Multi Objective Analysis

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River Basin and Economic Development

- **Typical Stages of Development**
- **Increase in agricultural productivity, with the agricultural sector maintaining dominance in the economy**
- **Urbanization of the economy**
- **Diversification of the economy, with agriculture becoming only one of several industries**
- **Development of concern for urban social and environmental values**

Requirement for New Planning Perspectives

- From project level to river basin scale
- From Static to Dynamic
- From short-term to long-term
- From single-purpose, single-objective to integrated multiple purpose and multiple objectives

Nonstructural Measures

- **Water Measures**
- **Land Measures**
- **Implementation means**

  Publicity ,Awareness, Technical Assistance, Legislation

Multiobjective Analysis

Suitable for analysing impacts in natural non monetary units
Suitable when the objectives/Purposes are conflicting,

- **Objective Quantification**
- **Formulation of Alternatives and**
- **Plan Selection**

Formulation of Multiobjective Programming Problem

Maximize

$Z(x_1, x_2, \ldots\ldots\ldots\ldots, x_n)$

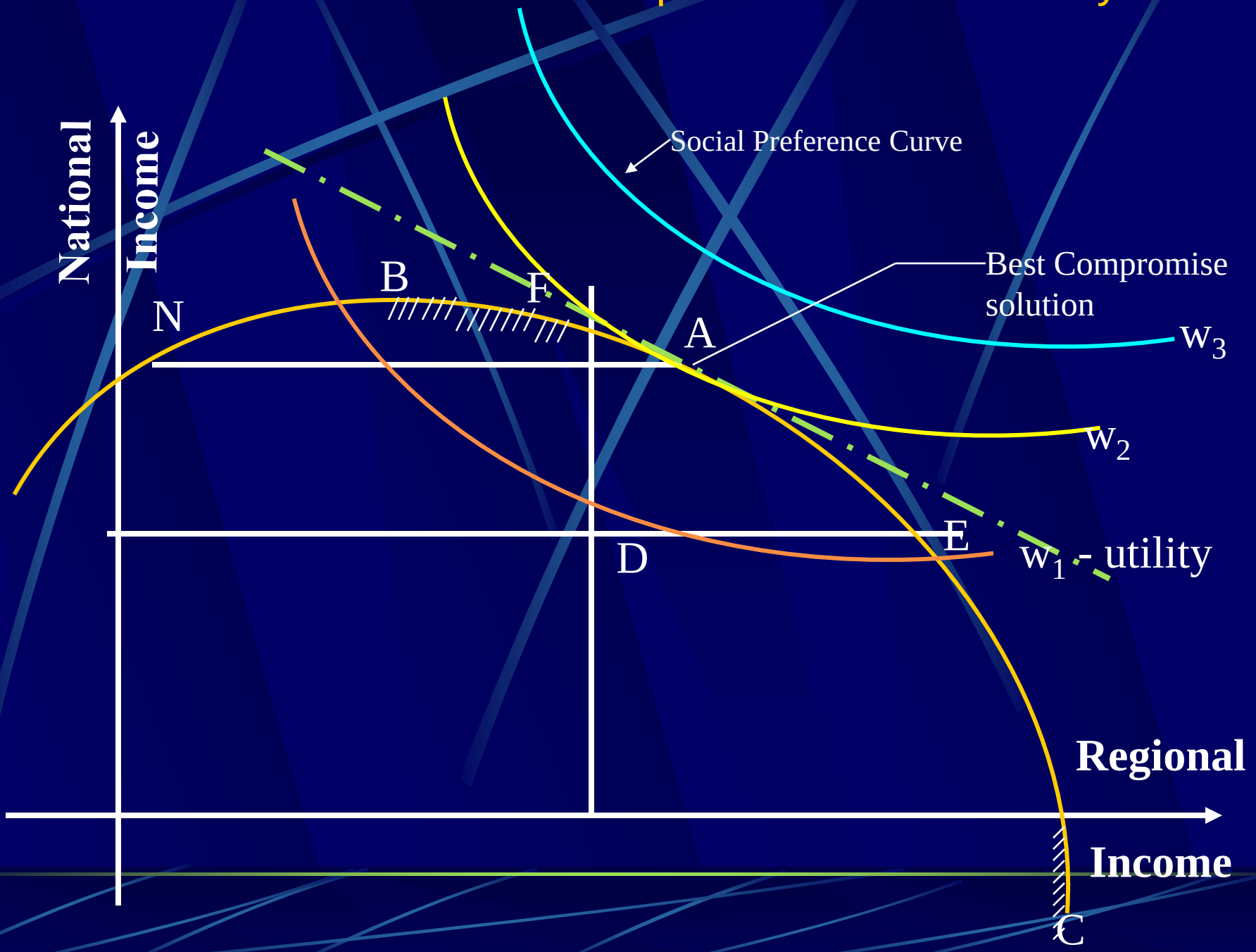
$[Z_1(x_1, x_2, \ldots\ldots\ldots\ldots, x_n), Z_2(x_1, x_2, \ldots\ldots\ldots\ldots, x_n)$

$\ldots\ldots\ldots\ldots\ldots, Z_p(x_1, x_2, \ldots\ldots\ldots\ldots, x_n)]$

Sub to $g_i(x_1, x_2, \ldots\ldots\ldots\ldots, x_n) \leq 0,\ i = 1, 2, \ldots\ldots m$

and $x_j(x_1, x_2, \ldots\ldots\ldots\ldots, x_n) \geq 0,\ j = 1, 2, \ldots\ldots, n$

Illustration of the concept of NonInferiority



Typical Two Objective Problem

$$\text{Max} \quad Z_1(x_1, x_2) = 5x_1 - 2x_2$$

$$Z_2(x_1, x_2) = -x_1 + 4x_2$$

$$\text{Sub to} \quad -x_1 + x_2 \leq 3$$

$$x_1 + x_2 \leq 8$$

$$x_1 \leq 6$$

$$x_2 \leq 4$$

$$\text{and} \quad x_1, x_2 \geq 0$$

Feasible region represented in Decision space

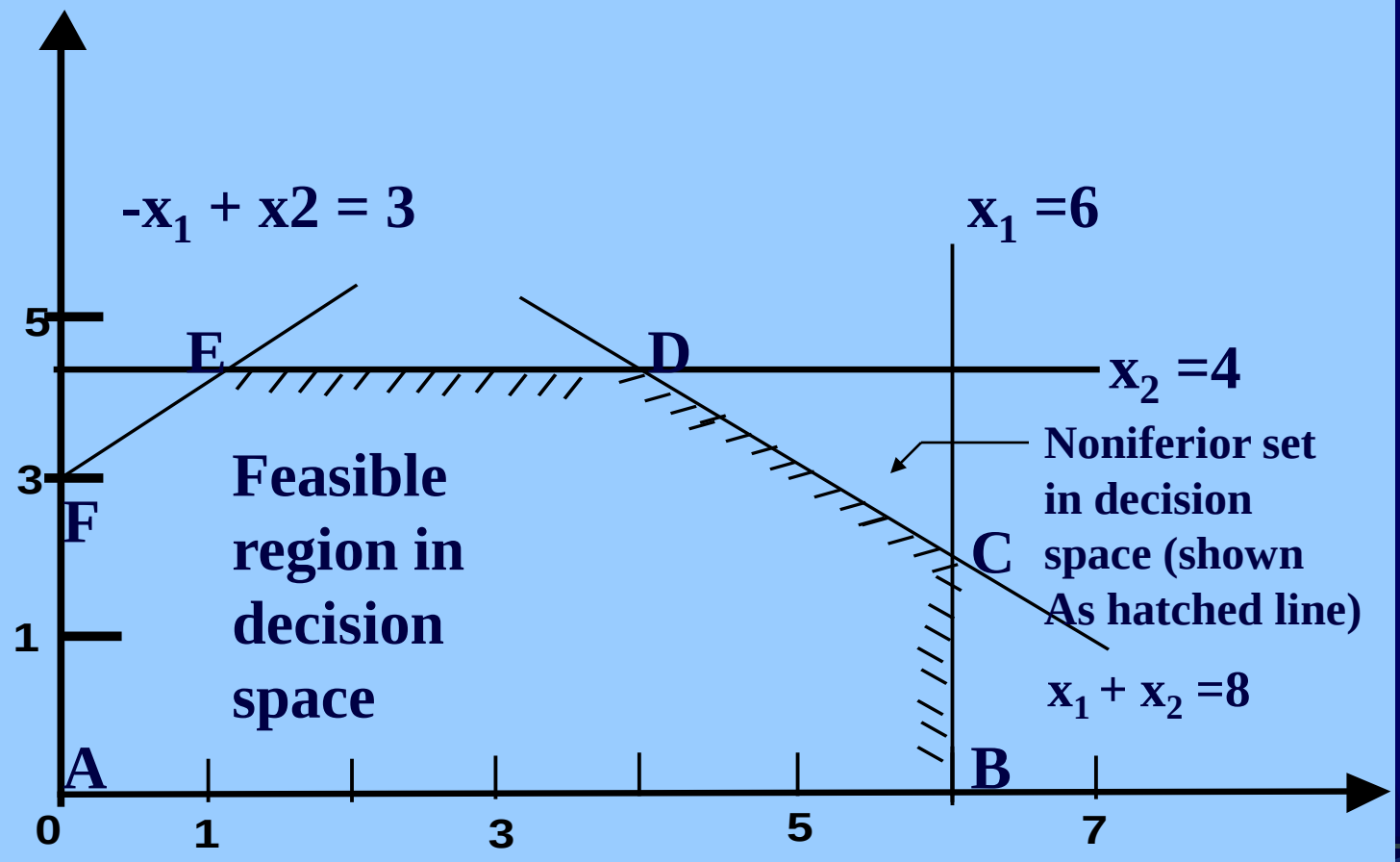
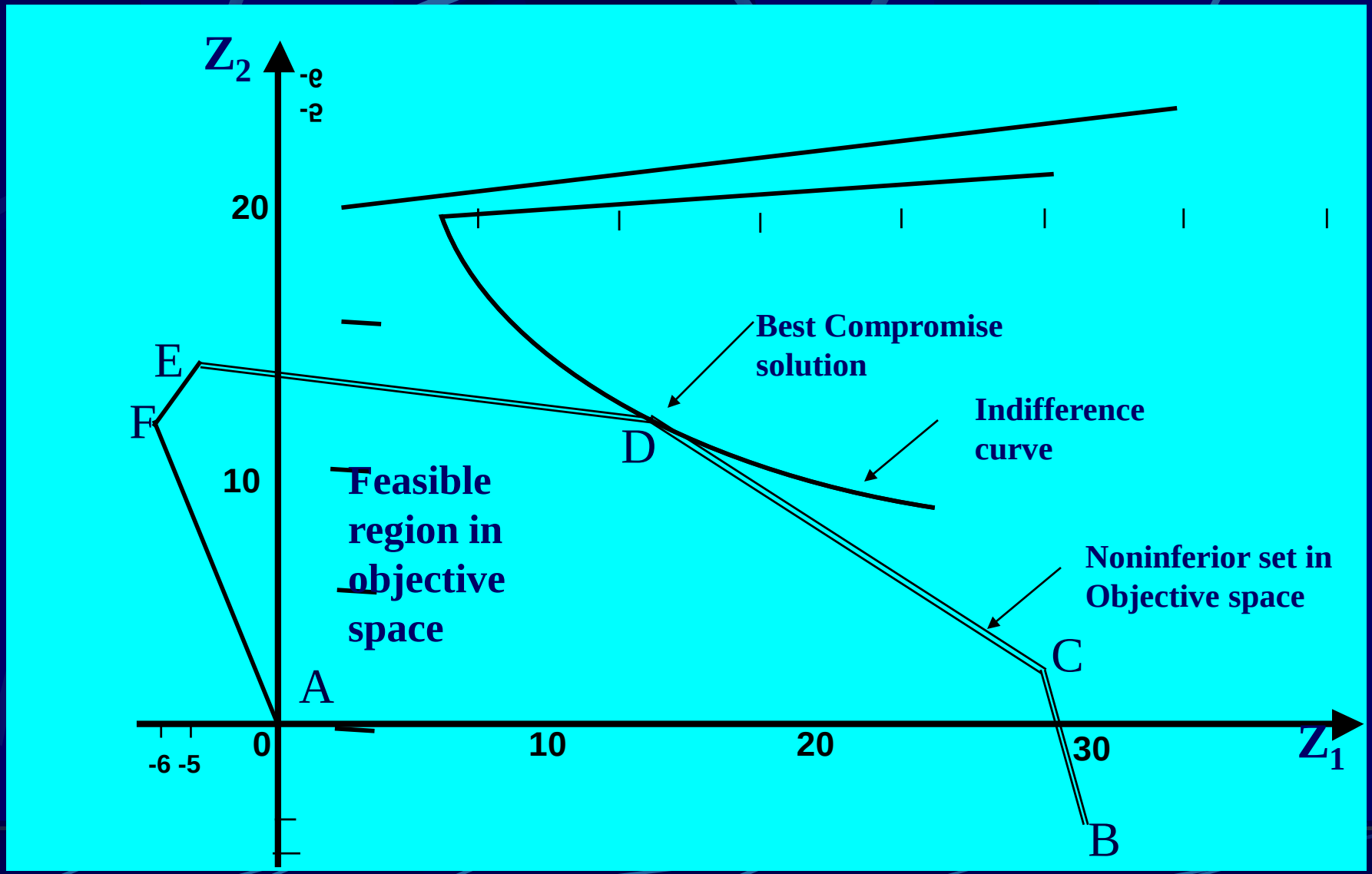


Table 2.1

Extreme Point	x_1	x_2	$Z_1 = 5x_1 - 2x_2$	$Z_2 = -x_1 + 4X_2$
A	0	0	0	0
B	6	0	30	-6
C	6	2	26	2
D	4	4	12	12
E	1	4	-3	15
F	0	3	-6	12

Feasible region represented in Objective space



Techniques for generating Non-inferior Solutions

- **The Weighting Method**

Max Z = $\sum$ wi Zi (x1, x2,.....xn)

sub to (x1, x2,.....xn) ε Fd

where wi is the weight attached to the ith objective function Zi

- **Constraint Method**

Solution by Constraint Method