Maximum likelihood
linear regression
logistic regression
principal components analysis
Support vector machines

\[ \text{kernel density estimation?} \]
\[ \text{not really solving an optimization problem} \]
\[ \text{cross-validation?} \]
\[ \text{bootstrap?} \]

Linear trend filtering

\[ \beta_i - 2\beta_{i+1} + \beta_{i+2} = 0 \quad \text{for many } i \]

\[ \Rightarrow \beta_{i+1} = \frac{\beta_i + \beta_{i+2}}{2} \]

\[ \text{dom}(f) = \{ x : f(x) \text{ is defined and finite} \} \]
\[ h_j(x) = 0 \]

\[ \iff \quad h_j(x) \leq 0 \]

\[ -a_j(x) \leq 0 \]

---

1. \( \overline{x} = tx + (1-t)\overline{z} \) is feasible.

   why? \( \overline{x} \in D \)

\[ g_j(\overline{x}) = g_j(tx + (1-t)\overline{z}) \]

\[ \leq tg_j(x) + (1-t)g_j(\overline{z}) \]

\[ \leq 0 \]

\[ h_j(\overline{x}) = a_j^T(tx + (1-t)\overline{z}) + b_j \]

\[ = 0 + 0 \]

2. choose \( 0 < t < 1 \) big enough so that

\( \overline{x} = tx + (1-t)\overline{z} \in \text{Ball} \)

\[ f(\overline{x}) \leq tf(x) + (1-t)f(\overline{z}) \]

\[ \leq tf(x) + (1-t)f(x) \]

\[ = f(x) \]