Read: H & L chapter 3.1-3.5

Example: Quidditch, "the sport of warlocks," is the premier sport of the wizarding world. Everyone follows Quidditch. The World Cup matches attract hundreds of thousands of fans from all over the world. Quidditch is a fast, dangerous, exciting game in which two teams flying on broomsticks compete for points scored by throwing a ball – the Quaffle – through hoops on either end of a large grassy pitch. ~ The Harry Potter Lexicon

The COMET TRADING CO. produces high-quality quidditch brooms, including the Nimbus and the Firebolt.

The Firebolt broom sports a streamlined, super-fine handle of ash, treated with a diamond-hard polish and hand-numbered with its own registration number. Each individually selected birch twig in the broomtail has been honed to aerodynamic perfection, giving the Firebolt unsurpassable balance and pinpoint precision. The Firebolt has an acceleration of 0-150 miles an hour in ten seconds and incorporates an unbreakable braking charm.

Nimbus Two Thousand: The Nimbus has a fast design, is very aerodynamic and luxurious. This one is sleek & shiny, with a mahogany handle, has neat slim twigs at the end with the words Nimbus Two Thousand emblazoned on it!

The Comet Trading Co. has three plants. Ash handles are treated with diamond-hard polish and engraved with an individual registration number in Plant 1, Mahogany handles are emblazoned with the words “Nimbus Two Thousand” and paired with slim twigs in Plant 2, and broom assembly and addition of the braking charm are done in Plant 3.

The Firebolt requires some of the production capacity in Plants 1 and 3, but none in Plant 2. The Nimbus needs only Plants 2 and 3.
The marketing division has concluded that the company could sell as much of either product as could be produced by these plants. However, because both products would be competing for the same production capacity in Plant and 3, it is not clear which mix of the two products would be most profitable. Therefore, a muggle OR team has been formed to study this question.

### Data for Comet Trading Co. problem

<table>
<thead>
<tr>
<th>Plant</th>
<th>Prod Time per Batch, h</th>
<th>Prod Time Avail, h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Product</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Profit per batch</td>
<td>30 G</td>
<td>15 G</td>
</tr>
</tbody>
</table>
The Linear Programming Model

Data Needed:

<table>
<thead>
<tr>
<th>Resource</th>
<th>Resource Usage per unit Activity</th>
<th>Amount Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>l</td>
<td>$a_{11}$ ... $a_{1n}$</td>
<td>$b_1$</td>
</tr>
<tr>
<td>:</td>
<td>:</td>
<td>:</td>
</tr>
<tr>
<td>m</td>
<td>$a_{m1}$ ... $a_{mn}$</td>
<td>$b_m$</td>
</tr>
<tr>
<td>Per unit contribution</td>
<td>$c_1$ ... $c_n$</td>
<td></td>
</tr>
</tbody>
</table>

Notation:
- $m$ resources
- $n$ activities
- $x_j$ level of activity $j$
- $Z$ overall measure of performance
- $c_j$
- $b_i$

Standard Form:

Other Forms:

1. Minimizing rather than maximizing the objective function

2. Constraints with a greater-than-or-equal-to inequality

3. Constraints in equation form

4. Unrestricted decision variables
Solution Terminology: solution
feasible solution
infeasible solution
feasible region
no feasible solutions
optimal solution
most favorable value
multiple optimal solutions
no optimal solutions
unbounded Z
corner-point feasible (CPF) solution

Theorem: Any LP with a bounded feasible region with feasible solutions must possess CPF solutions and at least one optimal solution.

Assumptions of Linear Programming:

1. Proportionality assumption: The contribution of each activity to the value of the objective function is proportional to the level of that activity. Similarly, the contribution of each activity to the LHS of each functional constraint is proportional to the level of the activity.

2. Additivity assumption: Every function is the sum of the individual contributions of the respective activities.

3. Divisibility assumption: Decision variables are allowed to have any values, including noninteger values, that satisfy the functional and nonnegativity constraints. (i.e. activities can run at fractional levels).

4. Certainty assumption: The value assigned to each parameter is assumed to be a known constant.

Homework: 3.1-6 (b) through (e) Due in class
For the next two questions, September 4, 2002
read Section 3.6 on the Excel solver
3.4-9 (use the Excel solver)
3.6-2