SHIPMENT PRICING PREDICITON

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Abstract

Predicting accurate pricing remains a crucial yet complex puzzle in the world of shipments. This work explores leveraging the power of data analysis and machine learning models to address this challenge. We delve into historical shipment data, analyzing key factors like distance, package weight, transportation mode, and fuel prices. By identifying the intricate relationships between these elements, we aim to build a robust model capable of predicting shipping costs with exceptional accuracy. This development promises significant benefits for both shippers and carriers, enabling optimized pricing strategies, cost transparency, and ultimately, a more efficient and profitable logistics ecosystem.

1.INTRODUCTION

In the ever-evolving world of logistics, accurately predicting shipment costs is a constant battle. Traditionally, this process has relied on flat rates, carrier quotes, and intuition – often leading to miscalculations, inefficiencies, and dissatisfied customers. Enter shipment pricing prediction, a revolutionary approach transforming the way we understand and estimate shipping costs

WHY IT MATTERS?

- *Transparency and Fairness*: Predicting shipping costs based on specific factors, like package size, distance, and urgency, creates a more transparent and fair pricing landscape for both shippers and carriers.

- *Cost Optimization*: Precise predictions allow businesses to optimize their shipping decisions, choosing the most cost-effective options without compromising on speed or reliability.

- *Enhanced Customer Experience*: Knowing shipping costs upfront builds trust and reduces cart abandonment, leading to a more positive customer experience.

- *Efficiency and Profitability*: By employing data-driven pricing, logistics companies can improve resource allocation, streamline operations, and ultimately boost profitability.

How does it work?

Shipment pricing prediction leverages the power of data analysis and machine learning algorithms. Historical shipping data, encompassing details like package characteristics, delivery routes, fuel prices, and carrier rates, is fed into the model. The algorithm then identifies patterns and relationships, allowing it to accurately predict future shipping costs for similar scenarios.

2.PROBLEM STATEMENT

The market for supply chain analytics is expected to develop at a CAGR of 17.3 percent from 2019 to 2024, more than doubling in size. This data demonstrates how supply chain organizations are understanding the advantages of being able to predict what will happen in the future with a decent degree of certainty. Supply chain leaders may use this data to address supply chain difficulties, cut costs, and enhance service levels all at the same time.

The main goal is to predict the supply chain shipment pricing based on the available factors in the dataset.

3.CUSTOMER/MARKET/BUSINEES NEED ASSESSMENT

3.1 Customer Need-

- *Accuracy and Transparency*: Customers need accurate estimations of shipment costs upfront to avoid surprises and build trust with businesses.

- *Cost-Effectiveness*: They seek the most economical shipping options without compromising on delivery speed or service quality.

- *Convenience and Choice*: Customers value a variety of shipping options tailored to their individual needs and budget constraints.

- *Predictability and Reliability*: Knowing estimated delivery times and proactive notifications on potential delays are crucial for planning and managing expectations.

3.2 Market Need-

- *Competition and Differentiation*: In a competitive logistics landscape, accurate pricing estimates can become a key differentiator for businesses.

- *Operational Efficiency*: Precise cost predictions enable efficient resource allocation and route optimization, leading to improved service and reduced operational costs.

- *Dynamic Adaptation*: Ability to adapt pricing to real-time market fluctuations and fuel price changes strengthens competitive advantage.

- *Customer Acquisition and Retention*: Offering transparent and competitive pricing strategies attracts and retains customers, fostering loyalty and positive brand image.

3.3 Business Need-

- *Profitability and Cost Optimization*: Accurate pricing minimizes miscalculations and ensures profitable margins on shipping services.

- *Customer Satisfaction and Retention*: Providing competitive and transparent pricing boosts customer satisfaction and increases repeat business.

- *Strategic Decision-Making:* Data-driven insights into cost factors facilitate informed decisions about pricing strategies, resource allocation, and market expansion.

- *Risk Management*: Proactive identification of potential cost overruns mitigates financial risks and protects business sustainability.

4. TARGET SPECIFICATION AND CHARACTERIZATION

The core target of shipment pricing prediction is to estimate the final cost of a shipment with high accuracy. This estimated cost should encompass all relevant factors, including:

- *Package characteristics*: Weight, dimensions, fragility, dangerous goods classification, etc.

- *Origin and destination*: Distance, geographic complexity, border crossings, etc.

- *Delivery mode*: Air, sea, ground, courier, etc.

- *Urgency/speed*: Standard, expedited, same-day, etc.

- *Additional services*: Insurance, tracking, packaging, etc.

- *Market factors*: Fuel prices, seasonal fluctuations, carrier capacity, etc.

The ideal shipment pricing prediction model should possess the following characteristics:

- *Accuracy*: Predicted costs should closely match the actual final costs, ideally within a specified margin of error.

- *Transparency*: The model should clearly explain the key factors influencing the price estimation, allowing for informed decision-making.

- *Granularity*: Predictions should be specific to the unique characteristics of each shipment, not relying on broad averages or generalizations.

- *Dynamic Adaptability*: The model should be able to adapt to real-time changes in market conditions, fuel prices, and carrier availability.

- *Scalability*: The model should be able to handle large volumes of data and diverse shipment profiles without compromising accuracy or processing speed.
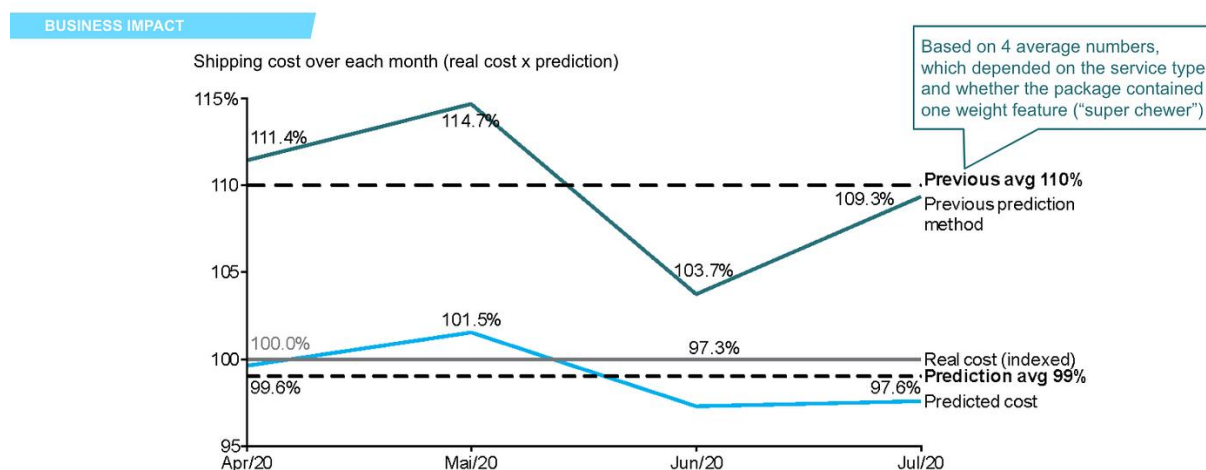
5.EXTERNAL SEARCHES

I have listed some of the Links/Resources that are useful to analyze the Shipment Pricing Prediction and understand how shipment of particular product happens from scratch like from Industries to Customer –

- https://www.kaggle.com/code/klmsathishkumar/shipping-cost-prediction

- https://www.mdpi.com/2071-1050/15/2/1122

- https://pubsonline.informs.org/doi/abs/10.1287/opre.2021.2204

- https://www.logisticsmgmt.com/

- https://arxiv.org/abs/2103.15096

6.BENCHMARKING

Most of the Shipping site like **Shippo** , **EasyPost**, **Frieghtos Marketplace** are using abundant resources and customer data to enhance their revenue and capture the market of Shipment they have good relationship between giant product based companies as they provide a type of service to that companies but this model can predict actual price of shipment of the goods by analysing their weights, size, distance, shape, as our product can useful to individual shippers also who are running small business of supplying or those who build their own company and want to ship their product can estimate the shipment price of the goods in home by using our Shipment Price Prediction Site / App.

BUSINESS IMPACT

Shipping cost over each month (real cost x prediction)

Based on 4 average numbers, which depended on the service type and whether the package contained one weight feature ("super chewer")

115%

111.4%
114.7%

110 .... **Previous avg 110%**
Previous prediction method
109.3%

105
103.7%

101.5%

100.0%
100 97.3% Real cost (indexed)
99.6% **Prediction avg 99%**
97.6% Predicted cost

95
Apr/20   Mai/20   Jun/20   Jul/20

7. APPLICABLE PATENT

- US Patent 8,600,705: System and method for predicting shipping costs for packages - This patent describes a system that uses historical shipping data and various factors (distance, weight, etc.) to predict shipping costs for packages.

- US Patent 9,204,980: Method and system for optimized parcel delivery routing and pricing - This patent focuses on optimizing delivery routes and pricing based on predicted travel times and costs

- US Patent 10,811,577: Freight shipment prediction and recommendation system- This patent presents a system that predicts delivery times and costs for freight shipments based on real-time market data and machine learning algorithms.

8.APPLICABLE REGULATION

The regulatory landscape surrounding shipment price prediction is still evolving, as the technology itself is relatively new. However, several regulations may need consideration depending on the specific implementation and target audience

- Transparency and Fairness
- Fuel Taxes and Carbon Pricing
- Eco-friendly Logistics Incentives
- Misrepresentation and Fraud
- Data Collection and Use
- Infrastructure Investments
- Algorithmic Bias
- Price Collusion and Antitrust
- Specific regulations for different transportation modes (air, sea, land) might apply depending on the shipments your model targets. These could relate to pricing transparency, safety standards, or documentation requirements.
- Intellectual Property Considerations

9.APPLICABLE CONSTRAINTS

When developing or utilizing shipment price prediction models, several practical constraints need to be considered

- Limited Historical Data
- Data Quality Issues
- Black Box Model
- Trade-off between Accuracy and Explainability
- Real Time Prediction Latency
- Fuel Price and Market Volatility
- Training Complex Model
- Ethical Consideration and Bias
- Operational Integration and Useability

10.BUSINESS MODEL

10.1 SaaS Subscription:

Offer your model as a software-as-a-service (SaaS) product with tiered subscription plans based on features, data volume, or user count. This is a recurring revenue model, promoting customer retention and predictable income.

Target: Logistics companies, e-commerce businesses, shipping aggregators.

10.2 Pay-per-Prediction:

Charge a small fee for each individual prediction generated by your model. This offers flexibility for clients and can attract a wider range of users with occasional needs.

Target: Small businesses, independent shippers, individual consumers.

10.3 Data Insights and Analytics:

Go beyond predictions and offer detailed data insights and analytics based on your model's output. This provides valuable market intelligence and strategic guidance to clients.

Target: Large logistics companies, consulting firms, market research firms.

10.4 API Integration and Partnership:

Integrate your prediction model as an API within existing logistics platforms or software solutions. This expands your reach and enables wider adoption without managing individual customers directly.

Target: Logistics software providers, e-commerce platforms, freight marketplaces.

10.5 White-Label Solution:

License your technology to other companies who can rebrand it and integrate it into their offerings. This provides upfront licensing fees and potentially recurring revenue depending on the agreement.

Target: Established logistics companies, technology solution providers.

11.CONCEPT GENERATION

While traditional shipment pricing prediction focuses on estimating costs based on distance, weight, and mode of transport, here are some innovative concepts to push the boundaries and offer unique value –
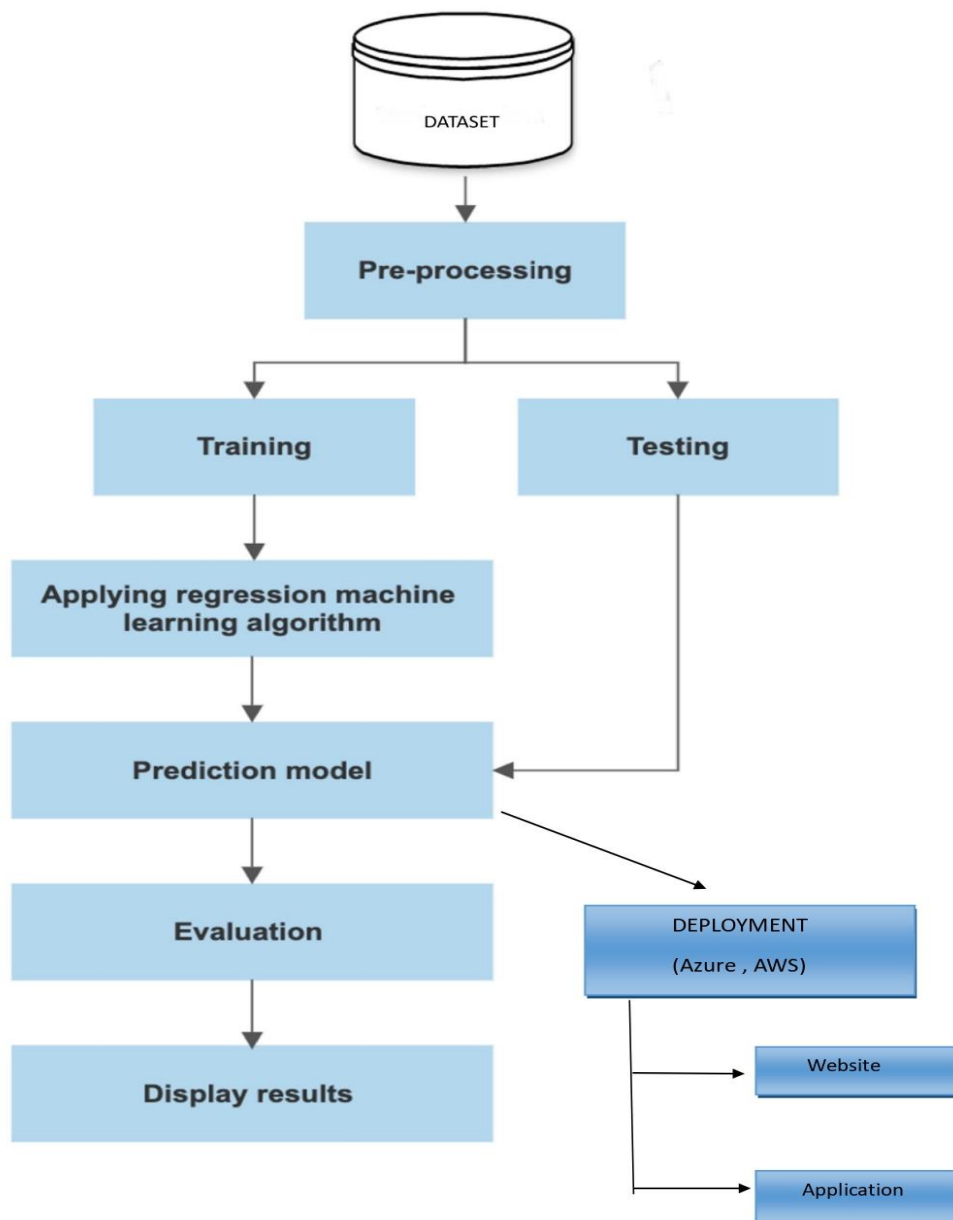
- Move beyond basic parameters and factor in real-time data like weather conditions, traffic congestion, fuel price fluctuations, and carrier capacity changes.

- Personalized Pricing for Customers

- Predictive Risk Management

- Offer predictions by specific time slots or routes, catering to businesses with precise delivery needs

12.CONCEPT DEVELOPMENT

The model is basically target the individuals and small business to move beyond the factors like distance, weight, size, it like Predict by the hour, factoring in real-time traffic, weather, and fuel fluctuations. Imagine pinpointing the cheapest 2pm delivery and also personalized pricing suitable for customers

13. FINAL PRODUCT PROTOTYPE

This is the Finale Product Prototype Roadmap that how it design from scratch taking predetermined dataset and perform pre-processing of dataset (EDA) on it and then split it into Train & Test Data on which train data are used in regression model and test data are used for evaluation. Then Final Prediction Model is ready to Predict the Shipment Price after that we can deploy it on Azure or AWS Cloud .

The figure is a flowchart. DATASET (cylinder) → Pre-processing → branches to Training and Testing. Training → Applying regression machine learning algorithm → Prediction model → Evaluation → Display results. Testing → Prediction model. Prediction model → DEPLOYMENT (Azure , AWS) → Website and Application.

14.PRODUCT DETAILS

14.1 *How does it Works?*

This digital sleuth gathers historical data on past shipments like a map, analyzing details like package size, weight, distance, and chosen mode of transport. It then delves into external factors like fuel prices and seasonal trends, piecing together the hidden formula behind shipping costs. Using different algorithms it analyzes the input data and uncover the shipment price of the goods .

14.2 *Data Source*

There are numerous of clean and uncleaned dataset found on the internet but I refer to use the dataset that is available on the Kaggle Website.
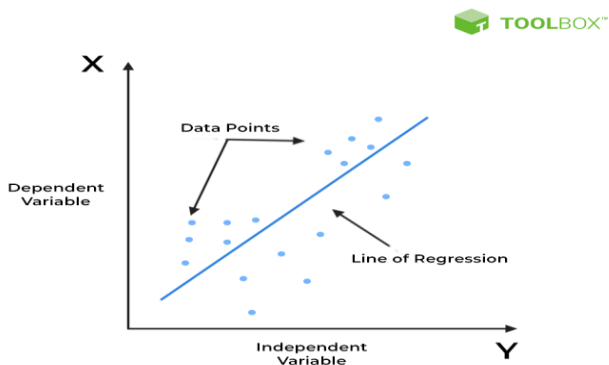
14.3 *Algorithms / Software / Frameworks*

Linear Regression:

Uncovers linear relationships between shipment features (weight, distance, etc.) and price.

Simple and fast to train, but might not capture complex interactions.

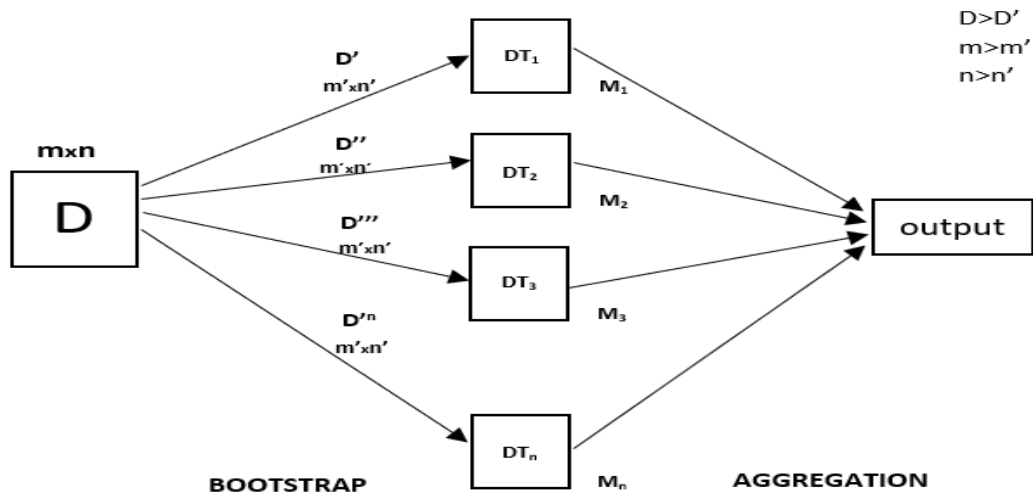Best for straightforward scenarios with clear linear patterns.

Random Forest:

Creates an ensemble of decision trees, each making independent predictions.

Combines these predictions for a more robust and accurate result.

Handles non-linear relationships and complex interactions well.

More computationally expensive than linear regression.

mxn

D

D'
$m'xn'$

D''
$m'xn'$

D'''
$m'xn'$

D'^n
$m'xn'$

DT_1 — M_1

DT_2 — M_2

DT_3 — M_3

DT_n — M_n

$D>D'$
$m>m'$
$n>n'$

output

BOOTSTRAP

AGGREGATION

Neural Networks:

Mimic the human brain's structure to learn complex patterns from data.

Can achieve high accuracy, but require large datasets and careful training.

Well-suited for capturing subtle relationships and handling large, diverse data.


A Simple Neural Network

Input Layer   Hidden Layer   Output Layer

Investopedia
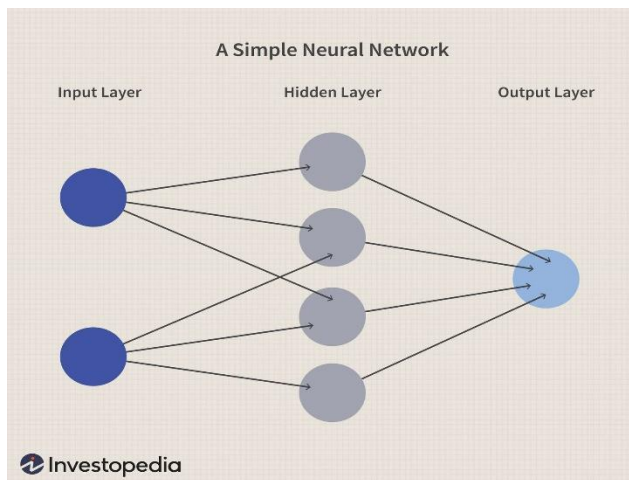
Time Series Analysis:

Focuses on the temporal nature of shipping costs, analyzing historical trends and patterns.

Models seasonal fluctuations, demand changes, and evolving market conditions.

Crucial for predicting future price movements and identifying pot

Time-Series Analysis

Dependent Variable

Time
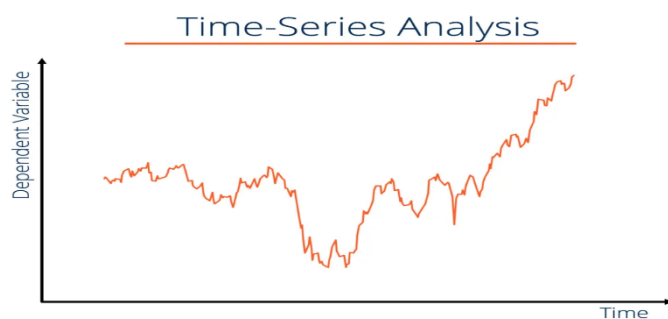
Programming Languages: Python (with libraries like Pandas, NumPy, Scikit-learn)

- Cloud-Based Platforms: Amazone Web Service , Microsoft Azure Machine Learning.

- Specialized Frameworks: TensorFlow, PyTorch (for neural networks), Prophet (for time series analysis).

- Transportation Management Systems (TMS): Often include built-in prediction modules or integrations with external tools.

- Data Visualization Tools: Tableau, Power BI (for understanding data and model results).

14.4 *Team Required*

- Machine learning Engineer

-Cloud Engineer

-Software Engineer

-UI/UX Engineer

-App Developer

-Data/Business Analyst

14.5 *Cost*

Depends upon the Goods Availability

15.CONCLUSION

Accurate shipment price prediction is pivotal for efficient logistics and cost-effective operations. By leveraging advanced data analytics, machine learning algorithms, and historical shipping data, predictive models can forecast shipping costs with precision. This forecasting facilitates better decision-making, allowing businesses to optimize routes, allocate resources effectively, and mitigate financial risks associated with transportation expenses. Additionally, these predictive models aid in offering customers transparent pricing, enhancing trust and satisfaction. However, challenges like fluctuating fuel costs, unforeseen events, and evolving market dynamics pose ongoing hurdles in achieving absolute accuracy. Continuous refinement and adaptation of predictive models through ongoing data analysis and algorithmic adjustments are imperative to improve forecast reliability. Ultimately, accurate shipment price prediction empowers businesses to streamline logistics, reduce overheads, and deliver superior service while maintaining competitive edges in the dynamic global marketplace.