

# quantile\_cv.py

## Summary

This code defines a `QuantileCV` class for automated quantile regression tree modeling with Bayesian optimization.

## Dependencies

### Standard Library

- `typing`
- `functools`

### Other

- `numpy`
- `pandas`
- `pydantic`
- `sklearn`
- `xgboost`

## Description

The `quantile_cv.py` file implements a `QuantileCV` class, which provides automated quantile regression using tree-based models and Bayesian optimization. This class is designed for flexible and robust quantile regression tasks, leveraging advanced machine learning techniques.

The implementation includes:

1. `QuantileCVConfig`: A Pydantic dataclass that defines configuration options for quantile regression, including:

2. `monotone_constraints` : Dictionary specifying monotonicity direction for variables (0 for none, 1 for increasing, -1 for decreasing)
3. `interactions` : List of lists containing permitted feature interactions
4. `n_jobs` : Number of parallel jobs to use when fitting the model
5. `parameters` : Hyperparameter search space definition (OptimizerParams instance)
6. `return_train_score` : Whether to include training scores during optimization
7. `quantile_alpha` : Parameter specifying the quantile to predict (e.g., 0.5 for median regression)
8. Pre-configured settings:
  9. `default_quantile` : A standard configuration using all hyperparameters
  10. `balanced_quantile` : A configuration focused on regularization parameters
  11. `QuantileCV` : The main class that inherits from `BaseAutoCV` and provides:
    12. Automated hyperparameter tuning via Bayesian optimization
    13. XGBoost-based quantile regression capabilities
    14. Support for custom quantile levels via the `alpha` parameter
    15. Integration with scikit-learn's scoring system for quantile regression metrics
    16. Parallel processing support

The class uses cross-validation during the optimization process to ensure model robustness and prevent overfitting. It supports various regression metrics, with a focus on quantile loss, and leverages Pydantic for configuration validation.

Overall, this module offers a comprehensive solution for quantile regression tasks, combining automated model selection, advanced regression techniques, and robust validation mechanisms.