

# Equal percent bias reduction and variance proportionate modifying properties with mean–covariance preserving matching

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**Abstract** Mean-preserving and covariance preserving matchings are introduced that can be obtained with conditional, randomized matching on sub-populations of a large control group. Under moment conditions it is shown that these matchings are, respectively, equal percent bias reducing (EPBR) and variance proportionate modifying (PM) for linear functions of the covariates and their standardizations. The results provide additional insight into and theory for EPBR and PM properties and confirm empirical and simulation findings that matchings can have the EPBR and PM properties also when the covariates are not exchangeable, or the treatment means are not equal.

**Keywords** Discriminant matching · Equal percent bias reducing · Mean–covariance preserving matching · Variance proportionate modifying matching