CIV 307
OPTIMIZATION

Lecture 2
Glass Production Problem.

Products:

- 8-foot glass door with aluminum framing
- 4 × 6-foot double hung wood-framed window.

Plants:

- Plant 1: Aluminum frame production.
- Plant 2: Wood frame production.
- Plant 3: Glass production and assembly.

Production is in batches over 200 units.

Data:

<table>
<thead>
<tr>
<th></th>
<th>Hrs/batch</th>
<th>Hrs avail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Door</td>
<td>Window</td>
</tr>
<tr>
<td>Plant 1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Plant 2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Plant 3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Profit/batch</td>
<td>$3,000</td>
<td>$5,000</td>
</tr>
</tbody>
</table>
Glass Production Problem

As a Linear Programming Problem:

\[
\begin{align*}
\text{maximize} & \quad 3x_1 + 5x_2 \\
\text{subject to} & \quad x_1 \leq 4 \\
& \quad 2x_2 \leq 12 \\
& \quad 3x_1 + 2x_2 \leq 18 \\
& \quad x_1, x_2 \geq 0.
\end{align*}
\]
Glass Production Problem

Graphical Representation:

\[ 3x_1 + 5x_2 = 36 \]
**Glass Production Problem**

**AMPL Formulation:**

```AMPL
var Batches1 >= 0;
var Batches2 >= 0;

maximize profit: 3 * Batches1 + 5 * Batches2;

subject to P1_Hrs_Avail: Batches1 <= 4;
subject to P2_Hrs_Avail: 2*Batches2 <= 12;
subject to P3_Hrs_Avail: 3*Batches1 + 2*Batches2 <= 18;

solve;

display Batches1, Batches2, profit;
```

**Output:**

```
MINOS 5.4: optimal solution found.
2 iterations, objective 36
Batches1 = 2
Batches2 = 6
profit = 36
```
Abstraction

The Model:

```plaintext
set Resources;  # Was plants in window prod
set Activities;  # Was products to produce

param avail {Resources};
param unit_profit {Activities};
param usage {Resources, Activities};

var amt {Activities} >= 0;

maximize profit:
    sum {j in Activities} unit_profit[j] * amt[j];

subject to capacity {i in Resources}:
    sum {j in Activities} usage[i,j] * amt[j]
    <= avail[i];
```
Instantiation

The Data:

```
set Resources := Plant1 Plant2 Plant3;
set Activities := Door Window;

param avail :=
    Plant1 4
    Plant2 12
    Plant3 18

param unit_profit :=
    Door 3
    Window 5

param usage: Prod1 Prod2 :=
    Plant1 1 0
    Plant2 0 2
    Plant3 3 2
```
The Solution Process

teal: ampl
ampl: model window2.mod;
ampl: data window2.dat;

ampl: solve;
MINOS 5.4: optimal solution found.
2 iterations, objective 36

ampl: display amt, profit;
amt [*] :=
Prod1 2
Prod2 6
;

profit = 36

ampl: quit