Machine Learning Driven Blood Demand Prediction Model

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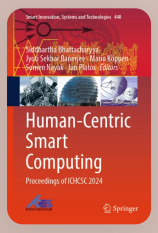

Human-Centric Smart Computing

(ICHCSC 2024)

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Abstract

Accurately forecasting blood demand is crucial for maintaining optimal inventory levels in blood banks, ensuring an adequate supply for emergencies while reducing wastage.

However, traditional forecasting methods often struggle to capture the intricate patterns inherent in blood demand data, leading to sub optimal inventory management. To address this, this study proposes an innovative approach to blood demand forecasting using the XGBoost machine learning model. XGBoost, a robust gradient boosting algorithm, performs well when it comes to the handling of high-dimensional data and can efficiently capture complex relationships in the data. Leveraging its capabilities, we develop a predictive model trained on historical blood demand data, considering factors such as demographic trends, seasonality, and past donation patterns. Through meticulous feature engineering and model optimization, our XGBoost-based approach aims to improve the accuracy and reliability of blood demand forecasts for blood banks. To evaluate our methodology, we conduct extensive experiments using real-world blood demand datasets from multiple blood banks. Comparative analyses against traditional methods assess the predictive performance and robustness of the XGBoost model.

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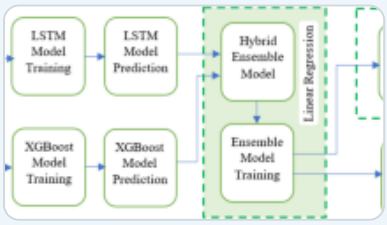

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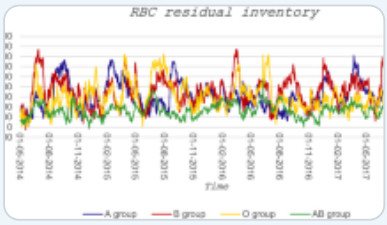

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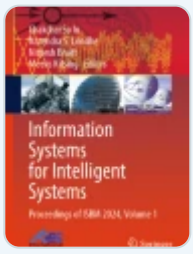

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References

1. Bashir, F., Khalid, A., Iqbal, S., Ghafoor, T., Ahmed, M.: Exploring the causes of wastage of blood and its components in a tertiary care hospital blood bank. Cureus. **13**(12), e20500 (2021). https://doi.org/10.7759/cureus.20500

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2. Sarvestani, S.E., Hatam, N., Seif, M., Kasraian, L., Lari, F.S., Bayati, M.: Forecasting blood demand for different blood groups in Shiraz using auto regressive integrated moving average (ARIMA) and artificial neural network (ANN) and a hybrid approaches. Sci. Rep. **12**(1), 22031 (2022). https://doi.org/10.1038/s41598-022-26461-y

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3. Chideme, C., Chikobvu, D., Makoni, T.: Blood donation projections using hierarchical time series forecasting: the case of Zimbabwe's national blood bank. BMC Pub. Health **24**, 928 (2024). https://doi.org/10.1186/s12889-024-18185-7

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4. Zhang, L., Bian, W., Qu, W., Tuo, L., Wang, Y.: Time series forecast of sales volume based on XGBoost. J. Phys.: Conf. Ser. **1873** (2021). https://doi.org/10.1088/1742-6596/1873/1/012067

5. Chen, T., Guestrin, C.:. XGBoost: A scalable tree boosting system. In: Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD'16), pp. 785–794. Association for Computing Machinery, New York, NY, USA (2016). https://doi.org/10.1145/2939672.2939785

6. Kumar, M., Anand, M.: An application of time series arima forecasting model for predicting sugarcane production in india. Stud. Bus. Econ. **9**, 81–94 (2014)

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7. Wu, H.Y., Li, Z.G., Sun, X.K., Bai, W.M., Wang, A.D., Ma, Y.C., Diao, R.H., Fan, E.Y., Zhao, F., Liu, Y.Q., Hong, Y.Z., Guo, M.H., Xue, H., Liang, W.B.: Predicting willingness to donate blood based on machine learning: two blood donor recruitments during COVID-19 outbreaks. Sci. Rep. **12**(1), 19165. PMID: 36357435; PMCID: PMC9647248. https://doi.org/10.1038/s41598-022-21215-2

8. Ramani, K.V., Mavalankar, D.V., Govil, D.: Study of blood-transfusion services in Maharashtra and Gujarat States, India. J. Health Popul. Nutr. **27**(2), 259–270 (2009). PMID: 19489420; PMCID: PMC2761785. https://doi.org/10.3329/jhpn.v27i2.3368

9. Shokouhifar, M., Mohammad Sabbaghi, M., Pilevari, N.: Inventory management in blood supply chain considering fuzzy supply/demand uncertainties and lateral transshipment. Transfus. Apheresis Sci. **60**(3), 103103 (2021). ISSN 1473-0502. https://doi.org/10.1016/j.transci.2021.103103

10. Ben Elmir, W., Hemmak, A., Senouci, B.: Smart platform for data blood bank management: forecasting demand in blood supply chain using machine learning. Information **14**(1), 31 (2023). https://doi.org/10.3390/info14010031

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