Guidelines on Formulating a Management Problem as
a Linear Programming Model – Prof. Stephen Graves

General Rules of Thumb

- There is usually more than one correct formulation of a problem.

- Sometimes it is unclear whether to use inequality or equality constraints.

- Sometimes our intuition tells us that a constraint is irrelevant (i.e., it is never binding). Try to find such constraints. But when in doubt, leave the constraint in.

Identifying Decision Variables

- Start by using decision variables that agree with your intuition. Ask yourself, "What decision must I make in order to determine the outcome?"

Identifying Constraints

- Some constraints are resource-related: can't use more than available

$$2G2 + G3 + W1 + W2 <= 16000 \ (256K \ memory)$$

- Other constraints are capacity limits

  Coal production from Consol mine   <=   mine capacity

- Requirements

  Must satisfy demand

- Quality Constraints

  Must have at least 19 % average volatility in coking coal

- Policy Constraints

  At least 50% union mines

  Must satisfy workstation demand from key customer

- Balance Constraints

    Conservation of Flow: Flow In equals Flow Out

    Inventory @ t+1 equals Inventory @ t plus production minus demand

Identifying Objective Function

- maximize revenue minus cost

    minimize cost minus revenue

    minimize number of people hired

- Be careful to make sure all costs and profits are properly accounted for, appearing once and only once.

- net out any sunk or fixed costs

Classes of LP Models
1. Product Mix (e.g., Digital Short Term Planning)

2. Blending

3. Multi Period Planning

4. Multi Stage Coordination

5. Covering and Cutting Stock Problems

6. Design Parameter Optimization

7. Network Planning

8. Network Design

9. Capital Budgeting

10. Process Design and Layout

Example - Logistics Planning Problem

One Product	Bulk Road Salt
Planning Period	Month
Planning Horizon	12 Months: April ---- March

Production Locations: 4 Mines

Stockage Locations: 4 Mines
                           50 Stockpiles
                           100's of Customer Sites

Transportation: Mines to Stockpiles by Rail (Barges)
                           Stockpiles to Customers by Truck

Issues: Production Plan for Seasonal Demand
                           Transportation and Inventory Plan
                           Decision Support for Bidding Process

Indices: i---mines; j--stockpiles; k--customers; t--time periods

Data Requirements:
             demand forecasts
             capacities
             cost coefficients

Decision Variables

     Production at i in time period t

     Inventory at i at end of time period t
     Inventory at j at end of time period t
     Inventory at k at end of time period t

     Rail shipments from i to j in t
     Truck shipments from j to k in t

Constraints

• Inventory Flow Balance

• Limits on Production/Transportation Activities

       mine production

       rail cars

       inbound at stockpiles

       outbound link limit

       inventory storage

• Objective

MIN Cost = production costs + inventory holding costs + mine to stockpile shipment costs + stockpile to customer shipment costs