Monotonic Constraints

- Model is often constrained in some way for various reasons
    - Based on prior beliefs
- Monotonic is a common type of constraint

$$f(x_1, x_2, \ldots, x, \ldots, x_{n-1}, x_n) \leq f(x_1, x_2, \ldots, x', \ldots, x_{n-1}, x_n)$$

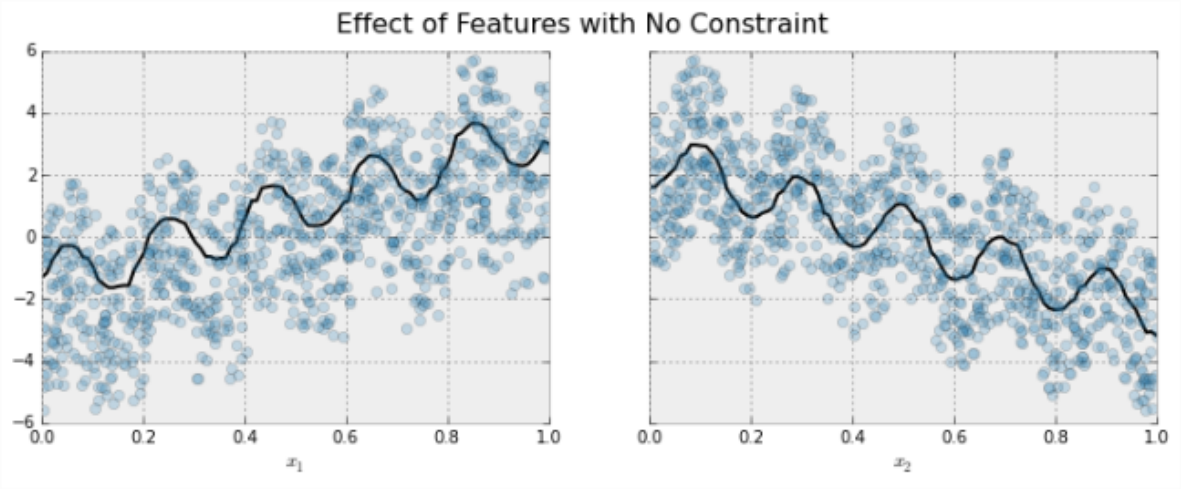
whenever $x \leq x'$ is an **increasing constraint**; or

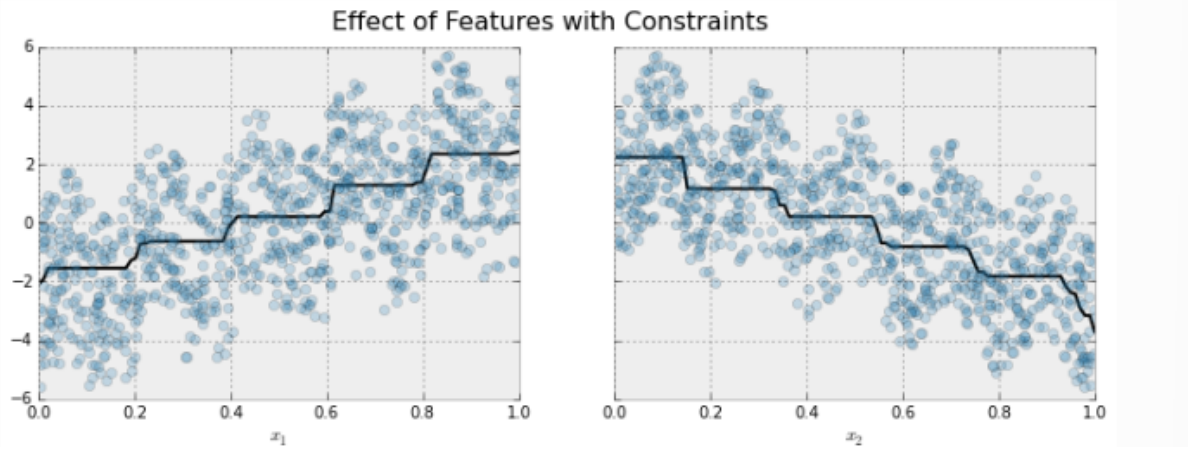
$$f(x_1, x_2, \ldots, x, \ldots, x_{n-1}, x_n) \geq f(x_1, x_2, \ldots, x', \ldots, x_{n-1}, x_n)$$

whenever $x \leq x'$ is a **decreasing constraint**.

XGBoost has the ability to enforce monotonicity constraints on any features used in a boosted model.

- Sinusoidal: having the form of a sine curve





- Oscillatory behavior is removed
- Implement by setting params to [‘monotone_constraints’] = (-1,1)

Using feature names

XGBoost's Python package supports using feature names instead of feature index for specifying the constraints. Given a data frame with columns `["f0", "f1", "f2"]`, the monotonic constraint can be specified as `{"f0": 1, "f2": -1}`, and `"f1"` will default to `0` (no constraint).