

The Optimal Order Policy for the Newsvendor Model under Worker Learning

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Abstract : We consider the worker-learning Newsvendor Model, under the case of lost-sales for unmet demand, with the research objective of proposing the cost-minimization order policy and lot size, scheduled to arrive at the beginning of the selling-period. In general, the New Vendor Model is used to find the optimal order quantity for the perishable items such as fashionable products or those with seasonal demand or short-life cycles. Technically, it is used when the product demand is stochastic and available for the single selling-season, and when there is only a one time opportunity for the vendor to purchase, with possibly of long ordering lead-times. Our work differs from the classical Newsvendor Model in that we incorporate the human factor (specifically worker learning) and its influence over the costs of processing units into the model. We describe this by using the well-known Wright's Learning Curve. Most of the assumptions of the classical New Vendor Model are still maintained in our work, such as the constant per-unit cost of leftover and shortage, the zero initial inventory, as well as the continuous time. Our problem is challenging in the way that the best order quantity in the classical model, which is balancing the over-stocking and under-stocking costs, is no longer optimal. Specifically, when adding the cost-saving from worker learning to such expected total cost, the convexity of the cost function will likely not be maintained. This has called for a new way in determining the optimal order policy. In response to such challenges, we found a number of characteristics related to the expected cost function and its derivatives, which we then used in formulating the optimal ordering policy. Examples of such characteristics are; the optimal order quantity exists and is unique if the demand follows a Uniform Distribution; if the demand follows the Beta Distribution with some specific properties of its parameters, the second derivative of the expected cost function has at most two roots; and there exists the specific level of lot size that satisfies the first order condition. Our research results could be helpful for analysis of supply chain coordination and of the periodic review system for similar problems.

Keywords : inventory management, Newsvendor model, order policy, worker learning

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