Business Solutions for Austen Bank using EDA

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1. Introduction and Project Plan

1.1 Purpose and Context:

Consumer banking institution S&S Austen Bank approaches its century of operations in UK markets as it seeks to enhance data analytics function for its strategic business expansion. This report conducts an evaluation of three S&S Austen Bank branches operating in Cardiff and Oxford and Edinburgh. The main objectives are:

- Strategic analysis will determine which of the three branches holds better potential for expansion through observing both customer numbers and deposit volumes.
- The performance evaluation of savings services needs to be analysed for developing marketing strategies.
- The 2023 renovation of Oxford branch gets analysed for its effects on deposit performance in the institution.

1.2 Project Plan:

The model development followed CRISP-DM methodology which represents a universal approach in the field of data mining (CRISP-DM Consortium, 2000.

1. During the business understanding phase stakeholders joined the project to identify Bank challenges related to market competition.
2. The data understanding phase required me to analyse datasets from various branches to find important patterns and trends.
3. The Pandas library of Python enabled data cleaning through standardization of format and shifting of null values and duplicate record filters in the data preparation phase.
4. Exploratory data analysis (EDA) served as the main tool in modeling and analysis to gain better insights into branch-level deposit behaviour and service usage patterns.
5. The evaluation step checked to confirm the outcomes matched with essential objectives of the study.
6. The final step of deployment combined all collected information into practical business suggestions.

1.3 Value of Data Analytics:

The data processing system employed Python version 3.9 as per Python Software Foundation (2023). It utilized pandas (McKinney, 2010) to handle data processing and matplotlib (Hunter, 2007) and seaborn (Waskom et al., 2021) for visualizations. The analytics delivery at S&S Austen Bank operates as follows:

- Evidence-based decision-making through KPIs like deposit value per customer and service-specific metrics.
- Operational efficiency via predictive modeling and machine learning for customer retention. Together with segmentation analysis and A/B testing the company conducts targeted marketing campaigns.
- Real-time transaction data and geographic data combined through expert-based expansion strategies form the bank's business growth approach.

2. Data Quality Issues and Remedies
2.1 General Challenges:

Initial data exploration revealed:

- Missing values in deposit and customer fields.
- Inconsistent formats (dates, currency, text).
- Duplicate records inflating metrics.

Integration problems persist because of inconsistencies between areas that use different systems across the regions.

2.2 Specific Issues:

The Pandas library from Python allowed standardization processes to become more efficient (McKinney, 2017).

- By using datetime standards, I was able to fix issues with date formats.
- The program used column median values as replacements for numeric values which either did not exist or were missing from the dataset.
- String matching algorithms corrected misspellings of service categories which fall under categorical anomalies.
- Standard deviation techniques helped identify abnormal data points which went through manual examination.

2.3 Remedial Actions:

2.2 Specific Issues:

Python's Pandas library streamlined data standardization (McKinney, 2017):

- Date format variations resolved via datetime standardization.
- Missing/negative numeric values imputed with column medians.
- Categorical anomalies (e.g., misspelled service categories) corrected through string matching.
- Outliers flagged using standard deviation and manually verified.

2.3 Remedial Actions:

The statistical imputation method addressed missing values in alignment with data quality principles as described by Redman (2016).

- The database maintains uniformity through standardization practices for date formats along with currency formats and all fields use standard text conventions.
- Statistical imputation techniques filled in all missing along with negative values within the datasets.

Manual review procedures verified the validity of real outliers before retention.

3. Data Analysis and Commentary:

We present numerical findings derived from **analysing** the cleaned dataset in this following part. The analysis proceeded through the execution of data analysis functions enabled by Python libraries. The article reviews essential tables alongside their acquired findings in detail.

3.1 Overall Performance by Month and Year

Table 1: Total Customer Volume and Deposit Value by Month and Year

Explanation:

This table presents a month-by-month breakdown of total customer volume and deposit value over a three-year period.

Month	Year	Customer Volume	Deposit Value (£000)
1.0	2021.0	1305.0	4098.25
1.0	2022.0	1265.0	4152.25
1.0	2023.0	1434.0	4117.75
2.0	2021.0	1419.5	3465.5
2.0	2022.0	1387.0	4370.25
2.0	2023.0	1393.0	4501.25
3.0	2021.0	1623.0	5125.75
3.0	2022.0	1546.5	5213.25
3.0	2023.0	1659.5	5097.75
4.0	2021.0	1746.0	6256.5
4.0	2022.0	1961.0	6120.0
4.0	2023.0	2068.5	6342.75
5.0	2021.0	1482.0	4937.75

5.0	2022.0	1587.5	5014.25
5.0	2023.0	1752.0	5210.25
6.0	2021.0	1572.5	5172.75
6.0	2022.0	1618.5	5742.75
6.0	2023.0	1799.4559999999997	5859.1939999999995
7.0	2021.0	1788.0	5452.5
7.0	2022.0	1783.0	6223.0
7.0	2023.0	2127.457999999999	7092.641999999997
8.0	2021.0	1845.5	5976.25
8.0	2022.0	2010.0	5810.5
8.0	2023.0	2449.6059999999984	7773.293999999994
9.0	2021.0	1483.0	4173.0
9.0	2022.0	1482.0	5294.25
9.0	2023.0	1822.8099999999981	5568.849999999995
10.0	2021.0	1519.0	4777.25
10.0	2022.0	1648.5	5313.0
10.0	2023.0	1836.7319999999977	5771.345999999993
11.0	2021.0	1452.0	4954.25
11.0	2022.0	1775.5	5268.0
11.0	2023.0	2016.8019999999972	6377.861999999991
12.0	2021.0	1711.0	4898.5
12.0	2022.0	1685.5	5883.0

| 12.0 | 2023.0 | 1818.3279999999968 | 5979.6719999999905 |

Key Insights:

Seasonal Trends:

- *The analysis shows that deposit values grow steadily throughout mid-year months including June through August.*
- *The cyclic variation indicates that customers' seasonal conduct and financial pattern cycles including mid-year bonuses and tax returns and business cash flow management likely drive the trend.*

Growth Indicators:

- *The banking institution shows consistent value growth throughout each year though customer numbers demonstrate small oscillations.*
- *The bank shows improvement in its overall financial performance within a competitive banking environment when looking at these trends.*

Volume vs. Value Analysis:

- *Data shows growing customer deposit values because people are putting increased sums of money into their accounts individually.*
- *The deposit values rise potentially because of improved quality in savings products or improved customer confidence in the bank's financial services.*

Key Takeaways (Bullet Points):

- *The bank's deposit values show significant growth during the months in between mid-year indicating seasonal financial patterns.*
- *Overall deposit values maintain a continuous upward rise which indicates strong financial development.*
- *The institution should explore ways to optimize customer volume strategies which will enhance acquisition results alongside engagement outcomes.*

3.2 Benchmark Comparisons by City

Table 2: Quarterly Performance by City

Explanation:

This table provides a side-by-side comparison of key performance metrics for the branches in Cardiff, Oxford, and Edinburgh on a quarterly basis.

City bank branch	Quarter	Year	Customer Volume	Deposit Value (£000)
Cardiff	1	2021	61.361111111111114	161.33333333333334
Cardiff	1	2022	49.7222222222222	183.44444444444446
Cardiff	1	2023	66.5	184.52777777777777
Cardiff	2	2021	62.7222222222222	218.97222222222223
Cardiff	2	2022	64.61111111111111	181.88888888888889
Cardiff	2	2023	75.11111111111111	214.0
Cardiff	3	2021	67.2222222222223	212.63888888888889
Cardiff	3	2022	59.666666666666664	225.27777777777777
Cardiff	3	2023	72.05555555555556	232.5
Cardiff	4	2021	57.44444444444444	196.25
Cardiff	4	2022	59.27777777777778	182.97222222222223
Cardiff	4	2023	66.27777777777777	191.94444444444446
Edinburgh	1	2021	69.94444444444444	223.08333333333334
Edinburgh	1	2022	78.63888888888889	230.375
Edinburgh	1	2023	75.97222222222223	244.45833333333334
Edinburgh	2	2021	82.61111111111111	306.6388888888889

Edinburgh	2	2022	94.69444444444	329.1666666667
Edinburgh	2	2023	103.80555555556	312.25
Edinburgh	3	2021	88.13888888889	245.84722222223
Edinburgh	3	2022	102.11111111111	318.2638888889
Edinburgh	3	2023	107.0	354.5416666667
Edinburgh	4	2021	90.05555555556	267.6388888889
Edinburgh	4	2022	98.4722222223	303.6388888889
Edinburgh	4	2023	94.08333333333	283.2361111111
Oxford	1	2021	110.22222222223	320.55555555554
Oxford	1	2022	104.88888888889	349.27777777777
Oxford	1	2023	106.77777777777	333.05555555554
Oxford	2	2021	121.36111111111	383.6666666667
Oxford	2	2022	127.75	426.55555555554
Oxford	2	2023	133.3031111111	441.0941111111
Oxford	3	2021	128.88888888889	408.27777777777
Oxford	3	2022	131.27777777777	419.1111111111
Oxford	3	2023	176.49299999999977	548.2242222222216
Oxford	4	2021	112.61111111111	348.8888888889
Oxford	4	2022	126.11111111111	428.05555555554
Oxford	4	2023	154.74233333333288	531.979444444443

Key Insights:

- *Deposits at Oxford's branch experienced substantial value increases because of its 2023 facility update and expanded operations which made it excel above other locations.*
- *Cardiff and Edinburgh branches maintain stable performance levels because their markets demonstrate solid customer establishment and minimal available opportunity.*
- *Other city branches could potentially experience similar growth because of the proven success in Oxford.*

Key Takeaways (Bullet Points):

The Oxford store shows superior performance since the recent renovation work.

- *Cardiff and Edinburgh exhibit steady, reliable trends.*

The potential benefits of using Oxford's strategies must be evaluated to expand their application across company branches.

3.3 Service Category Performance

Table 3: Performance of Savings Service Categories

Explanation:

This table details the performance of the bank's different savings services by quarter, comparing customer volume and deposit value across product lines such as current accounts, money savings accounts, bonds savings accounts, certificates of deposit, children's savings accounts, and ISAs (Porter & Heppelmann, 2015).

Service category	Quarter	Year	Customer Volume	Deposit Value (£000)
Bonds savings accounts	1	2021	87.22222222222223	212.72222222222223
Bonds savings accounts	1	2022	97.38888888888889	215.02777777777777
Bonds savings	1	2023	91.5	203.97222222222223

			accounts	

			accounts	
Bonds savings accounts	2	2021	94.88888888888889	302.4444444444446
Bonds savings accounts	2	2022	108.5	285.0
Bonds savings accounts	2	2023	136.94799999999998	326.81444444444446
Bonds savings accounts	3	2021	97.27777777777777	266.52777777777777
Bonds savings accounts	3	2022	117.38888888888889	309.6388888888889
Bonds savings accounts	3	2023	143.53866666666656	383.1799999999997
Bonds savings accounts	4	2021	96.11111111111111	263.5
Bonds savings accounts	4	2022	102.05555555555556	275.1666666666667
Bonds savings accounts	4	2023	119.07911111111093	284.6422222222218
Certificates of deposit	1	2021	50.0	210.0
Certificates of deposit	1	2022	34.05555555555556	234.38888888888889
Certificates of deposit	1	2023	39.2222222222222	231.0
Certificates of deposit	2	2021	46.2222222222222	253.33333333333334

Certificates of deposit	2	2022	54.666666666666664	247.66666666666666
Certificates of deposit	2	2023	59.999111111111105	272.99555555555554
Certificates of deposit	3	2021	48.666666666666664	236.0
Certificates of deposit	3	2022	44.888888888888886	284.22222222222223
Certificates of deposit	3	2023	69.84422222222219	303.7766666666664
Certificates of deposit	4	2021	48.05555555555556	232.72222222222223
Certificates of deposit	4	2022	51.611111111111114	208.16666666666666
Certificates of deposit	4	2023	63.488888888888795	301.5555555555551
Children's savings accounts	1	2021	31.72222222222222	154.66666666666666
Children's savings accounts	1	2022	35.55555555555556	180.88888888888889
Children's savings accounts	1	2023	30.666666666666668	184.88888888888889
Children's savings accounts	2	2021	37.55555555555556	195.22222222222223
Children's savings accounts	2	2022	42.72222222222222	171.0
Children's	2	2023	29.906666666666663	224.99555555555557

savings accounts				
Children's savings accounts	3	2021	38.111111111114	174.55555555554
Children's savings accounts	3	2022	42.833333333336	233.2222222223
Children's savings accounts	3	2023	42.6213333333	229.6168888887
Children's savings accounts	4	2021	30.6111111111	193.55555555554
Children's savings accounts	4	2022	42.166666666664	218.1111111111
Children's savings accounts	4	2023	49.26577777772	207.5946666663
Current accounts	1	2021	138.33333333334	526.222222222
Current accounts	1	2022	134.72222222223	559.222222222
Current accounts	1	2023	155.72222222223	575.0
Current accounts	2	2021	173.16666666666	692.5555555555
Current accounts	2	2022	179.5	723.1111111111
Current accounts	2	2023	174.35555555555	659.4222222222
Current accounts	3	2021	175.05555555554	703.4444444445

Current accounts	3	2022	171.22222222222223	705.0
Current accounts	3	2023	221.275111111111	859.2115555555552
Current accounts	4	2021	149.55555555555554	577.7777777777778
Current accounts	4	2022	177.83333333333334	699.1111111111111
Current accounts	4	2023	183.39066666666642	736.3404444444435
Individual savings account	1	2021	100.5	178.55555555555554
Individual savings account	1	2022	88.83333333333333	193.11111111111111
Individual savings account	1	2023	103.38888888888889	192.0
Individual savings account	2	2021	109.33333333333333	201.77777777777777
Individual savings account	2	2022	105.88888888888889	296.55555555555554
Individual savings account	2	2023	134.78444444444443	250.7911111111111
Individual savings account	3	2021	117.5	201.77777777777777
Individual savings account	3	2022	111.55555555555556	215.77777777777777
Individual	3	2023	149.8742222222221	278.52622222222203

savings account				
Individual savings account	4	2021	122.0	205.2222222222223
Individual savings account	4	2022	112.16666666666667	235.33333333333334
Individual savings account	4	2023	123.49266666666647	282.8742222222219
Money savings accounts	1	2021	75.27777777777777	127.77777777777777
Money savings accounts	1	2022	75.94444444444444	143.55555555555554
Money savings accounts	1	2023	78.0	137.2222222222223
Money savings accounts	2	2021	72.2222222222223	173.2222222222223
Money savings accounts	2	2022	82.83333333333333	151.88888888888889
Money savings accounts	2	2023	88.44577777777778	199.66933333333333
Money savings accounts	3	2021	91.88888888888889	151.2222222222223
Money savings accounts	3	2022	98.2222222222223	177.44444444444446
Money savings accounts	3	2023	83.9435555555555	216.2204444444433
Money savings accounts	4	2021	73.88888888888889	152.77777777777777

Money savings accounts	4	2022	81.88888888888889	193.44444444444446
Money savings accounts	4	2023	91.48977777777765	201.3128888888886

Key Insights:

- ***High-Value Services:***
  - *The Money Savings Account deposits have grown steadily since Q1 2021 to achieve a value of £201.31k in Q4 2023.*
  - *The deposits in Individual Savings Accounts maintain a steady pattern of growth starting from £178.56k during Q1 2021 and reaching £282.87k by Q4 2023.*
  - *These accounts provide sophisticated marketing prospects because they yield substantial deposit quantities for their number of customers.*

- ***Volume Considerations:***
  - *Current Accounts demonstrate the highest number of customers who increased from 138 in Q1 2021 to reach 221 customers in Q3 2023.*
  - *Each savings account deposit maintains lower values than what savings accounts provide per individual customer.*
  - *These customer-facing accounts serve well as contact points between financial institutions and clients but produce limited results for deposit-driven marketing initiatives.*

- ***Balanced Growth Strategy:***
  - *The analysed information suggests companies should move financial resources from Current Accounts towards Money Savings Accounts and ISAs for better returns.*
  - *New deposits within Bonds Savings Accounts and Certificates of Deposit maintain consistent growth patterns which points towards suitable moderate growth potential.*

Key Takeaways (Bullet Points):

- The deposit metric reveals that Money Savings Accounts and ISAs perform as high-performing products which bring strong increases in customer deposits.
- Current Accounts draw in many clients although each of them deposits less money into their accounts.
- Existing data reveals that promotional efforts should concentrate on financial services that produce higher returns for customers.
- Organizations should prioritize their resources against products leading to increased deposit value growth to maximize financial returns.

3.4 Exploratory Data Analysis (Summary Calculations):

Explanation:

The data shows different service categories performing based on customer volume and deposit values through this table. The table reports summary data consisting of average customer volume statistics together with total customer volume data, standard deviation values for customer volume and deposit value statistics.

Table 4: Service Category Performance Summary:

Service Category	Avg Customer Volume	Total Customer Volume	Std Customer Volume	Avg Deposit Value	Total Deposit Value	Std Deposit Value
Current accounts	169.511037	18307.192	60.813496	668.034889	72147.768	239.483579
Bonds savings accounts	107.658259	11627.092	44.873779	277.386389	29957.73	137.13502
Certificates of deposit	50.893426	5496.49	24.956812	251.318981	27142.45	104.553368
Individual	114.943167	12413.862	41.79494	227.691889	24590.724	105.489622

savings account						
Children's savings accounts	37.811519	4083.644	18.924485	197.359852	21314.864	89.458972
Money savings accounts	82.837148	8946.412	35.154772	168.813185	18231.824	80.068405

Key Insights:

- *Current Accounts hold the most customers yet show significant diversity in customer deposit amounts (£239.48 Std Deposit Value).*
- *Customers draw to strong deposit values in Bonds Savings Accounts and Certificates of Deposit because they seek higher returns.*
- *Individual Savings Accounts (ISAs) establish themselves through stable performance which makes them suitable for dependable deposits and account accessibility by customers.*
- *The Children's Savings Account presents the least customer engagement indicating promotional campaigns should be considered to build user base.*
- *Money Savings Accounts demonstrate minimal change in customer deposits which implies their deposits remain stable across the customer base.*

Key Takeaways (Bullet Points):

- *The financial institution should direct its promotional activities toward Bonds Savings as well as Certificates of Deposit and ISAs because these products attract larger deposit amounts from customers.*
- *Financial products should be cross promoted through Current Account systems because this bank segment possesses numerous potential customers.*
- *Children's Savings Accounts need promotional tactics to strengthen consumer interaction and boost saving amounts.*

- *Income generation efforts must concentrate on products displaying high deposit value expansion since they ensure long-term financial balance.*
- *The financial stability of the institution will benefit from increased Money Saving Account deposits among lower-performing portfolio positions.*

4. Data Charting and Commentary

Would-be insights into complex data sets are better revealed through visual data displays rather than numerical data alone. I employed the visualization tools from the Python ecosystem which included seaborn and matplotlib for making different types of charts.

4.1 Chart 1: Deposit Value Trends Across Cities

Explanation:

The chart displays deposit value changes for Cardiff, Oxford, Edinburgh branches during three consecutive years. The visual presentation shows both seasonal patterns and reveals Oxford's performance altered substantially in July 2023 following the renovation.
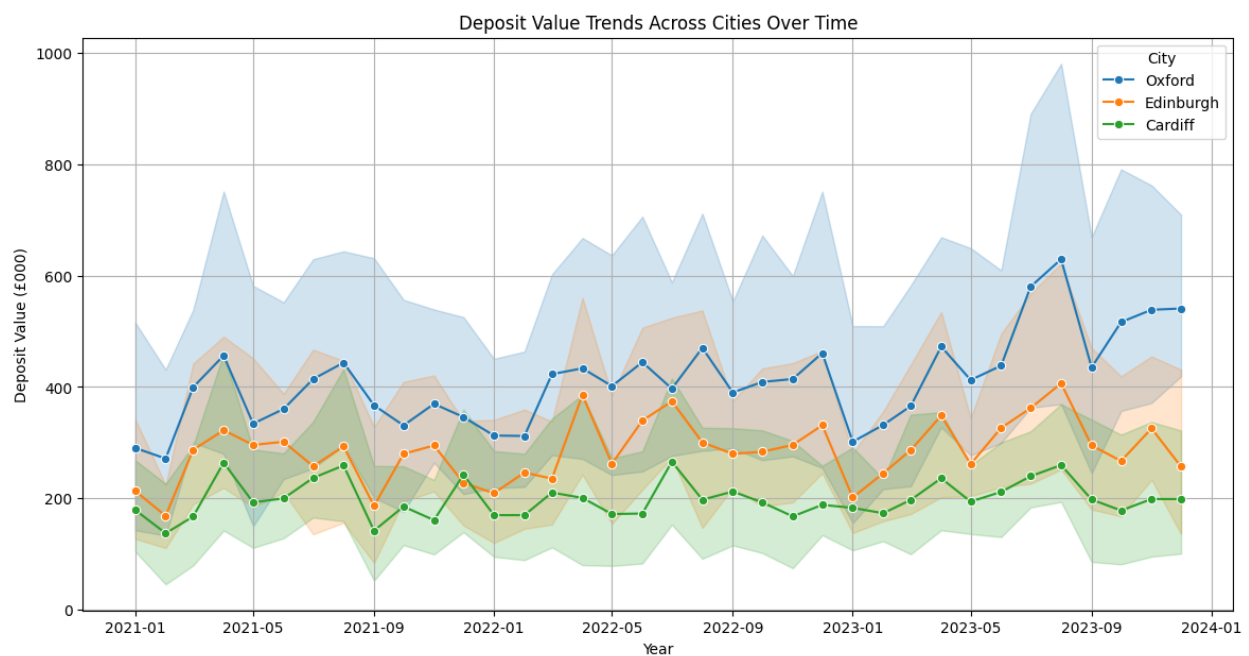
Key Findings:

- **Upward Shift in Oxford:** The branch redevelopment in Oxford produced an evident increase in the bank's deposit values. The financial performance of the organization improves substantially when branches receive modern facility upgrades.

- **Comparative Stability:** The financial data from Cardiff and Edinburgh demonstrates consistent stability yet Oxford demonstrates performance changes that match investments in strategy.

- **Business Implications:** Additional renovation projects can proceed in other branches based on the currently positive cost-benefit analysis.

Key Takeaways (Bullet Points):

- *Clear positive trend in Oxford post-renovation.*

All cities presented constant patterns during seasonal fluctuations. The gathered data confirms that more investment money should go toward modernizing bank facilities.

4.2 Chart 2: Service Categories – Customer Volume and Deposit Value

Explanation:

Aggregated bars in the chart helped display performance metrics between distinct savings service sectors. The chart presents precise information about the bank's valuable service locations by showing both client number and their associated deposit levels.

Customer Volume & Deposit Value by Service Category (3-Year Period)
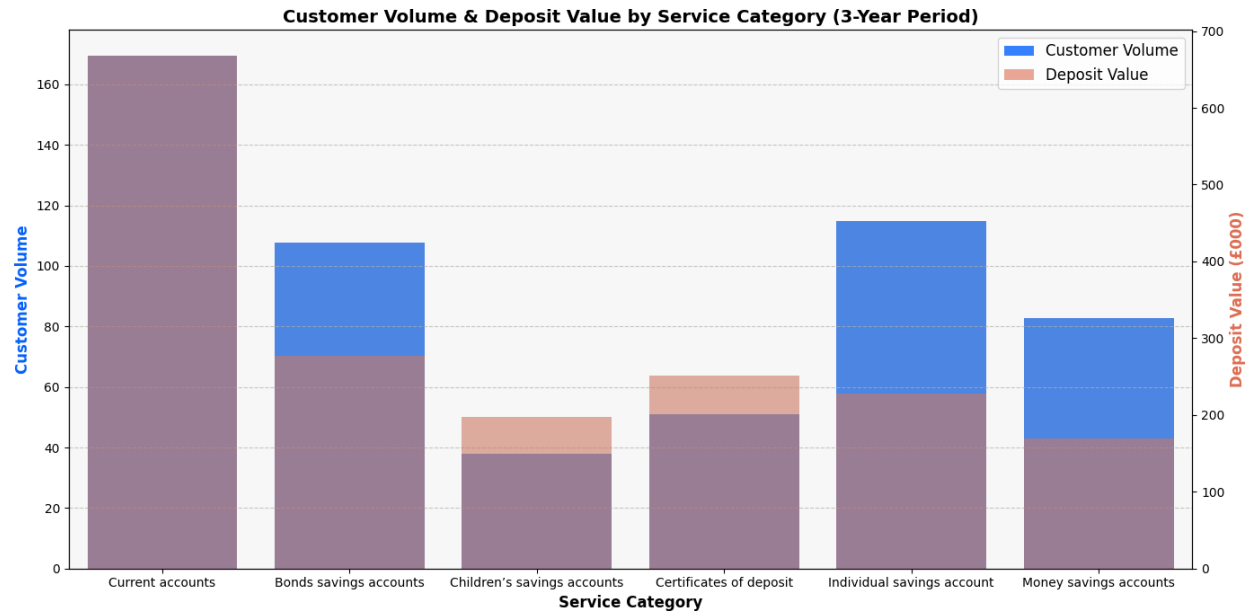
Key Findings:

- **Value Over Volume:** *The data demonstrates that current accounts bring in many clients yet the total deposited amounts from money savings accounts together with ISAs prove more substantial.*
- **Marketing Insights:** *This data reveals that the bank should direct its promotional activities toward generating profitable services instead of volume-based products.*
- **Strategic Focus:** *High-value products should receive marketing attention because doing so can create optimal financial returns from acquiring new customers and attracting their deposits.*

Key Takeaways (Bullet Points):

- *Money savings accounts alongside ISAs deliver the greatest deposit value to the bank.*
- *Though present customer account volume remains high it does not result in corresponding higher deposits.*
- *A change in marketing strategy would benefit from focusing on products that generate more deposits rather than just attracting increased customer numbers.*

4.3 Chart 3: Impact Analysis of Oxford Branch Expansion

Explanation:

The trend chart examines Oxford branch deposit values from before until after their 2023 expansion took place. The designed visualization sought to identify major changes resulting from the renovation work.
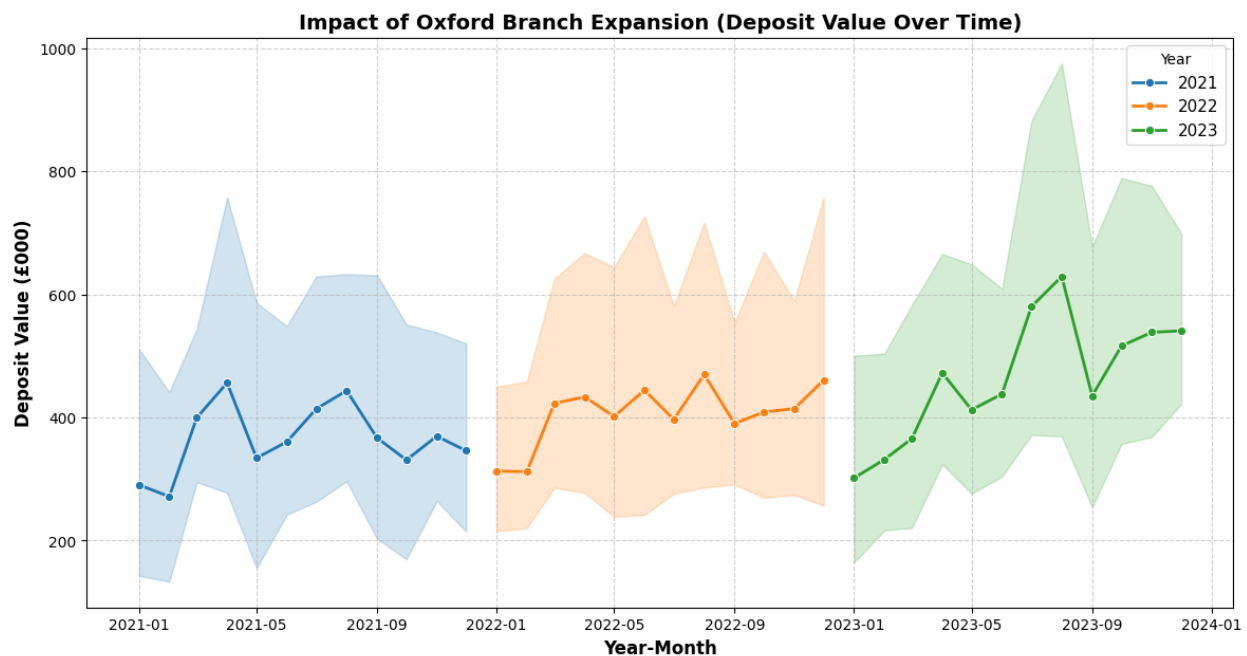
Key Findings:

- *Immediate Impact: The branch modernization creates a measurable positive impact on customer behaviour by driving up deposit values shortly after renovations.*
- *Long-Term Trends: The branch modernization demonstrates stable improvement through continued upward trends in future months.*
- *Benchmarking for Future Projects: Analysis results demonstrate that spending on other branches will likely deliver comparable results as observed here.*

Key Takeaways (Bullet Points):

- *The value of deposits increases substantially after the renovation takes place.*

- *Results from this observation period demonstrate the enduring positive effects the expansion has brought to the business.*
- *The data serves as an essential point of reference for determining future investment decisions for new branches.*

5. Conclusions and Recommendations

The CRISP-DM framework ensured alignment between analytics and business goals (Data Science PM, n.d.)

Key Insights:

- *The Oxford branch exceeds all other branches in financial performance following renovative improvements thus demonstrating updated facilities drive better financial outcomes in stores.*
- *High-value savings products which include money savings accounts together with ISAs create more deposit growth than current accounts.*
- *The implementation of self-service machines and advisory desks as part of renovation works positively affects deposits which establishes a strategic guide for upcoming investment choices.*

5.2 Strategic Recommendations:

1. *The renovation program of Oxford should be expanded to additional branches with high business potential by conducting cost-benefit studies.*
2. *The marketing efforts should target specific efforts to present high-yield savings products in selective advertising initiatives for acquiring premium customers.*
3. *The organization should use real-time dashboards and enhance data quality to make better decisions through improved monitoring.*
4. *The organization should invest in technology upkeep and workforce training for building better analytical operations.*

5. *Normalization of data collection should be enforced through standardized operations across all branches and customer insights and market trends should be used for creating precision data points.*

5.3 Final Thoughts The systematic data-driven analysis method delivered useful findings about both branch operations and customer conduct patterns. S&S Austen Bank will enhance its market strength and fostering future expansion by linking operational enhancements to its strategic investment and marketing plans.

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