

**Drug Sales Forecasting in the Iraqi Private
Pharmaceutical Market using Deep Neural
Network Algorithms**

التنبؤ بمبيعات الأدوية في سوق الأدوية العراقي الخاص باستخدام خوارزميات الشبكة
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Abstract

Drug sales and price forecasting have become an attractive investigation topic due to their important role in the pharmaceutical industry, a sales forecast helps every business to make better business decisions in overall business planning, budgeting, marketing and risk management. The traditional forecasting method focused on a conventional statistical model, which highly depends on the availability of historical sales data. However, for new drug entities, where not enough historical data is available, new methods of Machine Learning are applied. The aim of this thesis is to identify an efficient Deep Neural Network algorithm suitable to forecast drug sales and pricing by applying Deep Neural Network Algorithms such as Multilayer Perceptron, Convolutional Neural Network, and Long Short-Term Memory, which are expected to perform well on this issue. The results are carried out to determine the efficiency of these algorithms by evaluating the performances of the models using MAE and RMSE performance metrics to identify the best algorithm for Drug Sales and Price Forecasting. The accepted accuracy should be more than 80% of the actual value for quantity which is less than three thousand by unit and less than two Dollar (USD) for price, Based on the results of the experiments Long Short Term Memory performed better than MLP and CNN for generating predictions with average Root Mean Square Error of for sales is 1.28(k) and Mean Absolute Error of about 0.85(k), and with average Root Mean Square Error for USD Prices is about 0.75, and Mean Absolute Error is about 0.44. The forecasts are then used to adjust stock levels according to the predictions.

Keywords: Drug sales Forecasting, Multilayer Perceptron, Convolutional Neural Network, Long Short-Term Memory.