Dynamic Programming
Applications

Optimum Geometric Layout of Truss
Objectives

- To discuss the design of elastic trusses
- To formulate the optimization problem as a dynamic programming model
Consider a planar, pin jointed cantilever multi bayed truss
Assume the length of the bays to be unity
The truss is symmetric to the x axis
Geometry or layout of the truss is defined by the y coordinates
\((y_1, y_2, \ldots, y_n)\)
Truss is subjected to a unit load \(W_1\)
Optimum Geometric Layout of Truss …contd.
Consider a particular bay $I$.

Assume the truss is statically determinate.

Forces in the bars of bay $i$ depend only the coordinates $y_{i-1}$ and $y_i$.

Cross sectional area of a bar can be determined, once the length and force in it are known.

Cost of the bar can thus be determined.
The optimization problem is to find the geometry of the truss which will minimize the total cost from all the bars.

For the three bay truss, the relation between y coordinates can be expressed as:

\[ y_{i+1} = y_i + d_i \quad \text{for} \quad i = 1, 2, 3 \]

This is an initial value problem since the value \( y_1 \) is known.
Let the y coordinate of each node is limited to a finite number of values say 0.25, 0.5, 0.75 and 1.
Optimum Geometric Layout of Truss …contd.

- As shown in the figure, there will be 64 different possible ways to reach $y_4$ from $y_1$
- This can be represented as a serial multistage initial value decision problem and can be solved using dynamic programming
Thank You