CYCLING MARKET ANALYSIS IN COPENHAGEN

Detailed Report

Cycling Market Analysis in Copenhagen

This report presents a comprehensive analysis of the cycling market in Copenhagen, Denmark, focusing on market trends, consumer insights, sustainability impacts, and predictive analytics. The study leverages data from multiple sources. The objectives include assessing the market, understanding consumer behavior, evaluating environmental benefits, and forecasting future trends using specified predictive models.

1. Introduction

The cycling market in Copenhagen serves as an exemplary case study for understanding the interplay between urban mobility, sustainability, and economic activity. This project aims to:

- Analyzed the market structure, including physical and online cycle shops, import/export trends.
- Derived consumer insights, such as segmentation and seasonal demand patterns.
- Assess the sustainability perspective, focusing on CO_2 emissions and urban benefits.
- Applied predictive analytics to forecast market growth and trends.

Copenhagen's well-established cycling culture offers valuable lessons for sustainable urban planning, with potential applicability to contexts like Pakistan. This report details the data collection, cleaning, analysis, and modeling processes, culminating in actionable recommendations.

2. Data Sources and Acquisition

The analysis relies on diverse datasets, each selected for reliability and relevance to the cycling market. Below are the sources, their details, acquisition methods, and storage strategies:

2.1 Government and Industry Reports

- **Statistics Denmark**
  - **URL**: https://www.dst.dk/en
  - **Description**: Provides official data on transportation, including bicycle counts, motor vehicle statistics, and emissions.
  - **Acquisition Method**: Direct downloaded from the StatBank database.
  - **Data Collected**: Bicycle counts (1990-2023), motor vehicle totals (1990-2023), motor vehicle registration totals (1990-2023) and emissions from car driving (1990-2023).
  - **Storage**: SQLite3 relational database for structured time-series data.

2.2 Business Directories and E-commerce

- **DBA.dk**
  - **URL**: https://www.dba.dk
  - **Description**: A Danish online marketplace for second-hand goods, including bicycles.
  - **Acquisition Method**: Web scraping using Selenium and BeautifulSoup.
  - **Data Collected**: Listings with title, price, location, time posted, seller type, bike type, and date (524 entries from April 2025).
  - **Storage**: SQLite3 relational database for semi-structured data.

2.3 Trade and Customs Data

- **ITC Trade Map**
  - **URL**: https://www.trademap.org
  - **Description**: Offers detailed trade statistics on imports and exports.
  - **Acquisition Method**: Downloaded CSV reports.
  - **Data Collected**: Bicycle imports/exports (2005-2024), motor vehicle imports/exports (2005-2024) by country.
  - **Storage**: SQLite relational database for structured trade data.

2.4 Storage Strategy

- **SQLite**: Used for structured datasets (Statistics Denmark, ITC Trade Map) DBA data stored after proper cleaning and preprocessing to enable efficient querying and joins.

3. Data Cleaning and Preparation

Data cleaning ensured accuracy and consistency across datasets. Key steps included:

3.1 DBA.dk Listings

- **Handling Missing Values**: Missing prices were imputed with the median price (409.63 DKK) for the bike type.
- **Removing Duplicates**: Identified and removed 12 duplicate listings based on title, price, and time posted.
- **Standardization**: Location names were standardized (e.g., "København" to "Copenhagen").
- **Challenges**: Inconsistent date formats were parsed into a uniform TIMESTAMP format.

3.2 Statistics Denmark Data

- **Bicycle Counts**: No missing values; years standardized to YYYY format.
- **Motor Vehicles**: Removed pre-1990 data to align with emissions data timeframe.
- **Emissions**: Converted CO_2 values to a consistent REAL type, ensuring no missing entries.

3.3 ITC Trade Map Data

- **Imports/Exports**: Dropped rows with missing values for early years (e.g., 2005 imports for some exporters).
- **Integration**: Merged bicycle and motor vehicle import data on the 'Year' column for comparative analysis.
- **Challenges**: Handled unnamed columns (e.g., "Unnamed: 21") by excluding them from analysis.

3.4 Integrated Dataset

- Created a unified dataset linking bicycle imports with motor vehicle imports and emissions, indexed by year, to explore sustainability correlations.

4. Exploratory Data Analysis (EDA)

EDA revealed initial patterns and statistics, supported by visualizations:

4.1 DBA.dk Listings

- **Summary Statistics**:
  - Count: 524 listings.
  - Average Price: 767.82 USD, Std: 847.15 USD, Range: 217.50–5495.50 USD.
  - Top Location: Copenhagen (134 listings).
  - Bike Types: City (339), Mountain (others split).
- **Visualizations**:
  - Histogram of prices showed a right-skewed distribution, with most bikes under 1000 USD.
  - Bar chart of bike types highlighted city bikes' dominance.

4.2 Bicycle Counts

- **Statistics**: Mean: 2984.24 bikes/year, Std: 207.26, Range: 2555–3430 (1990-2023).
- **Trend**: Gradual increase over time, suggesting growing cycling adoption.

4.3 Imports and Exports

- **Bicycle Imports**: Mean increased from 8763 (2005) to 21960 (2024), peaking at 165888 (2011).
- **Motor Vehicle Imports**: Mean rose from 202941 (2005) to 778137 (2024), indicating a larger market scale.
- **Visualization**: Line plot showed bicycle imports fluctuating with peaks, unlike steadily rising motor vehicle imports.

4.4 Emissions

- **Statistics**: Mean: 93.79 thousand tons CO_2, Std: 7.11, Range: 77.1–102.3 (1990-2023).
- **Correlation**: Negative correlation (-0.65) between bicycle counts and emissions, suggesting cycling's environmental benefit.

5. Market Analysis

5.1 Cycle Shops Assessment

- **Physical Shops**: Inferred from DBA.dk location data; Copenhagen hosts the majority, reflecting its cycling hub status.
- **Online Market**: DBA.dk listings indicate a robust second-hand market, with city bikes prevalent.

5.2 Import/Export Trends

- **Bicycle Imports**: Peaked in 2011 (165888), stabilized around 120000 post-2020.
- **Exports**: Lower volume (mean 3437 in 2024), suggesting domestic focus.
- **Visualization**: Line graph showed import dominance over exports.

5.3 B2B Relationships

- **Inference**: ITC data indicates key exporters (e.g., China, Germany) supply Copenhagen retailers, with limited re-export activity.

6. Consumer Insights

6.1 Customer Segmentation

- **Segments**:
  - Commuters: City bikes (64.7% of listings).
  - Recreational: Mountain and hybrid bikes.
- **Evidence**: Price and type distribution from DBA.dk.

6.2 Trends in Behavior

- **Preference**: Affordable city bikes (median 409.63 USD) dominate, reflecting practical use.
- **Seasonality**: April 2025 data spikes on 2025-04-12 (162 listings), suggesting spring demand.

6.3 Visualization

- Pie chart of bike types and time-series plot of listings per day underscored seasonal patterns.

7. Sustainability Perspective

7.1 Environmental Impact

- **CO_2 Emissions**:
  - Bike Production: Assumed 5 kg CO_2/bike (industry estimate); 148333 imports in 2023 ≈ 741 thousand tons CO_2.
  - Cars: 93.79 thousand tons/year from families' driving (mean).
- **Savings**: If 2984 bikes/year replace car trips (10 km/day, 0.12 kg CO_2/km), ≈ 130 thousand tons CO_2 saved annually.

7.2 Urban Sustainability

- **Benefits**: Reduced congestion, improved air quality, and public health gains, as bicycle counts rise against motor vehicle trends.

7.3 Visualization

- Bar chart comparing emissions from biking vs. driving highlighted cycling's lower footprint.

8. Predictive Analytics

Five models were applied to forecast bicycle imports (target variable) using ITC data (2006-2024), extended to 2034:

8.1 Linear Regression

- **Description**: Models linear trends.
- **Target**: Imports vs. Year.
- **Performance**: $R^2 = 0.45$, MSE = 2.1e7.
- **Result**: Predicts steady growth (e.g., 130000 by 2034).
- **Visualization**: Line plot showed a moderate fit.

8.2 Decision Tree

- **Description**: Captures non-linear patterns.
- **Performance**: $R^2 = 0.78$, MSE = 9.8e6.
- **Result**: Predicts fluctuations, stabilizing at 125000.
- **Visualization**: Scatter plot with predictions aligned closely pre-2024.

8.3 Random Forest

- **Description**: Ensemble of trees for robustness.
- **Performance**: $R^2 = 0.85$, MSE = 6.5e6.
- **Result**: Forecasts 126896 by 2025-2034, smoothing peaks.
- **Visualization**: Line plot showed best fit to historical data.

9. Conclusion and Recommendations

9.1 Key Findings

- **Market**: Copenhagen's cycling market is robust, with significant imports and a strong second-hand segment.
- **Consumers**: Commuters drive demand for affordable city bikes, with seasonal peaks.
- **Sustainability**: Cycling reduces emissions significantly compared to motor vehicles.
- **Predictions**: Imports will stabilize around 126000 annually (LR).

9.2 Recommendations

- **Businesses**: Expand city bike offerings and target spring sales.
- **Policymakers**: Enhance cycling infrastructure to sustain growth and emissions reductions.