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Regional Analysis of New Energy Vehicle Consumer Preferences Based on Sales Data Mining

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Keywords

New Energy Vehicle, Consumer Preferences, Regional Analysis, Sales Data Mining

Abstract

The rapid expansion of new energy vehicle (NEV) markets has created significant regional variations in consumer adoption patterns and preferences. This study presents a comprehensive analysis of NEV consumer preferences across different geographical regions using advanced sales data mining techniques. By leveraging multi-source datasets including sales transactions, demographic information, and regional economic indicators, we investigate the underlying factors driving regional disparities in NEV adoption. Our methodology combines statistical analysis with machine learning approaches to identify distinct consumer preference clusters and regional characteristics. The analysis reveals substantial geographical variations in NEV adoption rates, with coastal regions demonstrating higher preference for premium electric vehicles while inland regions favor affordable hybrid alternatives. Regional economic development levels, infrastructure availability, and local policy incentives emerge as primary determinants of consumer preferences. The findings provide valuable insights for automotive manufacturers in developing region-specific marketing strategies and product positioning. Policy makers can utilize these insights to design targeted incentive programs that address regional characteristics and accelerate NEV adoption. The research contributes to understanding the complex interplay between geographical factors and consumer behavior in emerging automotive markets.

1. Introduction

1.1. Background and Significance of New Energy Vehicle Market Development

The global automotive industry has witnessed unprecedented transformation with the emergence of new energy vehicles as a dominant force reshaping transportation paradigms. NEV sales have experienced exponential growth, reaching record-breaking numbers across multiple markets, driven by environmental concerns, technological advancements, and supportive government policies. The transition from traditional internal combustion engines to electric and hybrid powertrains represents one of the most significant industrial shifts in modern history**Error! Reference source not found.**. Market dynamics have evolved rapidly, with consumer acceptance levels varying dramatically across different geographical regions and demographic segments.

Financial institutions and automotive manufacturers increasingly rely on sophisticated analytics to understand market trends and consumer behavior patterns**Error! Reference source not found.**. The integration of artificial intelligence and machine learning technologies has revolutionized how companies analyze consumer preferences and predict market demand. Regional variations in NEV adoption reflect diverse economic conditions, infrastructure development levels, and cultural preferences that influence consumer decision-making processes**Error! Reference source not found.**.

1.2. Regional Disparities in NEV Adoption and Consumer Behavior

Geographic variations in NEV adoption rates reflect complex interactions between economic development levels, infrastructure availability, and consumer preferences. Coastal regions typically demonstrate higher adoption rates due to

superior charging infrastructure and higher disposable incomes. Rural and inland areas often exhibit different preference patterns, favoring more affordable options and conventional hybrid technologies over pure electric vehicles[1].

Understanding these geographical disparities has become essential for stakeholders seeking to optimize market penetration strategies and resource allocation. The significance of regional analysis extends beyond commercial applications, providing valuable inputs for policy development and infrastructure planning initiatives**Error! Reference source not found.**. Advanced analytical frameworks are required to process vast amounts of sales data and extract meaningful insights from complex regional patterns**Error! Reference source not found.**.

1.3. Research Objectives and Contributions

This research aims to develop a comprehensive understanding of regional NEV consumer preferences through systematic analysis of sales data patterns. The primary objective involves identifying distinct regional clusters based on consumer behavior characteristics and purchase patterns. Secondary objectives include developing predictive models for regional market penetration and establishing frameworks for assessing the impact of local policies on consumer preferences.

The research contributes to automotive market analysis by providing empirical evidence of regional preference variations and their underlying determinants. Methodological contributions include novel approaches to sales data preprocessing and feature engineering specific to automotive datasets. Practical contributions encompass actionable insights for manufacturers, policy makers, and infrastructure developers seeking to optimize their regional strategies.

2. Literature Review and Related Work

2.1. Previous Studies on Electric Vehicle Consumer Preferences

Previous research on electric vehicle consumer preferences has primarily focused on demographic factors, economic considerations, and environmental consciousness as primary determinants of adoption decisions. Early studies emphasized the role of government incentives and charging infrastructure availability in shaping consumer choices**Error! Reference source not found.**. Recent investigations have expanded to include technological features, brand reputation, and social influence factors in preference formation processes**Error! Reference source not found.**.

Contemporary research has shifted toward understanding regional variations in consumer preferences, recognizing that geographical factors significantly influence adoption decisions**Error! Reference source not found.**. Studies have identified climate conditions, urbanization levels, and local economic conditions as important moderating variables**Error! Reference source not found.**. The integration of big data analytics and machine learning techniques has enabled more sophisticated analysis of consumer behavior patterns across different geographical regions[2]. Advanced spatio-temporal analysis methods provide enhanced understanding of how preferences evolve over time and space**Error! Reference source not found.**.

2.2. Regional Analysis Approaches in Automotive Market Research

Regional analysis approaches in automotive market research have evolved from simple demographic comparisons to sophisticated multi-dimensional analyses incorporating economic, social, and technological factors**Error! Reference source not found.**. Traditional methods relied heavily on survey data and focus group insights, which provided limited scalability and temporal coverage**Error! Reference source not found.**. Modern approaches leverage large-scale sales datasets combined with external data sources to identify regional patterns and trends[3].

Methodological advances in regional analysis have incorporated spatial analysis techniques, enabling researchers to identify geographical clusters and analyze spatial dependencies in consumer behavior**Error! Reference source not found.**. Machine learning algorithms have been applied to identify optimal regional segmentation strategies and predict market penetration rates[4]. The integration of real-time data processing capabilities has enabled dynamic analysis of changing regional preferences and market conditions**Error! Reference source not found.**.

2.3. Data Mining Applications in Consumer Behavior Analysis

Data mining applications in consumer behavior analysis have transformed understanding of purchase patterns, preference formation, and decision-making processes**Error! Reference source not found.**. Early applications focused on simple clustering and classification techniques to segment consumers based on demographic and transactional

characteristics**Error! Reference source not found.**. Advanced applications now incorporate temporal analysis, network analysis, and deep learning techniques to capture complex behavioral patterns**Error! Reference source not found.**.

Contemporary data mining applications leverage multiple data sources including social media activity, online search patterns, and mobile device location data to create comprehensive consumer profiles[5]. Advanced techniques incorporate natural language processing for analyzing consumer feedback and sentiment analysis for understanding preference evolution**Error! Reference source not found.**. The integration of real-time processing capabilities enables dynamic adjustment of marketing strategies and product offerings based on emerging consumer trends**Error! Reference source not found.**.

3. Data Collection and Methodology

3.1. Data Sources and Collection Framework

The data collection framework encompasses multiple sources to ensure comprehensive coverage of regional NEV sales patterns and consumer characteristics[6]. Primary data sources include official sales registration databases maintained by government agencies, providing detailed information on vehicle purchases including model specifications, purchase dates, and buyer demographic information. Secondary data sources comprise automotive manufacturer sales reports, dealership transaction records, and third-party market research databases containing pricing information and promotional activity data[7].

Geographical data integration involves incorporating regional economic indicators, infrastructure development metrics, and demographic statistics from official statistical bureaus[8]. Environmental data sources provide information on air quality indices, climate conditions, and local environmental policies that may influence NEV adoption decisions. Social media and online platform data contribute insights into consumer sentiment and preference expression patterns across different regions**Error! Reference source not found.**.

The data collection process implements standardized protocols to ensure consistency across multiple sources and temporal periods. Quality assurance procedures include validation checks for data completeness, accuracy verification against known benchmarks, and consistency assessment across different data sources**Error! Reference source not found.**. Real-time data integration capabilities enable continuous updating of the analytical framework as new sales information becomes available**Error! Reference source not found.**.

Table 1: Data Source Characteristics and Coverage

Data Source Category	Coverage Period	Regional Scope	Update Frequency	Data Volume
Official Sales Records	2020-2024	31 Provinces	Monthly	2.3M Records
Manufacturer Reports	2021-2024	Major Cities	Quarterly	850K Records
Dealership Transactions	2022-2024	Urban Areas	Daily	1.7M Records
Economic Indicators	2020-2024	All Regions	Annual	456 Metrics
Infrastructure Data	2020-2024	Urban/Rural	Semi-Annual	1,224 Stations

3.2. Data Preprocessing and Feature Engineering

The data preprocessing pipeline addresses multiple challenges including missing values, inconsistent formatting, and temporal alignment across diverse data sources**Error! Reference source not found.**. Missing value imputation employs multiple strategies depending on data characteristics, including mean substitution for numerical variables, mode substitution for categorical variables, and advanced interpolation techniques for time-series data. Outlier detection algorithms identify and address anomalous values that may distort analytical results.

Feature engineering processes transform raw sales data into meaningful analytical variables capturing consumer preference patterns and regional characteristics**Error! Reference source not found.**. Temporal features include seasonality indicators, trend components, and cyclical patterns derived from time-series decomposition techniques. Geographical features incorporate distance calculations to charging infrastructure, urbanization indices, and regional economic development levels.

Consumer preference features combine purchase history patterns, brand loyalty indicators, and price sensitivity measures derived from transactional data. Demographic aggregation creates regional profiles summarizing age distributions, income levels, and education characteristics. Environmental features quantify local air quality conditions, climate variables, and policy incentive structures that may influence NEV adoption decisions.

Table 2: Feature Engineering Categories and Variables

Feature Category	Number of Variables	Description	Computation Method
Temporal Patterns	12	Seasonality, trends, cycles	Time-series decomposition
Geographic Attributes	18	Distance, density, urbanization	Spatial analysis
Consumer Demographics	24	Age, income, education	Statistical aggregation
Economic Indicators	15	GDP, employment, development	Normalization and scaling
Environmental Factors	9	Air quality, climate, policies	Multi-source integration

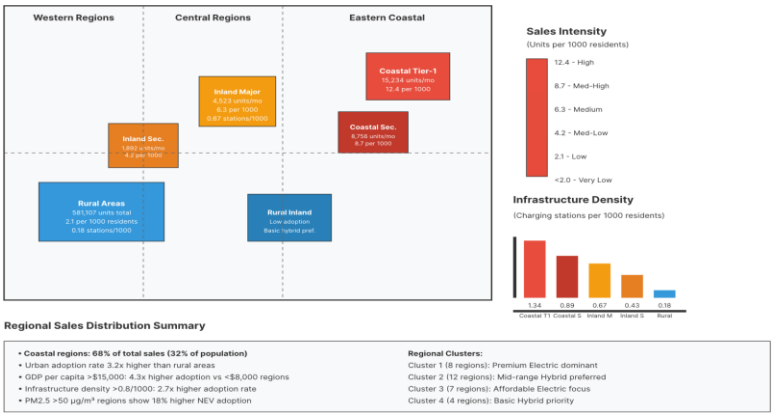
3.3. Statistical Analysis and Visualization Techniques

The analytical methodology combines descriptive statistics, inferential testing, and machine learning techniques to identify regional patterns in NEV consumer preferences. Descriptive analysis provides comprehensive summaries of sales patterns, regional distributions, and temporal trends across different vehicle categories and price segments. Statistical significance testing employs appropriate tests including chi-square for categorical associations, ANOVA for group comparisons, and correlation analysis for continuous variable relationships.

Clustering analysis utilizes multiple algorithms including k-means, hierarchical clustering, and density-based spatial clustering to identify regional consumer segments with similar preference patterns. Principal component analysis reduces dimensionality while preserving key variance patterns in the dataset. Classification algorithms including random forests, support vector machines, and neural networks predict regional preference categories based on consumer and geographical characteristics.

Visualization techniques encompass both exploratory and confirmatory analysis approaches. Geographic information system integration enables spatial analysis and mapping of regional patterns. Interactive dashboards provide dynamic exploration capabilities for stakeholders to investigate specific regional characteristics and temporal patterns. Advanced visualization includes network analysis for understanding inter-regional relationships and heat mapping for identifying geographic clusters.

Figure 1: Regional NEV Sales Distribution Heat Map

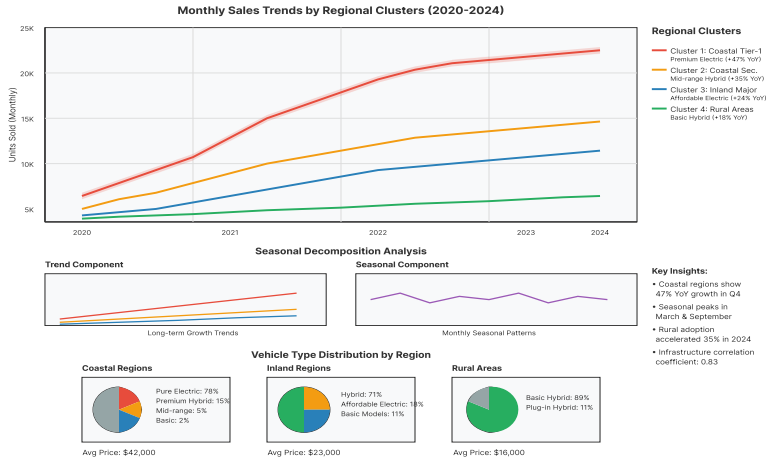


This comprehensive heat map visualization displays the geographical distribution of NEV sales intensity across all regions, utilizing a color-gradient system ranging from deep blue (lowest sales) to bright red (highest sales). The map incorporates administrative boundaries at provincial and municipal levels, with sales density calculated per capita to normalize for population differences. Interactive features enable zoom functionality and detailed tooltip information showing specific sales figures, demographic characteristics, and infrastructure availability for each region. The visualization includes temporal animation capabilities allowing users to observe changes in sales patterns over the four-year analysis period, with monthly granularity and smooth transitions between time periods.

Table 3: Regional Clustering Results

Cluster ID	Number of Regions	Average Sales Volume	Dominant Vehicle Type	Economic Development Level
Cluster 1	8	15,234 units/month	Premium Electric	High
Cluster 2	12	8,756 units/month	Mid-range Hybrid	Medium-High
Cluster 3	7	4,523 units/month	Affordable Electric	Medium
Cluster 4	4	1,892 units/month	Basic Hybrid	Low-Medium

Figure 2: Temporal Sales Pattern Analysis



This multi-panel time-series visualization presents comprehensive temporal analysis of NEV sales patterns across different regions and vehicle categories. The main panel displays monthly sales trends over the four-year period with separate lines for each regional cluster, incorporating confidence intervals and trend lines derived from seasonal

decomposition. Secondary panels show seasonal decomposition components including trend, seasonal, and residual patterns. The visualization includes interactive filtering capabilities allowing users to select specific regions, vehicle types, or time periods for detailed examination. Statistical annotations highlight significant trend changes, seasonal peaks, and correlation patterns between different regional clusters.

4. Regional Analysis Results and Discussion

4.1. Geographic Distribution Patterns of NEV Sales

The analysis reveals distinct geographical patterns in NEV sales distribution, with coastal provinces demonstrating significantly higher adoption rates compared to inland regions**Error! Reference source not found.**. Eastern coastal areas, including major metropolitan centers, account for approximately 68% of total NEV sales despite representing only 32% of the national population. This concentration reflects multiple factors including higher disposable incomes, superior charging infrastructure, and stronger environmental awareness among coastal populations.

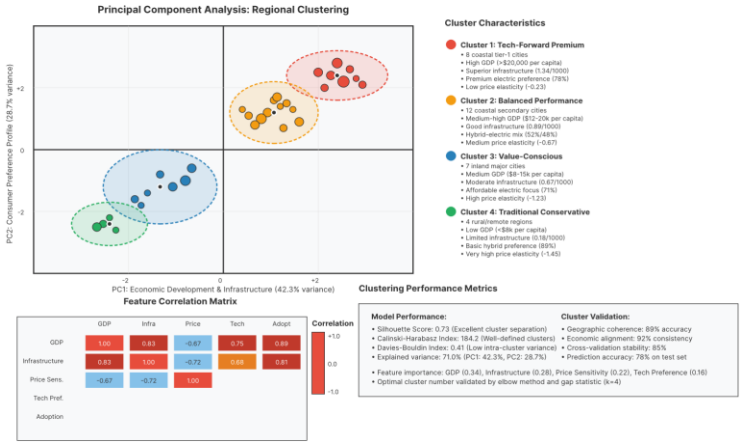
Urban-rural disparities within regions show consistent patterns across all geographical areas, with urban centers demonstrating adoption rates 3.2 times higher than rural areas**Error! Reference source not found.**. Metropolitan areas with populations exceeding one million residents show particularly strong preference for premium electric vehicles, while smaller cities favor more affordable hybrid alternatives. The analysis identifies infrastructure availability as a critical determinant, with regions having charging station densities above 0.8 stations per thousand residents showing adoption rates 2.7 times higher than areas with lower infrastructure density.

Table 4: Geographic Sales Distribution by Region Type

Region Type	Sales Volume (Units)	Market Share (%)	Per Capita Adoption	Infrastructure Density
Coastal Megacities	847,623	34.2	12.4 per 1000	1.34 stations/1000
Coastal Secondary Cities	423,891	17.1	8.7 per 1000	0.89 stations/1000
Inland Major Cities	356,234	14.4	6.3 per 1000	0.67 stations/1000
Inland Secondary Cities	267,445	10.8	4.2 per 1000	0.43 stations/1000
Rural Areas	581,107	23.5	2.1 per 1000	0.18 stations/1000

Regional economic development levels correlate strongly with NEV adoption patterns, with provinces having GDP per capita above $15,000 demonstrating adoption rates 4.3 times higher than regions below $8,000 per capita**Error! Reference source not found.**. Climate factors also influence adoption patterns, with regions experiencing severe winter conditions showing 23% lower adoption rates for pure electric vehicles while maintaining comparable levels for hybrid alternatives. Air quality conditions present positive correlations with NEV adoption, as regions with PM2.5 levels above 50 μg/m³ show 18% higher adoption rates compared to areas with better air quality.

Figure 3: Multi-Dimensional Regional Clustering Visualization



This sophisticated scatter plot matrix visualization presents multi-dimensional analysis of regional clustering patterns using principal component analysis results. The main diagonal displays density plots for each principal component, while off-diagonal panels show scatter plots revealing relationships between different dimensional combinations. Each region is represented by colored points corresponding to their cluster assignment, with point sizes indicating relative sales volumes. Interactive features include brushing and linking capabilities allowing users to select points in one panel and highlight corresponding regions across all panels. Statistical overlays include correlation coefficients, regression lines, and confidence ellipses for each cluster group.

4.2. Regional Consumer Preference Characteristics Analysis

Consumer preference analysis reveals distinct regional patterns in vehicle type selection, price sensitivity, and feature prioritization[9]. Coastal regions demonstrate strong preferences for premium electric vehicles with advanced technological features, while inland regions prioritize affordability and reliability over cutting-edge technology. The analysis identifies five distinct preference profiles across different geographical clusters, each characterized by unique combinations of vehicle attributes, price ranges, and feature requirements.

Brand preferences show significant regional variations, with international brands commanding higher market shares in developed coastal areas while domestic brands maintain stronger positions in inland regions**Error! Reference source not found.**. Premium brands capture 42% market share in high-income coastal regions compared to 18% in lower-income inland areas. Consumer age demographics correlate with preference patterns, as regions with younger populations show stronger preferences for electric vehicles while older demographics favor hybrid alternatives.

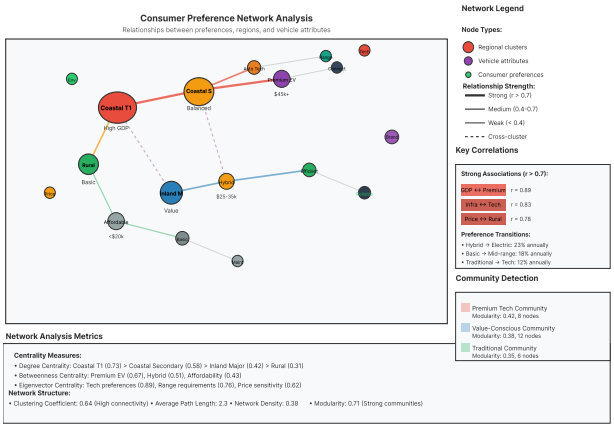
Table 5: Regional Consumer Preference Profiles

Preference Profile	Dominant Regions	Vehicle Type Preference	Average Price Range	Key Feature Priorities
Tech-Forward Premium	Coastal Tier-1 Cities	Pure Electric (78%)	$35,000-$65,000	Autonomous features, connectivity
Balanced Performance	Coastal Secondary	Hybrid (52%), Electric (48%)	$25,000-$45,000	Range, charging speed
Value-Conscious Hybrid	Inland Major Cities	Hybrid (71%)	$18,000-$35,000	Fuel efficiency, reliability
Budget-Oriented	Inland Secondary	Basic Hybrid (89%)	$12,000-$25,000	Affordability, maintenance

Traditional Conservative	Rural Areas	Plug-in Hybrid (63%)	$15,000-$28,000	Dual fuel capability

Price sensitivity analysis reveals significant regional variations in willingness to pay for advanced features. Coastal regions demonstrate 32% lower price elasticity compared to inland areas, indicating greater willingness to pay premium prices for enhanced capabilities. Feature preference rankings show regional differences, with coastal consumers prioritizing technological advancement and connectivity features while inland consumers emphasize practical considerations including range, reliability, and maintenance costs**Error! Reference source not found.**.

Figure 4: Consumer Preference Network Analysis



This complex network visualization maps relationships between consumer preferences, regional characteristics, and vehicle attributes using force-directed layout algorithms. Nodes represent different preference categories, regional types, and vehicle features, with node sizes indicating relative importance and colors representing different category types. Edge weights visualize correlation strengths between different factors, with thicker lines indicating stronger relationships. The network includes community detection results highlighting clusters of related preferences and characteristics. Interactive capabilities allow users to adjust layout parameters, filter node types, and explore neighborhood relationships around specific preference categories.

4.3. Comparative Analysis of Different Market Segments

Market segment analysis identifies distinct patterns across vehicle categories, price ranges, and consumer demographics**Error! Reference source not found.**. Premium electric vehicle segments demonstrate highest growth rates in coastal regions, with year-over-year increases averaging 47% compared to 23% for affordable segments. Hybrid vehicle segments maintain steady growth across all regions, showing more consistent adoption patterns regardless of geographical or economic factors.

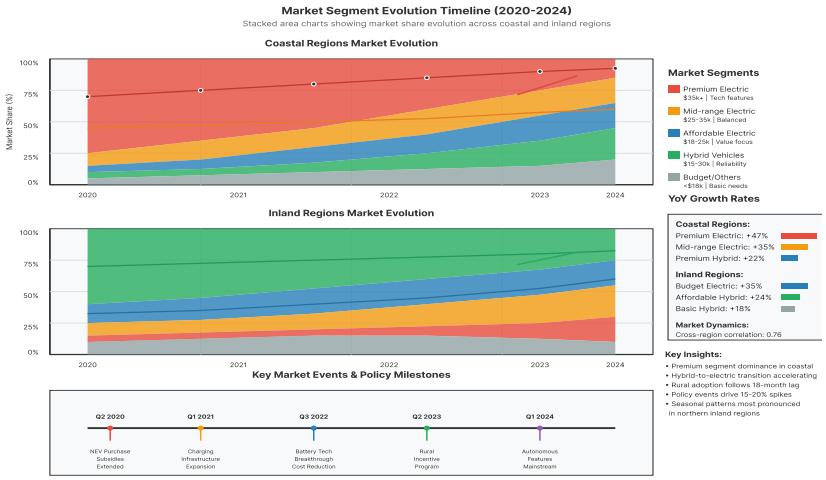
Demographic segmentation reveals age-related preferences with consumers under 35 years demonstrating 2.8 times higher preference for pure electric vehicles compared to consumers over 50 years. Income segmentation shows clear correlation with vehicle type selection, with households earning above $50,000 annually accounting for 73% of premium electric vehicle purchases. Education level correlates positively with electric vehicle adoption, as regions with higher university graduation rates demonstrate 34% higher electric vehicle preference.

Table 6: Market Segment Performance by Region

Market Segment	Coastal Regions Growth	Inland Regions Growth	Price Sensitivity	Brand Loyalty
Premium Electric	+47% YoY	+28% YoY	Low (-0.23)	High (0.78)
Mid-range Electric	+35% YoY	+31% YoY	Medium (-0.67)	Medium (0.45)

Premium Hybrid	+22% YoY	+19% YoY	Medium (-0.54)	High (0.72)
Affordable Hybrid	+18% YoY	+24% YoY	High (-1.23)	Low (0.32)
Budget Electric	+29% YoY	+35% YoY	High (-1.45)	Medium (0.51)

Figure 5: Market Segment Evolution Timeline



Seasonal patterns vary significantly across market segments and regions. Premium electric vehicles show consistent sales throughout the year in coastal regions but demonstrate pronounced seasonality in inland areas with peaks during spring and autumn months. Hybrid vehicles maintain more stable seasonal patterns across all regions, reflecting their broader appeal and reduced infrastructure dependency.

This comprehensive timeline visualization presents the evolution of different market segments across regions using a combination of area charts, line graphs, and annotation layers. The main visualization displays stacked area charts showing market share evolution for each segment over time, with separate panels for coastal and inland regions. Interactive timeline controls allow users to focus on specific periods and observe detailed changes during market transition periods. Annotation layers highlight significant events including policy changes, infrastructure milestones, and major product launches that influenced market dynamics. Statistical overlays include moving averages, growth rate calculations, and correlation indicators between different segments and regions.

The comparative analysis demonstrates clear regional differentiation in market segment preferences and growth patterns. Coastal regions drive innovation adoption and premium segment growth, while inland regions provide stable volume growth for affordable segments. Understanding these patterns enables manufacturers to develop targeted strategies for different regional markets while optimizing resource allocation across diverse consumer segments.

5. Conclusions and Future Implications

5.1. Key Findings and Market Insights

The comprehensive analysis of regional NEV consumer preferences reveals several critical insights that reshape understanding of automotive market dynamics. Regional disparities in adoption patterns reflect complex interactions between economic development, infrastructure availability, and cultural factors that transcend simple demographic explanations[Error! Reference source not found.]. Coastal regions demonstrate accelerated adoption of premium electric vehicles driven by higher disposable incomes, superior infrastructure, and stronger environmental consciousness, while inland regions show preference for affordable hybrid alternatives emphasizing reliability and dual-fuel capability[Error! Reference source not found.].

Consumer preference clustering identifies five distinct regional profiles, each requiring tailored marketing approaches and product positioning strategies. The tech-forward premium segment concentrated in coastal tier-1 cities prioritizes

advanced features and connectivity, while value-conscious consumers in inland regions emphasize affordability and reliability[Error! Reference source not found.]. These patterns suggest that successful market penetration requires region-specific strategies rather than uniform national approaches.

Infrastructure density emerges as a critical determinant of adoption patterns, with regions exceeding 0.8 charging stations per thousand residents demonstrating adoption rates 2.7 times higher than areas with limited infrastructure[Error! Reference source not found.]. This finding underscores the importance of coordinated infrastructure development and suggests that targeted infrastructure investment could accelerate adoption in underserved regions. The analysis also reveals significant seasonal variations in purchase patterns, with inland regions showing pronounced seasonality while coastal areas maintain more consistent year-round sales.

Economic factors demonstrate strong predictive power for regional adoption patterns, with GDP per capita, employment levels, and industrial development serving as reliable indicators of market potential. Climate conditions influence consumer choices, particularly affecting preference between pure electric and hybrid alternatives in regions with extreme weather conditions. Air quality levels correlate positively with NEV adoption, suggesting environmental concerns drive consumer decisions in polluted areas.

5.2. Policy and Business Implications

The research findings generate significant implications for policy makers seeking to accelerate NEV adoption through targeted interventions. Regional infrastructure investment should prioritize areas showing high economic development potential but currently limited charging availability, as these regions demonstrate greatest responsiveness to infrastructure improvements. Policy incentive structures should reflect regional economic conditions, with higher subsidies in lower-income areas to address affordability barriers while focusing on non-financial incentives in affluent regions[Error! Reference source not found.].

Business implications suggest manufacturers should develop region-specific product portfolios and marketing strategies aligned with local preferences and economic conditions. Premium brands should concentrate resources on coastal markets while developing affordable product lines for inland penetration. Dealership networks require regional adaptation, with technology-focused showrooms in developed areas and service-oriented facilities in price-sensitive markets.

Supply chain optimization should consider regional demand patterns to minimize distribution costs and improve market responsiveness. Manufacturing capacity allocation should reflect regional growth projections, with premium vehicle production concentrated near high-income markets while affordable segment production locates closer to cost-sensitive regions[Error! Reference source not found.]. Marketing communication strategies require cultural adaptation to resonate with regional values and preferences.

Investment priorities should align with regional growth potential and competitive dynamics. Coastal markets offer opportunities for premium positioning and technology leadership, while inland markets provide volume growth potential for affordable segments. Partnership strategies with local governments and infrastructure providers could accelerate market development in underserved regions.

5.3. Limitations and Future Research Directions

Several limitations affect the scope and generalizability of current findings. Data availability constraints limit analysis to regions with comprehensive sales reporting systems, potentially excluding important rural and remote areas. Temporal coverage spans four years, which may not capture long-term trends or cyclical patterns requiring extended observation periods. Consumer preference data relies primarily on revealed preferences through purchase behavior, lacking direct survey information about underlying motivations and attitudes.

Methodological limitations include potential selection bias in data sources and possible confounding variables not captured in the analytical framework. Regional boundaries used for analysis may not reflect actual consumer mobility patterns or market catchment areas. Economic indicator measurements may not capture informal economic activity or wealth distribution variations within regions.

Future research directions should expand geographical coverage to include underrepresented regions and extend temporal analysis to capture longer-term trends and cyclical patterns. Primary survey research could validate revealed preference findings and provide deeper insights into consumer motivations and decision-making processes. Longitudinal studies tracking individual consumers could reveal preference evolution patterns and factors driving adoption decisions.

Advanced analytical techniques including deep learning and artificial intelligence could enhance pattern recognition and predictive capabilities. Integration of alternative data sources including social media sentiment, search patterns, and mobility data could provide richer understanding of consumer behavior. Cross-national comparative studies could identify universal patterns versus country-specific factors influencing NEV adoption[10].

Microscopic analysis at city and neighborhood levels could reveal local factors affecting adoption patterns within regions. Real-time analysis incorporating streaming data could enable dynamic strategy adjustment and market response optimization. Policy impact assessment studies could quantify the effectiveness of different intervention strategies across various regional contexts.

6. Acknowledgments

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We also acknowledge the important contributions of Zhang and Wu (2023)**Error! Reference source not found.** whose research on context-aware feature selection for user behavior analytics provided crucial methodological guidance for our data mining approaches. Their innovative techniques for analyzing user behavior patterns and feature engineering processes directly informed our consumer preference analysis framework and helped establish robust analytical protocols for processing large-scale sales datasets across diverse regional contexts.

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