Academic Schedule Planning to meet Student Needs

Keith Murray
Purdue University
Does your institution have any of the following symptoms?

- Students have difficulty enrolling in required classes
- Lengthening times to graduation
- Few classes on Friday, early morning, or late afternoon
- Poor utilization of instructional space
Diagnosis:

All of these symptoms may result from a neglected academic planning and scheduling process.
Academic Planning and Scheduling Process

Student Demand
- Number of students
- Programs of study
- Elective interests
- Eligibility for courses

Instructional Planning
- What courses to offer
- Spaces per course/class
- Instructors
- Courses taken together
- Who may take the class
- Times offered
- Room needed by class

Student Scheduling
- Can student take class?
- Do desired classes conflict?
- Time preferences
- Best assignment to classes
  - for student preferences
  - for University resources

Delivery of Instruction
- Teaching classes
- Passing/not passing student

Management/Assessment
- Faculty teaching loads
- Adequate resources?

Corrective Actions
- Demand for more spaces
- Cancellations

Feedback (aka Enrollment Planning)
Key Areas of Planning to be Discussed

1. Instructional Planning and the Class Timetable
   a. Meeting Student Needs
   b. Tools Available

2. Class Selection (student registration/scheduling)
   a. Class Time Availability and Conflicts
   b. Alternative Approaches

3. Reporting and Feedback
   a. Understanding Demand and Utilization
   b. Planning for Change
Instructional Planning and the Timetable

Instructional planning requires the assignment of times, rooms, instructors, and students to classes. There are two traditional approaches.

Master Scheduling:

• Develop class timetable
• Schedule students to classes in timetable

Demand-driven Scheduling:

• Collect student demand for courses and times
• Develop optimized timetable and student schedules
## Timetabling Comparison

<table>
<thead>
<tr>
<th>Master Schedule</th>
<th>Demand-based Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros:</strong></td>
<td><strong>Pros:</strong></td>
</tr>
<tr>
<td>• Allows extended planning time</td>
<td>• Up to the minute demand data</td>
</tr>
<tr>
<td>• Predictable year to year</td>
<td>• Greatest ability to optimize use of resources</td>
</tr>
<tr>
<td>• Establishing schedule early facilitates student/faculty planning other activities</td>
<td>• Adaptability to current needs</td>
</tr>
<tr>
<td><strong>Cons:</strong></td>
<td><strong>Cons:</strong></td>
</tr>
<tr>
<td>• Based on projections of need</td>
<td>• Condensed planning time</td>
</tr>
<tr>
<td>• Limits flexibility</td>
<td>• Late completion complicates planning other activities</td>
</tr>
</tbody>
</table>
What is most important:

- Know student demand for each course, and
- Which courses need to be taken together

A good timetable requires providing both sufficient space in classes to meet student demand and providing those spaces at non-conflicting times when courses need to be taken together.
Model of Courses and Student Conflicts

Let:  ① = course 1
      \ = students in common between courses

The **color** of a course node represents its period assignment

Then:

Courses with no students in common can meet in the same period

Courses sharing students between all meetings must meet in different periods
Time Conflicts and Schedule Hours

Larger clusters of courses having students in common require additional periods.

Example: 5 courses

The minimum number of scheduling periods required to avoid conflicts depends on the largest set of courses with students in all members of the set.
Providing students with more options of courses that can be taken together requires more periods in the scheduling week.

More periods also allows better utilization, but the goal is putting classes at the right times for student needs.
Room and Instructor Requirements

Other factors can also create a need for more periods.

If two courses with no students in common require the same resource (e.g., room, teacher) an additional period may also be required to avoid conflicts.
Providing more choice to students requires a sufficient number of periods in the scheduling week, but how do you assign courses to times and rooms to avoid conflicts?
Automating the Timetabling Process

Research on course timetabling has become important in many areas of the world due to expanding university enrollments but constrained resources. Some resulting tools are:

- Infosilem (Canada)
- Lantiv Timetabler (Israel)
- Mimosa (Finland)
- O! Timetabling (South Africa)
- Scientia Syllabus Plus (United Kingdom)
- UniTime (United States)
- Untis (Austria)

More complete list at:  http://www.asap.cs.nott.ac.uk/watt/resources/university.html
Automating the Timetabling Process

Timetabling Demonstration
“Statistical analysis found that there is a clear correlation between HEIs that centrally timetable all their teaching space (both general purpose and specialist) and space performance. On average, and allowing for a range of external drivers affecting institutional size, HEIs with 100 per cent of teaching space centrally timetabled have 17 per cent less space than those which do not.”
Student Sectioning

Student sectioning is the assignment of individual students to classes when there is more than one section of a course.

• In demand-driven scheduling, sectioning is done at the same time that timetable is created.

• With master scheduling, sectioning done later as students enroll. This can both solve problems left by the timetable and create new ones.
Sectioning – Benefits and Challenges

Example:

4 courses with 3 periods and 2 available rooms

Note: number of students in common shown as labels on arcs

<table>
<thead>
<tr>
<th>Room 102</th>
<th>Room 101</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>Period A</th>
<th>Period B</th>
<th>Period C</th>
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<tbody>
<tr>
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</table>

Conflicts

0

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0
Sectioning – Benefits and Challenges

Best timetable has 2 conflicts:

Courses 2 and 4 have two students in common

Note: 4 periods are required to avoid all student conflicts

Conflicts

<table>
<thead>
<tr>
<th>Room 102</th>
<th>Room 101</th>
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<tbody>
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<th>Period B</th>
<th>Period C</th>
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</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>Course 2</td>
<td>Course 2</td>
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</table>
Sectioning – Benefits and Challenges

Sectioning may resolve conflicts

May be possible to schedule 2 conflicting students during added time period.

<table>
<thead>
<tr>
<th>Room 102</th>
<th>Room 101</th>
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<tbody>
<tr>
<td>Course 4</td>
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<td>Course 4'</td>
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<tr>
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<tr>
<td>Period B</td>
<td>Period C</td>
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Conflicts 0 0 0
Sectioning – Benefits and Challenges

However:

Total conflicts may increase if care not taken with how students are assigned to sections.

<table>
<thead>
<tr>
<th>Room 102</th>
<th>Room 101</th>
<th>Course 1</th>
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<tbody>
<tr>
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<td>Period B</td>
<td>Period C</td>
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Conflicts

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<td>Conflicts</td>
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<td>8</td>
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Sectioning – Benefits and Challenges

When multiple sections are created, the scheduling system must maintain sufficient available spaces in non-conflicting sections of courses with students in common.

Otherwise,
- students unable to enroll in all required courses
- lower satisfaction
- longer time to graduation
Are You Still Operating in the 13th Century?

Traditional student scheduling approaches used by most colleges and universities do not maintain space in courses at required times. They have remained essentially the same since the middle ages — some with the addition of a web interface.

• Tally kept of spaces left in each class.
• Queueing order determines odds of success.
Possible Approaches for the 21st Century

Real-Time Sectioning Demonstration
Experimental Results

Average Choices Available per Course Request

Thousands of Students Scheduled
Unmet Course Requests for Different Sectioning Methods

Purdue University, Fall 2007 - Average of 14 Runs
Reporting/Feedback

Understanding student course and time demand allows for better academic planning and scheduling.

How well course needs are met during scheduling determines your capacity to serve students. Information from effective scheduling tools can:

- Help better refine admissions targets
- Determine where resources best used to meet student needs
Important Data

- Student Course Demand
  - Enrollment Projections by Curricular Area
  - Curriculum Course Requirement Changes
  - Student Plans of Study

- Course Joint Demand

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<tr>
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<th>MA 153</th>
<th>MA 161</th>
<th>MA 165</th>
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- Course Wait Lists (Unmet Demand)
Collect and Report Data on How Planning and Scheduling Process is Affecting Distribution of Student Class Hours, not just room utilization.
Think You Have Space Utilization Problems?

The major Bottleneck is Time

A timetable and student scheduling process that do not meet student course needs will require additional resources
Scenarios

The timetabling tools demonstrated can be used to run “what if” scenarios:

- **Effect of Curriculum Changes**
  - Required Adjustments to Course Times?
  - Adequate Amount and Types of Space?

- **Effect of Removing Rooms on Class Schedule**
  - Does Adequate Space Remain?
  - Make Necessary Schedule Adjustments

- **Disaster Recovery**
Planning Ahead for Change

Difficulty understanding how change will affect the class schedule often makes universities reluctant to make beneficial changes.

Having tools that simplify adaptation to change can make universities more responsive to student needs.
Planning Ahead for Change

Developing an academic planning and scheduling process that closely ties how and when courses are offered to student needs can improve both student satisfaction and the bottom line.
Questions?