

# Capstone Interim Report: Sales Forecasting Report

## Introduction

This report talks about our work in finding the best way to guess future sales. We looked at different methods including AR, MA, ARIMA, SARIMAX, and LSTM. Our goal was to find which method works best.

## Summary of What We Did

### Simple Models

- **AR (Autoregressive):** We tried AR models with 1, 2, and 3 past points. AR (1) was the best among them.
- **MA (Moving Average):** Similar to AR, we tried MA models. MA (2) worked best here.

### Complex Models

- **ARIMA Models:** These models are a mix of AR and MA. The ARIMA (2,2,2) model was the best, meaning it used a good mix without being too complicated.
- **SARIMAX Model:** This is a special model that also thinks about seasons. The SARIMAX model we looked at did well, but its results were so good that we think there might be a mistake.

### A New Approach: LSTM

- We're also trying out a smart computer model called LSTM. It's supposed to be good at spotting patterns over time. We're working on making it better.

### What We Found

- The ARIMA (2,2,2) model was the best among the regular methods. It found a good balance.
- The SARIMAX model's results were surprising and might need a double-check because they were much better than expected.
- The LSTM model is something we're looking into as it can spot complex patterns.

### Simple Conclusion

We think the ARIMA (2,2,2) model is the best choice for now, based on our tests. The SARIMAX model looks promising, but we need to check its results again. We're also working on improving the LSTM model because it could help us understand our sales better in the future.

### Next Steps

- We're focusing on making the LSTM model work better. This means tweaking it to see what gives us the best guesses for future sales.
- We'll keep comparing our models to make sure we're using the best one.

## Model Comparison Results:

Model Type	Parameters	AIC
AR	(1)	3082.57
AR	(2)	3084.57
AR	(3)	3083.58
MA	(1)	3114.88
MA	(2)	3101.52
MA	(3)	3104.26
ARIMA	(0,0,0)	3478.70
ARIMA	(0,1,3)	3041.81
ARIMA	(0,2,3)	3019.02
ARIMA	(1,1,3)	3036.78
ARIMA	(1,2,3)	3018.72
ARIMA	(2,1,3)	3038.24
ARIMA	(2,2,2)	3017.22
ARIMA	(3,1,3)	3037.93
ARIMA	(3,2,3)	3022.32
SARIMAX	(2, 0, 1)x(1, 0, 2, 12)	14.0

## Resources used for Learning:

1. Blog on LSTM: <https://colah.github.io/posts/2015-08-Understanding-LSTMs/>
2. YouTube:
  - <https://www.youtube.com/watch?v=whmI0WHuIK4&list=PLZoTAE LR MXVPs3evaTrU2i9dF143m7Mvh>
  - <https://www.youtube.com/watch?v=W-YCKMNTcqE&list=PLZoTAE LR MXVNty3jyJkYXuyQY3lMSpr3b&index=2>