Proposal Talk Example: Exam Scheduling

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Exam Scheduling with Conflict Minimization

Basic problem:

- 4 exam periods per day of final exams.
- Given length of exam period, minimize exam conflicts.
- Looking for sensitivity and threshold phenomena.
- Data to model UBC.

More difficult problems:

- Miminize exam conflicts (need student schedules).
- What happens if large class exams given section by section.
- What about other universities?
- Are there heuristics better than ILP solver with 45,000 students?

Models, Part 1

Basic model:

- n classes, m exam periods.
- For $i = 1, \ldots, n$, and $k = 1, \ldots, m$, have variable $x_{ik} = 0, 1$; our intention is that $x_{ik} = 1$ if exam i scheduled in period k, 0 otherwise.
- Constraint $\forall i \in [n]$

$$x_{i1} + x_{i2} + \cdots + x_{im} = 1$$

  means each class assigned to one exam period.
- No conflicts: given P set of pairs (i, j) where class i and j have common students, $\forall (i, j) \in P$ and $k \in [m]$,

$$x_{ik} + x_{jk} \leq 1 \ .$$

Question: is there a feasible point?

Models, Part 2

With the same n, m and variables x_{ik}, we allow conflicts:

- Let $y_{ij} = 1$ if classes i, j are scheduled simultaneously, 0 otherwise.
- y_{ij} are the minimum $0, 1$-valued solution to

$$x_{ik} + x_{jk} \leq 1 + y_{ij} \quad \forall k \in [m].$$

- Can minimize an objective function

$$z = \sum_{i<j} \mathrm{Weight}(i,j) y_{ij},$$

where $\mathrm{Weight}(i,j)$ is larger for (i,j) with more conflicts.

Models, Part 3

More elaborate model: same n, m and variables x_{ik}. Have s students, and for $\ell \in [s]$ given

$$A_\ell \subset [n]$$

i.e., the subset of classes taken by ℓ-th student.
Exam hardship: student ℓ has hardship if min $h_\ell = 0, 1$ s.t.

$$\sum_{j=k}^{k+3} \sum_{i \in A_\ell} x_{ij} \leq 2 + 2h_\ell \quad \forall k \in [m-3]$$

is $h_\ell = 1$. Objective:

$$\text{Miminize} \sum_{\ell=1}^{s} h_\ell$$

This is larger problem (e.g., 45,000 students for 2,000 classes), more data.

Another Slide or Two

- Maybe a slide about obtaining data.
- Maybe a slide about how parameters will be varied.
- Maybe a slide about algorithms (if you are going to try something to compete with LP/ILP/QP solvers).