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A Reinforcement Learning Approach to Sequential Acceptance Sampling as a Critical Success Factor for Lean Six Sigma

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Abstract

In the 21st century, globalization coupled with technological advancement and free trade has created competition among various businesses enterprises. This competition has led many businesses to adopt various management techniques such as acceptance sampling aimed at transforming their processes in order to remain competitive in the global market and adapt to new market demands. The successful implementation of acceptance sampling is highly dependent on what the academic literature refers to as acceptance sampling optimization. A literature review on the optimization of acceptance sampling has not shown any work that studied whether acceptance sampling and machine learning (ML) plans can be considered as an optimal acceptance sampling technique (sequential sampling being one improved acceptance sampling technique). ML algorithms can be divided into four categories: supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning. Reinforcement learning is different from the other types of machine learning, since it is a method of self-learning and acting based on observed data.

The aim of this paper is to develop a model based on coupling reinforcement learning methodology (RL) and sequential acceptance sampling in manufacturing to improve and achieve optimality in process and product monitoring. This model will serve as a continuous improvement strategy towards a better acceptance sampling implementation in the manufacturing industry. Simulation has been used as the model for proof of concept. The simulation model is designed to simulate any manufacturing process. However, this paper focuses on simulating the inspection process in a production line. In order to determine if an RL-based sequential sampling model is able to reduce the sample size and time of inspection, this paper compares the proposed model with the sequential acceptance sampling plan and the MIL-STD 1916

The result of the research will show the integration of sequential sampling and RL as a key to reduce the sample size and the sampling time interval during the inspection process in a manufacturing industry.

Biographies

Hani A. Khalil is a graduate student from the University of Wisconsin-Milwaukee with a PhD degree in Industrial and Manufacturing Engineering and an MSc of engineering management from the University of Milwaukee School of Engineering. He was awarded the University of Wisconsin-Milwaukee Chancellor's Graduate Award in 2017 and 2018. Areas of expertise and interest for Dr. Khalil include Project Management, Lean Six Sigma Black Belt tools, Manufacturing Management, Continuous Improvement, and Machine Learning. He is member of the Institute of Industrial and Systems Engineers, the American Society for Engineering Management, the American Society for Quality, INFORMS, and POMS. He has taught courses in Lean Manufacturing, Quality Control, Engineering Economic Analysis, and Methods Engineering.