Preventative Maintenance, Impact on the Optimal Replacement Strategy of Secondhand Products

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Abstract : This paper investigates optimal replacement and preventative maintenance policies of secondhand products under a Finite Planning Horizon (FPH). Any consumer wishing to replace their product under FPH would have it undergo minimal repairs. The replacement provided would be required to undergo periodical preventive maintenance done to avoid product failure. Then, a mathematical formula for disbursement cost for products under FPH can be derived. Optimal policies are then obtained to minimize cost. In the first of two segments of the paper, a model for initial product purchase of either new or secondhand products is used. This model is built by analyzing product purchasing price, surplus value of product, as well as the minimal repair cost. The second segment uses a model for replacement products, which are also secondhand products with no limit on usage. This model analyzes the same components as the first as well as expected preventative maintenance cost. Using these two models, a formula for the expected final total cost can be developed. The formula requires four variables (optimal preventive maintenance level, preventive maintenance frequency, replacement timing, age of replacement product) to find minimal cost requirement. Based on analysis of the variables using the expected total final cost model, it was found that the purchasing price and length of ownership were directly related. Also, consumers should choose the secondhand product with the higher usage for replacement. Products with higher initial usage upon acquisition require an earlier replacement schedule. In this case, replacements should be made with a secondhand product with less usage. In addition, preventative maintenance also significantly reduces cost. Consumers that plan to use products for longer periods of time replace their products later. Hence these consumers should choose the secondhand product with lesser initial usage for replacement. Preventative maintenance also creates significant total cost savings in this case. This study provides consumers with a method of calculating both the ideal amount of usage of the products they should purchase as well as the frequency and level of preventative maintenance that should be conducted in order to minimize cost and maintain product function.

Keywords : finite planning horizon, second hand product, replacement, preventive maintenance, minimal repair

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