MAE 552
Heuristic Optimization

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Lecture #34

4/24/02

Fully Stressed Design

Fully Stressed Design (FSD)

- Just a few final words on FSD:

  – The resizing algorithm we looked at is only appropriate for truss type structures because there are no bending moments and inertial loads are considered negligible (recall our assumption that F's remain the same before and after resizing).

  – Even with all its limitations, FSD has been very successful and has prompted investigation into applications other than truss type structures.

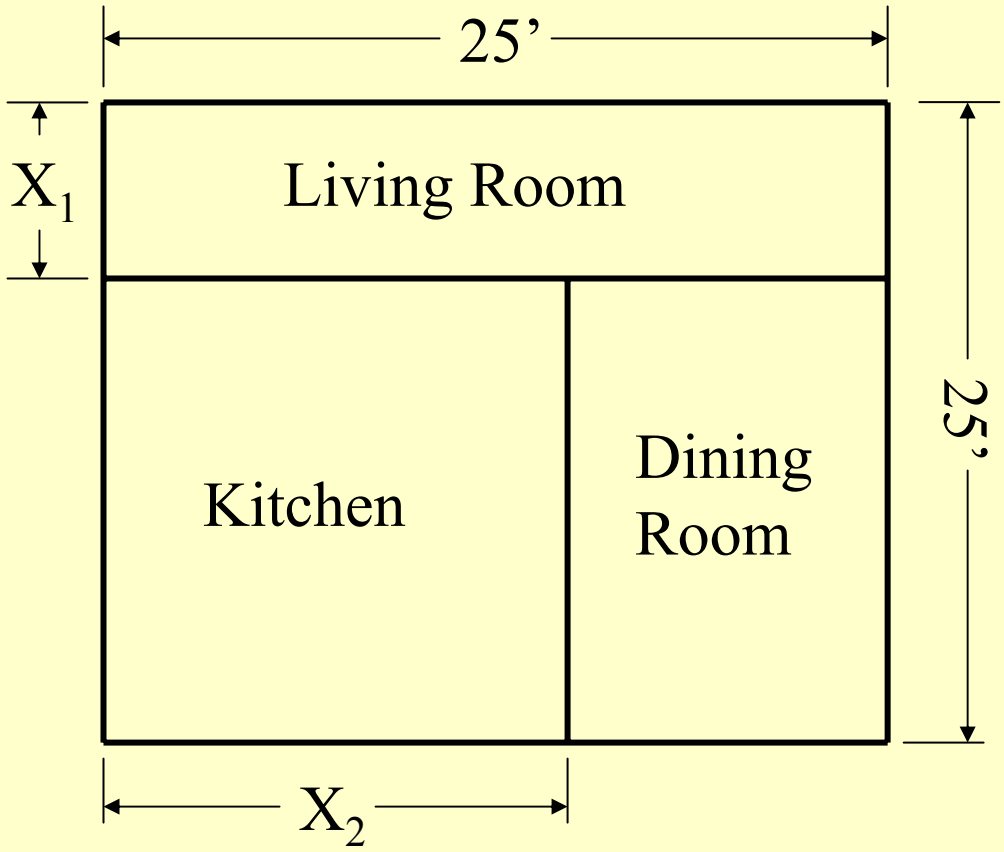
Fully Stressed Design (FSD)

- Some additional work has included application to thin wall structures and structures in which bending moments exist.

- Finally, FSD has also been extended to optimize under displacement constraints.

Fuzzy Logic

Consider the following Room design problem:



Kitchen -> \$60 /ft^2
Living Room -> \$30 /ft^2
Dining Room -> \$45 /ft^2

Fuzzy Logic

We will state the problem in fuzzy terms as follows:

1. *The kitchen area should be as much larger than 100 as is possible.*

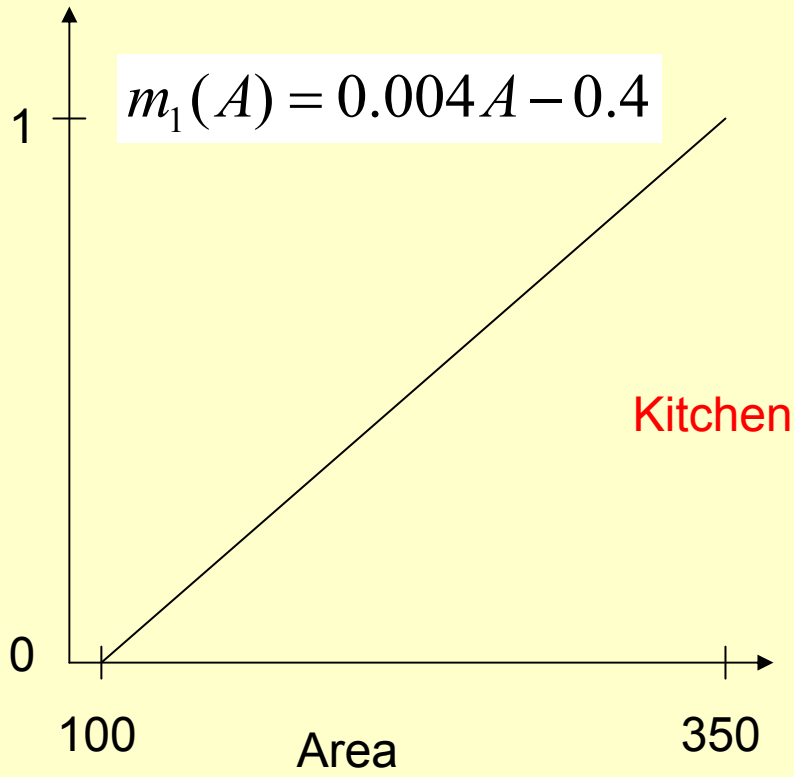
2. *The kitchen area should be no larger than 270 ft^2*

3. *The cost should be as much below $28,425 as possible.*

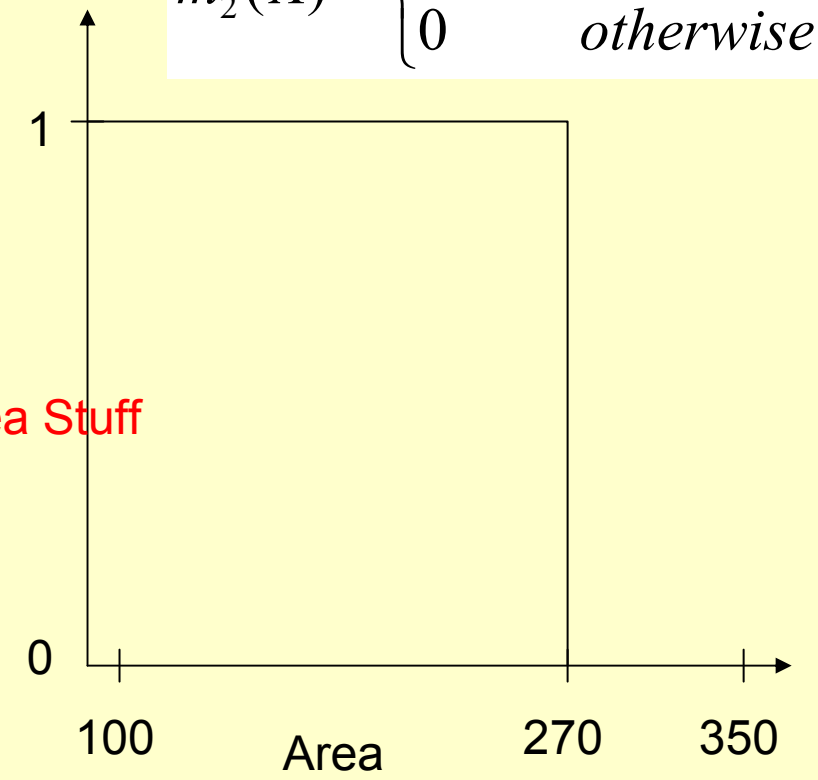
Fuzzy Logic

We will use linear membership functions as follows:

$$m_1(A) = 0.004A - 0.4$$



$$m_2(A) = \begin{cases} 1 & if\ A <= 270 \\ 0 & otherwise \end{cases}$$

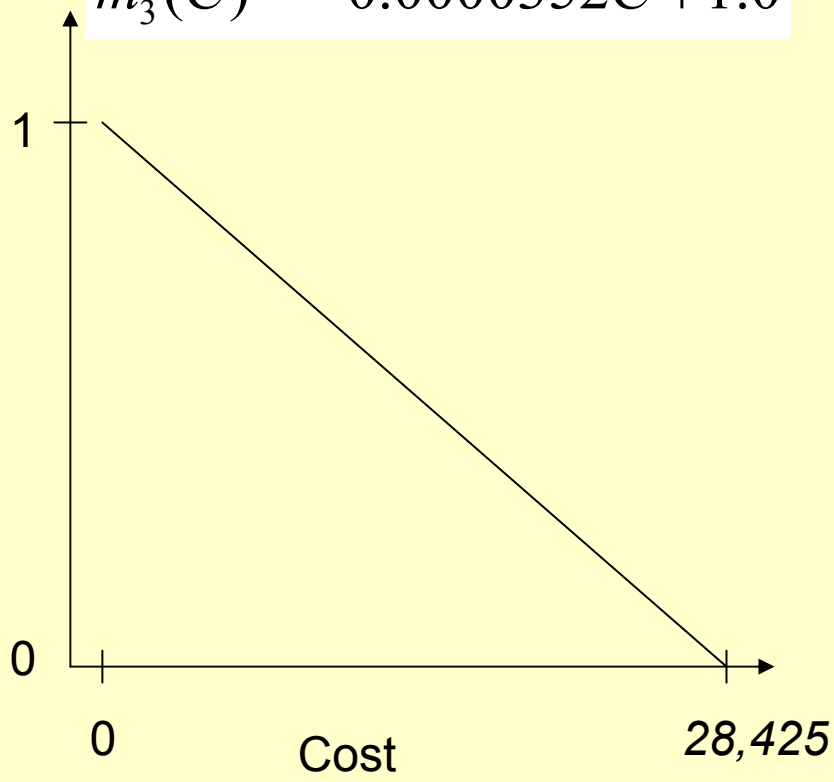


Kitchen Area Stuff

Fuzzy Logic

Cost Stuff

$$m_3(C) = -0.0000352C + 1.0$$



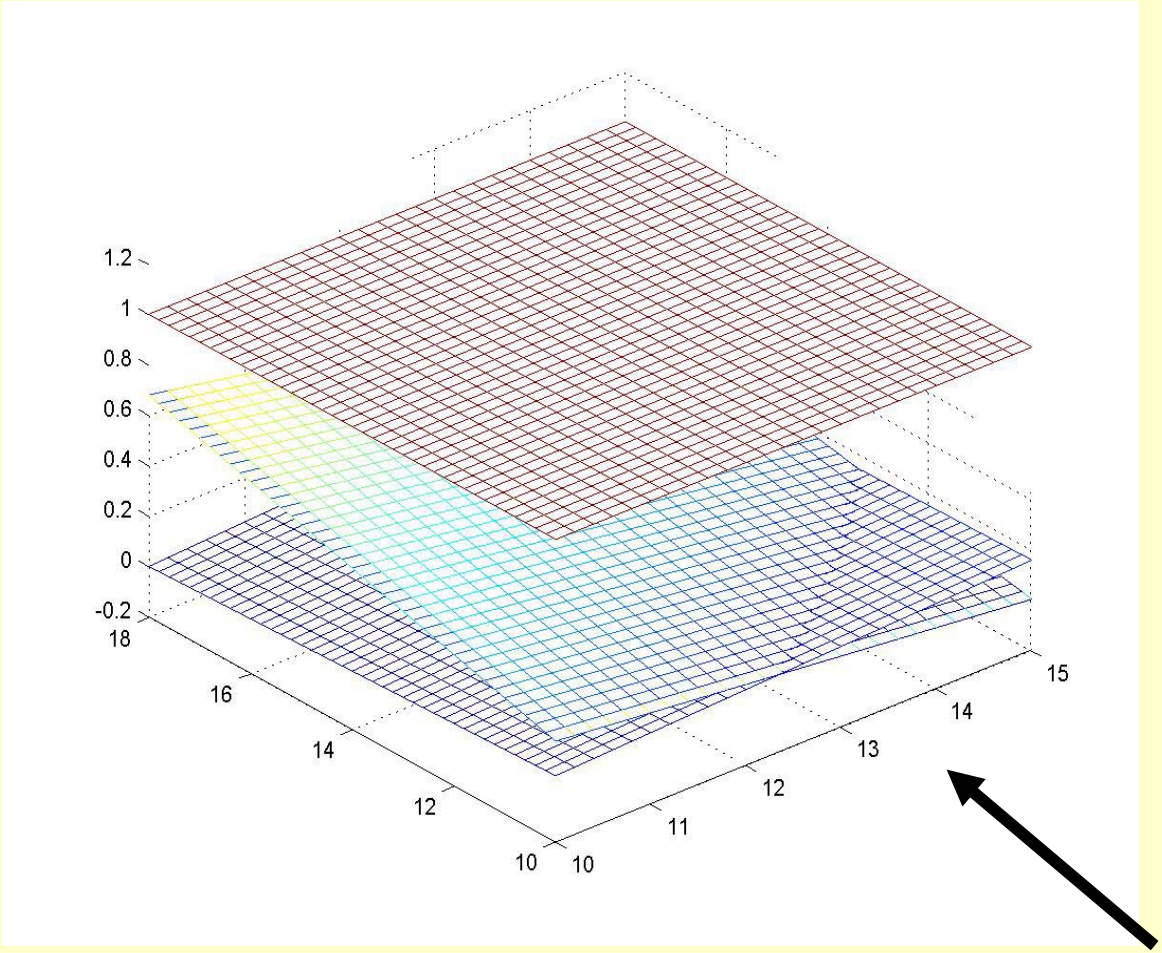
Both A and C are functions of X1 and X2 as follows:

C=750x1 + 60(25-x1)x2 + 45(25- x1)(25- x2)

A = (25- x1) x2

Fuzzy Logic

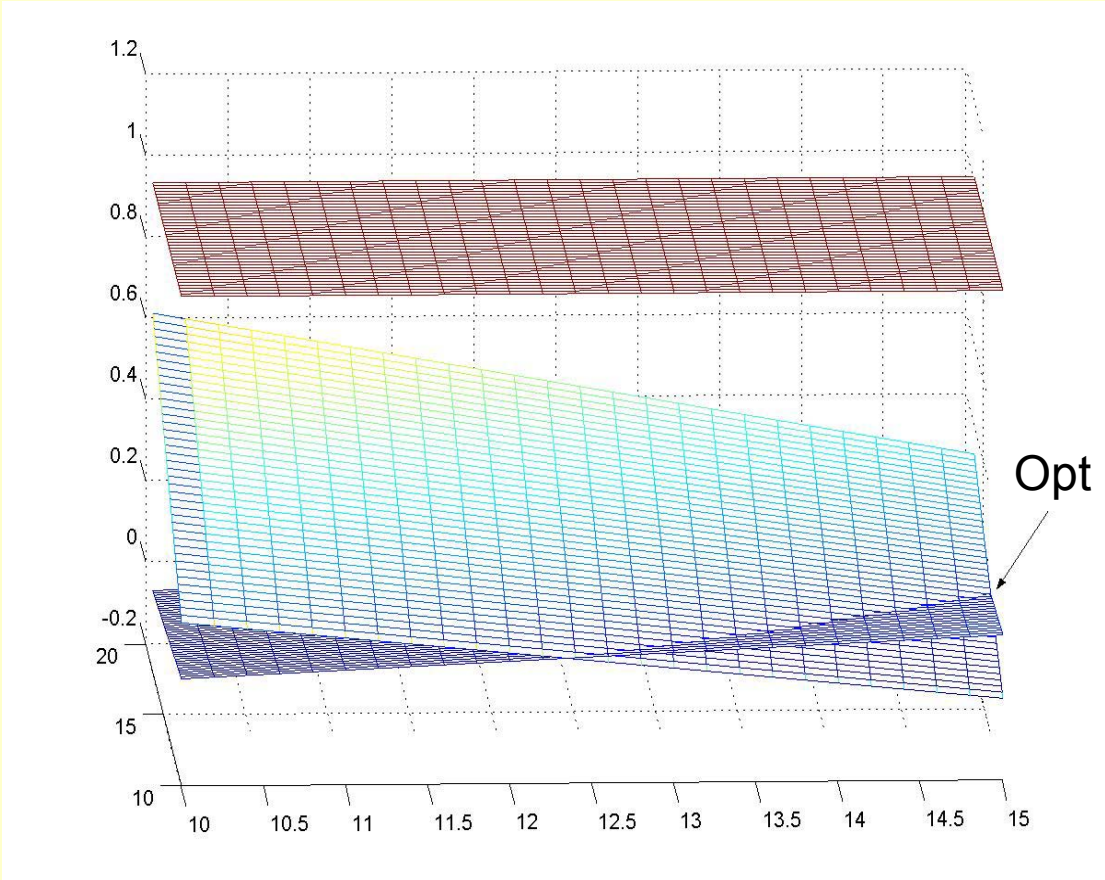
So what we'll do is to plot our membership functions versus X1 and X2 all on the same plot



Fuzzy Logic

Here is another view showing where the optimal point is.

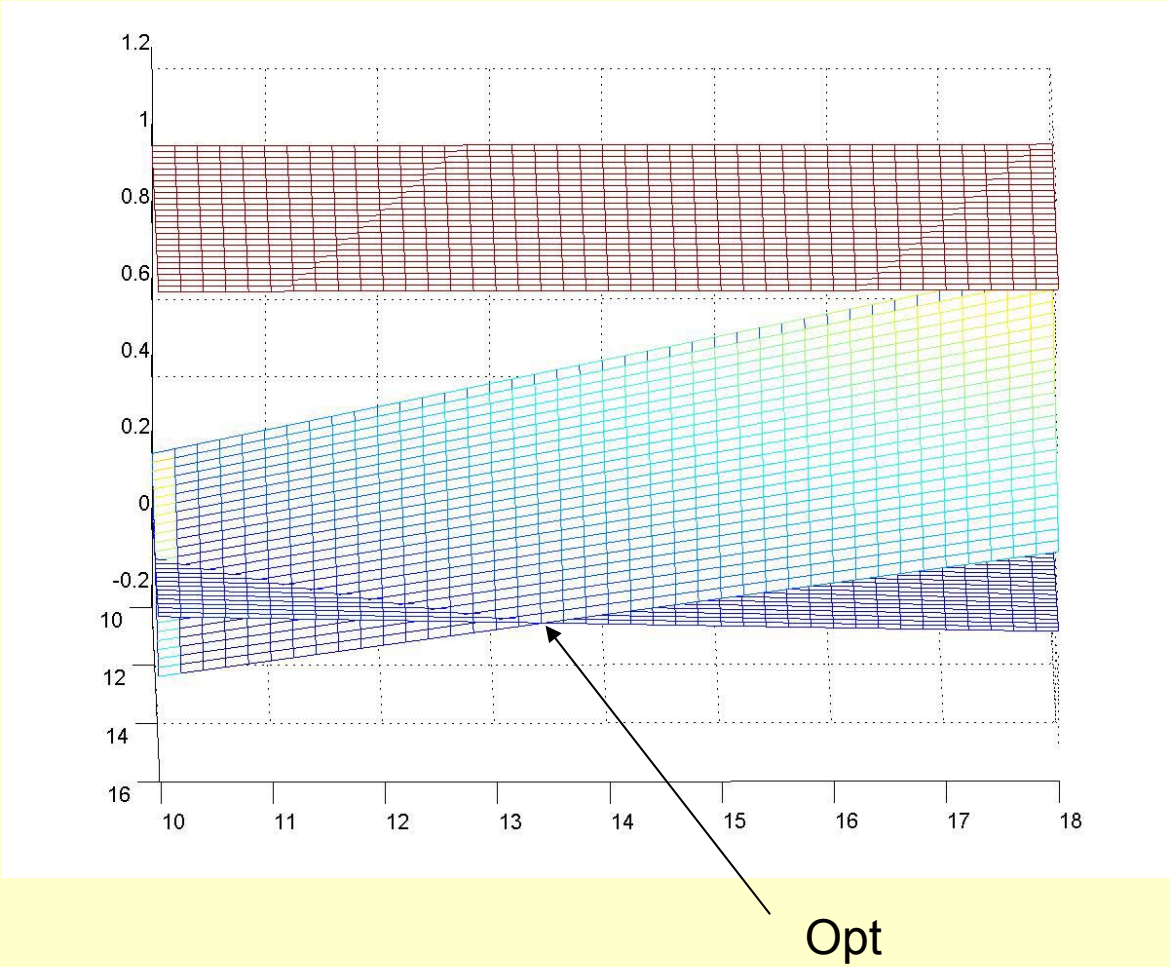
We see that it is at X1 = 15.



Fuzzy Logic

Here is the final view showing the optimum point

We see that it is at X2 = 13.5.



Fuzzy Logic

So the final answer is:

X1 = 15

X2 = 13.5

Kitchen Area = 135 ft^2

Cost = $24,525