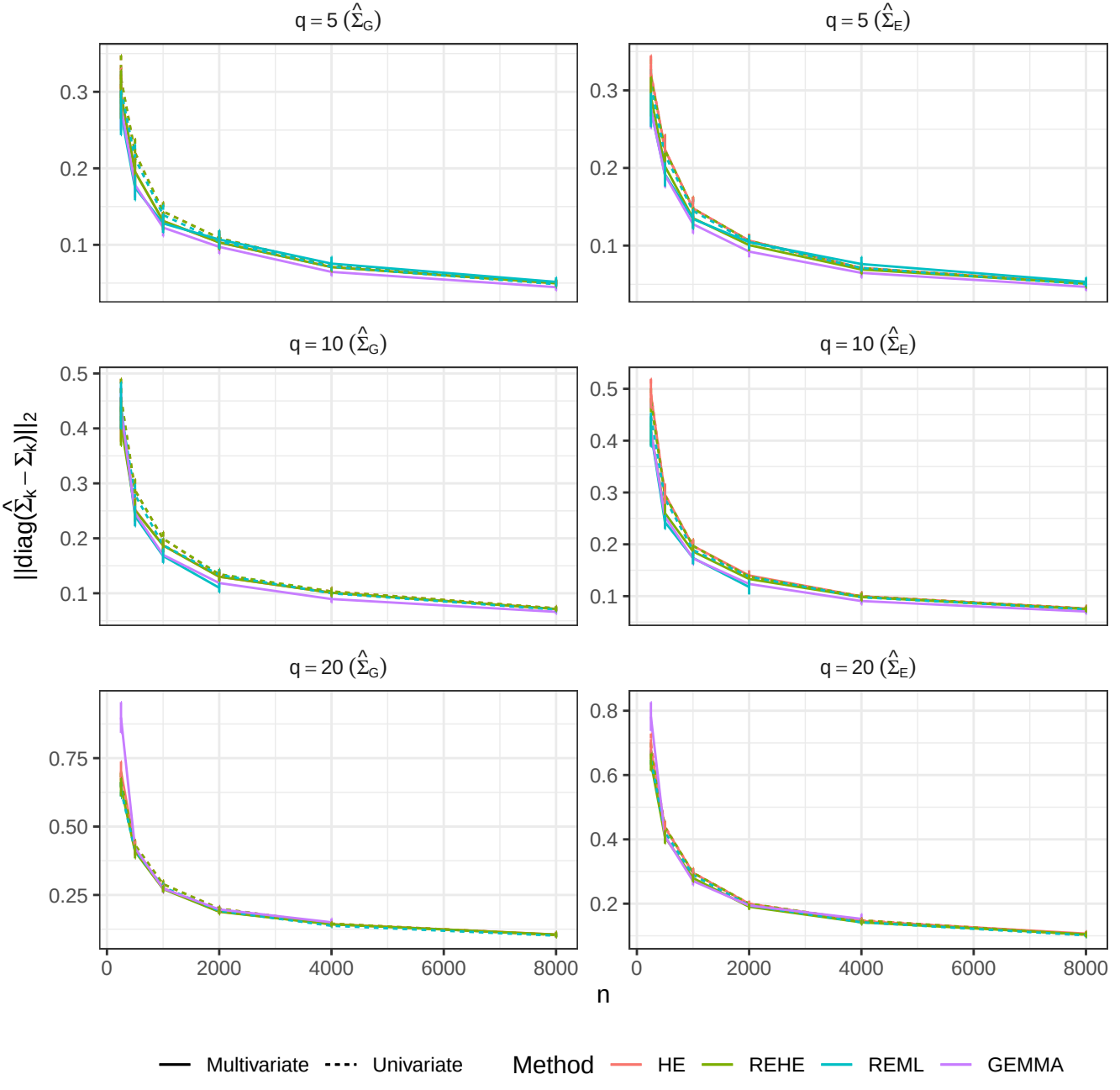
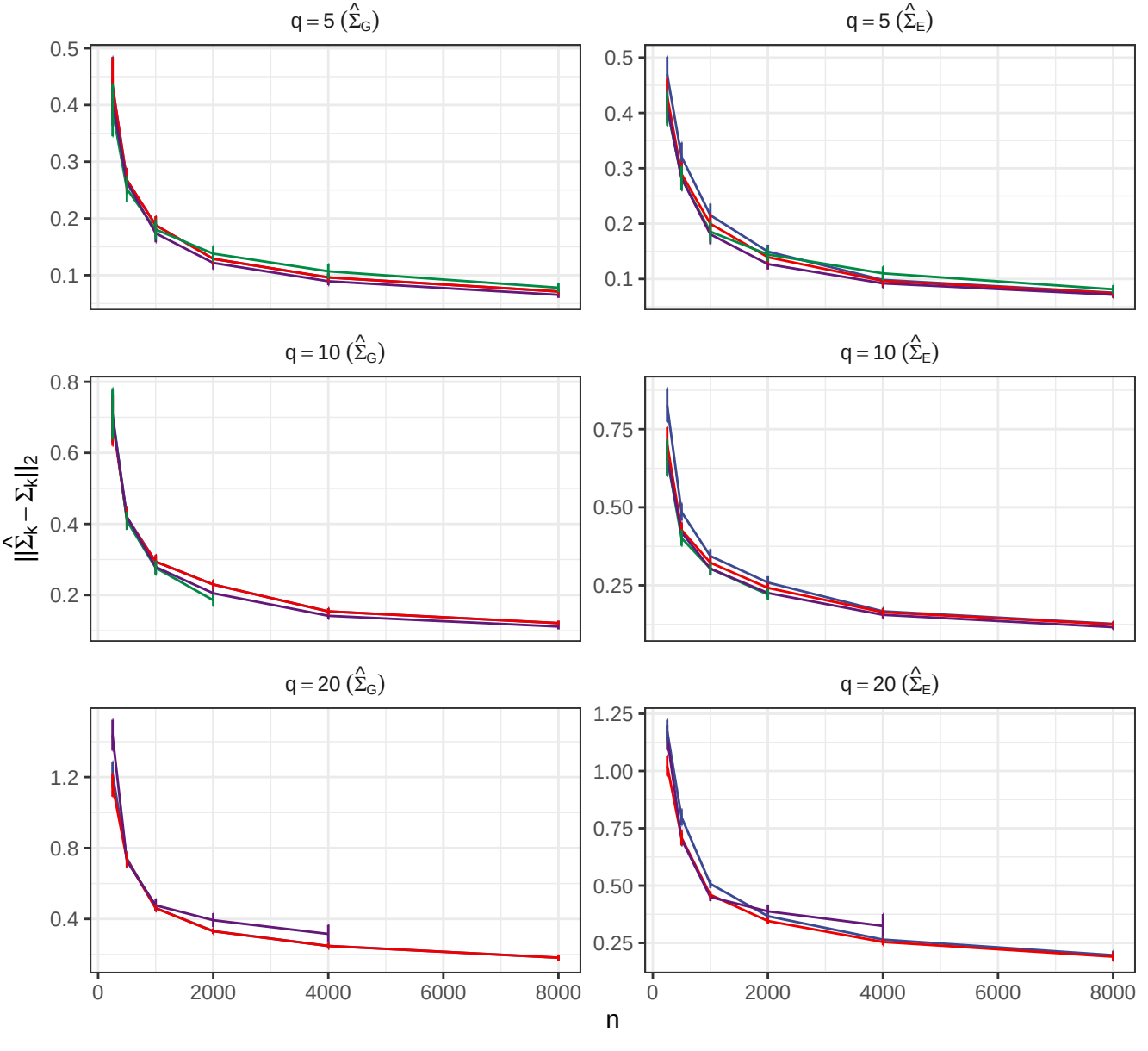

q = 5 ($\hat{\Sigma}_G$)
q = 5 ($\hat{\Sigma}_E$)
q = 10 ($\hat{\Sigma}_G$)
q = 10 ($\hat{\Sigma}_E$)
q = 20 ($\hat{\Sigma}_G$)
q = 20 ($\hat{\Sigma}_E$)
$||\text{diag}(\hat{\Sigma}_k - \Sigma_k)||_2$
n
Multivariate
Univariate
Method
HE
REHE
REML
GEMMA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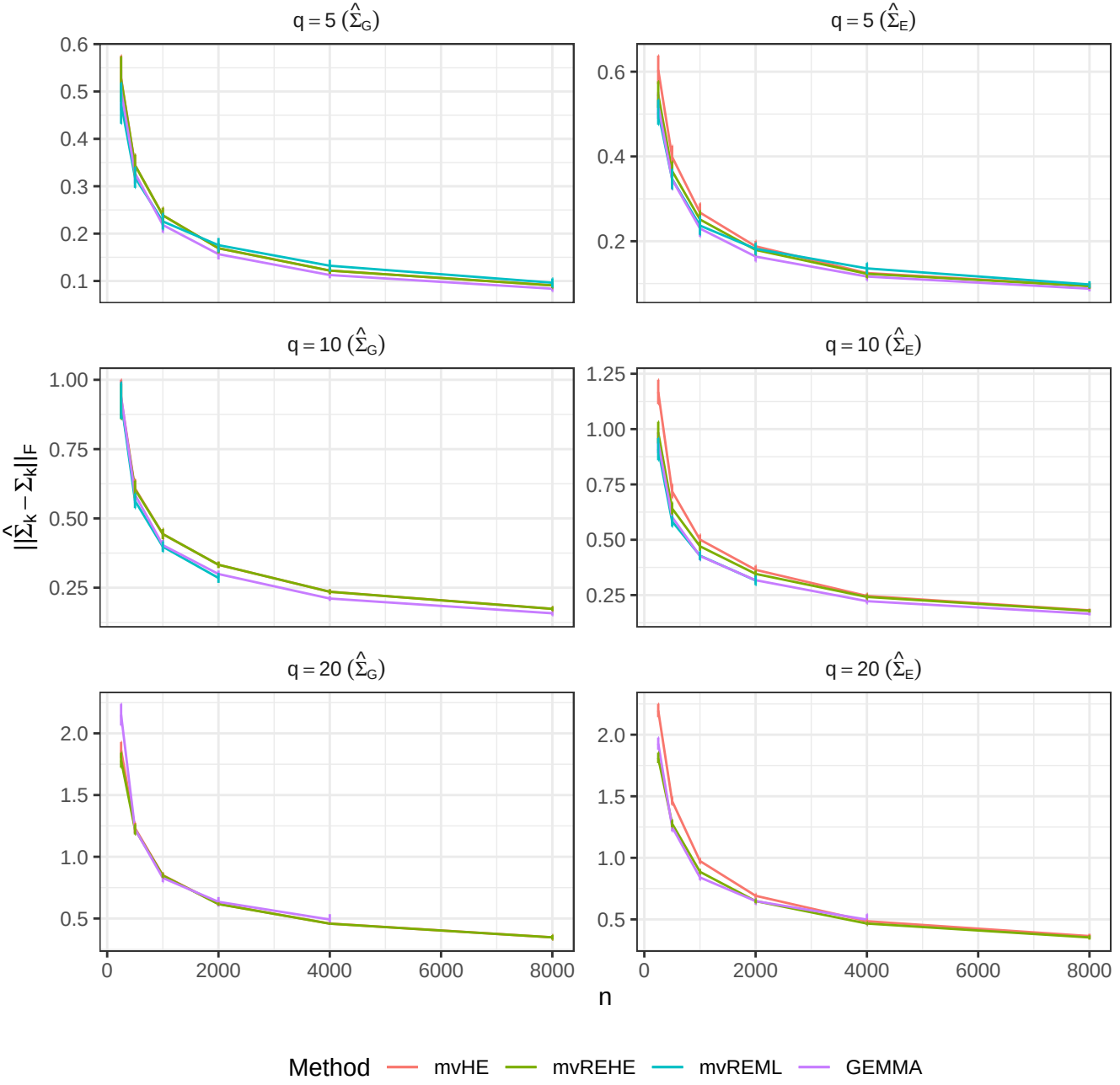
q = 5 ($\hat{\Sigma}_E$)
q = 10 ($\hat{\Sigma}_G$)
q = 10 ($\hat{\Sigma}_E$)
q = 20 ($\hat{\Sigma}_G$)
q = 20 ($\hat{\Sigma}_E$)
$||\hat{\Sigma}_k - \Sigma_k||_2$
n
Method
mvHE
mvREHE
mvREML
GEMMA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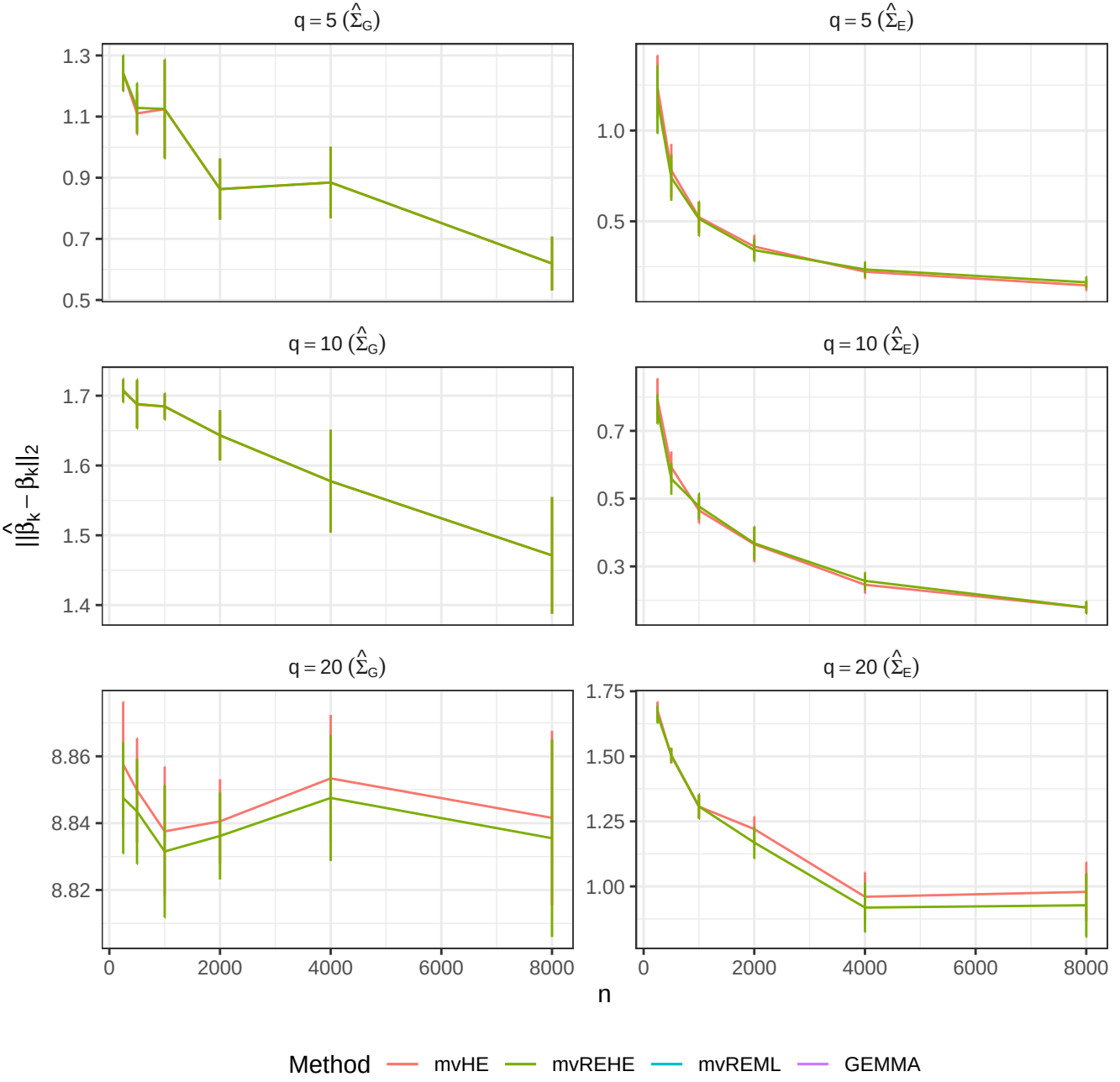
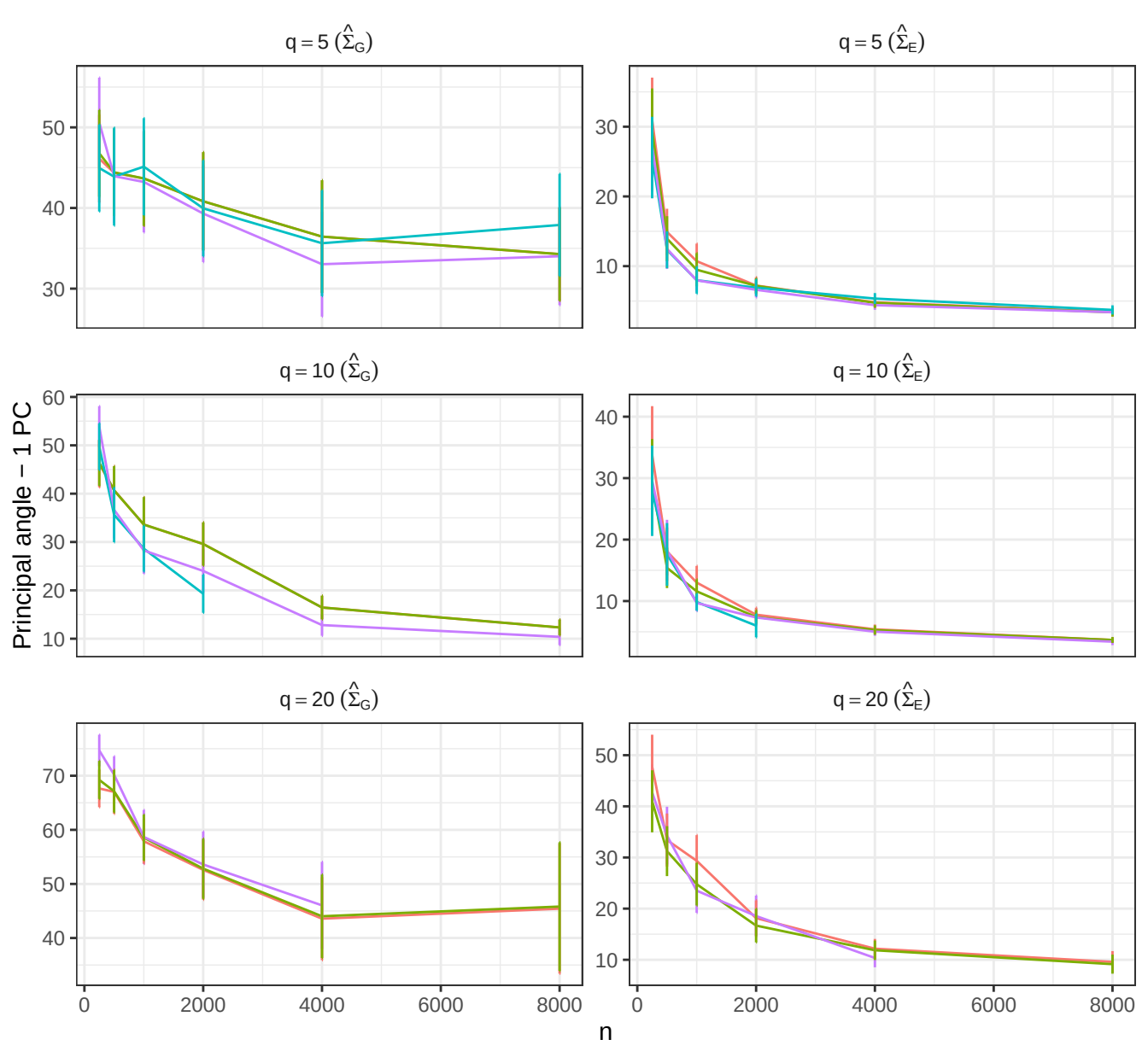
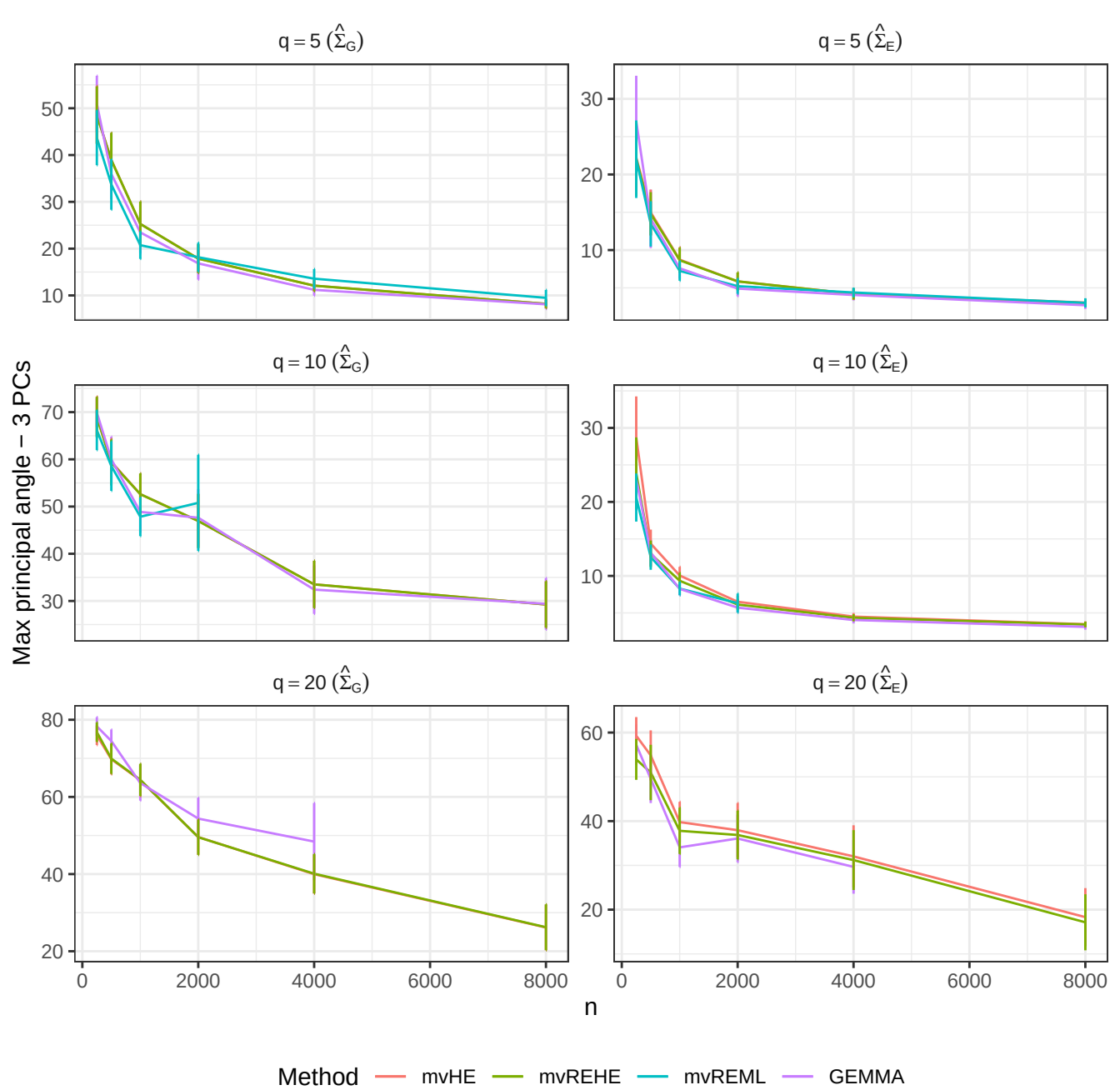
q = 5 ($\hat{\Sigma}_E$)
q = 10 ($\hat{\Sigma}_G$)
q = 10 ($\hat{\Sigma}_E$)
q = 20 ($\hat{\Sigma}_G$)
q = 20 ($\hat{\Sigma}_E$)
$||\hat{\Sigma}_k - \Sigma_k||_F$
n
Method
mvHE
mvREHE
mvREML
GEMMA


q = 5 ($\hat{\Sigma}_G$)
q = 5 ($\hat{\Sigma}_E$)
q = 10 ($\hat{\Sigma}_G$)
q = 10 ($\hat{\Sigma}_E$)
q = 20 ($\hat{\Sigma}_G$)
q = 20 ($\hat{\Sigma}_E$)
$\|\hat{\beta}_k - \beta_k\|_2$
n
Method
mvHE
mvREHE
mvREML
GEMMA


q = 5 ($\hat{\Sigma}_G$)
q = 5 ($\hat{\Sigma}_E$)
q = 10 ($\hat{\Sigma}_G$)
q = 10 ($\hat{\Sigma}_E$)
q = 20 ($\hat{\Sigma}_G$)
q = 20 ($\hat{\Sigma}_E$)
Principal angle – 1 PC
n
Method
mvHE
mvREHE
mvREML
GEMMA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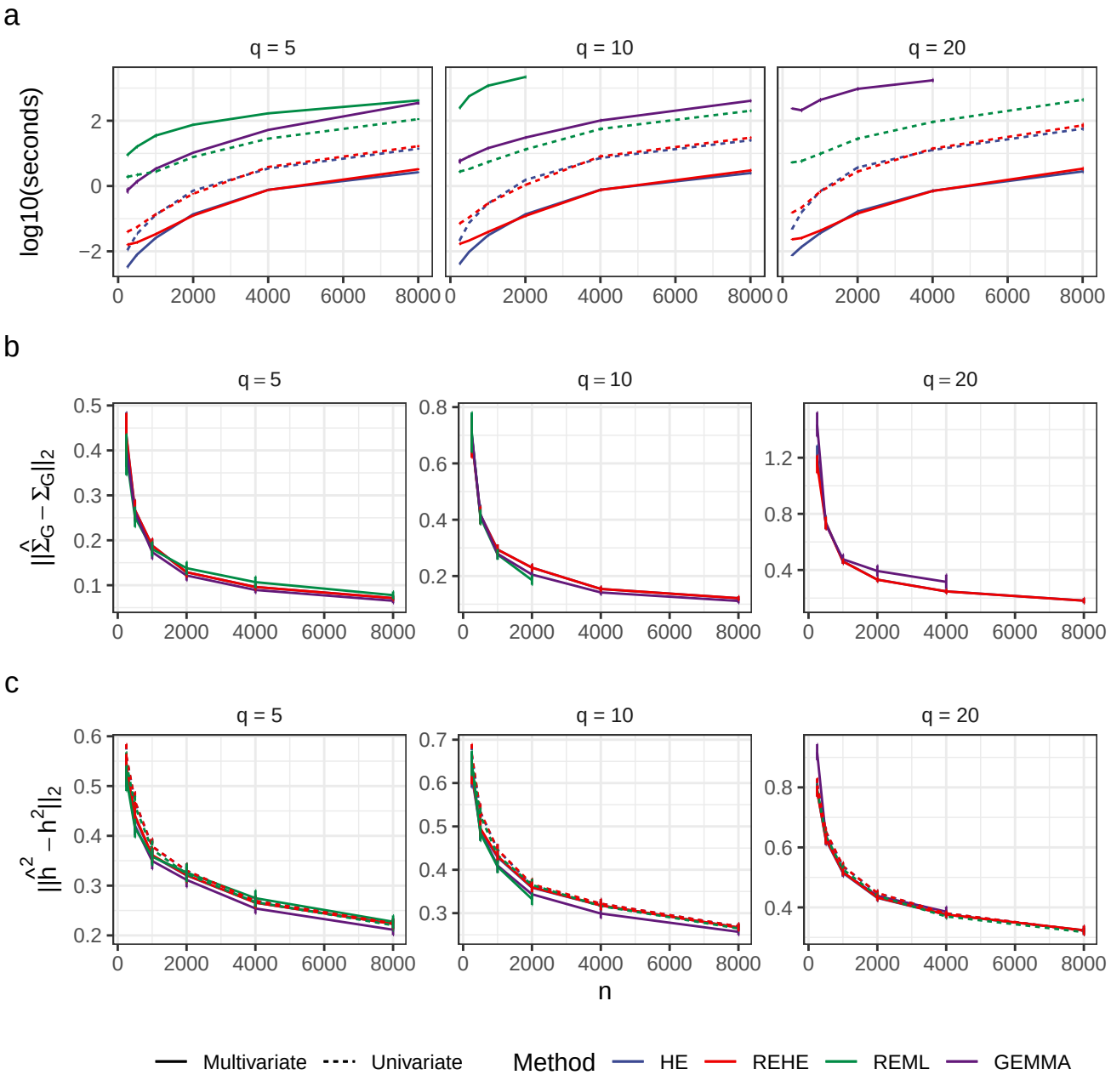
q = 5 ($\hat{\Sigma}_E$)
q = 10 ($\hat{\Sigma}_G$)
q = 10 ($\hat{\Sigma}_E$)
q = 20 ($\hat{\Sigma}_G$)
q = 20 ($\hat{\Sigma}_E$)
Max principal angle – 3 PCs
n
Method
mvHE
mvREHE
mvREML
GEMMA


a
q = 5
q = 10
q = 20
log10(seconds)
2
0
−2
0
2000
4000
6000
8000
b
q = 5
q = 10
q = 20
$||\hat{\Sigma}_G - \Sigma_G||_2$
0.5
0.4
0.3
0.2
0.1
0.8
0.6
0.4
0.2
1.2
0.8
0.4
c
q = 5
q = 10
q = 20
$||\hat{h}^2 - h^2||_2$
0.6
0.5
0.4
0.3
0.2
0.7
0.6
0.5
0.4
0.3
0.8
0.6
0.4
n
Multivariate
Univariate
Method
HE
REHE
REML
GEMMA