

Applying Machine Learning Algorithms Based on Support Vector Machines to Forecast the Patient Volume at an Emergency Room

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Abstract

At an emergency room (ER) supplies, personnel and infrastructure must be ready and available to provide immediate care whenever is needed. Since these are limited resources, a good estimation of the near future patient volume might help when planning in advance. This research approaches the forecast of the patient volume at an ER by means of applying machine learning algorithms based on Support Vector Machines (SVM). The research was carried out following a 4-phase methodology: analysis, design, development, and validation. During the analysis, over 50,000 ER records preprocessed and sorted as daily time series. During the design, datasets, forecast horizons, SVM-based forecasting algorithms, and performance metrics were defined. The development was carried out entirely using the data processing software WEKA. Lastly, the validation was completed using held out data so that forecasts were compared to actual values. Forecasts based on linear regressions (LR) were used as baseline. The first approach consisted in using the cumulative data to forecast one month ahead, while the second approach considered only the last available month to forecast one month ahead. Besides MAE, MSE, RMSE, and MAPE, the number of months where the forecast underestimated the actual value was also used to compare approaches. The results revealed that, when using cumulative time series, LR-based forecast underestimated the patient volume 8 out of 10 months. SVM-based forecast underestimated only 2 out of 10 months. When forecasting with the last available month, the underestimation was 6 out of 10 and 3 out of 10 respectively. In conclusion, in some cases SVM-based forecasts can outperform LR-based forecasts. The availability of accurate patient volume estimations might serve well when planning and allocating resources.

Keywords

Forecasting, Machine Learning, Gaussian Process, Linear Regression, Emergency Room

Biographies

Carlos Hernández is an industrial engineer, consultant, and university professor. He earned Master of Sciences in Engineering and Doctor of Engineering from Technische Universität Braunschweig, Brunswick, Germany. He has taught lectures in Discrete Event Simulation, Engineering Economics, Corporate Finances, Data Mining and Machine Learning for engineering students. He has developed a professional career working for large multinational companies (PricewaterhouseCoopers, BHP Billiton, and Merck Sharp & Dohme). He also worked as a scientific researcher in the Institut für Produktionsmesstechnik at TU Braunschweig, Germany. His research interests include manufacturing process simulation, supply chain design and simulation, and machine learning for finances. He is a member of IEOM.

Jaime Castillo is an industrial engineer, consultant, and university professor. He earned Licentiate Degree in Forest Engineering from Universidad de Concepción, Concepción, Chile, and Master in Industrial Engineering from

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Dafne Lagos is an industrial engineer and university professor. She obtained a Bachelor of Science in Engineering and a Master's in Management from the Universidad de La Frontera (Temuco, Chile) and a Doctor of Science from Atlantic International University (USA). She has lectured in Engineering Economics, Probability Modeling, Logistics, and Operations Research for engineering students. She has also written several scientific articles in the area of operations research. During her academic tenure, she has been appointed to different managerial positions and has mentored more than forty students. Her research interests include financial planning, supply chain management, and logistics.

Paola Leal is an industrial engineer and university professor. She earned Licentiate Degree in Engineering from Universidad de La Frontera, and Master of Sciences from Universidad Mayor, Temuco, Chile. She has taught lectures in Operations Research, Logistics, and Supply Chain Management for engineering students. During her academic tenure she has been appointed in different management positions and has mentored over a sixty students. Her research interests include logistics, optimization, and supply chain management.