

OPTIMIZING COURSE OFFERINGS IN A SCIENCE DEPARTMENT

Yu Kay Law, Department Chair
Department of Natural Science, Indiana University East

Abstract

We will discuss how enrollment data and faculty/advisor input can be used to maximize schedule efficiency in course offerings and providing for student success. We will also discuss how best to monitor and rearrange course schedules in light of actual enrollment.

Introduction

As a department chair, a common responsibility is to manage the course scheduling process. Course schedules need to be prepared to meet students' needs to have the courses available to graduate on time and in a predictable pattern. On the other hand, particularly with institutions being increasingly financially stressed, it is important to be efficient with human resources and minimize low-enrolled sections. This process is particularly important with demographic changes which has already led to enrollment challenges for many primarily undergraduate institutions (Grawe, 2017). In addition, enrollment trends have increasingly favored online course offerings rather than in-person course offerings. This particularly challenging for science programs (with laboratory courses) to navigate.

It is therefore vital that course offerings are matched to student demand. If there are insufficient sections to meet demand, students are closed out of course sections and their ability to complete their degrees may be compromised (and the department's credit hour generation is impaired). Alternatively, if low-enrolled sections must be cancelled, student and faculty schedules need to be changed at the last minute. The planned staffing of unnecessary sections make it more challenging to add new courses that are needed. At a personal level, we cannot forget the loss of expected income for part-time faculty members when their teaching assignments are cancelled.

In this presentation, I describe how our department reviews the course offering pattern to optimize the pattern. In addition, I describe how we manage the scheduling process each semester to minimize cancelling sections as well as students who are closed out of course sections.

Department Context

Indiana University East is a regional campus that offers primarily four-year undergraduate degrees with a significant online component to its offerings.

The Department of Natural Science offers BS degrees in Biology, Biochemistry, and Human Life Science, and we also participate in offering other degree programs both with other departments on our campus as well as online collaborative degrees with other IU campuses. We also teach general education and pre-nursing courses for non-science majors. There are nine full-time faculty members and several part-time faculty members who teach courses in astronomy, physics, chemistry, biology, and geology.

In the last few years, the department's academic year enrollments have had significant fluctuations (Figure 1). This trend is not uniform between courses; in particular, the decrease in the number of majors in our department's core degree programs since 2020 outpaced the decline in credit hours (Figure 2). Part of this volatility is associated with our inability to predict what general education courses will be shared across the five regional campuses at IU.

In previous years, loss of tuition associated with enrollment decreases within the School of Natural Science and Mathematics has significantly affected faculty work conditions including the availability of course assistants and laboratory supplies.

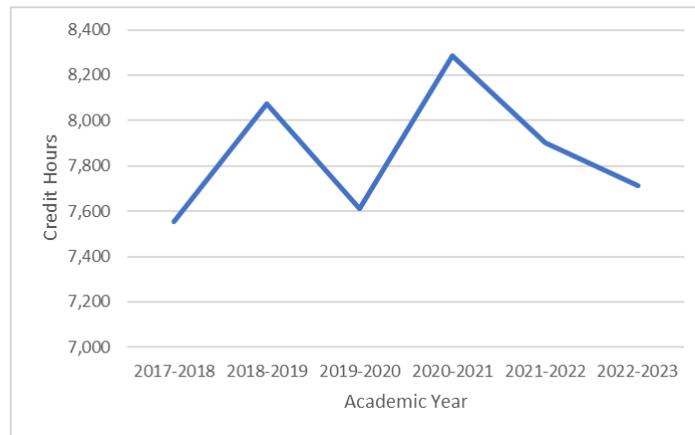


Figure 1. Student credit hours generated by the Department of Natural Science per academic year.

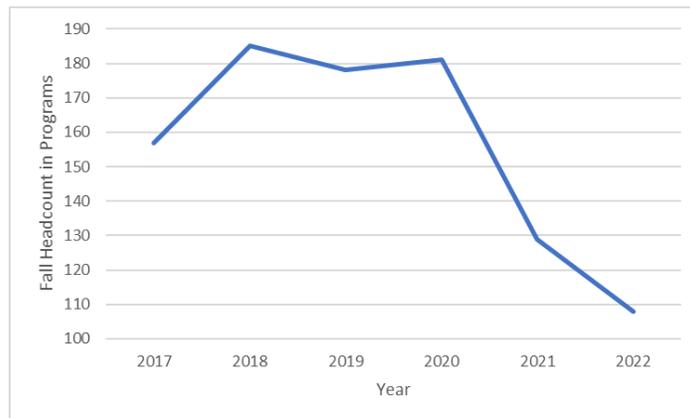


Figure 2. Total fall student headcount in the BS Biochemistry, Biology, and Human Life Science degree programs.

Historical Background

Up until the late 2010s, most full-time faculty members were responsible for scheduling specific courses in the department, with administrative staff in the school being responsible for collating and submitting these changes. The Dean will then cancel low enrolled class sections as these emerge during the scheduling process. There were a number of problems with this model, particularly with the lack of intentionality in determining course offerings (which led to significant inertia in course offerings and a number of low-enrolled courses) and the possibility of conflicts between commonly offered courses (once we had biochemistry lecture and laboratory being offered at the same time).

Goals of Course Offering Planning

As mentioned above, a major goal in managing the course offering pattern is to maximize credit hour production and minimize low enrolled courses. However, it is vital that students' time and path to graduation is not impeded by scheduling constraints either when course offerings are minimized or if courses are offered at the same time. This information is also critical for degree planning.

For this purpose, we need to determine the course offering frequency (every semester, every year, or every other year), modality, and the timeslot for each course (particularly since we rarely have more than one section of any course each year).

Constraints to consider for our department beyond simple optimization include:

- Faculty expertise: No faculty member is qualified to teach all courses in our department. While there are part-time faculty available particularly for online courses, they are challenging to recruit for specialty courses as well as in-person courses (due to our rural location). Retirements and resignations would often challenge our ability to offer specific courses – sometimes courses with high enrollment.
- We need to minimize conflicts between courses that are often taken simultaneously by students and those that are taught in the same laboratory. Anatomy and physiology course scheduling is fixed to meet the needs of students in the nursing program.
- There needs to be a predictable offering cycle that allows students to graduate on time.

Course Rotation Planning: Overview

The process for schedule planning is an iterative process similar to the assessment cycle (Figure 3).

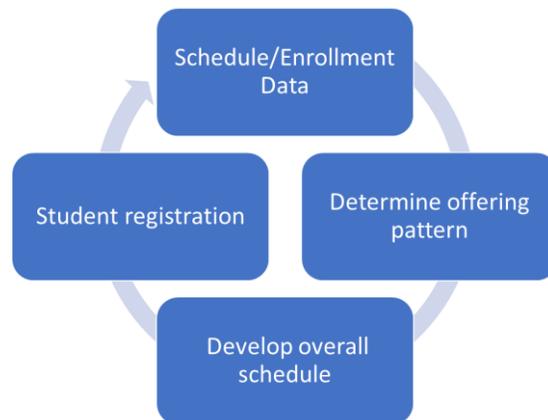


Figure 3. Schedule planning cycle.

1. Collate and organize course schedule and enrollment data from previous semesters.
2. A draft course offering pattern is developed:
 - a. Identify courses that are in demand and/or commonly low enrolled.
 - b. Analyze offerings that are in demand to see if they can be increased.
 - c. Analyze low-enrolled offerings based on whether reducing or removing these offerings would increase student time to degree.
 - d. When instructors who teach elective courses resign or retire, these are reviewed carefully to determine the extent to which efforts are made to find alternative.
3. The draft course offering pattern is discussed and finalized.

- a. Academic advisors are consulted to ensure that these changes are unlikely to affect student success and to identify possible new electives.
 - b. The faculty are consulted to ensure that there is input on these scheduling decisions.
4. The new course offering pattern is reviewed periodically.
- a. Course enrollments are reviewed periodically, restarting this loop. However, when course enrollment trends are routinely reviewed, it is likely that these changes will be more incremental in nature.

I will now present our department's strategic schedule planning process as well as the semester-by-semester scheduling procedure, with a subset of courses being presented.

Strategic Schedule Planning Process: 2020

In Fall 2020, an *ad hoc* committee was established to review course offerings, around the same time that the course scheduling process became centralized for the department. There were two reasons this occurred. Firstly, there were a large number of course offerings, some of which did not have significant enrollment per section (and there were multiple offerings each academic year). Secondly, a faculty member who taught the Biology of Mental was about to retire, and no full-time faculty member had expertise in Biology of Mental Illness.

To illustrate this process, Table 1 shows a subset of the courses examined. When this was reviewed, several recommendations were reached based on enrollment pattern

- Most summer courses had rather low enrollment. All courses except for Biology of Mental Illness and Murder 101 were discontinued.
- Microbiology had low enrollments outside of the spring semester and was discontinued
- The Capstone in Biology course had relatively low enrollment in the fall semester, and that offering was reduced.
- Additional offerings of Murder 101 was added in the Spring semester.

However, not every low enrolled course was eliminated:

- The physical chemistry course is required for the BS Biochemistry degree. We chose to reduce its offering frequency to every other year.
- While Biochemistry II often has relatively low enrollment, it is required both for the BS Biochemistry degree and admission into many professional schools. The prerequisites for this course meant that reducing the offerings of this course will prevent many students from graduating on time if it were offered every other year.

Table 1 Enrollments by semester in selected courses, 2016-2020. Course offerings that were reduced are italicized.

Course	Required for Degree Programs ¹	Enrollments												
		Fall					Spring				Summer			
		'16	'17	'18	'19	'20	'17	'18	'19	'20	'17	'18	'19	'20
Introductory Biology	B,C,H	142	157	164	145	127	41	46	52	32	<i>5</i>	<i>11</i>	<i>6</i>	
Molecular Biology	B,C	11	17	29	24									
Cell Biology	B,C						21	16	21	19				
Capstone in Biology	B,C,H	<i>13</i>	<i>9</i>	<i>9</i>	<i>13</i>		16	23	21	22				
Intro to Animal Kingdom	B	24	20	25	16									
General Chemistry I	B,C,H	52	64	70	53	82					<i>17</i>	<i>10</i>	<i>11</i>	<i>10</i>
General Chemistry II	B,C,H						38	47	40	34	9	5	12	7
Physical Chemistry	C	9	4	6		7				8				
Biochemistry I	C	18	12	21	21	20								
Biochemistry II	C						13	9	11	10				
Biology of Mental Illness		129	99	82	97	90	109	132	103	75	29	38	32	39
Microbiology		<i>15</i>	<i>10</i>				79	84	81	100	27	9	<i>10</i>	8
Body 101			18	27	30	28	30	27	39	30	<i>16</i>	<i>16</i>	9	
<i>Human Biology</i>		<i>13</i>	<i>10</i>	<i>14</i>		5	<i>18</i>	<i>14</i>	<i>16</i>		8	<i>10</i>	8	<i>10</i>
Murder 101														43

¹ Letters denote programs that the course is required for. B = BS Biology; C = BS Biochemistry; D = BS Human Life Science

We made significant efforts (and succeeded) to identify a new part-time faculty member to teach the Biology of Mental Illness course and the offering pattern for that course was maintained. At the same time, we noticed that enrollments in the Human Biology course was significantly lower than that in Body 101, and upon closer inspection we realized that the courses were almost identical. We therefore removed the human biology course from our course offering schedule.

Semester Scheduling Cycle

At Indiana University East, the course schedule is developed in the middle of the same semester in the previous year.

- 1) A template is provided based on last year's course schedule.
- 2) Changes are made to the template to:
 - a) Reflect agreed upon changes or course offering cycles.
 - b) Remove duplicate sections of online (asynchronous) courses. As we are not able to place hidden sections on the schedule and with the possibility of low-enrolled sections in mind, we minimize the number of course sections initially placed on the course schedule.
 - c) Make initial changes to teaching assignments.
- 3) A grid schedule is created using the free Gizmoa college schedule maker (<https://gizmoa.com/college-schedule-maker/>) to visualize the in-person course offering schedule. This is examined to identify schedule overlaps. The Dean (who also serves as the Chair of Mathematics) works with me to avoid conflicts with mathematics courses and communicate other changes that are needed (such as those needed to accommodate our CollegeNow high school concurrent enrollment students).
- 4) I send the draft schedule to all faculty in our department as well as advisors. I typically meet with colleagues in smaller groups based on laboratory rooms that are assigned for specific courses. Given the wide range of disciplines and subdisciplines represented in our department, smaller group discussions are more efficient. The final draft is sent to all faculty for comments.
- 5) The revised draft is then sent to the department for final comments before they are submitted to the administration. At our campus, the Advising Office reviews these and make recommendations based on what they see.

While adjuncts' teaching assignments (particularly long-time adjuncts) are often known at this stage, I confirm their teaching assignments in the middle of the following semester (around the same time that book orders need to be submitted).

As students enroll in courses, I review the course section enrollments on a regular basis (at least weekly). When sections become full and past history suggests that there will likely be additional

students enrolled in that course additional course sections are added to the course schedule. As mentioned previously, adding new course sections when needed is less disruptive for all parties concerned than having to cancel course sections due to low enrollment.

Unfortunately, sometimes course cancellations are unavoidable. I choose to do this as soon as practicable (again, consulting with advisors first as they are likely to be aware of potential additional enrollment or students who need this course for graduation) for the following reasons:

- It gives students maximum opportunity to register for other courses, thus minimizing the possibility that students' graduation will be delayed.
- It allows instructors to adjust to new teaching assignments and/or know about an impending loss in enrollment.

There will inevitably be errors. During Spring registration this year, the General Chemistry II laboratory section was filled in the first week of registration. Unsurprisingly, I thought that we had stronger than expected enrollment (particularly with students returning to studies after having departed or dropped in the 2020-2021 academic year) and decided to add a second laboratory section. However, the enrollment for this section was low and I probably should not have scheduled this section.

Reviewing the Course Offering Pattern

With decreasing enrollments since the return to normality after the pandemic particularly in our degree programs (Figures 1 and 2), we reviewed the enrollments for each course since the return to normal operations (Table 2).

Table 2. Fall course enrollments by modality in 2021 and 2022.

Course	Required for Degree Programs ¹	Fall 2021		Fall 2022	
		In-person	Online	In-person	Online
Introductory Biology	B,C,H	99	29	67	40
Molecular Biology	B,C	13		17	
Genetics	B,C,H	30		27	
Intro to Animal Kingdom	B		10		7
General Chemistry I	B,C,H	45	8	23	9
Physical Chemistry	C	3		10	
Biochemistry I	C		19		20
Biology of Mental Illness			80		76
Body 101			25		17

Two particular areas of concern were found. Firstly, online general chemistry enrollments have been low, and students have preferentially enrolled in the in-person sections. We therefore decided to cancel all online sections of this course. In addition, with low enrollments in the Introduction to Animal Kingdom course, we decided to reduce the offering frequency to every other year.

Concluding Remarks

The fundamental principle associated with this must be to “do no harm”, particularly to students. Just like the requirement to “teach out” any students when degree programs are suspended or closed, it is important that any changes in course offering patterns are clearly communicated and understood by academic advisors. In addition, efforts must be made to ensure that these measures do not increase time to degree, such as by delaying the implementation of reduced course schedules. This may necessitate delaying the implementation of course reductions.

Finally, it is important that the faculty and advising staff (as well as laboratory staff) are thoroughly consulted and any changes are made transparently throughout the process. While not every change will be welcome and may face resistance, it is important for everyone to have a voice in the process.

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