Problem Set 5

The goal of this set of problems is to give you a sense of how the size of the optimization problem influences the SOS programming.

1. Consider the following unconstrained optimization problem

$$\mathrm{P}^* = \underset{x \in \mathbb{R}^n}{\text{minimize}} \quad 5 + \sum_{i=2}^{n} \left(x_i - x_{i-1}^2\right)^2 + (1 - x_i)^d$$

Where, n is the number of variables and $d \geq 4$ represents the degree of the objective function. Solve the optimization problem using:

1.a SOS programming with $n = 10, d = 6$.
1.b Sparse SOS programming with $n = 10, d = 6$.
1.c Sparse SOS programming with $(n, d) = (20{,}6), (30{,}6), (30{,}10)$.
1.d What is the maximum n, d $(even)$ to solve the SOS program in a reasonable time? (this numbers depend on the memory of your computer)
1.e SDSOS/DSOS programming with $n = 30, d = 2$.

2. Consider the following constrained optimization problem

$$\mathrm{P}^* = \underset{x \in \mathbb{R}^n}{\text{minimize}} \quad 5 + \sum_{i=2}^{n} \left(x_i - x_{i-1}^2\right)^2 + (1 - x_i)^d$$

$$\text{subject to} \quad 2 - x_i^2 \geq 0, \ \ i = 1, \ldots, n$$

2.a SOS programming with $n = 10, d = 6$.
2.c Sparse SOS programming with $(n, d) = (20{,}6), (30{,}6), (30{,}10)$.
2.d What is the maximum n, d $(even)$ to solve the SOS program in a reasonable time?

16.S498 Risk Aware and Robust Nonlinear Planning
Fall 2019