**Integer programming**

**Definition**

Integer programming is an optimisation method that involves the use of integer variables, or “whole numbers”. It is a type of mathematical programming problem used to find optimal solutions for certain types of problems. The goal of this technique is to maximise profit while minimising cost and resources. Integer programming differs from linear programming in its use of integer constraints, instead of real number constraints. Linear programming techniques can be applied to solve all kinds of problems, but when it comes to dealing with binary (0/1) and mixed-integer decisions, they are not always suitable.

**Key concepts**

1. **Decision variables**

Integer programming involves decision variables that represent the quantities to be determined. Unlike linear programming, which allows variables to take any real value, IP requires these variables to be integers.

1. **Objective function**

The objective function in IP defines the goal of the optimization problem, whether it is to maximize or minimize a certain quantity. This function is typically a linear combination of the decision variables.

1. **Constraints**

Constraints are conditions or limitations that the solution must satisfy. These constraints are linear relationships involving the decision variables and constants. Integer programming adds the requirement that some or all decision variables must be integers.

**Integer Programming’s advantages**

1. More modelling power
2. More readily implementable answers

**Integer Programming’s disadvantages**

1. More complex models
2. Much longer to get answers

**Harvesting problem**

**Decision variables**

di : the productivity of field i  
 m : the minimum productivity of a day  
 M : the maximum productivity of a day  
 xij = 0, 1 : whether the field I is harvest in the day j or not

**Constraint**

m ≤ di xij for all possible day j ≤ M

**Objective function**

Maximize f(x) = di xij

**Idea for harvesting using IP**

1. **Variable Definition**

Defines 2 series of variables, one to decide if a field should be harvested or not, one to decide when should that field be harvested.

1. **Objective**

The goal is to maximize total harvest products.

1. **Constraint 1**

Each field must be harvested exactly once within the given time period.

1. **Constraint 2**

The daily harvest products must be between m and M.