Data Science Lifecycle

How EDA Enhances Decision-Making and Business Value

15 minute read

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August 6th, 2024

Overview

Tip: You don't have to read all of this document to get the most out of it! Just interested in EDA? Just review #2, #3, and #4. In response to common client questions, we wrote this document to provide concise answers and knowledge to key concerns that most clients tend to have. Not all of it may be relevant to your needs but it should help answer the question **"Why do I need to do exploratory research on my data before starting a longer-term project?"**

1. Introduction

YERRINGTON CONSULTING

About Maximum Labs / Yerrington Consulting

Maximum Labs is a full-service data science firm specializing in the analysis and development of prototype applications. Founded by David Yerrington, a seasoned data scientist and engineer, our company excels in leveraging data to solve complex business challenges. With expertise in startups, machine learning, AI, and product development, we are committed to transforming data into actionable insights and strategic assets for your business.

Our Mission and Values

In a world awash with data, our mission is to empower businesses by delivering clarity and actionable insights. We blend advanced data science, machine learning, and AI technologies to foster innovation and drive growth. Our values are centered around a business-first approach, ensuring that every data-driven solution aligns with your strategic goals and delivers tangible results.

Business-First Approach

Alignment with Business Goals: We prioritize understanding your business objectives and aligning our data science initiatives to meet these goals. This ensures that our efforts directly contribute to your success.

Strategic Insights: Our focus is on transforming data into strategic insights that inform decision-making and drive growth.

Measurable Outcomes: We are committed to delivering solutions that provide measurable business value, whether through cost savings, revenue generation, or operational efficiencies.

Our Key Differentiators

Customized Solutions: Unlike other agencies that offer one-size-fits-all services, we tailor our data strategies to your unique needs, ensuring relevance and impact. A lot of agencies don't take on clients that require more than just a solution. We aim to give not just good advice but also a long-term partnership.

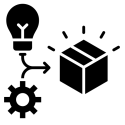
Proven Expertise: With a diverse portfolio that includes LLMs, NLP prototypes, recommender systems, and AI-driven applications, we bring proven expertise to every project. We can deliver not just data understanding but also production applications that scale with your business.

Educational Focus: With a background in education, we empower your team through education and training, fostering a culture of data literacy and continuous improvement. We believe if we can help the least technical person on your team understand complex technical problems, then everyone can understand and contribute to the discussion.

Guiding Principles

Transparency: We maintain an open and transparent process, ensuring you are informed and involved at every stage.

Collaboration: We believe in a collaborative approach, working closely with your team to integrate data science seamlessly into your business operations.



Innovation: We stay at the forefront of technological advancements, ensuring that you benefit from the latest tools and methodologies in data science.

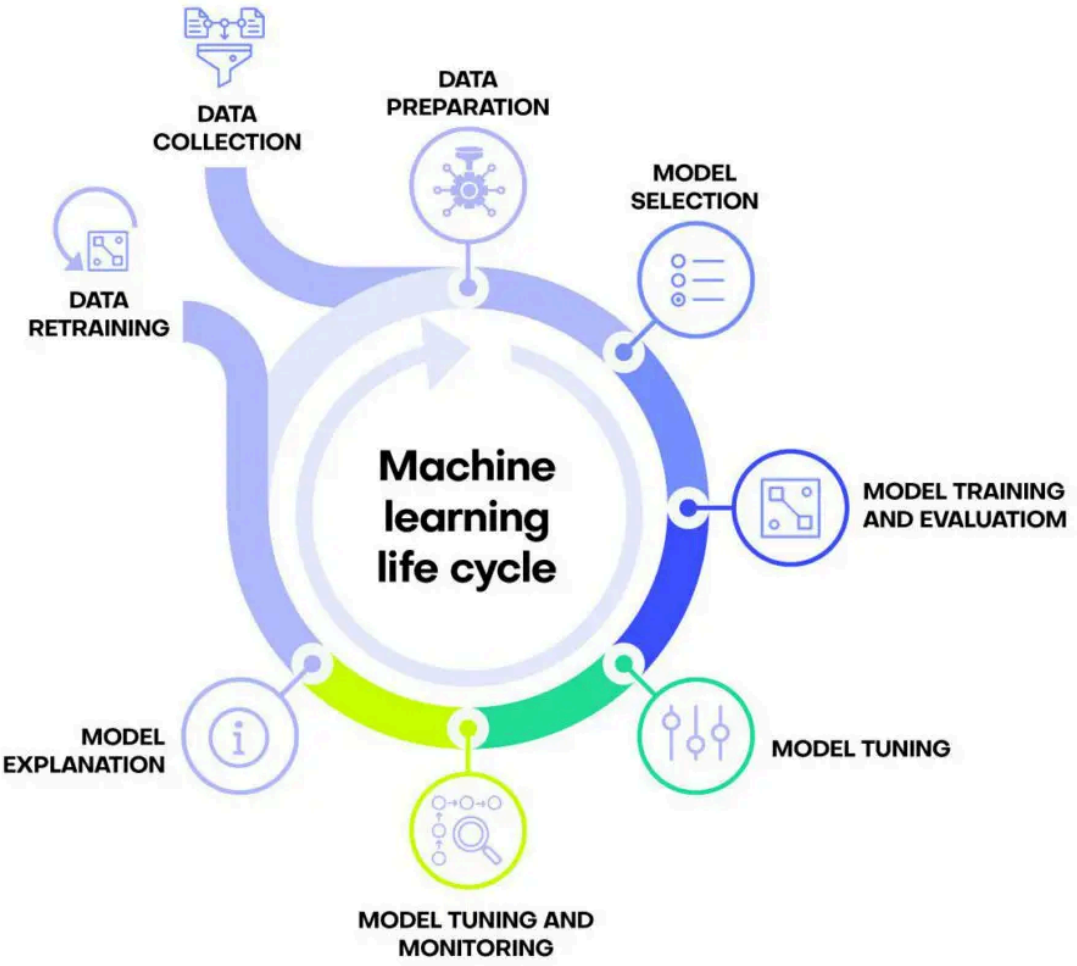
Purpose of This Document

This document serves as a guide for new clients to understand the data science lifecycle and the pivotal role of Exploratory Data Analysis (EDA) in driving business success. By outlining our approach and methodologies, we aim to demonstrate how data science can inform strategic decisions, uncover opportunities, and mitigate risks.

What You Can Expect to Learn:

- The stages of the data science lifecycle and their business implications
- How EDA contributes to understanding your data and informing decision-making
- Real-world examples of data science success stories
- Best practices for integrating data science into your business strategy

Importance of Understanding the Data Science Lifecycle



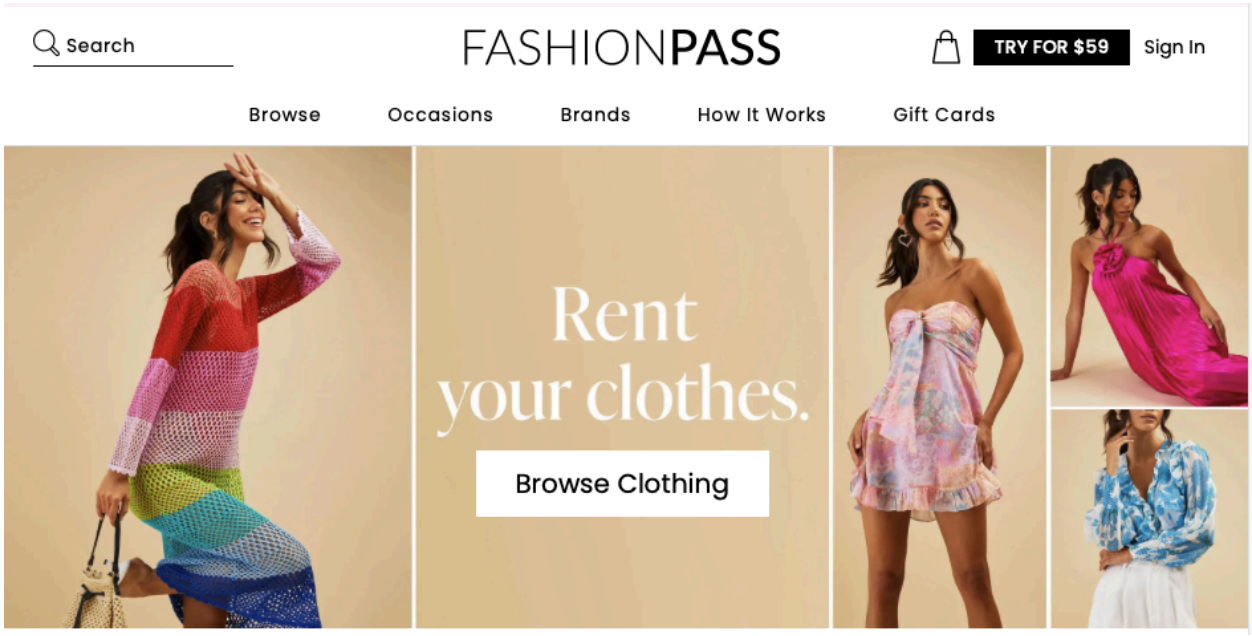
In today's data-driven world, businesses must leverage data to remain competitive and innovative. Understanding the data science lifecycle—from problem definition to model deployment—ensures that data initiatives are aligned with your business goals and deliver measurable value. EDA is a critical step in this process, providing the insights needed to shape effective data strategies and drive informed decision-making.

2. The Business Value of the Data Science Lifecycle

Problem Definition

Aligning Data Science Projects with Business Goals

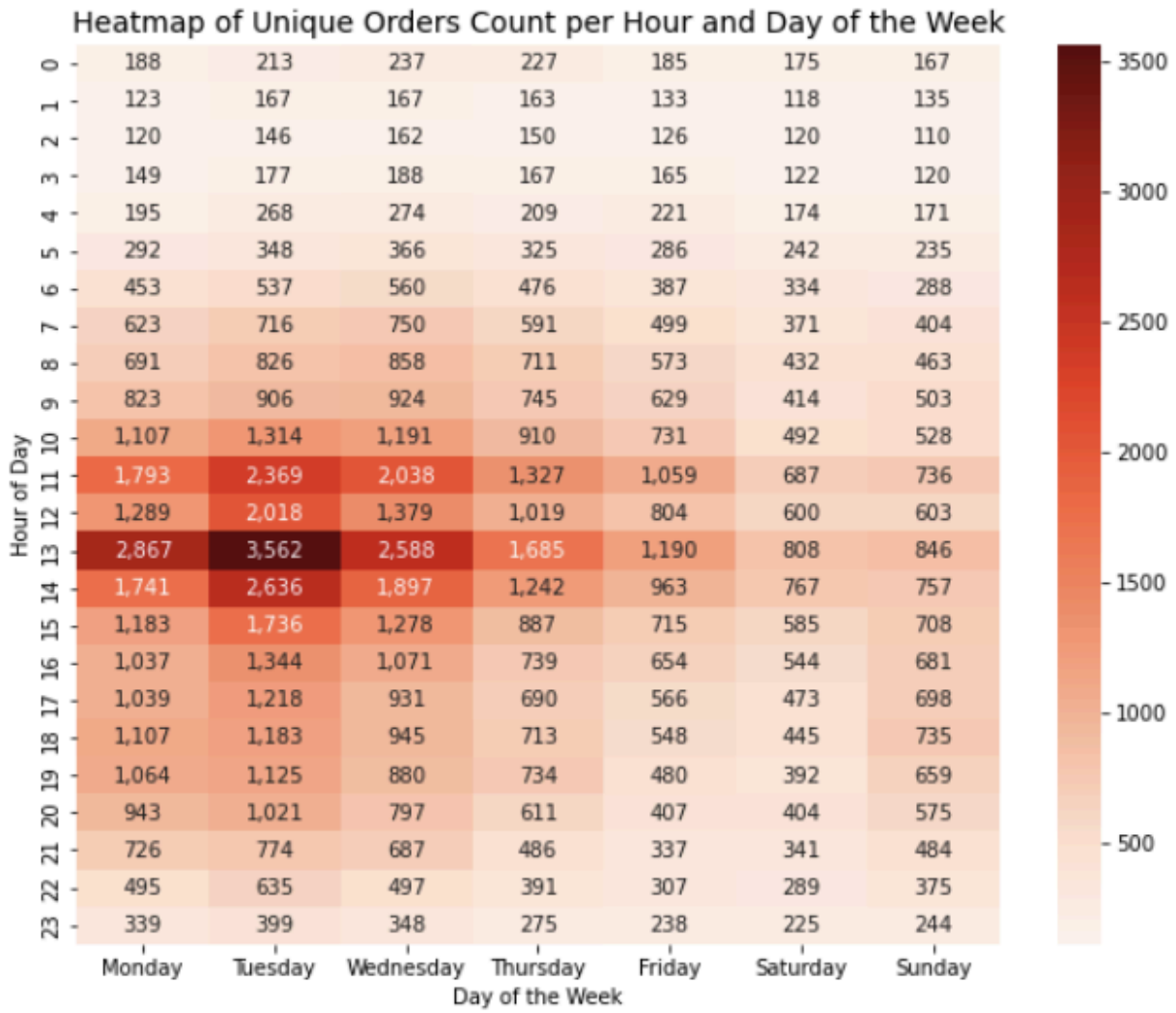
The foundation of any successful data science initiative is a clear alignment with your business goals. This alignment ensures that the insights and solutions derived from data science directly contribute to achieving your strategic objectives. At Yerrington Consulting, we start by thoroughly understanding your business context, challenges, and aspirations.



For example, we once worked with a retail fashion subscription company, FashionPass, struggling to understand why certain products were underperforming. By aligning our analysis with their goal of improving product selection conversions, we identified key factors impacting product performance, leading to strategic adjustments that increased sales by 15%.

Defining Clear Objectives and Success Metrics

Setting precise, measurable objectives is crucial for the success of data science projects. These objectives guide the project's direction and provide benchmarks to assess progress and impact. *For instance, in a project with a financial services firm, we defined success metrics around reducing customer churn by 10%. This clear objective focused our efforts on analyzing customer behavior data and detailed correspondence support cases, leading to the development of targeted retention strategies through targeted notifications and personalized recommendation.*

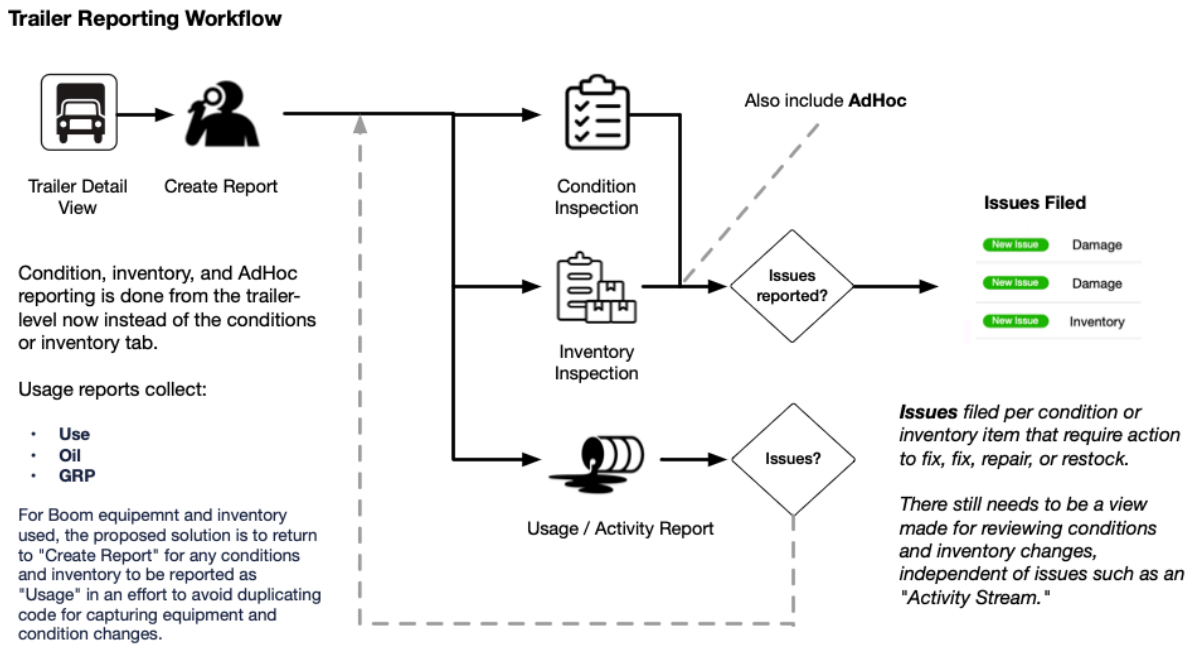


Establishing such metrics ensures that every project has well-defined goals that align with your business priorities, helping track the effectiveness of our efforts and demonstrating tangible results.

Data Collection

Importance of Data in Decision Making

In today's competitive landscape, data is a vital asset for informed decision-making. High-quality data enables businesses to understand market trends, customer behavior, and operational efficiencies. At Yerrington Consulting, we emphasize the importance of robust data collection processes to gather relevant, accurate, and timely data.



For example, with Massachusetts Departments of Environmental Protection (MassDEP) we worked with their field operations team to understand key areas of inefficiency related to how they collect data. We were able to tie a basic exploratory analysis to key risks for emergency response logistics using past data but also identify key data needs unmet by their current methodology. By analyzing their data before proposing any type of machine learning strategy or improvements to their existing analytic systems, we identified areas of most value to automate with machine learning but also setting the direction for how and what data should be collected for managing key risks and budget predictability.

Identifying Valuable Data Sources for Business Insights

Not all data is created equal. Identifying and leveraging the most valuable data sources is critical for deriving meaningful insights. We assist you in pinpointing key data sources, whether internal (such as sales data, customer feedback) or external (such as market reports, social media analytics, web APIs). By focusing on high-impact data, we help you uncover insights that drive business growth and efficiency.

We created a relationship platform that we actually enjoy being on

The #1 LGBTQIA+ Dating App

HER was the first app to launch that exclusively focussed on the needs of queer, bisexual and lesbian dating. While there were over 40 apps for other sexualities, not a single dating app existed for LGBTQ+ women and non-binary people until there was HER. Eight years later, HER has made over 300 million lesbian matches, thousands of queer marriages and hundreds of lil babies.

HER is the world's largest (and most iconic) dating and community-building platform for lesbian, bisexual, queer women and gender-non-conforming icons worldwide. Whilst most heteronormative apps focus on the experience of cis men (the people those apps make their money from), **HER is designed** to focus exclusively on the **needs of queer women, non-binary and trans people.**

For example, by integrating social media sentiment analysis, with mobile dating client WeAreHer.com discovered emerging promoters of their brand with the most reach, enabled their marketing team to prioritize outreach to users most likely to help promote their app.

Data Cleaning

If your data collection is wrong, your conclusions are wrong.

Why do we have to clean data anyway? Data cleaning and data preparation can be up to 80-90% of a project's budget. Most data is not in the form that can be immediately used by machine learning or AI so it has to be *transformed*.

Ensuring Data Quality for Reliable Analysis

Data cleaning is like preparing ingredients before cooking a meal. Just as you wouldn't cook with spoiled or contaminated ingredients, you shouldn't analyze or draw conclusions from messy data. Cleaning data involves removing inaccuracies, filling in missing values, and ensuring consistency, much like washing and chopping vegetables before cooking. This step is crucial because even the best data analysis techniques can't compensate for poor-quality data.

Impact of Clean Data on Business Outcomes

Think of clean data as the foundation of a sturdy building. If the foundation is shaky, no matter how well you build the structure, it won't stand strong. Clean data ensures that the subsequent stages of the data science process, such as data acquisition and Exploratory Data Analysis (EDA), are built on reliable information. This enhances the accuracy of predictive models and analytical insights, leading to better business outcomes.

Bad Data, Bad Decisions

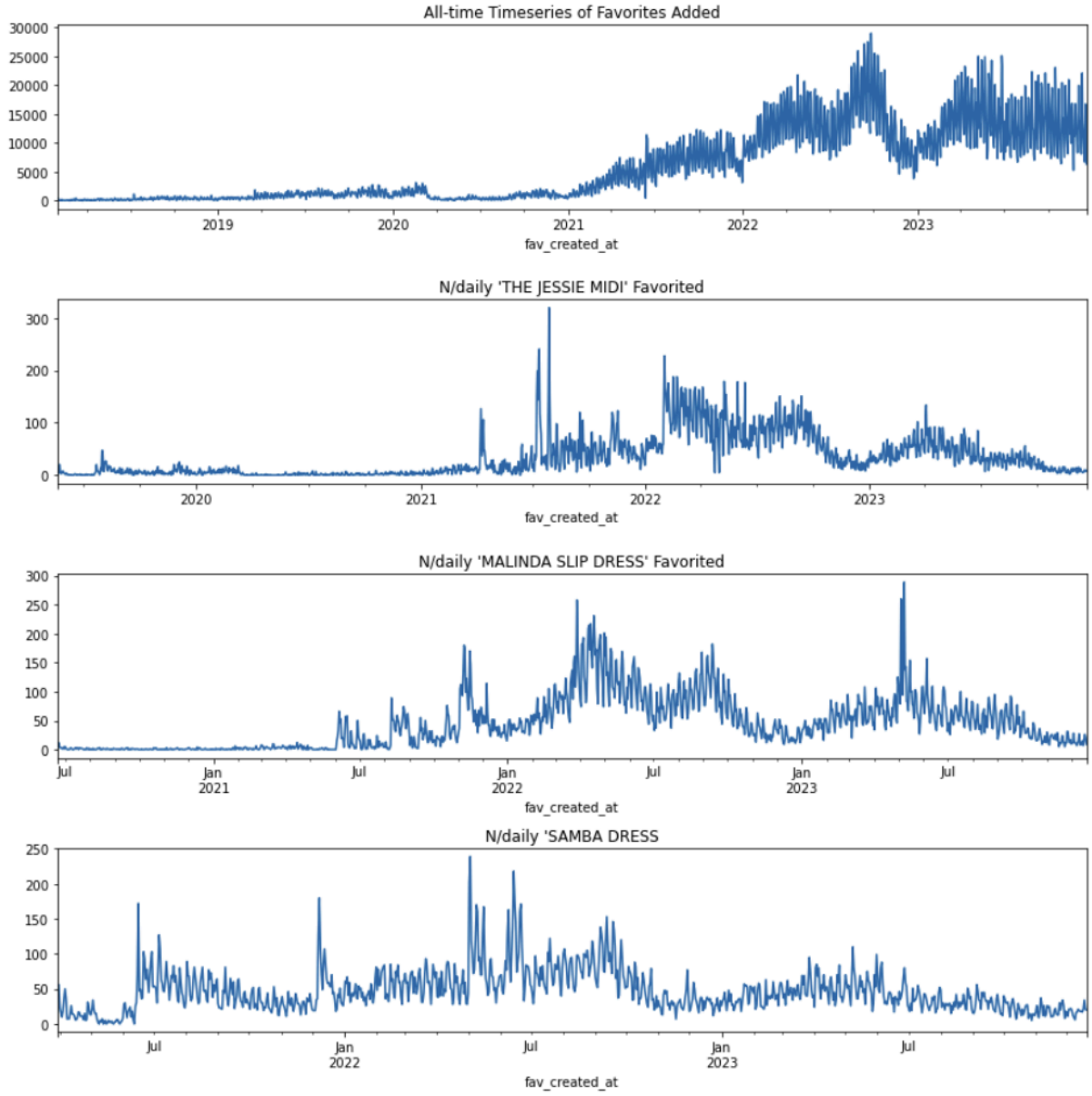
Example 1: Sensitivity Analysis for Price Changes:

- **Scenario:** You analyze the impact of a price increase on product demand by comparing data before and after the change.
- **Problem:** You conclude the price increase is detrimental due to a drop in conversion rate.
- **Overlooked Factor:** The product team made homepage changes during the same period, impacting user experience (UX) but also didn't look at the trend overall to understand baseline characteristics and totally missed the change in pattern caused by the homepage changes.
- **Lesson:** Without considering multiple influencing factors and ensuring clean data, looking from a broad view and establishing baseline assumptions, your analysis may lead to incorrect conclusions.

Example 2: Sentiment Analysis:

- **Scenario:** Your company uses sentiment analysis to gauge customer opinions from social media.
- **Problem:** The data contains slang, sarcasm, and misspellings not accounted for in your analysis.
- **Overlooked Factor:** Sentiment scores are inaccurate due to features missed with slang and negation introduced by sarcasm (“that’s cool.. NOT” @1980sTroll).
- **Lesson:** Clean and preprocess data to accurately reflect customer sentiment, avoiding misguided assumptions about what is actually being said online.

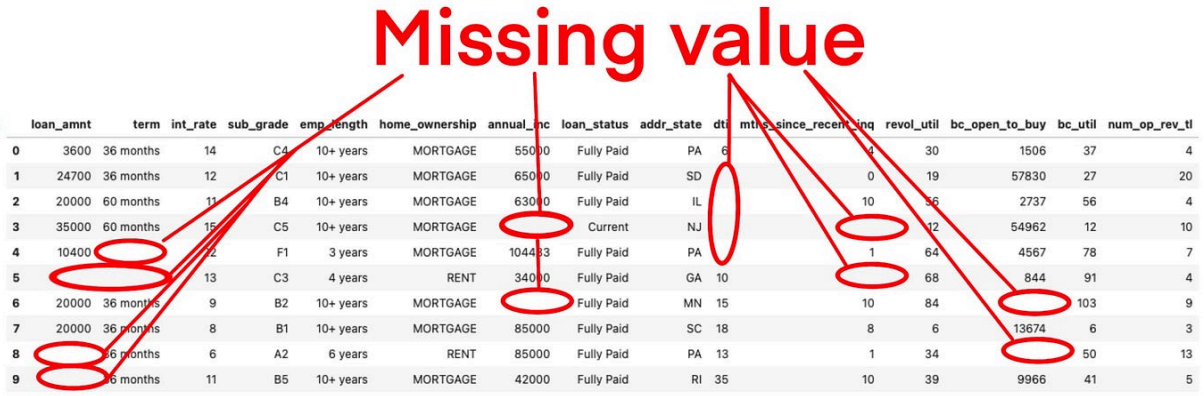
Example 3: Recommendation Systems



Without knowing that products are popular over time, seasonable sales promotions, and the general patterns that exist in the data, it's very easy to overlook that very old discontinued products which were popular in the past could be served up to users despite their preference for new items that better fit their personal preferences.

- **Scenario:** You deploy a recommendation system based on user interaction data.
- **Problem:** The data includes duplicate entries and irrelevant user interactions but also products that were popular but very old.
- **Overlooked Factor:** Recommendations are not personalized and relevant, leading to user dissatisfaction.
- **Lesson:** Clean data is crucial for effective recommendation systems that enhance user engagement and satisfaction.

Example 4: Classification Business Problem



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6	20000	36 months	9	B2	10+ years	MORTGAGE		Fully Paid	MN	15	10	84		103	9
7	20000	36 months	8	B1	10+ years	MORTGAGE	85000	Fully Paid	SC	18	8	6	13674	6	3
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- **Scenario:** You develop a classification model to identify high-risk loan applicants.
- **Problem:** The training data contains mislabeled entries and missing values.
- **Overlooked Factor:** The model inaccurately biases the classification of applicants based on the wrong features, leading to potential financial losses.
- **Lesson:** Accurate classification models depend on clean, well-labeled data to make reliable predictions.

The Relationship to Data Acquisition and Exploratory Data Analysis (EDA)

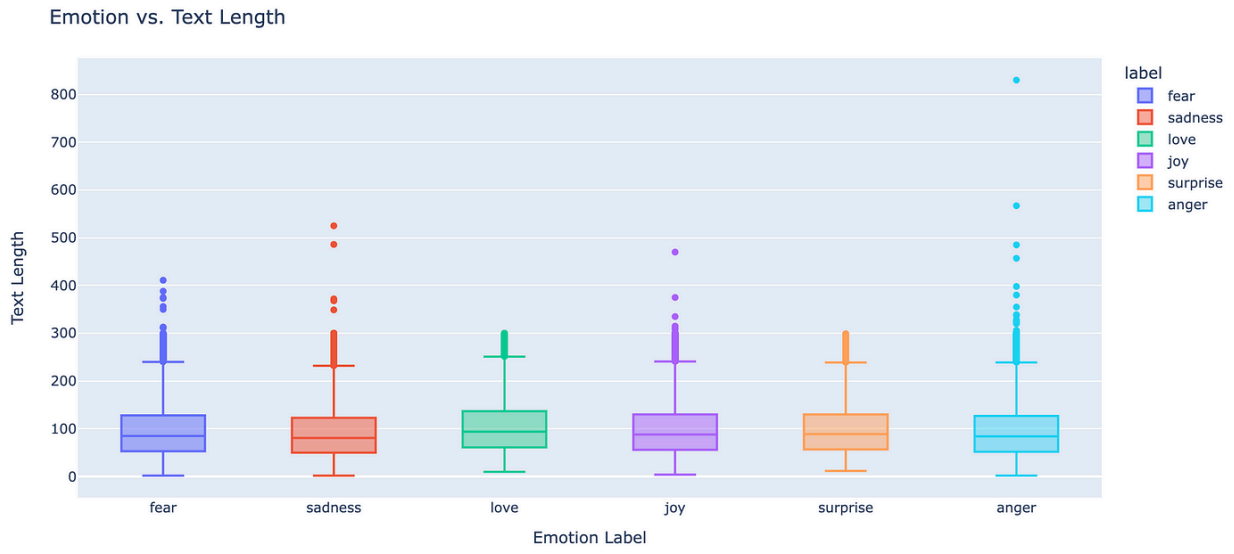
> **Analogy**: Imagine data acquisition as gathering ingredients for a recipe, data cleaning as preparing those ingredients, and EDA as the cooking process where you start combining and understanding the flavors.
>
> **Process Integration**: Clean data from the beginning ensures a smooth transition through the data science lifecycle, allowing EDA to uncover accurate patterns, trends, and relationships. This foundation supports more precise and insightful analysis, ultimately driving better business decisions and outcomes.

By ensuring data quality from the beginning, you set a strong foundation for the entire data science lifecycle, facilitating more accurate analyses and reliable outcomes. This clean data foundation is essential as you move towards more advanced analytics and AI applications, where precision and reliability are paramount.

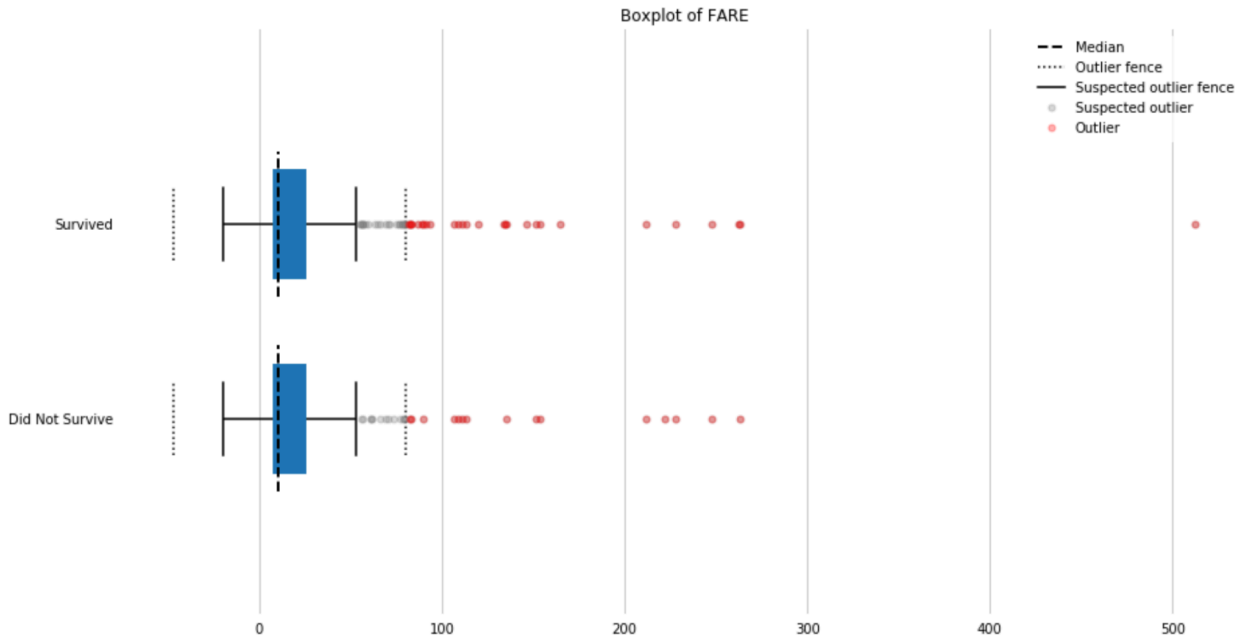
3. Exploratory Data Analysis (EDA): A Business Perspective

Understanding the Importance of EDA

Every machine learning project requires a deep understanding of the data to ensure it accurately represents the problem at hand. This understanding typically takes place during the Exploratory Data Analysis (EDA) phase. EDA is a critical and creative process used to gain insights into the data's characteristics, such as its distribution, outliers, and completeness. This phase is essential for assessing the data's suitability, informing hypothesis generation, and guiding experimentation. Assumptions gained from EDA create the foundation for which types of machine learning work best for the business problems proposed, and set a strong precedent for the scope of developing solutions at scale based on the EDA findings. **Without looking at data, it's impossible to know what's possible with any solution or level of effort required by engineering resources to provide it.**

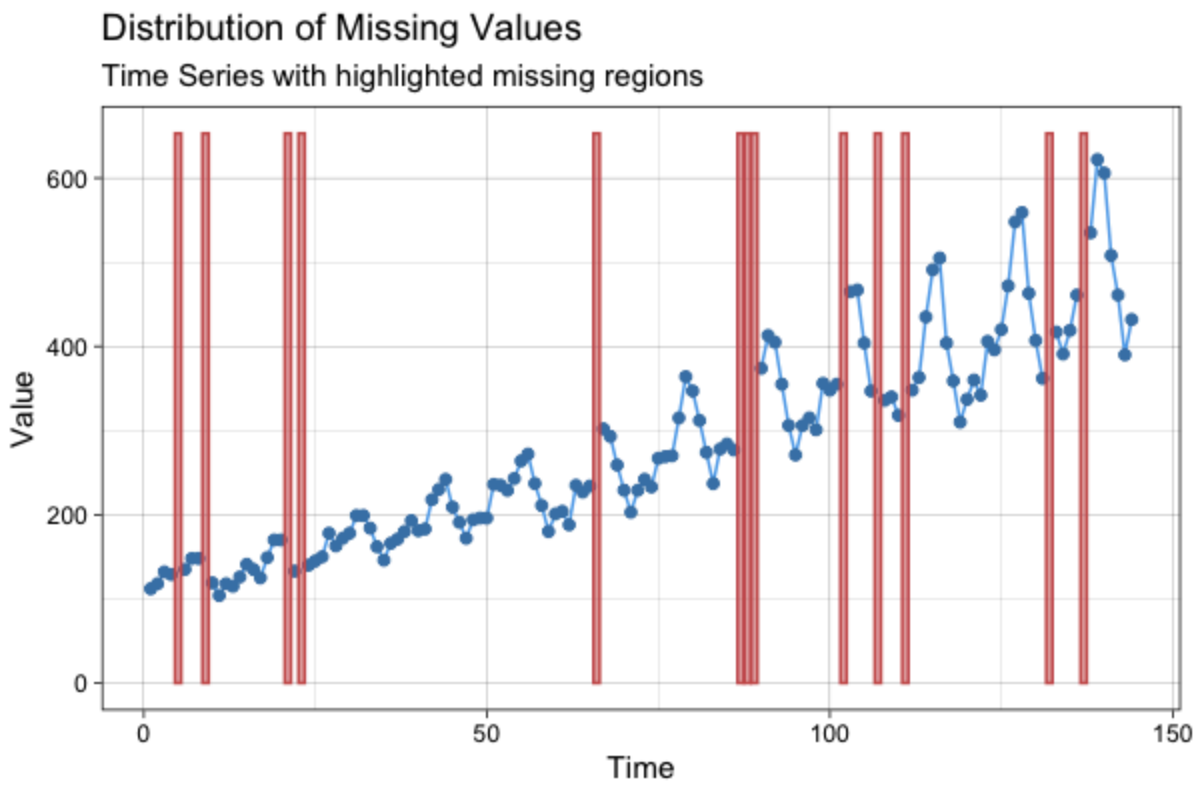


EDA is not just about cleaning data; it's about structuring and understanding it in a way that reveals its relevance to solving specific business problems. Here's how EDA contributes to a successful data science project:



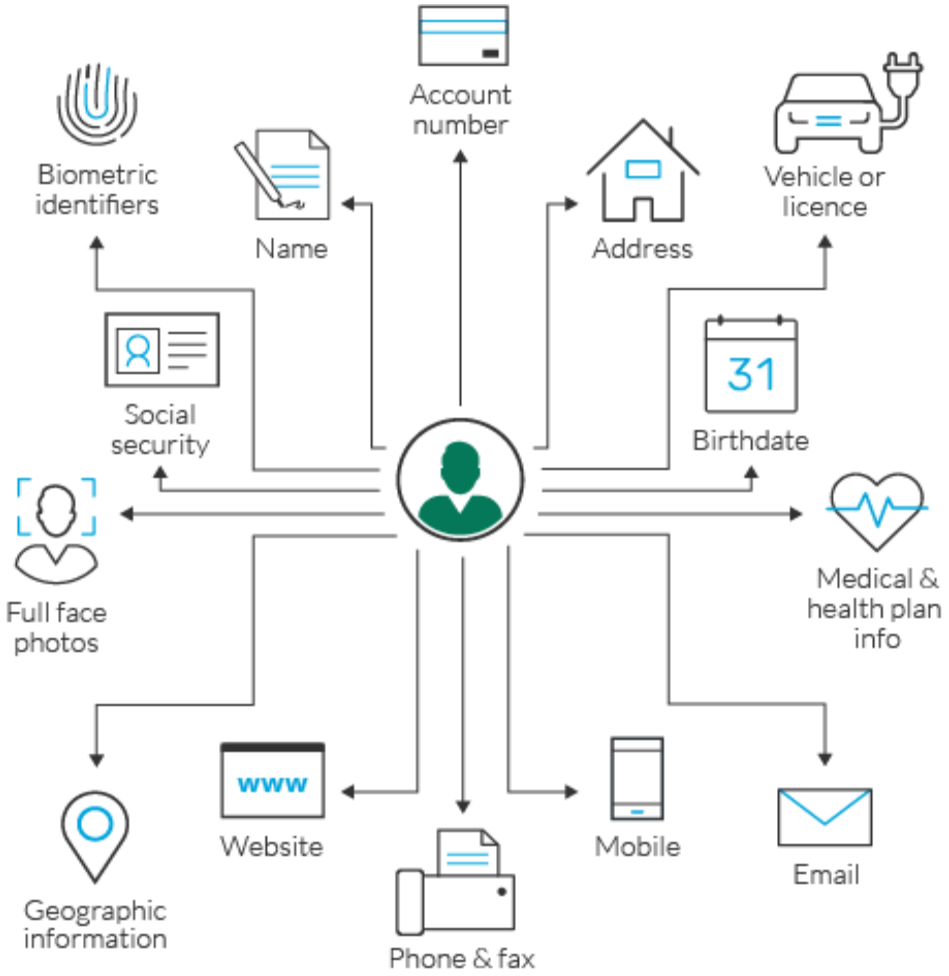
Data Distribution and Outliers

- Understanding the distribution of data helps in identifying patterns and anomalies.
- Detecting outliers is crucial as they can significantly skew the results and affect the performance of machine learning models.



Data Completeness and Relevance

- Assessing data completeness ensures there are no missing values that could compromise the analysis.
- Evaluating the relevance of data helps in determining if it aligns with the business problem being addressed.



PII and Data Security

- Identifying Personally Identifiable Information (PII) is vital to ensure compliance with data privacy laws in some countries and regions.
- Redaction or obfuscation of sensitive data might be necessary to protect privacy and maintain data security.

Why EDA is Essential for Your Business

1. **Informing Strategic Decisions within the Data Science Lifecycle**

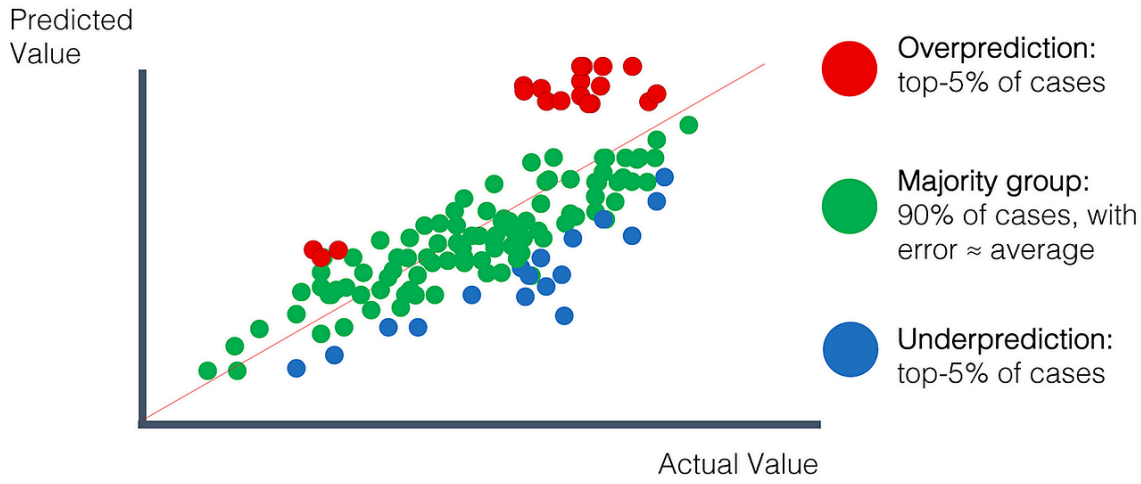
   EDA provides critical insights that help inform strategic business decisions. By understanding the underlying data, businesses can identify trends and patterns that influence how machine learning and AI can work (remember: bad data = bad decisions). This phase helps in setting realistic expectations and defining the scope of the project, ensuring that resources are allocated efficiently.

2. **Reduces Risk and Prevents Unnecessary Work**

   EDA helps identify potential issues early in the data science lifecycle, such as data quality problems or insufficient data volume, which can impede project success. By addressing these issues upfront, EDA reduces the risk of pursuing infeasible projects and prevents unnecessary work. For example, if EDA reveals significant gaps in the data required for a predictive model, the project scope can be adjusted accordingly, or alternative data sources can be explored.

   EDA can also validate potential to align with customer vision. For instance, if a client wanted to create a sophisticated machine learning solution that identifies whether or not certain products featured in social media will go viral or not, but there is limited historical data available on posts, the level of accuracy envisioned by the client may be unachievable. **With EDA, we can test the most basic assumptions about a project before building a complex machine learning solution with heavy data processing workflows of millions of records before diving into a specific solution.**

3. Establishing Reasonable Scope and Identifying Feasibility



Understanding key data patterns ahead of time informs the feasibility of machine learning.

By exploring the data comprehensively, EDA helps establish what is realistically achievable with the available data. This phase allows businesses to scope projects accurately and set feasible goals. For instance, if EDA reveals that certain features are highly predictive of an outcome, the project can focus on these features, ensuring that the machine learning model is both effective and efficient.

4. **Uncovers Opportunities**

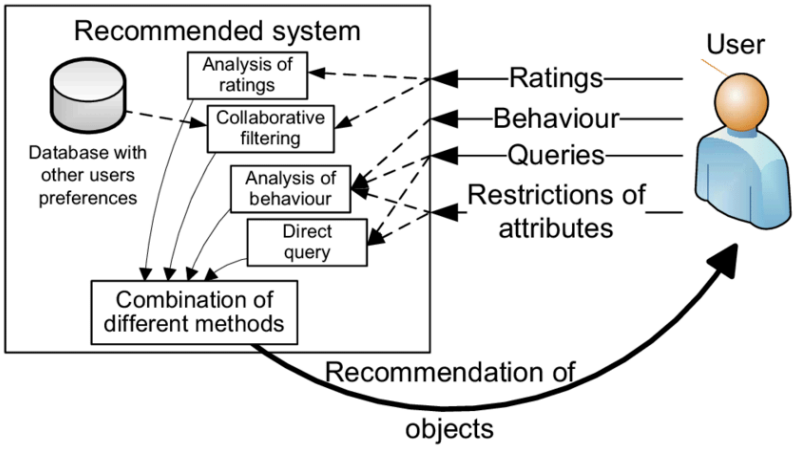
EDA helps uncover hidden opportunities by revealing unexpected trends and correlations in the data. For instance, when we were doing an analysis for Genesys to help pinpoint specific characteristics in survey data, we used EDA to analyze temporal data of when most emails containing a survey were actually read and also opened, uncovering new insights that lead to a new schedule for sending surveys that lead to a 20% improvement to conversion of survey participation.

Practical Examples

Example 1: Sentiment Analysis

Scenario: Your company uses sentiment analysis to gauge customer opinions from social media.
Importance: Clean and preprocess data to accurately reflect customer sentiment, avoiding misguided business strategies.

Outcome: Understand customer sentiment to improve product offerings and customer satisfaction.

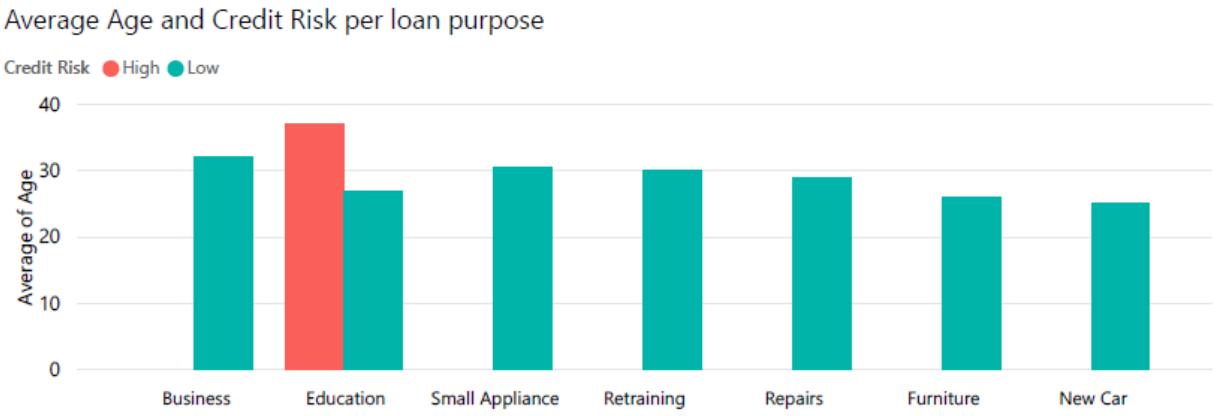


Example 2: Recommendation Systems

Scenario: You deploy a recommendation system based on user interaction data.

Importance: Clean data is crucial for effective recommendation systems that enhance user engagement and satisfaction.

Outcome: We know how many items must be rated before an accurate recommendation can be provided and we have a general idea about what a user prefers as a baseline. Personalized recommendations lead to increased user satisfaction and higher sales.

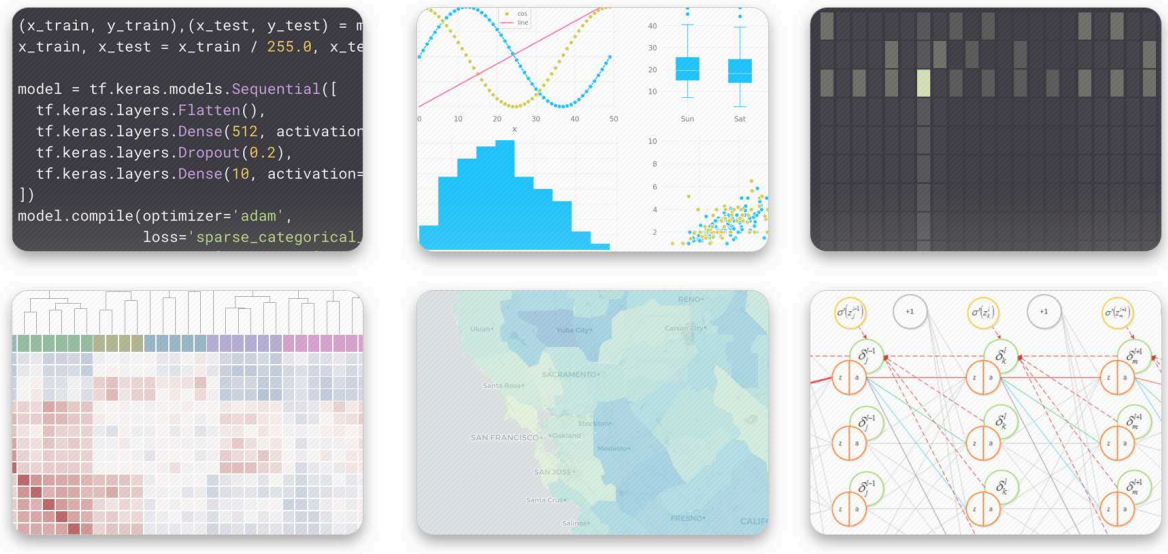


Example 3: Classification Problems:

Scenario: You develop a classification model to identify high-risk loan applicants. Importance: Accurate classification models depend on clean, well-labeled data to make reliable predictions.

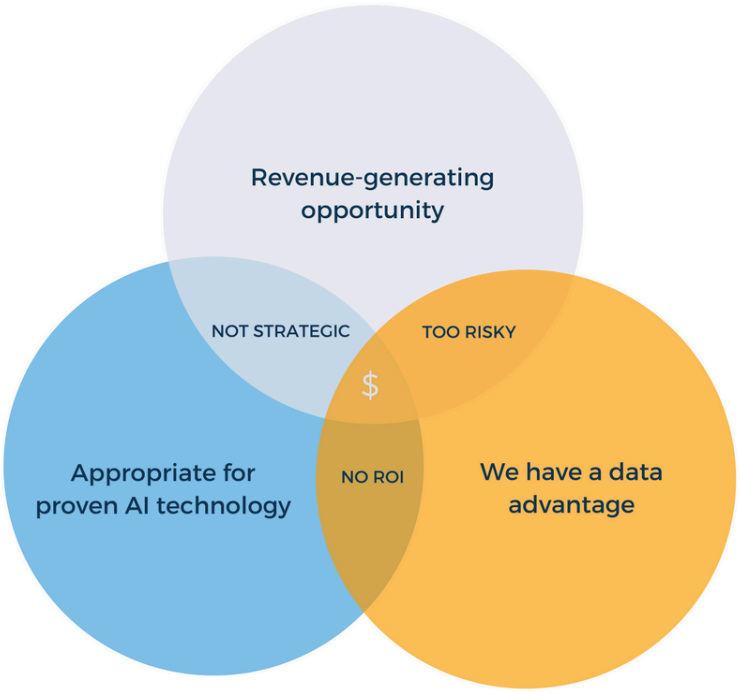
Outcome: Reduce financial risk by accurately identifying high-risk applicants.

Future-Facing Outcomes and Establishing Success Criteria



Building a Strong Foundation for Advanced Analytics

EDA sets the stage for more sophisticated analyses and AI applications by ensuring that the data used is accurate and reliable. Clean data from EDA facilitates the development of robust predictive models, helping businesses stay competitive and innovative.



Establishing Success Criteria

EDA is pivotal in establishing success criteria for any data science project. By understanding the data's characteristics and limitations, businesses can define clear, measurable objectives and success metrics. This ensures that the project's goals are realistic and aligned with business priorities, providing a clear framework for evaluating progress and outcomes.

Key Takeaways:

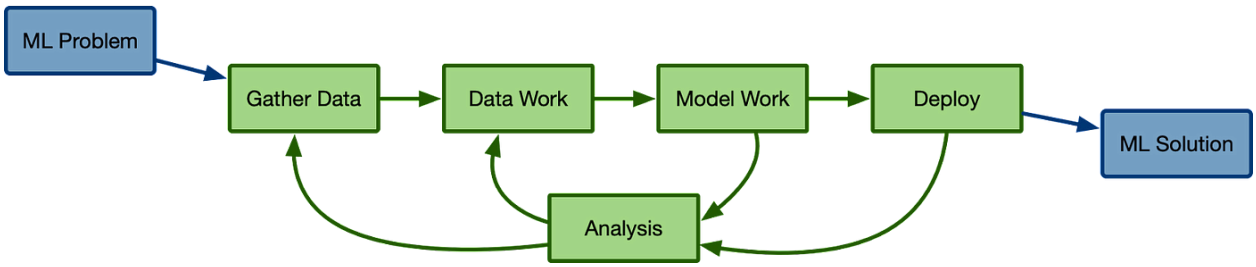
- **EDA not only improves the quality and reliability of data used in machine learning but also helps in setting realistic project scopes, identifying potential risks, and uncovering new opportunities before committing to larger projects.**

- By effectively applying EDA, businesses can ensure that their data science initiatives are well-informed, strategically aligned, and positioned for success.

By understanding and applying EDA effectively, businesses can uncover valuable insights, make informed decisions, and establish clear success criteria, paving the way for successful machine learning projects that drive growth and efficiency. Without EDA, it's impossible to understand scope, risk, or deliver a solution that is high quality and within a predictable timeframe. When working with data at scale, this crucial step helps scope and detail the role of data engineering for data processing requirements and any infrastructure requirements.

4. Overcoming Common Challenges in Data Science Projects

At Yerrington Consulting, we understand that embarking on data science projects can be challenging – but we love challenges. To help you navigate these challenges and achieve successful outcomes, we focus on three key areas: addressing data quality issues, managing stakeholder expectations, and balancing quick wins with long-term value.



Addressing Data Quality Issues

The Importance of Data Quality
High-quality data is critical for the success of any data science project. Poor data quality can lead to inaccurate insights and misguided decisions, ultimately impacting your business outcomes.

Our Approach to Improving Data Quality

1. **Data Cleaning**: We implement rigorous data cleaning processes to remove inaccuracies, fill in missing values, and ensure consistency. Regular audits and validation checks help maintain data integrity.

    - **Example**: For a realestate broker services client, we used automated tools to identify and correct language errors in proposal documents, ensuring accurate and reliable machine learning extraction of financial terms within letters of intent.

2. **Data Standardization**: We establish standardized data formats and definitions across your organization to ensure consistency and compatibility before a project starts.

    - **Example**: For a multinational retailer, we standardized product categories and customer information across all branches, improving data quality and enabling more accurate cross-branch analyses so it was possible to use a wider breadth of data available through their organization.

3. **Data Governance**: We develop and enforce data governance policies that define roles, responsibilities, and processes for maintaining data quality.

    - **Example**: For a healthcare provider, we integrated key project areas to their data stewards for each department to oversee data quality and ensure compliance with their governance policies.

Managing Stakeholder Expectations

Clear Communication

Setting realistic goals and providing regular updates are essential for managing stakeholder expectations. This ensures everyone is aligned and understands the project's potential and limitations. With EDA, we ensure that the data we collect is aligned with our customers expectations before engaging on any machine learning or AI project.

Our Strategies for Effective Communication

1. **Realistic Goal Setting**: We clearly communicate the potential and limitations of data science projects to stakeholders. Setting realistic expectations from the outset helps prevent misunderstandings and ensures stakeholder buy-in and avoid **confirmation bias**.

    - **Example**: During a project kickoff meeting, we explained to executives at a client firm that while the new predictive model could significantly improve sales forecasts, it would not be 100% accurate due to inherent uncertainties in the data that were uncovered during EDA.

2. **Regular Updates**: We provide regular progress updates to stakeholders via our own project management platform, highlighting key milestones, successes, and any challenges encountered. It's highly recommended that the client attends these meetings and provides prompt feedback.

    - **Example**: A project manager at Yerrington Consulting sends bi-weekly reports to stakeholders detailing the progress of a machine learning project, including completed tasks, upcoming milestones, and any issues that need addressing.

Engaging Stakeholders

Involving stakeholders early and demonstrating the value of data science initiatives are crucial for gaining their support and ensuring project success. As we kick projects off, it's necessary to ensure that the success criteria of the project is possible but also quantifiable.

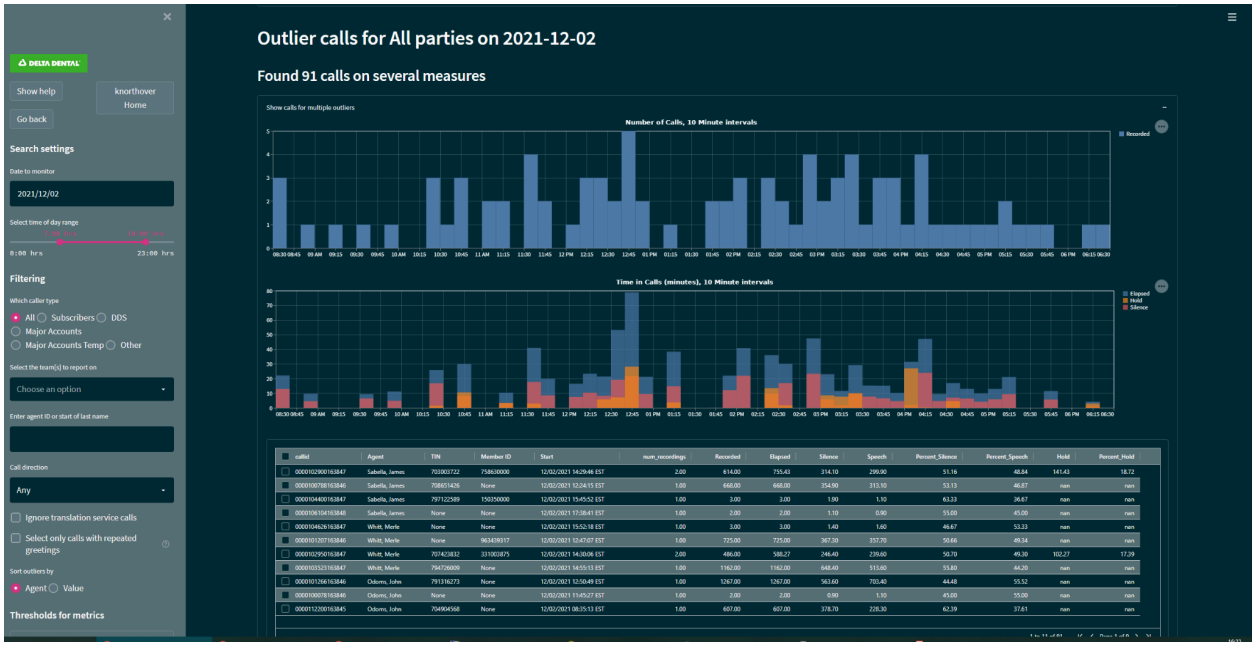
Our Approach to Stakeholder Engagement

Involve Stakeholders Early: We engage stakeholders early in the project to gather their input and ensure their needs and expectations are understood.

> **Example**: We held workshops with marketing, finance, and operations departments at a client company to understand their requirements and incorporate their feedback into the project plan.

Demonstrate Value: We use pilot projects or prototypes to demonstrate the value of data science initiatives to stakeholders. Showcasing quick wins can build confidence and support for larger projects.

> **Example**: Before deploying a full-scale recommendation system, we developed a prototype that demonstrated its potential impact on sales and customer satisfaction, gaining stakeholder approval for further investment.



Prototyping an ML-powered application on a small scale using open source frameworks like Streamlit are useful for rapidly prototyping a client idea before committing to a larger project to ensure use cases are achievable at a smaller scale as part of an EDA process.

Balancing Quick Wins with Long-Term Value

Achieving Short-Term Success
Starting with small, manageable projects that deliver quick wins can provide immediate value and build momentum for larger initiatives.

Our Strategy for Quick Wins

1. **Pilot Projects**: We begin with pilot projects that can deliver quick wins, providing immediate value and building momentum.

    - **Example**: For a geologist client, we started with a pilot project to optimize a single machine learning tool to help identify and visualize specific weather anomalies, achieving significant cost savings and demonstrating the potential of broader implementation.

2. **Incremental Improvements**: We focus on making incremental improvements that show tangible results, rather than attempting to achieve everything at once.

    - **Example**: For a Genesys, a fortune 500 company, we gradually enhanced a sentiment solution first improving their ability to quickly find trends in their current data for a few key products, then gradually expanding the solution to their entire product range.

Building Long-Term Value

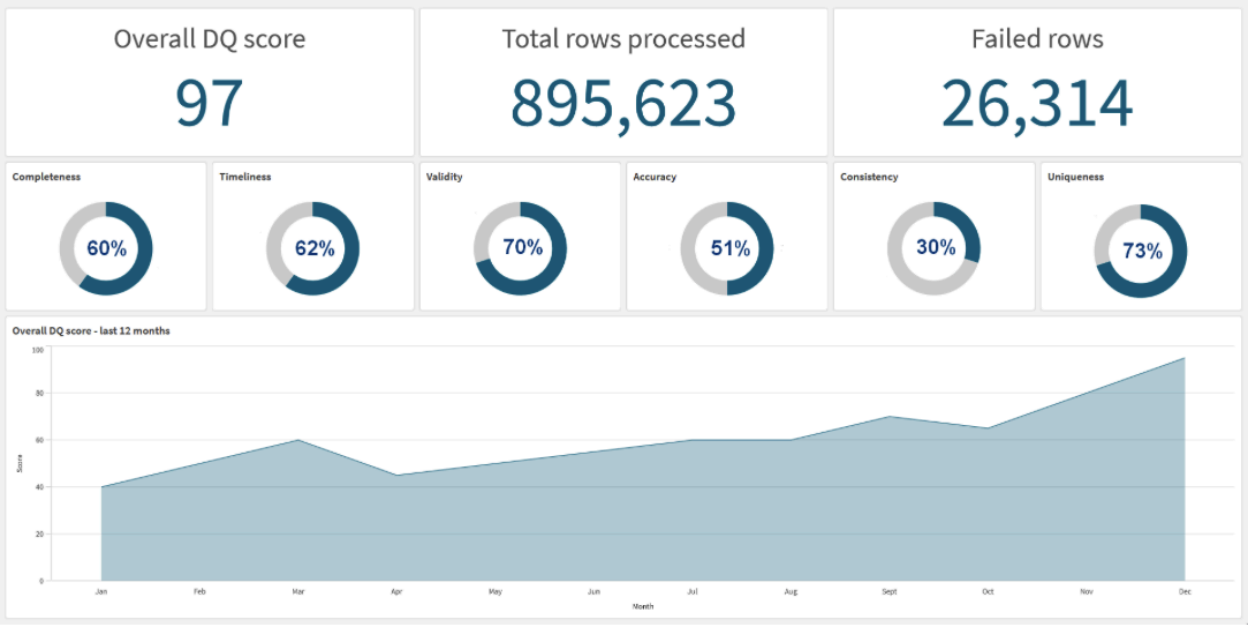
We ensure that quick wins are part of a sustainable strategy that aligns with your long-term business objectives.

Our Approach to Long-Term Success

1. **Strategic Roadmap**: We develop a strategic roadmap that outlines the long-term vision for data science initiatives, including key milestones and goals.

    - **Example**: For a private finance company brokering USDA loans, we created a five-year data science roadmap that included goals for improving their ChatGPT costs, reducing operational costs through better data workflow management, and enhancing targeted customer outreach through improved CRM integration.

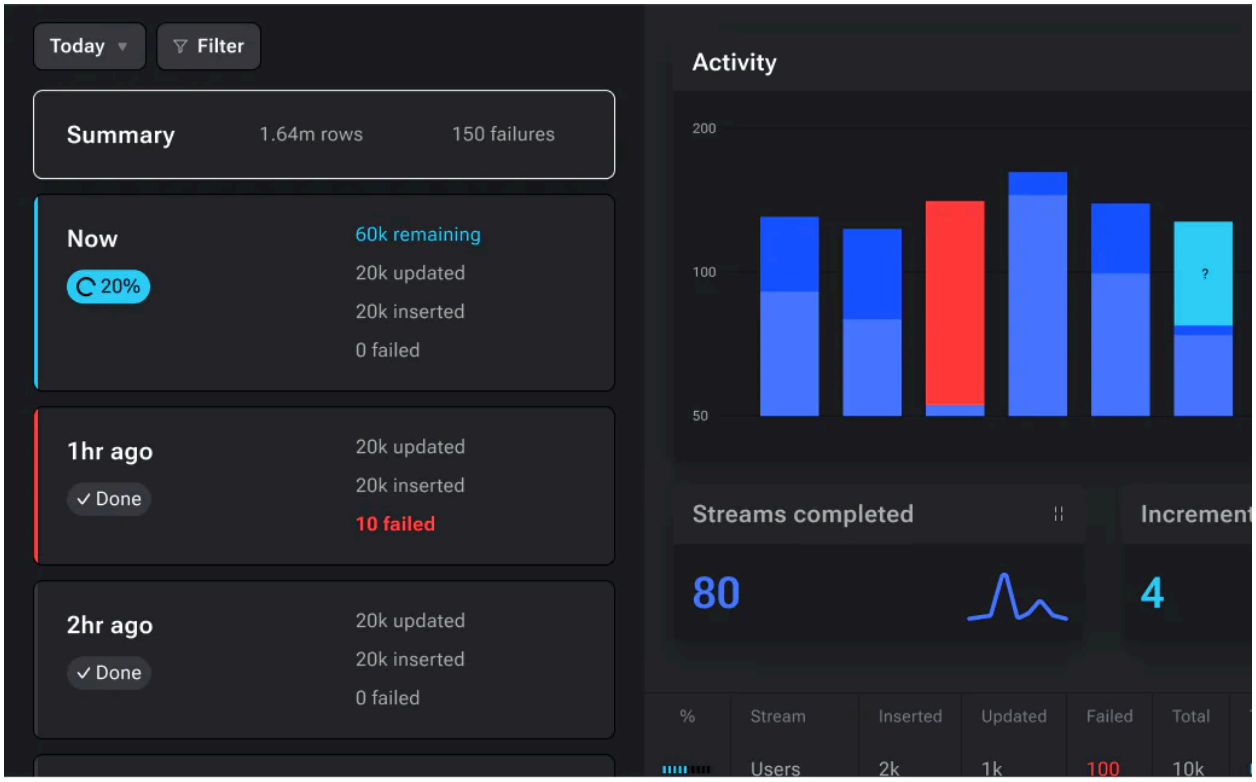
2. **Sustainable Practices**: We ensure that quick wins are part of a sustainable strategy that aligns with your long-term business objectives.



    - **Example**: For a games analytics company, we implemented a data quality evaluation process that not only delivered immediate results as part of an EDA evaluation but was also scalable and adaptable to their existing ETL processes on Google Cloud Platform to help quickly identify data issues and scope their engineering engagements with new clients.

Ensuring Integration and Scalability

We design solutions with scalability in mind to ensure they can grow and adapt with your organization.

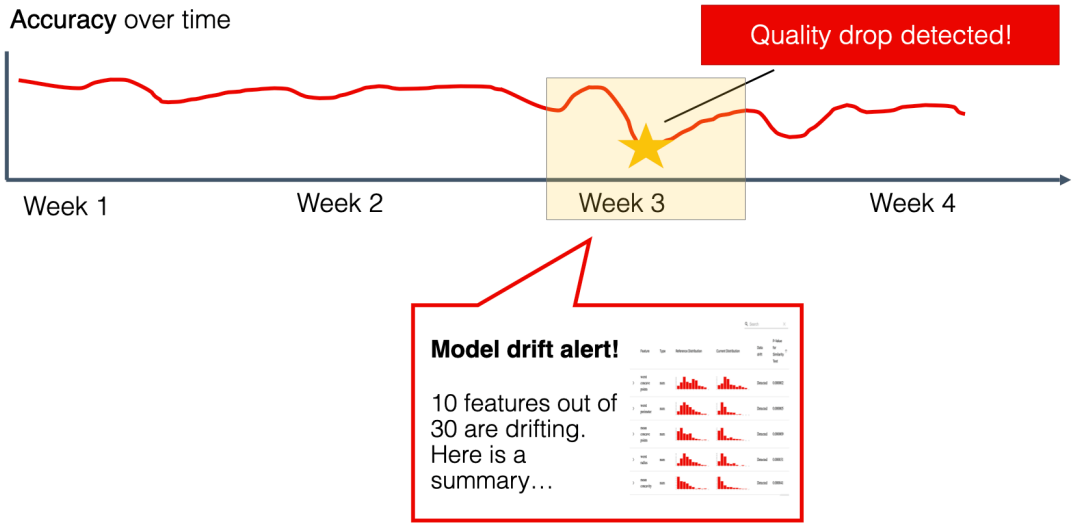


We standardize on MageAI for data processing which has excellent support for actualizing machine learning and data workflows.

Our Scalability Solutions:

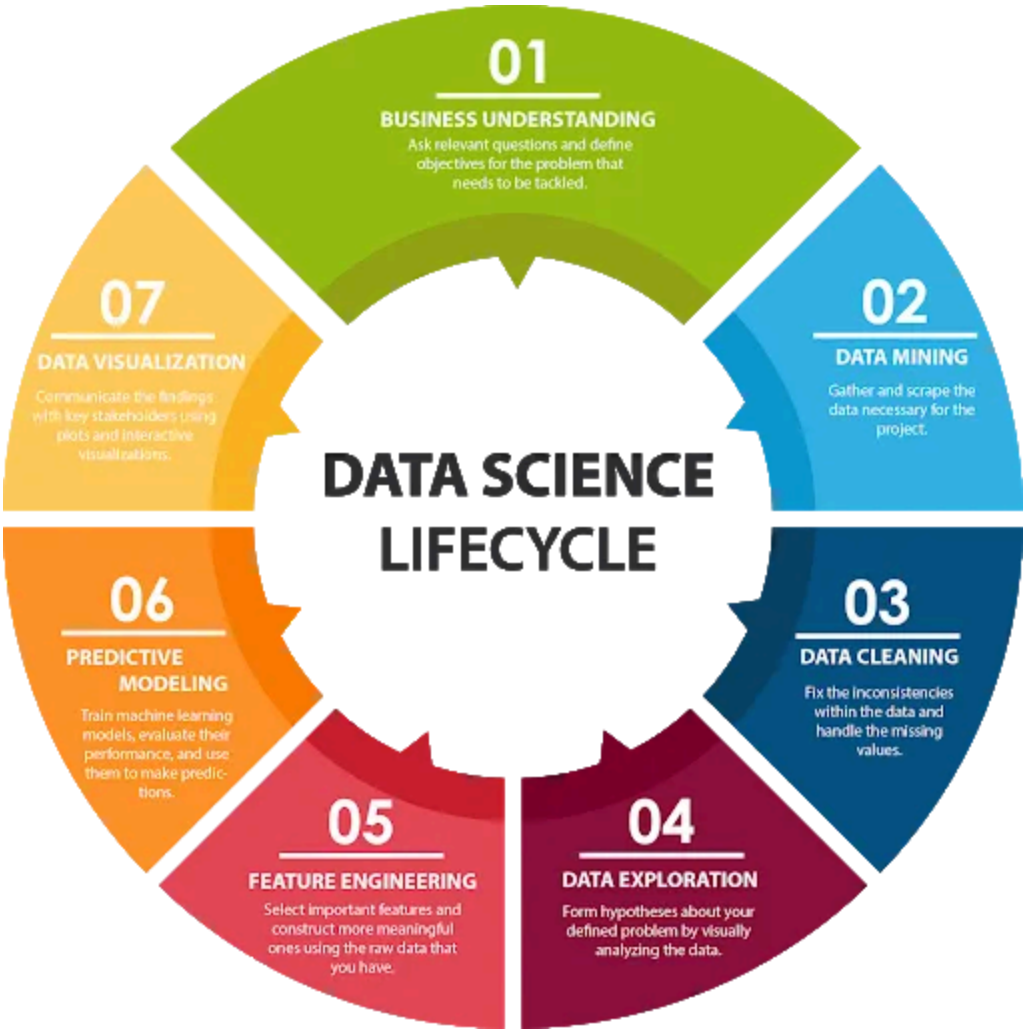
- **Scalable Solutions**: We design solutions with scalability in mind to ensure they can grow and adapt with your organization. Since each problem is unique, our approach should also be unique to your business.

- **Continuous Improvement**: We foster a culture of continuous improvement where data science initiatives are regularly evaluated and refined based on feedback and performance metrics.



By addressing data quality issues, managing stakeholder expectations effectively, and balancing quick wins with long-term value, Yerrington Consulting helps you overcome common challenges in data science projects. This approach ensures sustained success and continuous improvement in leveraging data for strategic advantage.

5. Conclusion



EDA is just one part of the data science lifecycle that can be revisited at any stage of a data science project to substantiate evidence and reasoning for insights, product features, or even engineering scope for future ideas. EDA is ***data exploration*** *but with a specific focus and intent on business objectives.*

Summary of Key Points

As we've explored throughout this document, the data science lifecycle and the role of Exploratory Data Analysis (EDA) are pivotal in driving successful data science projects. By understanding and applying these concepts, businesses can unlock the full potential of their data, make informed decisions, and achieve measurable outcomes. Here are the key takeaways:

1. **Data Science Lifecycle**: From problem definition to data collection, cleaning, and EDA, each step in the data science lifecycle plays a critical role in ensuring project success.

2. **EDA Enhances Decision-Making**: EDA provides essential insights that inform strategic decisions, reduce risks, and uncover opportunities, setting the foundation for effective machine learning and AI applications.

3. **ROI of Data Science and EDA**: Investing in data science and EDA delivers significant returns by improving efficiency, driving growth, and providing a competitive edge. EDA helps us understand the potential to work with machine learning but also the cost/benefit of scaling ideas after they have been effectively prototyped.

4. **Overcoming Challenges**: Addressing data quality issues, managing stakeholder expectations, and balancing quick wins with long-term value are crucial for navigating common challenges in data science projects.

Points of Contact and Support Resources

For more information or to get started with our services, please reach out to us:

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We also provide additional resources and support materials to help you navigate your data science journey so if there's a specific topic within data science you're curious about, let us know.

Tip: It's important to give your opinion! Would you recommend this document to someone else? Why or why not?