the general education competency requirements is based on course attributes in ISIS. The centralized waitlist functionality was first implemented in 2011 and usage continues to expand. Because one of the course bottleneck features is based on waitlist, there is not sufficient data to establish trends based on prior years.

We have included the full list of courses one or more bottleneck features.

UW-Madison Undergraduate Courses with Bottleneck Features
Sorted in Ascending Order by Subject and Course Number

Subject Name	Course #	Course Title	"Bottleneck" Feature Type						Summary Counts		
			Access/Demand		Outcomes	Gateway/Requirements			Total Number of:		
			High Enrollment ¹	Excess Demand ²	High D/F/Drop Rate ³	Gen Ed. Competency ⁴	Part of Course Seq. ⁵	Major Require. ⁶	Bottleneck Features	Bottleneck Types	
Accounting and Info Systems	100	Intro Financial Accounting	x	x	x			x	x	5	3
Accounting and Info Systems	300	Accounting Principles					x			1	1
African Languages & Literature	201	Intro to African Language and Lit.			x		x			2	2
Afro-American Studies	260*	Latin America: An Introduction			x					1	1
Agriculture and Applied Economics	215	Intro to Ag and Applied Economics					x			1	1
Anatomy	328	Human Anatomy		x				x	x	3	2
Anatomy	329	Human Anatomy/Kinesiology		x				x	x	3	2
Anthropology	104	Cult Anthro&Human Diversity	x				x			2	2
Art	102	Two Dimensional Design			x					1	1
Art History	201	Ancient and Medieval Art			x					1	1
Astronomy	103	The Evolving Universe	x		x		x	x		4	3
Astronomy	113	Hands on the Universe					x			1	1
Astronomy	160*	Life in the Universe			x					1	1
Biochemistry	501	Introduction-Biochemistry	x						x	2	2
Biocore	301	Evolution, Ecology, and Genetics					x			1	1
Biocore	302	Evolution, Ecology, and Genetics Lab.					x			1	1
Biocore	304	Cellular Biology Laboratory					x			1	1
Biology/Zoology	151*	Introductory Biology	x		x			x	x	4	3
Biology/Zoology	152*	Introductory Biology	x				x	x	x	4	2
Biology/Zoology	153*	Introductory Biology			x			x	x	3	2
Botany	130*	General Botany			x				x	2	2
Botany	460*	General Ecology					x			1	1
Botany	466*	General Genetics			x				x	2	2
Chemistry	103	General Chemistry	x					x	x	3	2
Chemistry	104	General Chemistry	x					x	x	3	2
Chemistry	109	Advanced General Chemistry	x					x	x	3	2
Chemistry	327	Fundamentals of Analytic Science			x				x	2	2
Chemistry	329	Fundamentals of Analytic Science			x				x	2	2
Chemistry	343	Intro Organic Chemistry	x	x	x			x	x	5	3
Chemistry	344	Intro Organic Chemistry Lab	x					x	x	3	2
Chemistry	345	Intmed Organic Chemistry	x						x	2	2
Communication Arts	100	Intro to Speech Composition	x					x		2	2
Communication Arts	262	Theory/Pract. Arguementation/Debate						x		1	1
Communication Arts	266	Theory/Pract. Group Discussion						x		1	1
Communication Arts	272	Intro. to Interpersonal Comm.						x		2	2
Communication Sci. and Disorders	201	Speech Science			x					1	1
Computer Sciences	202	Introduction to Computation						x		1	1
Computer Sciences	302	Introduction to Programming	x		x			x	x	4	3
Computer Sciences	367	Intro to Data Structures			x				x	2	2
Computer Sciences	368	Learn a Programming Language		x	x					2	2

UW-Madison Undergraduate Courses with Bottleneck Features
Sorted in Ascending Order by Subject and Course Number

Subject Name	Course #	Course Title	"Bottleneck" Feature Type						Summary Counts	
			Access/Demand		Outcomes	Gateway/Requirements			Total Number of:	
			High Enrollment ¹	Excess Demand ²	High D/F/ Drop Rate ³	Gen Ed. Competency ⁴	Part of Course Seq. ⁵	Major Require. ⁶	Bottleneck Features	Bottleneck Types
Computer Sciences	412	Intro to Numerical Methods			x			x	2	2
Computer Sciences	540	Intro to Artificial Intelligence		x				x	2	2
Computer Sciences	564	Database Management Systems		x				x	2	2
Computer Sciences	577	Introduction to Algorithms		x				x	2	2
Computer Sciences	240*	Intro to Discrete Mathematics			x			x	2	2
Computer Sciences	352*	Digital System Fundamentals					x		1	1
Computer Sciences	354*	Machine Organization and Program.					x		1	1
Computer Sciences	552*	Intro to Computer Architecture			x			x	2	2
Counseling Psychology	115	Human Dev: Ed Effectiveness	x						1	1
Curriculum and Instruction	277	Video Games and Learning		x	x		x		3	3
Economics	101	Principles-Microeconomics	x		x		x	x	5	3
Economics	102	Principles-Macroeconomics	x					x	3	2
Economics	301	Intmed Microeconomic Theory	x		x			x	3	3
Economics	302	Intmed Macroeconomic Theory	x					x	2	2
Economics	310	Stats./Measurement in Economics		x			x	x	3	2
Economics	435	The Financial System		x				x	2	2
Economics	521	Game Theory and Economic Anal.			x			x	2	2
Economics	522	Law and Economics		x				x	2	2
Educational Psychology	321	Human Dev. In Adolescence			x			x	2	2
Electrical and Computer Eng.	203	Signals, Information, Computation			x			x	2	2
Engineering Professional Dev.	155	Basic Communication					x		1	1
Engineering Professional Dev.	397	Technical Communication		x			x	x	3	2
English	100	Intro to College Composition	x				x		2	2
English	117	Academic Writing I (ESL)		x				x	2	2
English	118	Academic Writing II (ESL)		x			x		2	2
English	168	Intro to Modern Lit since 1900	x				x		2	2
English	201	Intermediate Composition					x		1	1
English	215	British Literature Before 1750			x			x	2	2
English	236	Bascom Course			x		x		2	2
English	324	Structure of English		x				x	2	2
Engr Mechanics & Astronautics	201	Statics	x		x			x	4	3
Entomology	201*	Insects and Human Culture		x					1	1
Environmental Studies	339*	Environmental Conservation			x				1	1
Finance, Investment & Banking	300*	Introduction to Finance	x					x	3	2
Folklore	100	Introduction to Folklore					x		1	1
French	102	Second Semester French			x			x	2	2
Gender and Women's Studies	101	Gender, Women, and Cultural Rep.		x					1	1
Gender and Women's Studies	103	Women and Their Bodies/Health		x	x				2	2
Gender and Women's Studies	424	Women's Intern. Human Rights		x					1	1
Gender and Women's Studies	533	Special Topics/Women and Health		x					1	1

UW-Madison Undergraduate Courses with Bottleneck Features
Sorted in Ascending Order by Subject and Course Number

Subject Name	Course #	Course Title	"Bottleneck" Feature Type						Summary Counts		
			Access/Demand		Outcomes	Gateway/Requirements			Total Number of:		
			High Enrollment ¹	Excess Demand ²	High D/F/ Drop Rate ³	Gen Ed. Competency ⁴	Part of Course Seq. ⁵	Major Require. ⁶	Bottleneck Features	Bottleneck Types	
General Business	301	Business Law	x							1	1
General Business	304	Intermediate Business Statistics	x	x					x	3	2
Geography	101	Bascom Course					x			1	1
Geography	340	World Regions in Global Contexts			x					1	1
Geoscience	110	Evolution and Extinction			x					1	1
Geoscience	111	Volcanoes and Civilization			x					1	1
Geoscience	333	The Age of Dinosaurs			x					1	1
History	201	The Historian's Craft					x			1	1
Human Development & Fam. Stud.	362	Development of the Young Child		x					x	2	2
Human Development & Fam. Stud.	363	Development in Adolesc./Old Age		x					x	2	2
Human Development & Fam. Stud.	474	Racial/Ethnic Families in the U.S.		x			x			2	2
Industrial and Systems Engineering	575	Intro to Quality Engineering		x						1	1
Interdis Courses (Engr)	160	Intro to Engineering Design	x						x	2	2
Intergrated Liberal Studies	200	Critical Thinking and Expression					x			1	1
Intergrated Liberal Studies	201	Western Culture/Science/Tech			x					1	1
Journ and Mass Communication	201	Intro to Mass Communication	x				x	x	x	4	2
Journ and Mass Communication	447	Strategic Media Planning		x						1	1
Journ and Mass Communication	676	Topics in Mass Communication		x						1	1
Journ and Mass Communication	662*	Mass Media and Minorities		x			x			2	2
Kinesiology	116	First Aid and Basic Life Support		x						1	1
Landscape Architecture	250	Survey of Landscape Arch. Design			x				x	2	2
Library and Information Studies	201	The Information Society					x			1	1
Life Sciences Communication	100	Introduction to Communication		x			x			2	2
Life Sciences Communication	250	Res. Methods in Comm. Industry		x						1	1
Life Sciences Communication	332	Print/Electromic Media Design		x						1	1
Linguistics	101*	Human Language			x					1	1
Literature in Translation	275*	The Tales of Hans Christian Anderson					x			1	1
Management and Human Resources	300	Organizational Behavior	x					x	x	3	2
Management and Human Resources	322	Intro to Entrepreneurial Manage.		x						1	1
Management and Human Resources	434	Venture Creation		x						1	1
Marketing	300	Marketing Management	x	x				x	x	4	2
Marketing	305	Consumer Behavior		x						1	1
Mathematics	101	Intermediate Algebra			x			x		2	2
Mathematics	112	Algebra	x		x		x			3	3
Mathematics	114	Algebra and Trigonometry					x			1	1
Mathematics	130	Mathematics for Teaching					x			1	1
Mathematics	141	Quant. Reasoning and Prob. Solving					x			1	1
Mathematics	171	Calculus w/ Algebra and Trig I					x			1	1
Mathematics	211	Calculus	x		x		x		x	4	3
Mathematics	213	Calculus/Intro to Diff. Equations					x			1	1

UW-Madison Undergraduate Courses with Bottleneck Features
Sorted in Ascending Order by Subject and Course Number

Subject Name	Course #	Course Title	"Bottleneck" Feature Type						Summary Counts	
			Access/Demand		Outcomes	Gateway/Requirements			Total Number of:	
			High Enrollment ¹	Excess Demand ²	High D/F/ Drop Rate ³	Gen Ed. Competency ⁴	Part of Course Seq. ⁵	Major Require. ⁶	Bottleneck Features	Bottleneck Types
Mathematics	217	Calculus with Algebra and Trig II			x	x			2	2
Mathematics	221	Calculus&Analytic Geometry 1	x			x	x	x	4	2
Mathematics	222	Calculus&Analytic Geometry 2	x		x	x	x	x	5	3
Mathematics	234	Calc--Functns of Variables	x				x	x	3	2
Mathematics	319	Tech. in Ordinary Diff. Equations			x			x	2	2
Mathematics	320	Linear Alg & Diff Equations	x		x			x	3	3
Mathematics	321	Applied Mathematical Analysis			x			x	2	2
Mathematics	521	Analysis I			x			x	2	2
Mathematics	431*	Intro to the Theory of Probability			x			x	2	2
Microbiology	101	General Microbiology			x		x		2	2
Microbiology	102	General Microbiology Lab		x					1	1
Microbiology	304	Biology of Microorganisms Lab		x					1	1
Music	113	Music in Performance	x						1	1
Nursing	319	Nursing Care in the Inpatient Setting				x			1	1
Nutritional Sciences	132	Nutrition Today	x						1	1
Nutritional Sciences	203*	Intro to Global Health		x					1	1
Operations & Technology Mgmt	300	Operations Management	x					x	2	2
Philosophy	101	Introduction to Philosophy	x						1	1
Philosophy	210	Reason in Communication			x	x			2	2
Philosophy	211	Elementary Logic		x	x	x			3	3
Philosophy	341	Contemporary Moral Issues	x			x			2	2
Physics	103	General Physics	x			x	x	x	4	2
Physics	104	General Physics	x					x	2	2
Physics	107	Ideas of Modern Physics				x			1	1
Physics	109	Physics in the Arts				x			1	1
Physics	115	Energy				x			1	1
Physics	201	General Physics			x	x	x	x	4	2
Physics	202	General Physics	x					x	2	2
Physics	207	General Physics				x			1	1
Physiology	335	Physiology	x	x				x	3	2
Political Science	104	Intro-Amer Politcs&Governmt	x			x			2	2
Population Health	370	Public Health Local/Global Perspec.		x					1	1
Psychology	202	Introduction to Psychology	x	x	x		x	x	5	3
Psychology	210	Basic Statistics for Psychology				x			1	1
Psychology	225	Experimental Psychology				x			1	1
Psychology	411	Current Topics in Psychology		x					1	1
Psychology	509	Abnormal Psychology			x			x	2	2
Psychology	528	Intro to Cultural Psychology			x				1	1
Psychology	560	Child Psychology		x					1	1
Psychology	530*	Intro to Social Psychology		x					1	1

UW-Madison Undergraduate Courses with Bottleneck Features
Sorted in Ascending Order by Subject and Course Number

Subject Name	Course #	Course Title	"Bottleneck" Feature Type						Summary Counts	
			Access/Demand		Outcomes	Gateway/Requirements			Total Number of:	
			High Enrollment ¹	Excess Demand ²	High D/F/Drop Rate ³	Gen Ed. Competency ⁴	Part of Course Seq. ⁵	Major Require. ⁶	Bottleneck Features	Bottleneck Types
Sociology	134	Probs. of Racial/Ethnic Minorities		x		x			2	2
Sociology	441	Criminology			x				1	1
Sociology	475	Classical Sociologic Theory			x				1	1
Sociology	210*	Survey of Sociology				x			1	1
Sociology	211*	The Sociological Enterprise			x				1	1
Sociology	220*	Ethnic Movements in the U.S.		x		x			2	2
Sociology	357*	Methods of Sociological Inquiry		x				x	2	2
Sociology	360*	Statistics for Sociologists I				x			1	1
Spanish (Spanish and Portug)	203	Third Semester Spanish	x					x	2	2
Spanish (Spanish and Portug)	204	Fourth Semester Spanish	x					x	2	2
Spanish (Spanish and Portug)	226	Interm Lang Prac-Writng&Grammr	x	x					3	2
Statistics	224	Intro Stats for Engineers			x				2	2
Statistics	301	Intro-Statistical Methods	x		x	x		x	4	3
Statistics	311	Theory/Methods of Math. Stats			x				1	1
Statistics	371	Intro Applied Stats-Life Sci	x			x			2	2
Theatre and Drama	120	Intro-Theatre & Dramatic Lit	x	x		x			3	2
Zoology	101*	Animal Biology	x		x			x	4	3
Zoology	102*	Animal Biology Laboratory	x					x	3	3

Notes:

Courses listed on this tabulation are identified as meeting one or more of the bottleneck features as defined below.

A. Access/Demand Bottleneck Type: Courses with these features either had 1) high enrollments (700 or more students enrolled in their 2012-13 academic year) or 2) excess demand (15 or more students left on a course waitlist at the end of the enrollment period in fall or spring 2012-13).

B. Outcome Bottleneck Type: Courses with these features had 3) at least 100 undergraduates enrolled in 2012-13 and either an overall course D/F/Drop rate of 20% or higher OR a D/F/Drop rate of 20% or higher for any subgroup of student (male/female, targeted minority/not targeted minority, first generation/not first generation).

C. Gateway/Requirement Bottleneck Type: Courses with these features 4) meet key general education competency requirements (Comm A, Comm B, QRA, QRB, or ethnic studies), for a large number of students (100 or more), 5) are key parts of critical course sequences that are prerequisites for many other courses, or 6) are major course requirements for one or more medium to large majors.

An asterisk following a course number indicates that the course is cross listed with at least one other subject listing.