Math 441 Assignment #4 Due Monday February 9

1.

The main point of this problem is to compare two possible solutions to modelling a piecewise linear function. The first is somewhat problem specific, hard to understand but the idea seems clever and potentially faster. The second asks you to use our standard approach using SOS2 handout.

You are the coach of a men's swimming team at a three day championship meet. The first day's events are the 500m freestyle, 200m IM, and 50m freestyle. Each of your 9 swimmers must be entered in exactly one event. Each of the first 12 finishers in an event earns points for the team, as follows:

Place	1	2	3	4	5	6	7	8	9	10	11	12
Points	16	13	12	11	10	9	7	5	4	3	2	1

You want to maximize the number of points your team earns. You have a fairly good estimate of how well each of your swimmers would do against the competition (i.e. if he were the only swimmer from your team in the event):

		500m free	200m IM	50m free
swimmer 1	would place	*4th*	*3rd*	*1st*
swimmer 2	"	*7th*	*7th*	*6th*
swimmer 3	"	*5th*	*5th*	*4th*
swimmer 4	"	*4th*	*6th*	*2nd*
swimmer 5	"	*3rd*	*1st*	*2nd*
swimmer 6	"	*2nd*	*4th*	*2nd*
swimmer 7	"	*1st*	*5th*	*2nd*
swimmer 8	"	*3rd*	*2nd*	*1st*
swimmer 9	"	*3rd*	*4th*	*2nd*

Of course, these placings will be affected by the presence of other swimmers from your team in the race, e.g. if swimmers 5,6,7 were the ones entered in the 500m freestyle, swimmer 7 would still be first but swimmer 6 would be third and swimmer 5 would be fifth. The problem is who should be entered in which events?

a) I started by assigning variables

$$x_{ij} = \begin{cases} 1 & \text{if swimmer } i \text{ entered in race } j \\ 0 & \text{otherwise} \end{cases}$$

Then the 'rank' of a swimmer i in event j can be given by inequalities so that the 'rank' is either 13 or, if the player is entered in the event, the rank is the placing from the table + the number of competitors on the same team who would do better (or tie and have a smaller swimmer number). The tie breaking is somewhat arbitrary. Yes, actual ties in the races could occur but lets ignore them. The points associated with the rank is essentially 13−rank. But we must add 1 if the rank is higher than or equal 7, add a further 1 if the rank is higher than or equal 6 and add a further 2 if the rank is 1. Hence the funny variable names. Provide documentation to go along with the input program that I have placed on our course page. Now solve using LINDO. My run time was around 90,000 iterations. Now appropriately interpret the output. In particular the objective function will be negative but that is because it has been shifted by a constant. What is the actual point total?

b) Try formulating the point function using the second technique given in class for general piecewise linear curves. That is the formulation that used the idea that any point in a line segment is a convex combination of the endpoints. Run using LINDO or . LINGO. Comment. My solution, with the points for all swimmers computed using this convex combination technique, ran in about the same time as the formulation in a), to my surprise.

c) Any suggestions how to get improved run times (for either formulation)?