**Iowa Economic Indicators and GDP Analysis**

**Introduction**

The economic health of a state like Iowa is shaped by a complex web of interrelated sectors, from manufacturing and agriculture to employment and financial markets. To better understand how various sectors influence or forecast economic growth, this analysis explores the Iowa Economic Indicators dataset, a monthly time series of key statistics from 1999 to 2024. In particular, this study investigates how different indicators correlate with Iowa’s annual GDP and evaluates the predictive potential of select indicators using machine learning techniques.

The report aims to answer three central research questions:

1. How does the Iowa Leading Indicator Index correlate with Iowa's annual GDP growth?
2. How well can a machine learning model predict Iowa’s GDP based on monthly indicators?
3. How do agricultural and general industry indicators relate to Iowa’s GDP?

Understanding these patterns associated with the economic indicators and Iowa’s GDP could have significant implications for state-level policy decisions, business investments, and economic forecasting. For instance, if certain indicators consistently show strong correlations with GDP growth, they could serve as leading signals for future economic performance.

**Data and Methodology**

The data used in this project combines two primary sources. First, monthly economic indicators were obtained from Iowa’s publicly available Economic Indicators dataset[[1]](#footnote-1), containing over two decades of monthly metrics. These include employment figures, market indices, fuel consumption, and profitability measures for key agricultural sectors. This was the original dataset that inspired this project, as through the varying metrics on the monthly basis, interesting insight could be gleaned especially when combined with the second source of data. That second source was annual GDP data for Iowa from 1999 through 2023 was scraped from the federal reserve of St. Louis’s website[[2]](#footnote-2).

**Data Cleaning and Preparation**

Because of the high standard of quality from the chosen economic indicators dataset, and the relative simplicity of the scraped GDP data, minimal cleaning was necessary. Largely the data just needed to be prepped prior to and throughout the project on a per problem basis, with the few steps taken from the beginning outlined below:

* The 'Month' column was converted to datetime format.
* A 'Year' column was extracted to enable merging with annual GDP.
* Null values were identified and removed.
* All indicators were converted to consistent numeric types.
* GDP values were forward filled for each month of a year.

**Data Dictionary**

The following table outlines all columns used in the analysis, along with their data types and descriptions.

|  |  |  |
| --- | --- | --- |
| **Column Name** | **Data Type** | **Description** |
| **Month** | String | The month and year of the data point, formatted as 'Month Year' (e.g., 'Jan 1999'). |
| **Iowa Leading Indicator Index** | Float | A composite index used to predict the future performance of Iowa’s economy. |
| **Avg Weekly Manufacturing Hours** | Float | The average number of hours worked per week by manufacturing employees in Iowa. |
| **Residential Building Permits** | Integer | The number of residential building permits issued in Iowa during the given month. |
| **New Orders Index** | Float | An index reflecting the volume of new orders for Iowa-based manufacturers. |
| **Avg Weekly Unemployment Claims** | Integer | The average number of unemployment claims filed per week in Iowa. |
| **Yield Spread** | Float | The difference between long-term and short-term interest rates, often used as an economic signal. |
| **Diesel Fuel Consumption (Gallons)** | Float | The total number of gallons of diesel fuel consumed in Iowa during the given month. |
| **Iowa Stock Market Index** | Float | A stock market index tracking the performance of stocks relevant to Iowa’s economy. |
| **Agricultural Futures Profits Index** | Float | An index tracking the profitability of Iowa’s agricultural futures markets. |
| **Non-Farm Employment Coincident Index** | Float | An index of non-farm employment trends in Iowa, serving as a coincident indicator. |
| **Corn Profits** | Float | The profitability index for Iowa’s corn industry. |
| **Soybean Profits** | Float | The profitability index for Iowa’s soybean industry. |
| **Cattle Profits** | Float | The profitability index for Iowa’s cattle industry. |
| **Hog Profits** | Float | The profitability index for Iowa’s hog industry. |
| **1 Month Diffusion Index** | Float | An index reflecting the net change in economic indicators over the past month. |
| **6 Month Diffusion Index** | Float | An index reflecting the net change in economic indicators over the past six months. |
| **Year** | Integer | The year of the data point, used for yearly aggregation and alignment with GDP. |
| **Iowa\_GDP** | Float | The Gross Domestic Product (GDP) for Iowa in the corresponding year (in billions USD). |

**Exploratory Analysis**

**Research Question 1: Iowa Leading Indicator Index and GDP Growth**

The first question investigates Iowa’s leading indicator index, to determine if the indexes that make up the dataset have a relationship with the GDP when combined into one. To explore the relationship between the Iowa Leading Indicator Index (ILII) and GDP growth, I first looked at the Pearson correlation coefficient, and after discovering a value of .8002 I went on to develop a scatter chart as pictured below. A graph with blue dots

AI-generated content may be incorrect.Noticing the horizontal lines from each of the months within the given years, I annualized the leading indicator values and produced this improved scatter chart with a correlation coefficient of .8275, indicating a strong, positive, linear relationship between the and the GDP.A graph with blue dots

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This finding supports the design of the ILII as a predictive composite indicator. Notably, sharp declines in the ILII typically preceded slowdowns in GDP, consistent with recession periods. While relatively basic compared to the next few questions, upon this finding I felt confident moving forward analyzing individual features to find those most impactful.

**Research Question 2: Machine Learning to Predict GDP**

To further test the validity of this connection and implement machine learning techniques, a binary target for GDP was created with GDP values over the mean having a value of 1, and those below having a value of 0. This target was subjected to a logistic regression that was cross validated with 5 folds to ensure consistent accuracy given the small sample size, producing the following results:

* Average Accuracy: .8467
* Accuracy Scores ranging from .8 to 1.0

I then created a scatter matrix to further visualize this relationship between high GDP and the ILII and produced the below visualization. Note the prominent distinction between the high and low GDP values as is indicated by the blue and orange color difference of the lower right plot, representing the strong relationship between the variable and target.A graph of different sizes of graphs

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**Research Question 3: Agricultural Profits and GDP**

I began by examining the agricultural features against GDP, dividing them by those associated with crops (Corn Profits and Soybean Profits), from those under livestock (Cattle Profits and Hog Profits). These developed two line charts of the two groups of features against GDP over time, looking like the two below. Worth noting is the surprisingly weak relationship between hog and cattle profits, and the minimal impact of any individual feature on the GDP.

A graph with lines and numbers

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A graph with lines and numbers

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The values for the above plots had to be normalized as the profits were of minimal scale compared to the GDP, but regardless produced more interest in the correlation amongst these varying agricultural features and the GDP. I answered this question by creating a correlation heatmap looking at these same four features (Soybean profits, Corn Profits, Hog Profits, Cattle Profits), in their correlation with GDP and produced this plot.A red and blue squares with white text

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This shows the four agricultural features represent a fairly weak relationship regarding their predictive capabilities with the state’s GDP, as the strengths for the correlation of the four variables are -0.23 for Cattle Profits, -0.13 for Hog Profits, 0.21 for Corn Profits, and 0.15 for Soybean Profits. Corn being the strongest was not particularly surprising, although the data suggesting an inverse relationship between the two livestock indexes and Iowa’s GDP was not anticipated, and may represent the relative minimal impact it as an industry sector has over the states gross domestic product.

**Research Question 4: General Industry and GDP**

After looking at the agricultural features, I wanted to observe the other industry’s indicators to determine if they had similarly weak relationships with GDP. I began by running a large-scale plot of each of the pertinent remaining features and GDP in a matrix, just to observe if the shapes of any represented something with strength greater than agriculture. The only two features with notable correlation patterns were the Iowa Stock Market Index and Diesel Fuel Consumption in gallons, which are depicted in the below plot.

A group of blue and white graphs

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The bottom left and plot above it show the seemingly positive linear relationship between the two features and GDP, which I further investigated through a linear regression that returned a R^2 value of 0.9706, showing the strength of these two features relative to the agricultural features, or any other within the dataset.

**Conclusion**

This analysis of Iowa’s economic indicators and their relationship with state GDP from 1999 to 2024 provides valuable insights into the structure and predictive power of key economic metrics. The Iowa Leading Indicator Index (ILII) emerged as a strong predictor of GDP performance, with a Pearson correlation of 0.8275 after annualization—validating its purpose as a forward-looking composite index. This foundational result supported the application of machine learning techniques, where a logistic regression model accurately classified high versus low GDP years with an average accuracy of 84.67%, reinforcing the idea that economic indicators carry significant forecasting power.

While agricultural profit indicators—such as those for corn, soybeans, cattle, and hogs—showed relatively weak correlations with GDP, their analysis revealed important sectoral distinctions. Corn profits had the highest positive correlation among them, whereas livestock indicators unexpectedly showed inverse relationships, suggesting a lower overall influence of this sector on state-level economic output. This highlights a potential disconnect between agricultural profitability and broader economic performance, or possibly structural changes within Iowa’s agricultural economy over time.

The strongest predictors beyond the ILII came from general industry indicators, particularly the Iowa Stock Market Index and Diesel Fuel Consumption, both of which demonstrated robust linear relationships with GDP. A linear regression model incorporating these features achieved an R² value of 0.9706—suggesting that industry activity and transportation-related consumption may serve as reliable signals for economic growth in Iowa.

Overall, the findings from this project suggest that certain indicators—especially composite indexes and industry consumption metrics—can effectively anticipate changes in Iowa’s GDP, making them valuable tools for policymakers, investors, and analysts. Conversely, while agriculture remains a cultural and economic cornerstone of the state, its profitability alone appears to be a weaker predictor of macroeconomic performance. Future research may expand on these results by incorporating more granular industry-level data or applying advanced forecasting models over longer time horizons.

1. <https://data.iowa.gov/Economic-Statistics/Iowa-Economic-Indicators/qd3t-kfqg/about_data> [↑](#footnote-ref-1)
2. <https://fred.stlouisfed.org/series/IARGSP> [↑](#footnote-ref-2)