Predicting Possible Bank Failures Using the Percentage of Assets to Deposits.

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Banking dates back to the temples of Rome, Greece, and Babylon, where the first coins were minted, and the wealthy stored their gold and jewels in the temple basement. Soon coins were used to pay for goods instead of trading grain and pigs. Temples also started lending money to the wealthy, who were storing their gold in the basement, while wealthy merchants loaned money to the rest of the people.

In the late 1700s, Alexander Hamilton established the first national bank in the United States, creating a uniform currency and starting the process of banking that we have today. The United States formed the Federal Reserve in 1913. During the Great Depression, the Federal Deposit Insurance Corporation (FDIC) was created to restore faith and trust in the United States banking system. In 1933, the insurance limit was only $2,500. Now deposit accounts are insured for up to $250,000. The FDIC has regulations to ensure banks have enough assets to cover deposits.

Now we have banking for everyone. People deposit paychecks to fund their daily lives, teach their children about money with their first savings account, obtain home loans, and start or expand businesses. Large corporations with thousands of employees to small, local businesses with just five employees use banks to conduct business and make their payrolls. These financial institutions use these deposits to purchase assets to make money to pay interest and dividends to their stockholders.

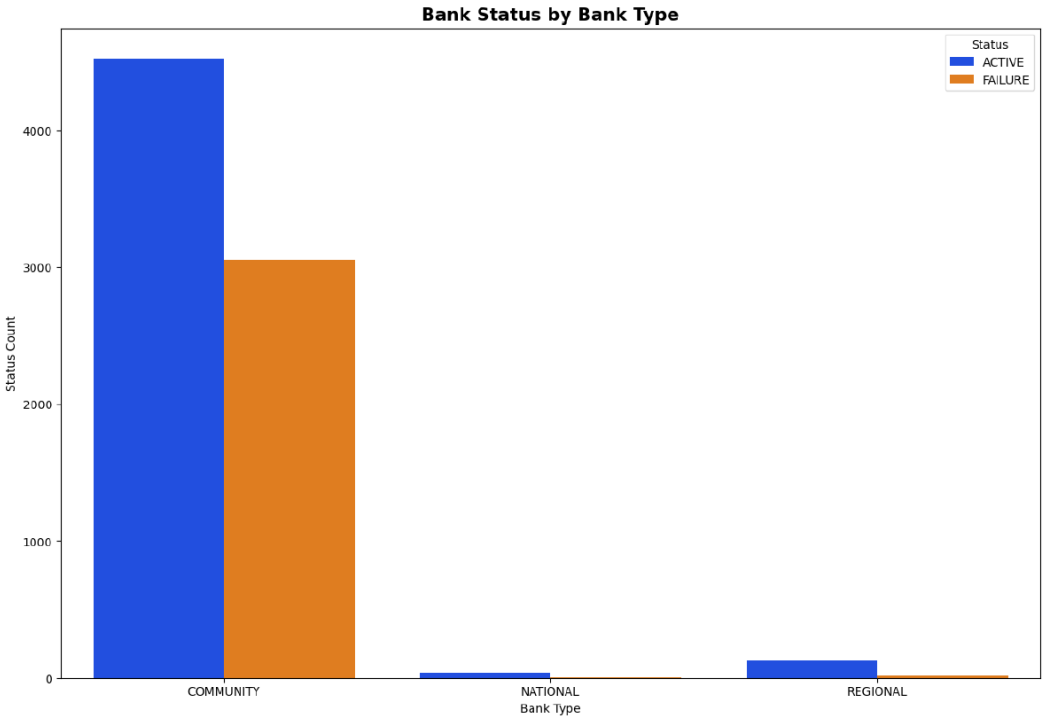
What happens when banks do not have enough assets to maintain the level of deposits? Another bank acquires that bank, or it fails. When a bank fails, accounts are frozen, companies cannot make payroll, and customers cannot pay their bills or pay for necessities. Even though deposits are insured, enormous hassle, fear, and uncertainty are still part of a bank failure. Are

there warning signs that signify that a bank might be in trouble, and could these institutions be identified so a person can avoid doing business with a possibly failing institution?

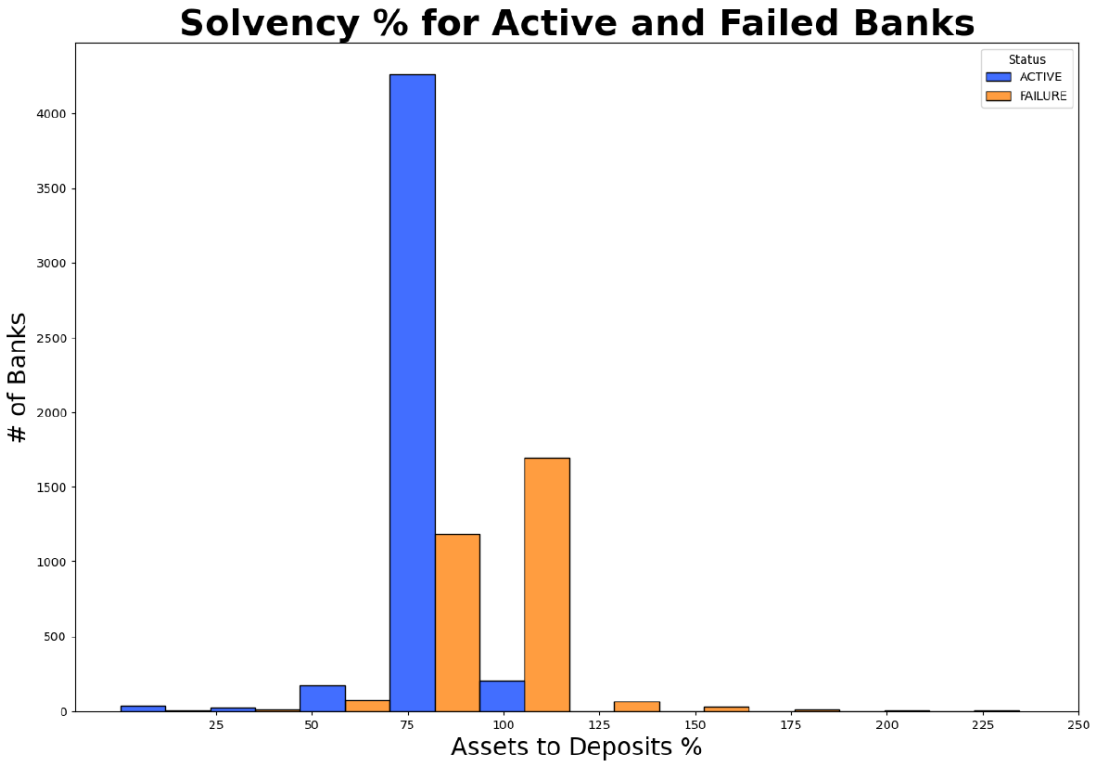
The FDIC has regulations to ensure banks have enough assets to cover deposits. The FDIC requires its member banks to provide a quarterly report of assets and deposits. A report summary is available to the general public through their website.

Data for this project was obtained directly from the FDIC website based on the quarterly reporting mentioned above. These reports give basic information about currently "solvent" banks in the United States. The FDIC website also provides similar information for failed institutions dating back to 1934. For this project, only failed banks starting in 1960 will be considered.

There are various ways of looking at the original solvent and failed bank information from the FDIC: by Status (Active and Failure), by Bank Type (Community, National, and Regional), and by Assets-to-Deposits Percentages.



The three bank types, Community, Regional, and National, are based on the level of deposits. Community banks have deposits of less than $10 billion. Regional banks are larger, with deposits between $10 billion and $100 billion and possibly branches in multiple states. National banks have deposits greater than $100 billion and could be located in countries outside of the United States. Community banks account for 95% of all banks; they are local in small towns and big cities with average deposits of as little as $443,000. Community banks are also responsible for 95% of all failures. Regional banks are medium size and make up less than 2% of bank failures, and National banks account for the rest.



Most currently solvent banks have an asset-to-deposit percentage of approximately 75%, meaning the available assets cover all the deposits. The current banks that are approaching 100% are those that would require a more detailed review looking for other contributing factors for the high asset-to-deposit percentage. The majority of failures have an asset-to-deposit percentage

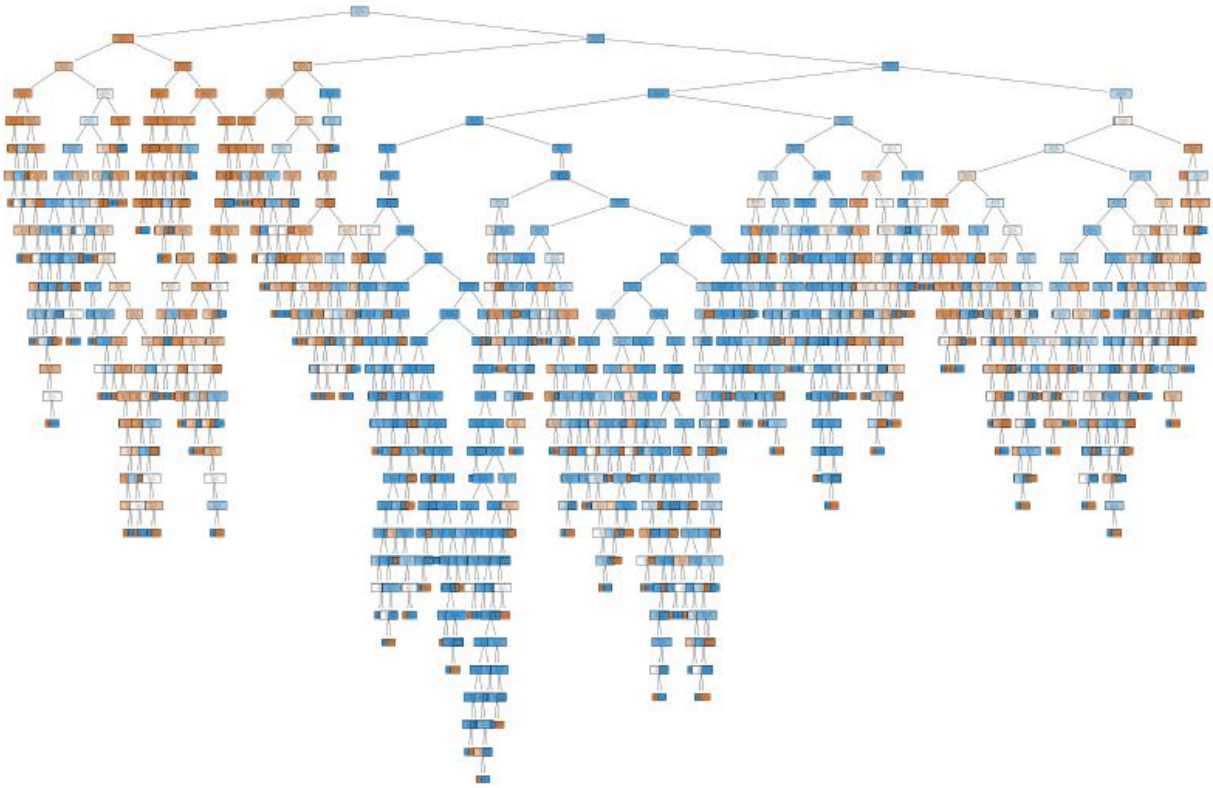
approaching or above 100%. With some as high as 225%, these banks could not cover their deposits' value with an FDIC guarantee.

Data Preparation is crucial in producing any results from the Machine Learning algorithms. The following steps are performed in preparing the data for the Decision Tree Classifier and Linear Regression models.

- Replace missing Record IDs with a generated sequential number.
- Convert the State Abbreviations to numeric values.
- Convert the Status (Active and Failure) column to a numeric value.
- Standardize the Failure records with an asset-to-deposit ratio of 120% maximum.
- Remove the Failure records in the lower 10% of asset-to-deposit ratios, as these cannot be considered reliable.
- Remove category columns: Institution Name, City, State.
- Remove additional columns not previously identified as categorical: State Number and Record ID.
- Convert the Status Name, Bank Class, and Bank Type into separate columns based on their value. Each column reflects one column value.

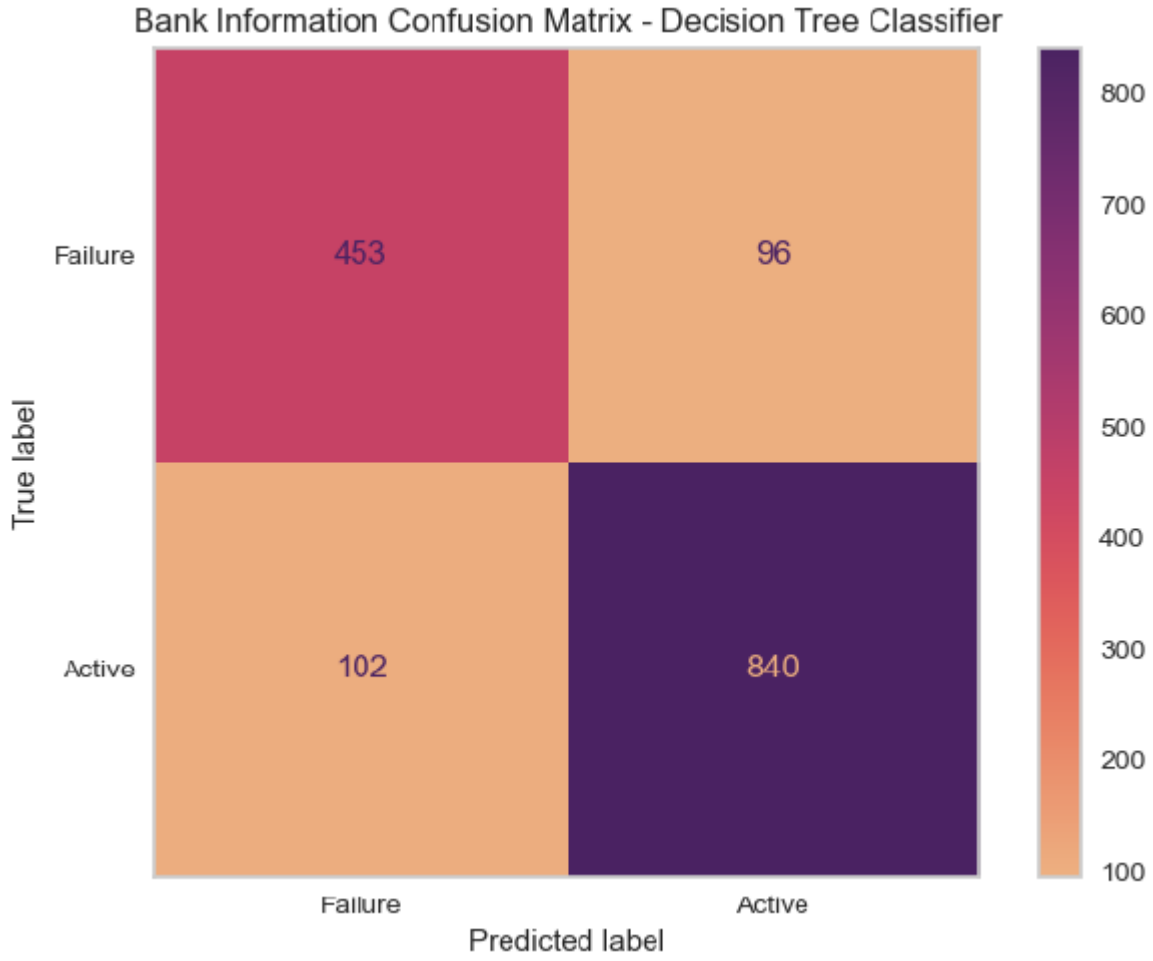
Decision Tree Classifiers and Logistic Regressions are Binary Algorithms in returning either a positive or negative result. (Yes or No). These models predict outcomes as Truly Positive and Negative and Falsely Positive and Negative. If a bank is genuinely solvent (Active), then it should be considered an excellent place to open an account. A bank that would truly be a failure (Failure) in the future is not worth the risk, and you should put your money elsewhere. The false positives and failures (Actives/Failures) are the ones to research why these were mislabeled. For this project, the Decision Tree Classifier will be examined.

The prepared data is split into two subsets: 1 without the Status information and the other with just the Status Number. The two subsets create the training and testing datasets with an 80/20 split. These datasets create the Decision Tree Classifier model. The accuracy of this model is considered very good at 87%.



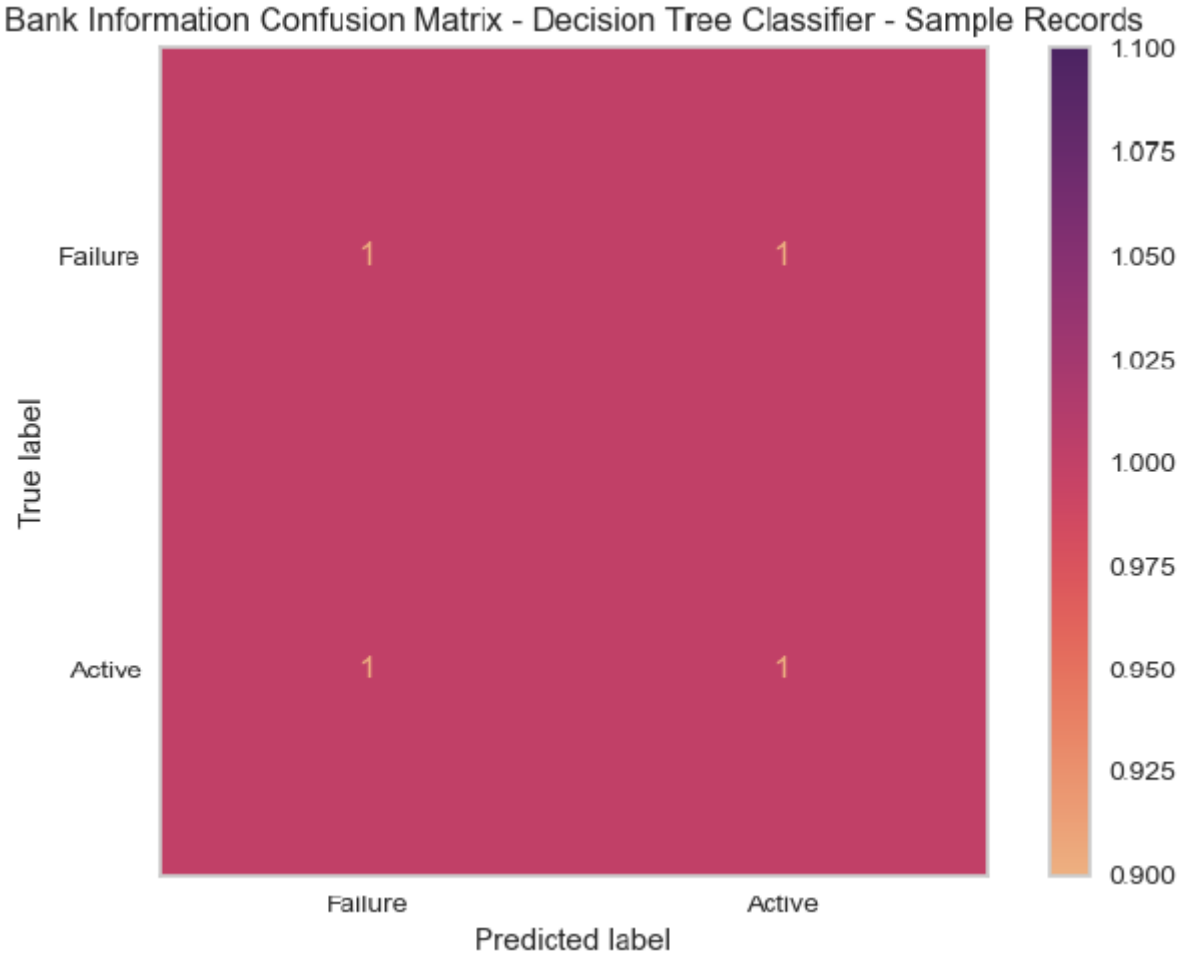
Decision Tree Classifiers allow for moving through each step of the decision tree until the outcome is reached. In this case, will this be a bank that will remain active and solvent, or could this bank fail and the deposit is lost? The bank's solvency or failure Decision Tree has hundreds of branches, making this very difficult to follow to a conclusion.

Another way to display the data using the Decision Tree Classifier model is a Confusion Matrix. While not as detailed, a Confusion Matrix gives information on which records are Yes, No, somewhere in between (Mislabeled)



A bank that is Active/Active would be a good place to make a deposit. Banks listed as either Failure/Failure or a Failure misclassified as Active (Failure/Active) would not be in consideration because they have failed and the banks are no longer in business. The Active banks misclassified as Failure (Active/Failure) would require a more detailed review before any money should be deposited.

Another test is performed by running new data through the model before moving the Decision Tree Classifier into production. The file contains four records: 2 Active and 2 Failures. Of the active bank records, one has a 75% asset-to-deposit ratio showing the current deposits are funded; the other has a 97% asset-to-deposit ratio and should be given a second look. Of the banks that failed, one had an asset-to-deposit ratio of 120% and indeed failed; the other record also failed but only had an asset-to-deposit ratio of 90%.



For every run of the Decision Tree Classifier, there is only one genuinely active bank and one false failure. Of the failed banks, one is an actual failure and one is falsely active or both records are failures.

The model is ready to be moved to pre-production for more testing over an extended period. Since solvent and failed bank data is based on a point in time, the model must be recreated after the active institutions provide quarterly reports to the FDIC. Also, this model does not guarantee that a bank that can cover its deposits when reporting to the FDIC will not fail during the next three months. Finally, this model is only a guide, before depositing money into a financial institution, additional research is required to ensure this bank meets your needs.

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