Efficient linear models for solving the machine-part cell formation problem in group technology manufacturing

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Abstract

In this paper, new linear models are presented for solving the machine-part cell formation problem in group technology manufacturing. The models are far superior to the Boctor models(1991, 1996) in terms of the number of extra variables and constraints. New quadratic formulation under linear constraints is suggested to directly minimize the total number of exceptional elements. A linearization for the quadratic model needs only extra mt continuous variables and the same number of constraints, where m is the number of machines and t is the number of cells. This is an improvement over both the first version of Boctor model(1991) which needs extra $2p|A|$ continuous variables and $p|A|$ constraints, where $|A|$ denotes the cardinality of the binary machine-part incidence matrix A and the second version of the same author(1996) which needs extra $p|A|$ continuous variables and $mp+p|A|$ constraints. The linearized model is further reduced in terms of the number of binary variables. The resulting model has $(m+n)[\log_2 p]^+$ binary variables, where n is the number of parts and $[\log_2 p]^+$ is the smallest integer greater than $\log_2 p$. The model reduced in terms of the number of binary variables needs extra $(2m+n)p$ continuous variables and $mp+(m+n)(p+1)$ constraints. This is a great improvement in terms of the number of binary variables over both Boctor models having $(m+n)t$ binary variables in common.