# Education Investment Forecasting for Regional Economic Development

## Project Description

This project uses Recurrent Neural Networks (RNNs) to analyze time-series data on education expenditures and predict regional economic outcomes 10–15 years ahead. Students will investigate how foundational education investments drive long-term economic growth and workforce development.  
  
For similar studies, refer to:  
- https://www.mdpi.com/2227-7390/11/14/3085?utm\_source=chatgpt.com  
-https://www.nber.org/system/files/working\_papers/w21770/w21770.pdf?utm\_source=chatgpt.com

## Project Steps

### Part 1: Data Collection and Preliminary Analysis (10 points)

#### Data Collection

- Obtain K-12 education expenditure data (or similar) from NCES school finance surveys and teacher salary databases.

- Collect regional economic indicators from the Bureau of Economic Analysis (BEA) and employment statistics from the Bureau of Labor Statistics (BLS).

#### Data Cleaning

- Standardize geographical units.  
- Handle missing values.  
- Align temporal sequences.  
- Categorize expenditures and normalize economic indicators.

#### Preliminary Data Analysis and Visualization

- Investigate long-term relationships between education spending and economic outcomes.  
- Visualize trends and perform cross-regional comparisons using appropriate time-series plots.

### Part 2: Deep Learning Model (10 points)

#### Build RNN Model

- Develop an LSTM (Long Short-Term Memory) or similar architecture using PyTorch for long-term predictions (10–15 year horizons).

- Use a multivariate time series model.

- Provide well-commented, reproducible code in a repository linked in the report.

#### Model Training and Validation

- Train the model using historical education-economic outcome data with appropriate sequence lengths.

- Use temporal cross-validation and long-term prediction accuracy metrics for model validation.

#### Deployment and Testing

- Apply the model to recent data to forecast future outcomes.

- Identify which categories of education expenditure most strongly correlate with economic growth.

### Part 3: Education Policy Analysis (10 points)

#### Analysis Using the Predictive Model

- Use model insights to identify optimal education investment strategies for regional development.

- Evaluate the policy implications of the findings.

#### Presentation and Report

- Summarize findings on the effectiveness of education investments.

- Discuss policy applications for educational planning and regional economic strategies.

## Grading Criteria

### Presentation of Data and Preliminary Data Analysis (10 points)

- Effective handling of long-term time-series datasets.  
- Clear and informative data visualizations.  
- Insightful analysis of trends and regional differences.

### Deep Learning Model (10 points)

- Accuracy and robustness of long-term economic forecasts.  
- Appropriateness of LSTM architecture for the task.  
- High-quality documentation and reproducibility.

### Education Policy Analysis (10 points)

- Insightful recommendations for investment strategies.  
- Relevance of analysis to real-world policy development.  
- Clarity and organization of the final report.