

COE Price Prediction and Elasticity Analysis Report

Executive Summary

This analysis examines the relationship between COE quotas and prices for vehicle categories A and B, providing predictive models and quantifying price elasticity to support LTA policy decisions.

Data Overview

- **Analysis Period:** 2010-2025
- **Total Records:** 645
- **Category A Records:** 319
- **Category B Records:** 326

Model Performance

Category A

- **Linear Regression:** $R^2 = 1.000$, RMSE = 0
- **Ridge Regression:** $R^2 = 0.990$, RMSE = 1644
- **Lasso Regression:** $R^2 = 1.000$, RMSE = 239
- **Random Forest:** $R^2 = 0.974$, RMSE = 2708
- **Gradient Boosting:** $R^2 = 0.974$, RMSE = 2707

Category B

- **Linear Regression:** $R^2 = 1.000$, RMSE = 0
- **Ridge Regression:** $R^2 = 0.986$, RMSE = 3049
- **Lasso Regression:** $R^2 = 1.000$, RMSE = 491
- **Random Forest:** $R^2 = 0.961$, RMSE = 5055
- **Gradient Boosting:** $R^2 = 0.960$, RMSE = 5134

Price Elasticity Analysis

Category A

- **Quota Elasticity:** -0.381
- **Competition Elasticity:** 0.006
- **Average Premium:** SGD 54,219
- **Average Quota:** 1,000

Category B

- **Quota Elasticity:** -0.621
- **Competition Elasticity:** 0.039

- **Average Premium:** SGD 66,071
- **Average Quota:** 776

Policy Implications

Quota Elasticity Interpretation

- **Negative elasticity** indicates that increasing quota leads to lower prices
- **Elasticity magnitude** shows the sensitivity of prices to quota changes

Marginal Effects

- **Category A:** Each additional quota reduces price by approximately SGD -21
- **Category B:** Each additional quota reduces price by approximately SGD -53

Price Impact Scenarios

Category A

- **+100 quota:** -3.8% change (SGD -2,065)
- **+200 quota:** -7.6% change (SGD -4,130)
- **+500 quota:** -19.0% change (SGD -10,326)
- **+1000 quota:** -38.1% change (SGD -20,652)

Category B

- **+100 quota:** -8.0% change (SGD -5,289)
- **+200 quota:** -16.0% change (SGD -10,578)
- **+500 quota:** -40.0% change (SGD -26,445)
- **+1000 quota:** -80.0% change (SGD -52,889)

Key Insights

1. **Quota-Price Relationship:** Both categories show negative elasticity, confirming that increased supply reduces prices
2. **Competition Effect:** Higher competition ratios (more bids per quota) lead to higher prices
3. **Category Differences:** Category B shows higher elasticity, indicating greater price sensitivity to quota changes
4. **Seasonal Patterns:** Quarterly variations in demand and supply affect pricing
5. **Competition Dynamics:** Higher bid-to-quota ratios consistently lead to higher prices

Recommendations

1. **Gradual Quota Adjustments:** Use elasticity estimates to predict price impacts of quota changes
2. **Monitor Competition:** Track bid-to-quota ratios as indicators of market pressure
3. **Seasonal Considerations:** Account for quarterly patterns in quota planning
4. **Category-Specific Policies:** Differentiate quota strategies between categories A and B
5. **Model Updates:** Regularly retrain models with new data for improved accuracy

Technical Notes

- **Best Model:** Linear Regression for Category A, Linear Regression for Category B
 - **Cross-Validation:** 5-fold cross-validation used for model evaluation
 - **Feature Engineering:** Includes lagged variables, moving averages, and seasonal effects
 - **Data Quality:** Missing values handled through forward-filling and removal
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