

Online Learning Session 3: Projections and Libraries

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1 Projections

2 Dynamic Libraries

Projections

- Transforming the problem from class slightly,

$$\begin{aligned} \min_{x_1, x_2, x_3, x_4, x_5} \quad & 10.00 \exp(y_1) + 15.00 \exp(y_2) \\ & -1.50x_1 - 2.00x_2 - 1.25x_3 - 0.95x_4 - 0.50x_5 \end{aligned}$$

$$\text{s.t. } y_1 = f_1(x_1, x_2, x_3, x_4, x_5) = 0.15 \ln(x_1) + 0.25 \ln(x_2) + 0.05 \ln(x_3) + 0.10 \ln(x_4) + 0.45 \ln(x_5)$$

$$\begin{aligned} y_2 = f_2(x_1, x_2, x_3, x_4, x_5) = 0.30 \ln(x_1) + 0.15 \ln(x_2) + 0.25 \ln(x_3) + 0.25 \ln(x_4) + 0.05 \ln(x_5) \end{aligned} \tag{1}$$

- The gradient for the objective function then becomes

$$\nabla_x \pi(x) = \begin{bmatrix} 10.00 \exp(y_1) \\ 15.00 \exp(y_2) \\ -1.50 \\ -2.00 \\ -1.25 \\ -0.95 \\ -0.50 \end{bmatrix}' \quad (2)$$

- The Jacobian becomes

$$\nabla_x G(x) = \begin{bmatrix} 1.00 & 0 & -\frac{0.15}{x_1} & -\frac{0.25}{x_2} & -\frac{0.05}{x_3} & -\frac{0.10}{x_4} & -\frac{0.45}{x_5} \\ 0 & 1.00 & -\frac{0.30}{x_1} & -\frac{0.15}{x_2} & -\frac{0.25}{x_3} & -\frac{0.25}{x_4} & -\frac{0.05}{x_5} \end{bmatrix} \quad (3)$$

- Again, take the point $y_1 = 0.2026$, $y_2 = 0.942447$, $x_1 = 3.9588$, $x_2 = 1.2450$, $x_3 = 3.2176$, $x_4 = 2.4740$, and $x_5 = 0.6241$. The gradient of the objective function becomes

$$\begin{bmatrix} 12.2453 \\ 38.4938 \\ -1.50 \\ -2.00 \\ -1.25 \\ -0.95 \\ -0.50 \end{bmatrix} \quad (4)$$

- The Jacobian then becomes

$$\nabla_x G(x) = \begin{bmatrix} 1.00 & 0.00 & -0.03789 & -0.20006 & -0.01554 & -0.04042 & -0.72107 \\ 0.00 & 1.00 & -0.07578 & -0.12038 & -0.07770 & -0.10105 & -0.08012 \end{bmatrix} \quad (5)$$

- Next, we consider the Fortran code to compute:
 - (1) The value of the objective function and its gradient (FUNOBJ), and
 - (2) The value of the constraint and its gradient (FUNCON).These routines will be used by MINOS.

Dynamic Libraries

- Pull FUNOBJ and FUNCON into a secondary file Online03-02.for.
- Save the main files as Online03-01.for.
- Compile Online03-02.for as a dynamic library Online03-02.a.
- Compile the main file using the libraries.