Tutorial 1: Problem Formulation

Subject: CTMT
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Problem 1: The Artisan's Fair Dilemma

Amina, a talented artisan from a small village in Jharkhand, is preparing for the annual state-level crafts fair in Ranchi. She is famous for two of her signature products: intricately hand-painted terracotta lamps and beautifully woven Sabai grass wall hangings.

The fair is in three weeks, and Amina wants to make the most of this opportunity to earn money for her family and showcase her craft. She needs to decide how many of each item to create.

Resources, Time, and Profit

- **Total Available Time:** 150 hours.
- **Lamps:** Each lamp requires **3 hours** of work, **2 kg** of special clay, and **1 unit** of organic paint. The profit per lamp is **₹400**.
- **Wall Hangings:** Each wall hanging requires **5 hours** of work and **1.5 kg** of Sabai grass. The profit per wall hanging is **₹600**.
- **Raw Materials Stock:** She has **60 kg** of clay, **45 kg** of Sabai grass, and **35 units** of paint.
- **Demand and Orders:** A boutique has pre-ordered **at least 5 wall hangings**. Amina knows she is unlikely to sell more than **25 lamps**.

Task: Formulate the Problem

Set up the problem by defining the decision variables, objective function(s), constraints, and bounds.

Problem 2: The Dhanbad Industrial Supply Challenge

”Dhanbad Heavy Engineering” produces two types of mining equipment: Drill-Bits (Type D) and Conveyor Belts (Type C). They have orders from clients in Ranchi and Bokaro Steel City and must determine the most profitable production and shipping plan.

Production, Demand, and Shipping Details

- **Production Capacity:** A total of **500 units** (D and C combined) per month.
- **Machine 1: 1,200 hours** available. A Drill-Bit requires 3 hours; a Conveyor Belt requires 2 hours.
- **Machine 2: 1,000 hours** available. A Drill-Bit requires 1.5 hours; a Conveyor Belt requires 2.5 hours.
- **Ranchi Demand:** At least 150 Drill-Bits and 100 Conveyor Belts.
- **Bokaro Demand:** At least 120 Drill-Bits and 80 Conveyor Belts.
- **Profit (Ranchi):** ₹5,000 per Drill-Bit, ₹7,000 per Conveyor Belt.
- **Profit (Bokaro):** ₹4,500 per Drill-Bit, ₹7,200 per Conveyor Belt.
- **Shipping Weight Limit:** Total shipping weight cannot exceed **10,000 kg**. A Drill-Bit weighs 20 kg; a Conveyor Belt weighs 35 kg.

Task: Formulate the Problem

Set up a linear programming model by defining the decision variables, objective function, constraints, and bounds.