Validate Power: d3.2

December 30, 2021

Design: Blocked Cluster RCT, with 3 levels, and randomization done at level 2 (school level).

Models: random and fixed treatment effects.

Default parameters:

- M = 3
- J = 30
- K = 10
- rho: $\rho = 0.5$
- MDES: 0.125, 0.125, 0.125
- R2: $R_1^2 = 0.1, 0.1, 0.1$, $R_2^2 = 0.1, 0.1, 0.1$, $R_3^2 = 0$
- ICC: $ICC_2 = 0.2, 0.2, 0.2$, $ICC_3 = 0.2, 0.2, 0.2$
- Omega2: $\omega_2 = 0$

Parameters by model type:

- Omega3: $\omega_3 = 0$ for fixed effects, $omega_3 = 0.1, 0.1, 0.1$ for random effects

Remark. For some of the scenarios, the PUMP estimate is slightly outside the range of the monte carlo intervals. This occurs for the `d3.2_m3rr2rc` model when either $\omega_3 = 0$ or $ICC.3 = 0$. In general, we find that this model is difficult to fit. Across all scenarios, many of the simulated datasets result in either models that do not converge, or have a singular fit. We believe that the poor-fitting model is exacerbated when there is no truly variation at level 3 (due to $\omega_3 = 0$ or $ICC.3 = 0$), but the model is attempting to fit random effects to the treatment impacts. The poor-fitting models may result in the simulations not achieve accurate estimates of power.
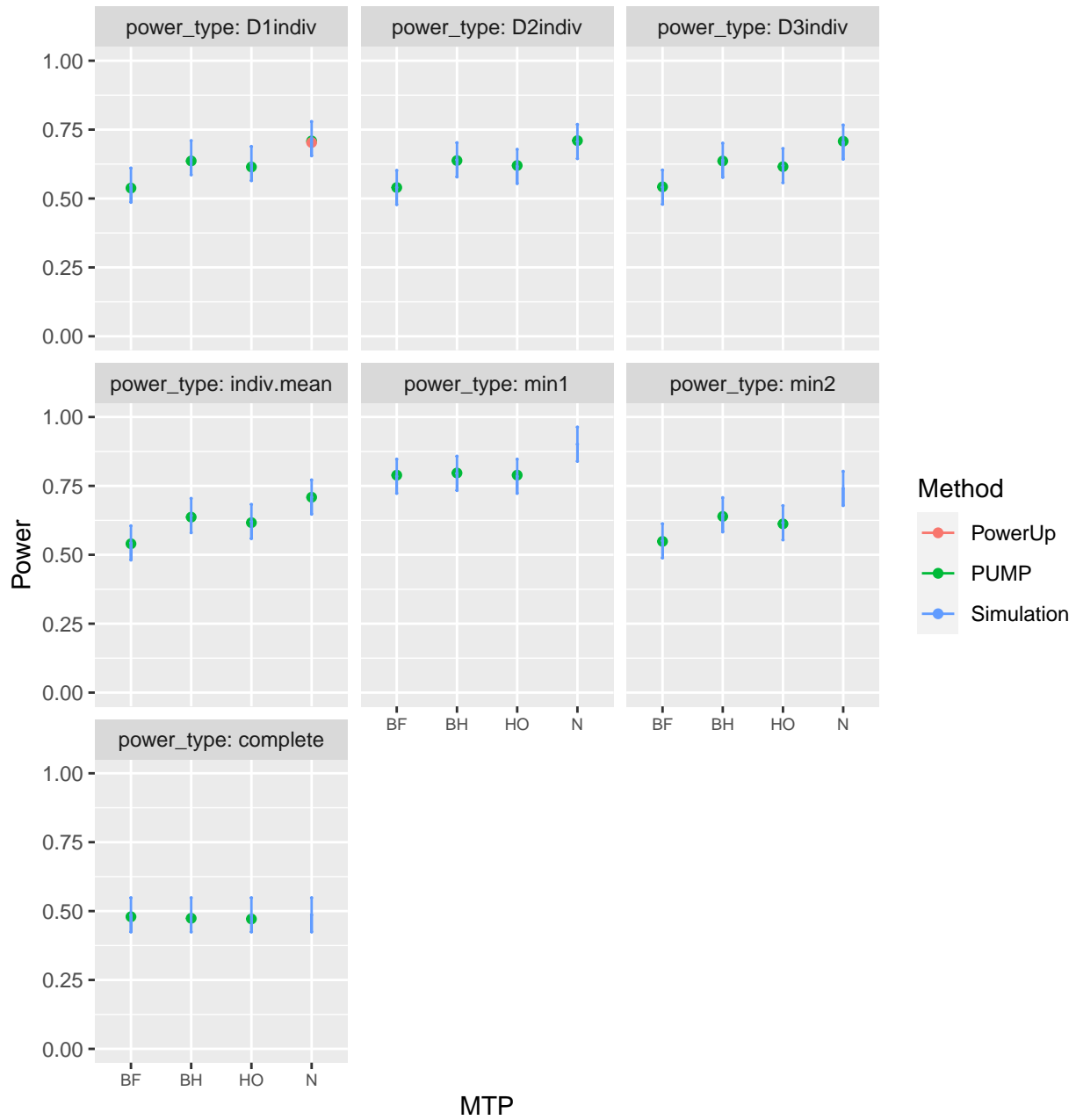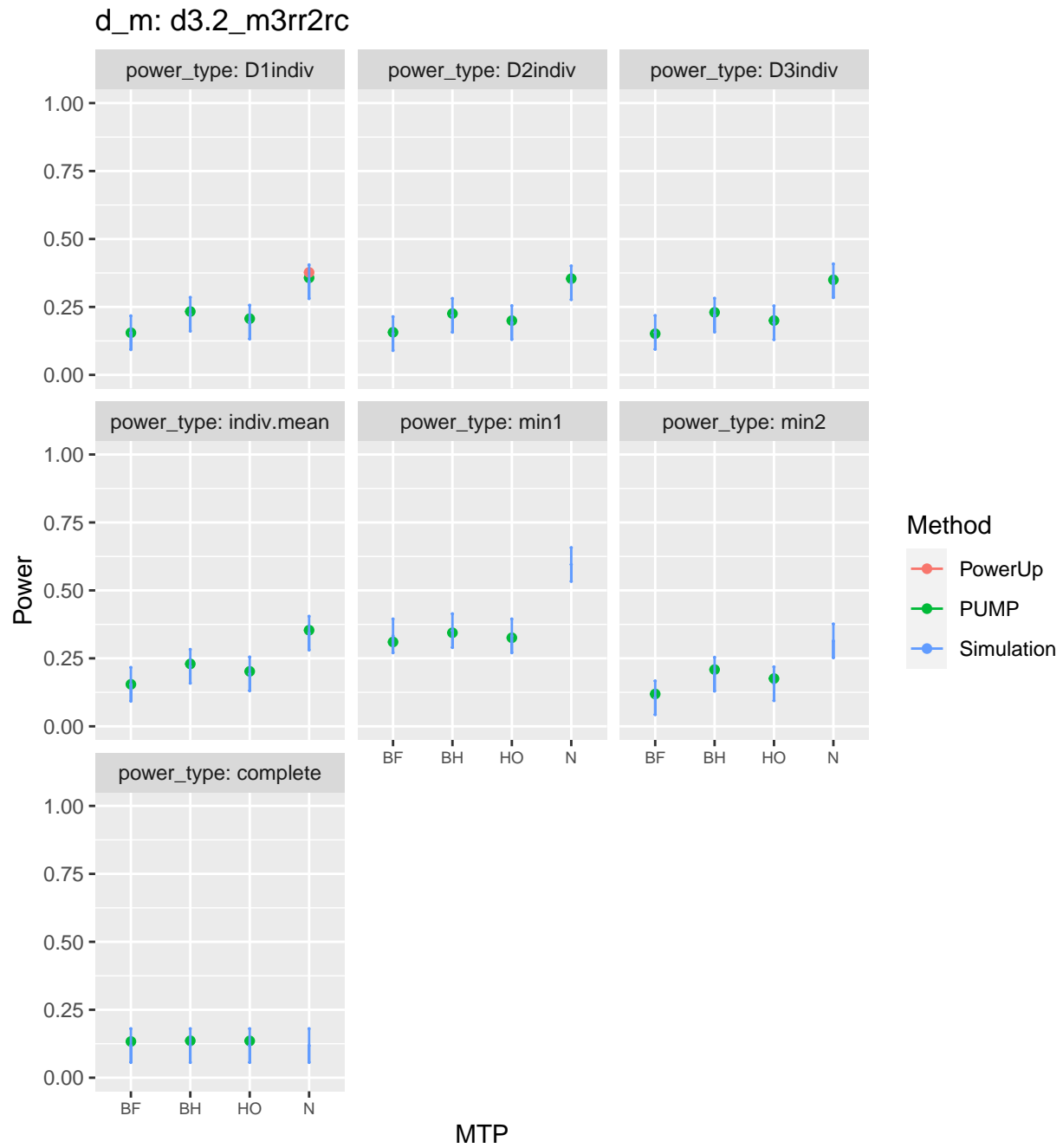
Power Validation

Base case

d_m: d3.2_m3ff2rc

d_m: d3.2_m3rr2rc
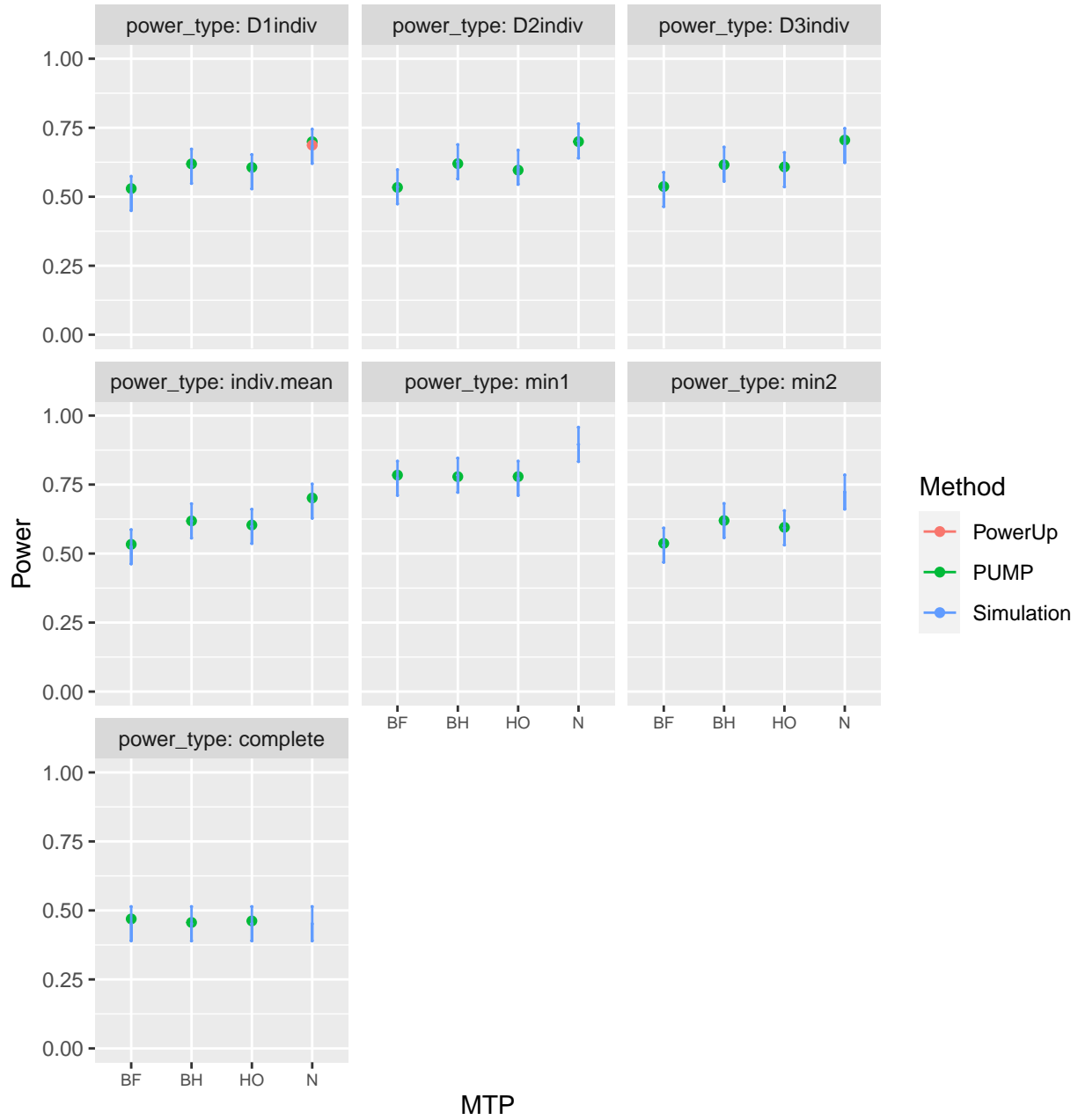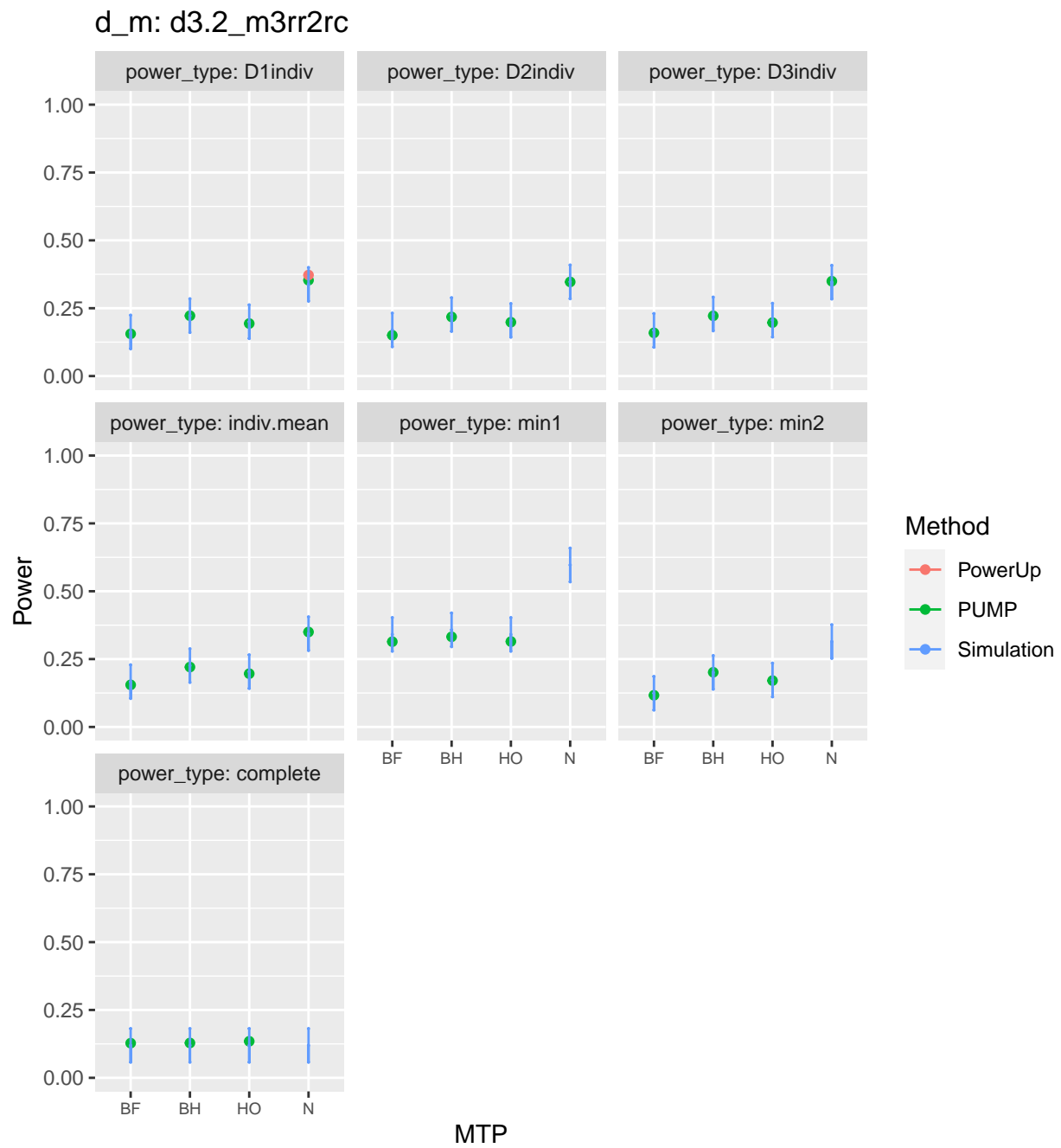
Varying school size

$\bar{n} = 100$

d_m: d3.2_m3ff2rc

d_m: d3.2_m3rr2rc

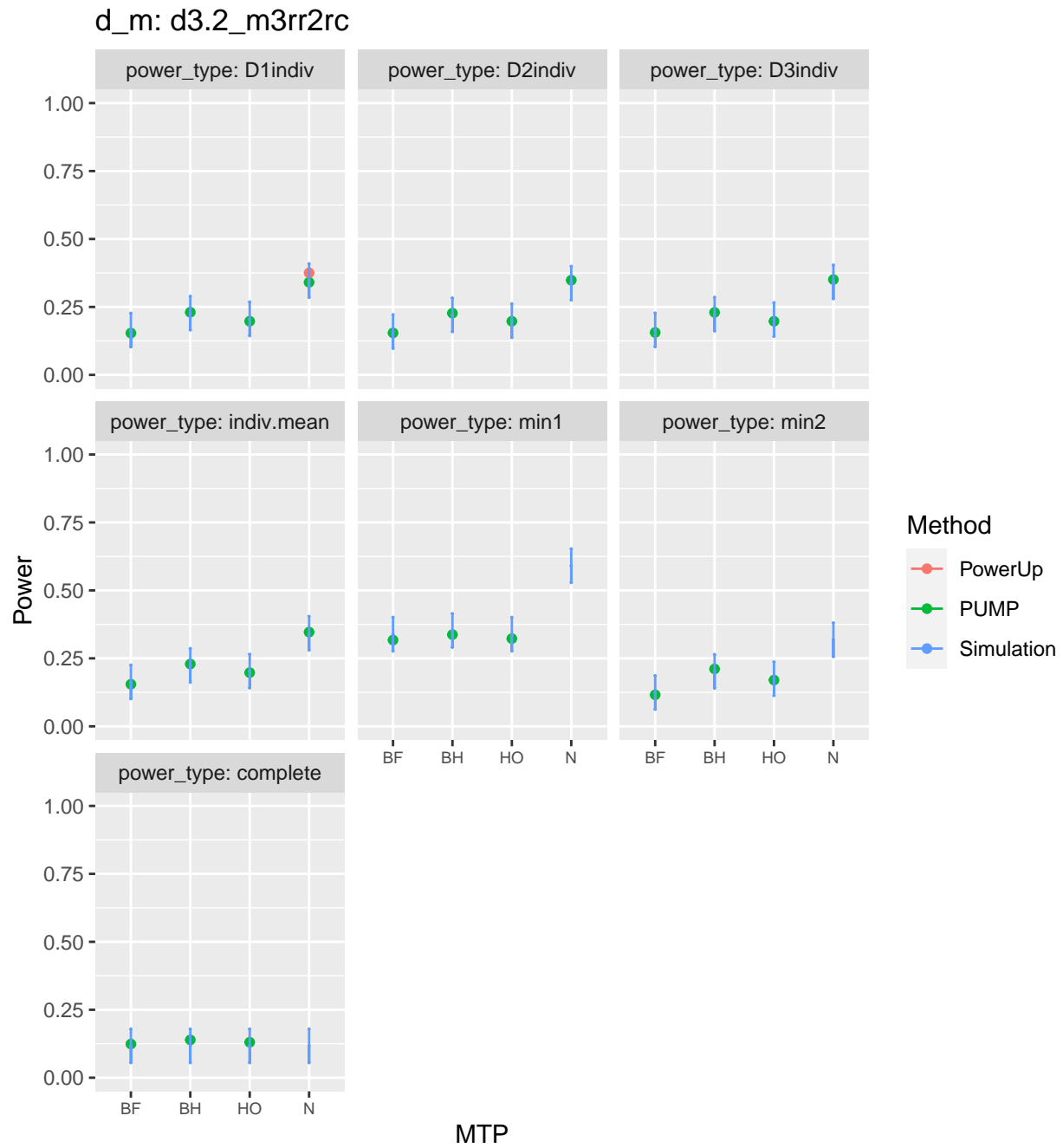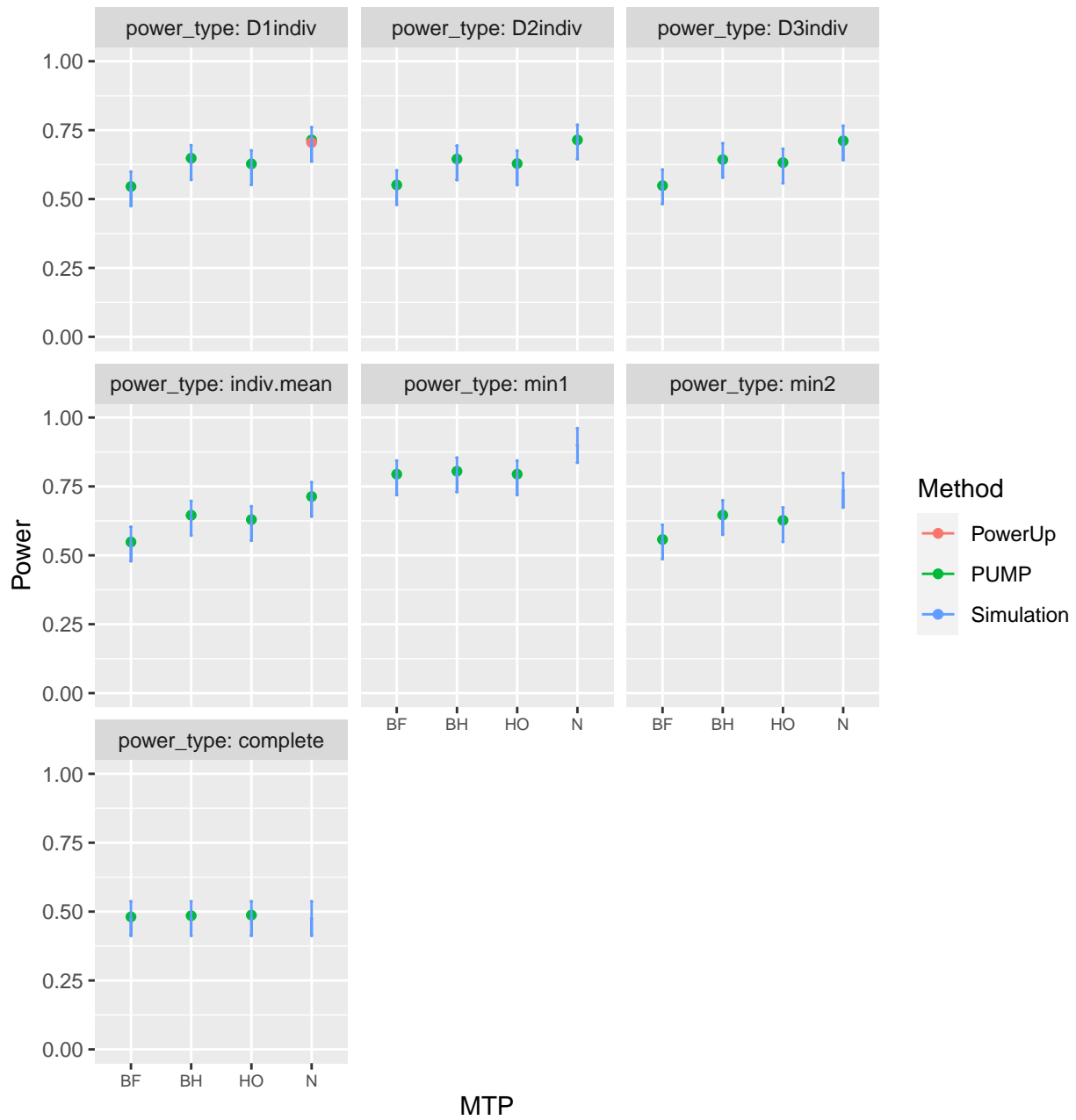# d_m: d3.2_m3ff2rc

d_m: d3.2_m3rr2rc
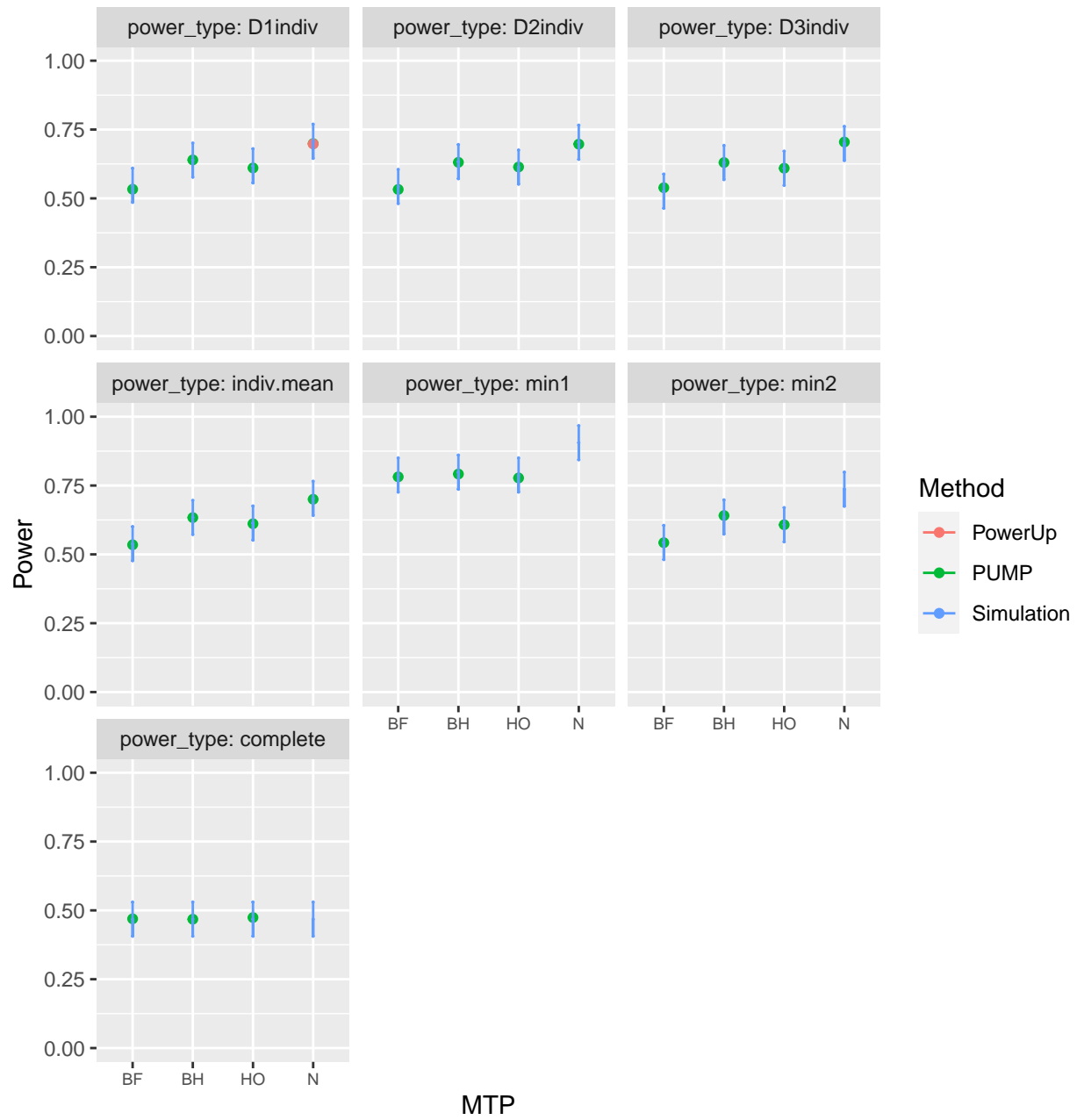
Varying R2

$R_1^2 = 0.6, 0.6, 0.6$

d_m: d3.2_m3ff2rc

d_m: d3.2_m3rr2rc
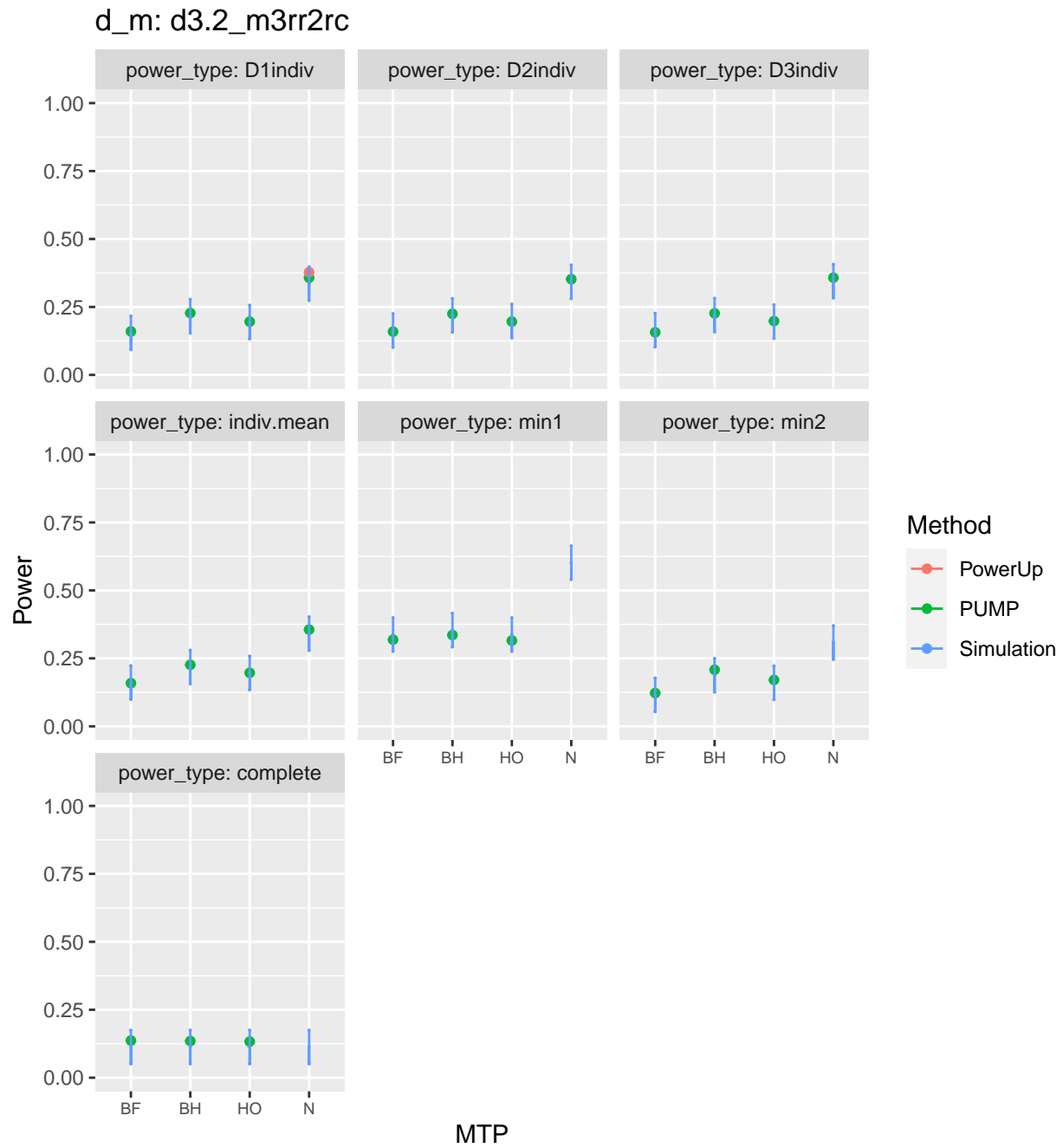
$R_2^2 = 0.6, 0.6, 0.6$
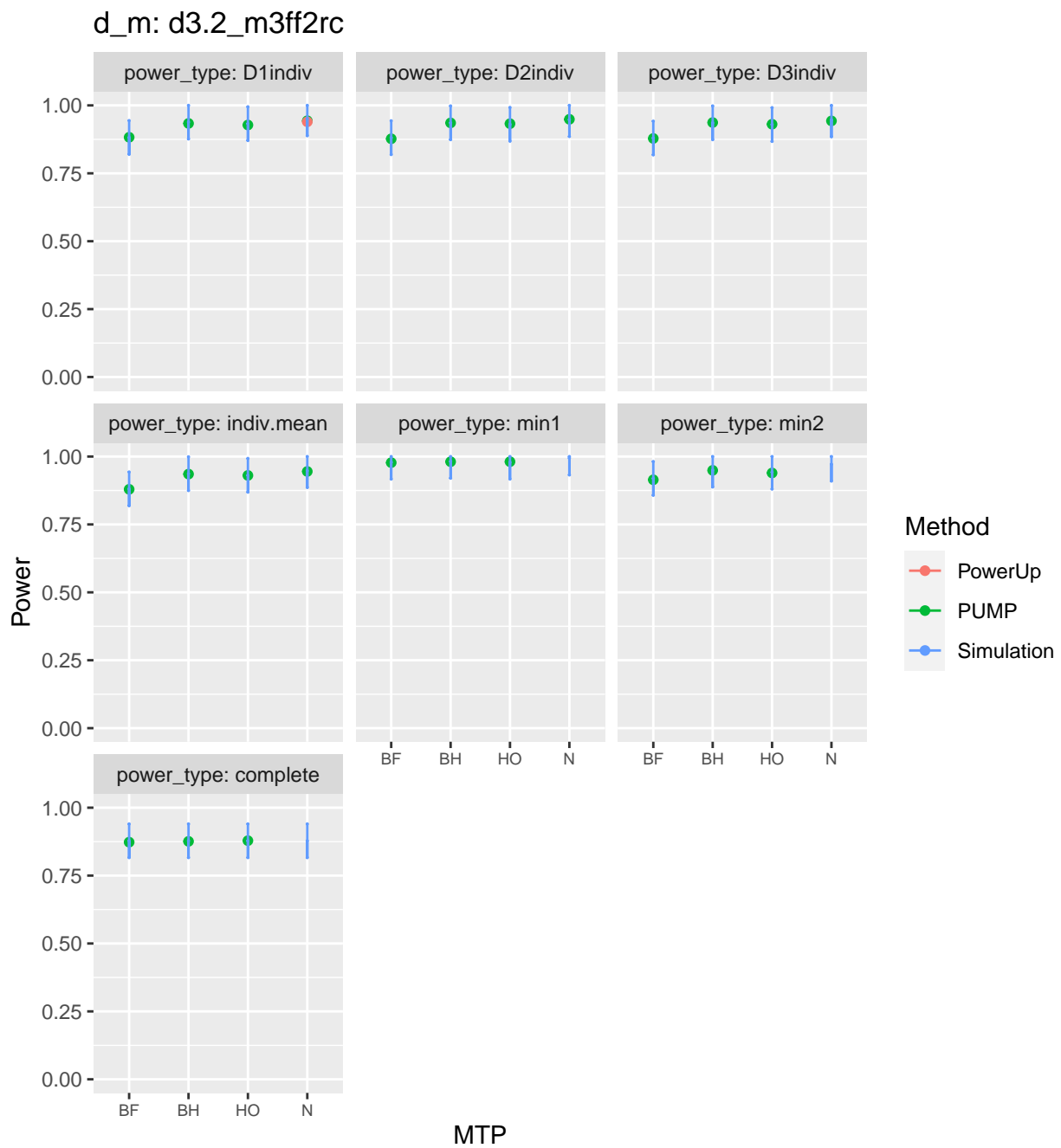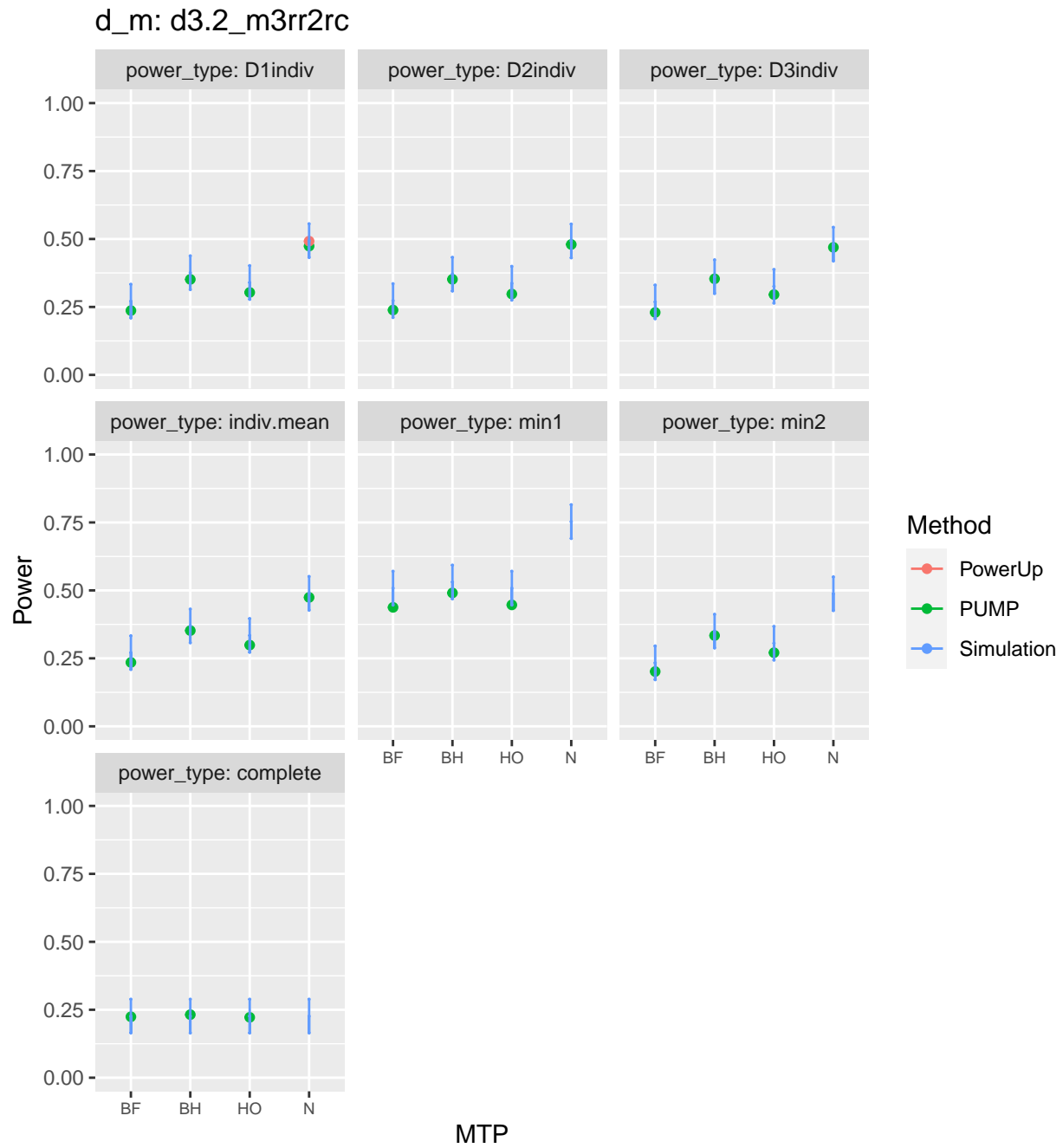
d_m: d3.2_m3rr2rc

$R_1^2 = 0, 0, 0 \ R_2^2 = 0, 0, 0$

d_m: d3.2_m3ff2rc
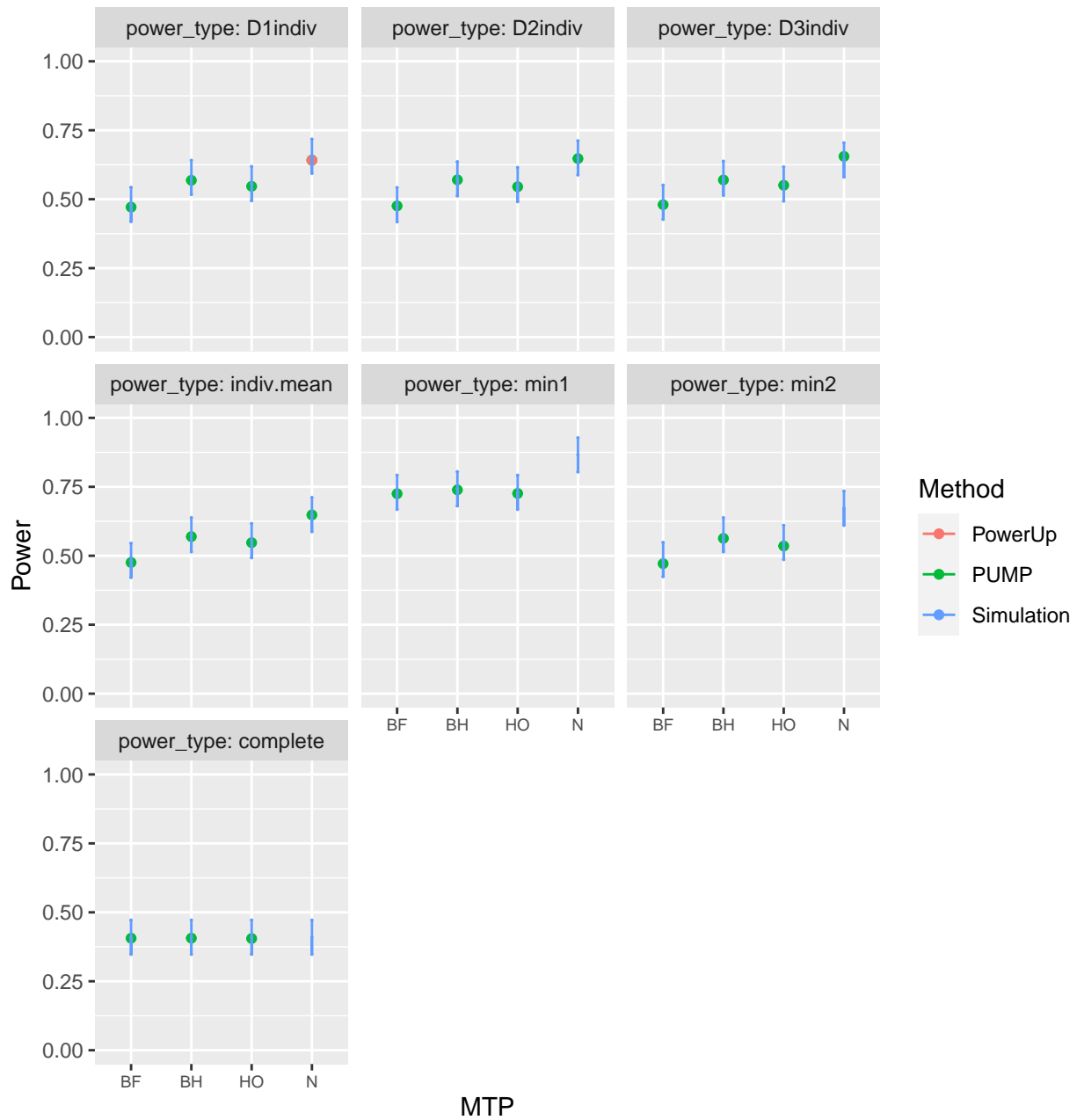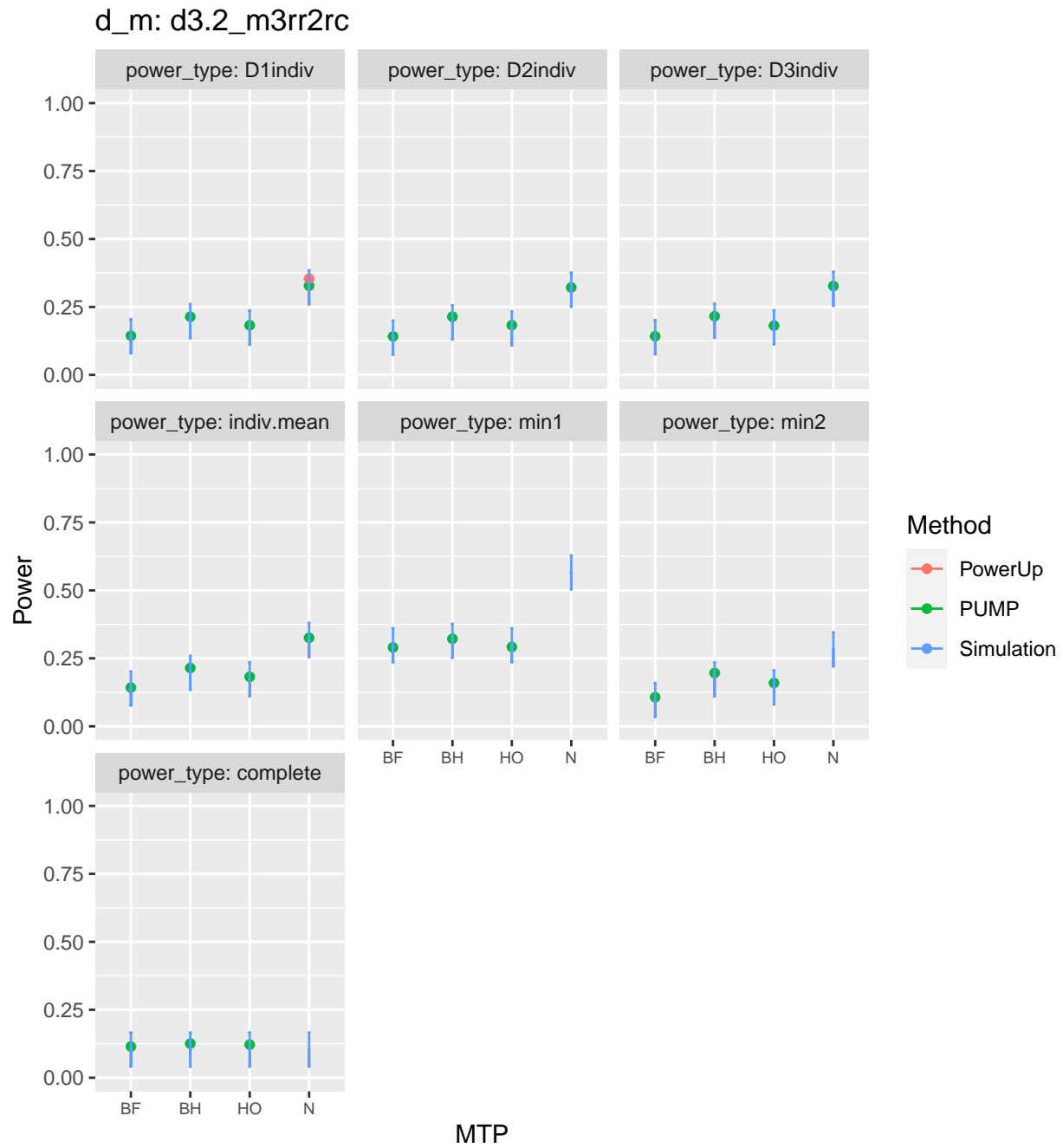
d_m: d3.2_m3rr2rc

Varying rho

$\rho = 0.2$

d_m: d3.2_m3ff2rc
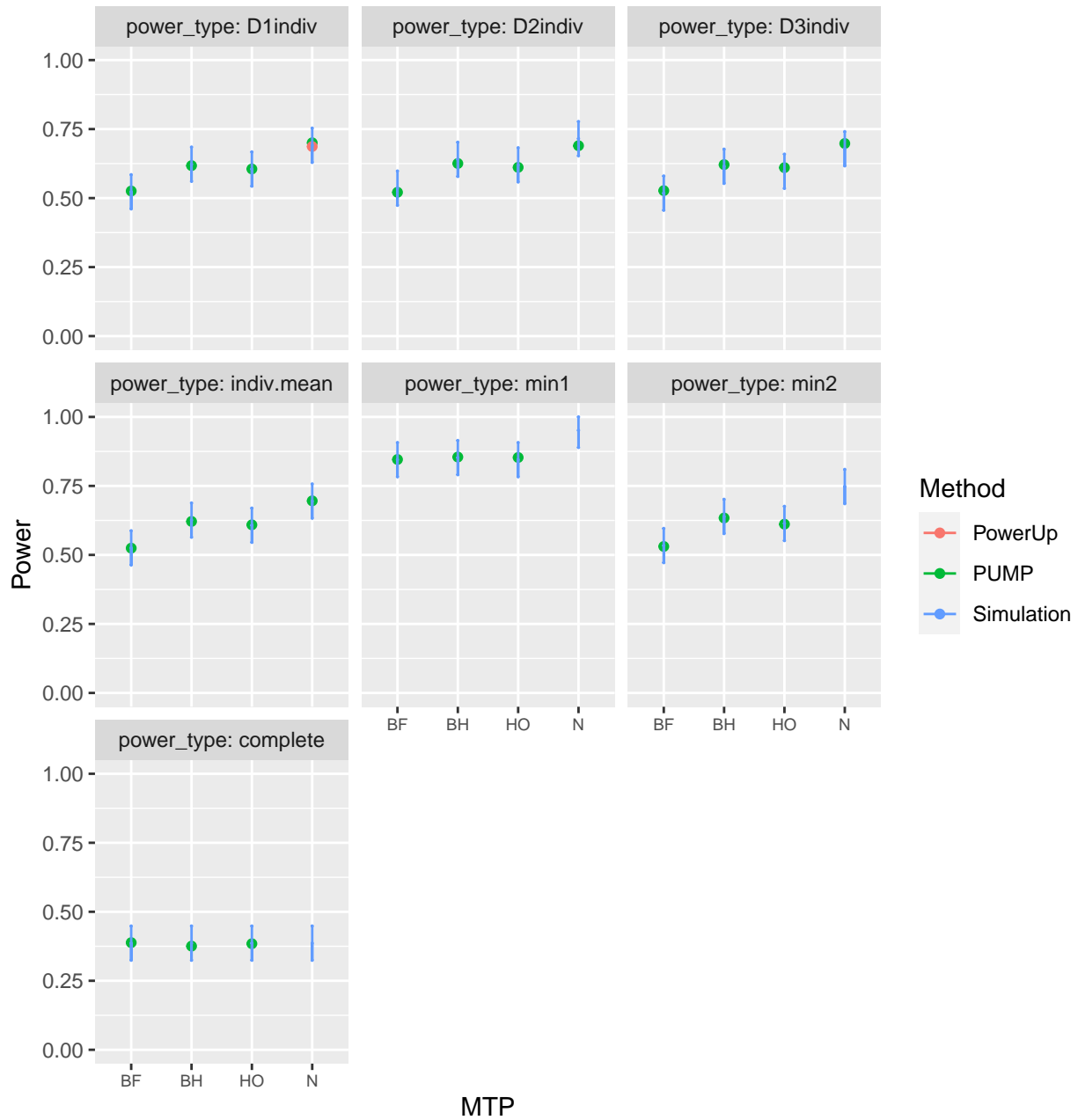
$\rho = 0.8$
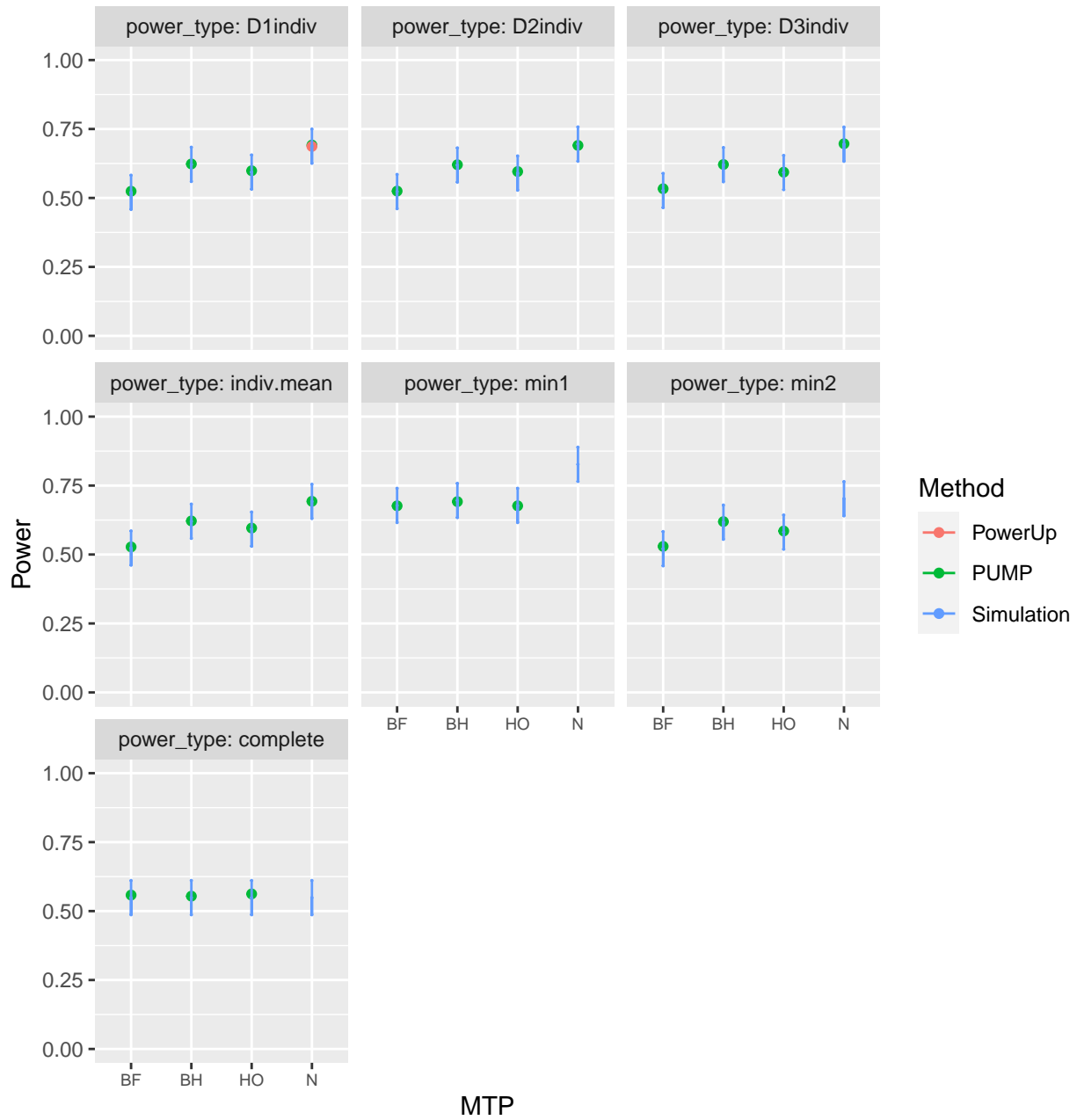
d_m: d3.2_m3ff2rc

Varying true positives

MDES = 0.125, 0, 0

d_m: d3.2_m3ff2rc
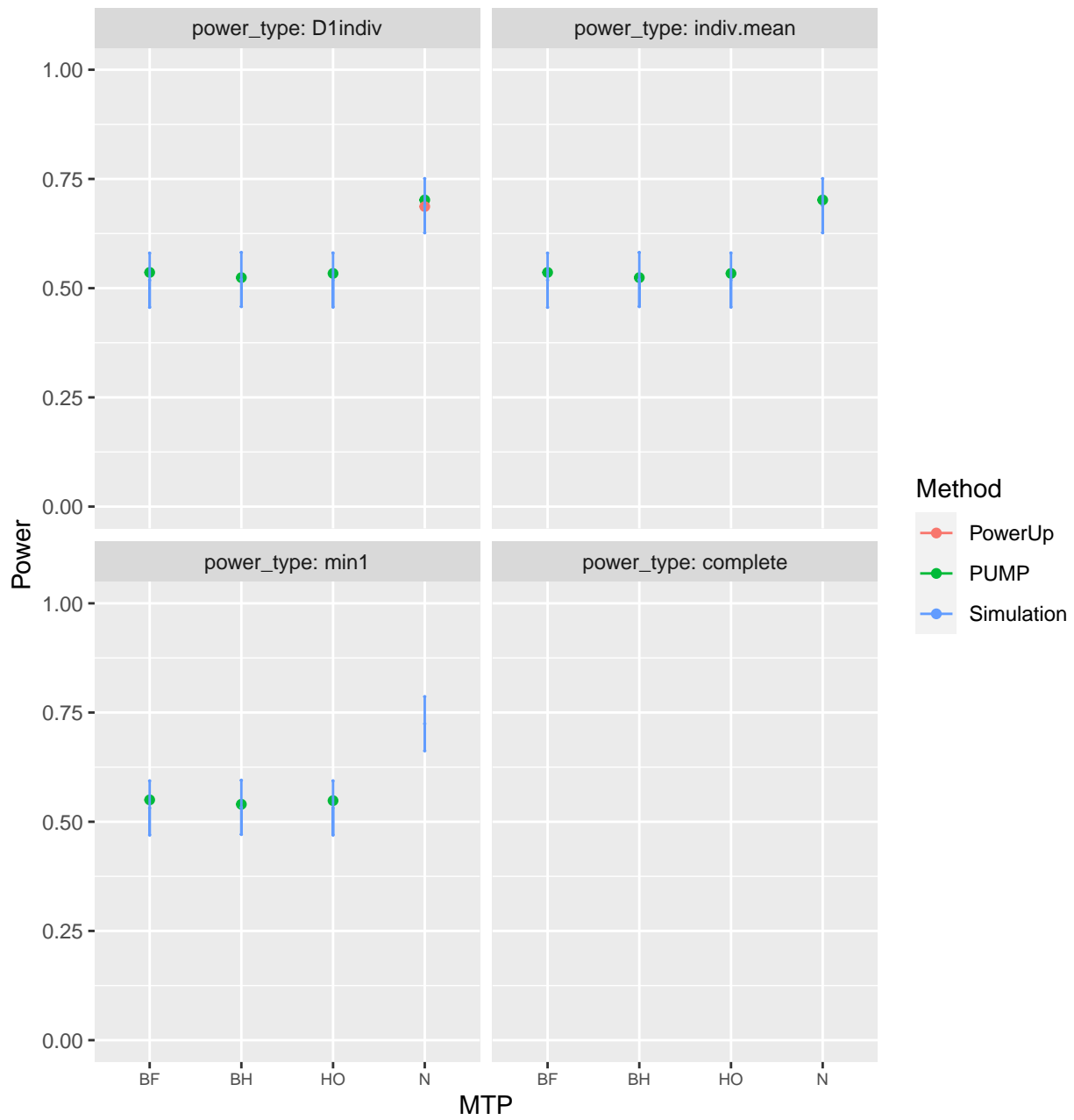
Varying ICC

$ICC_2 = 0.7, 0.7, 0.7$ $ICC_3 = 0.2, 0.2, 0.2$

d_m: d3.2_m3ff2rc
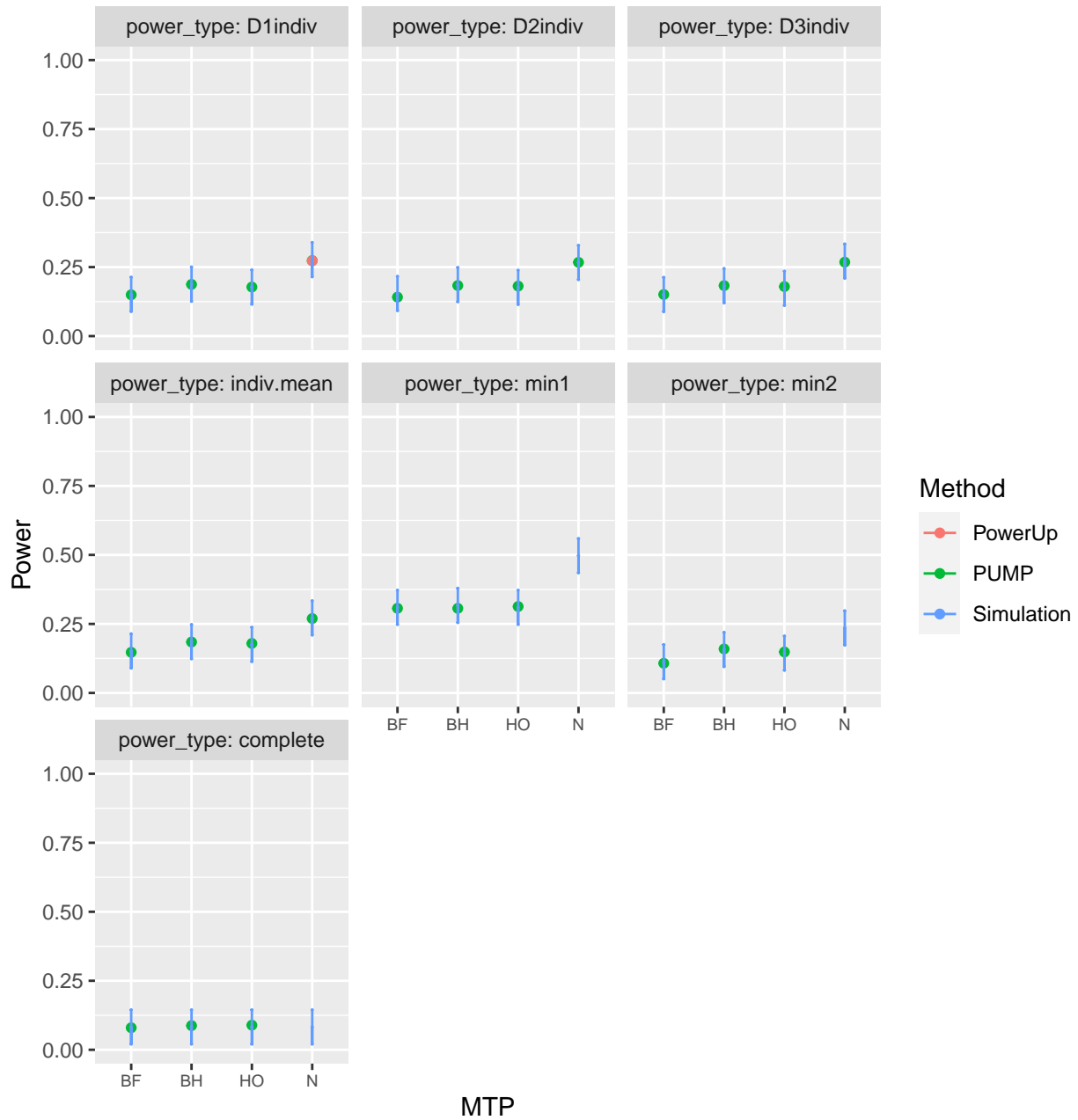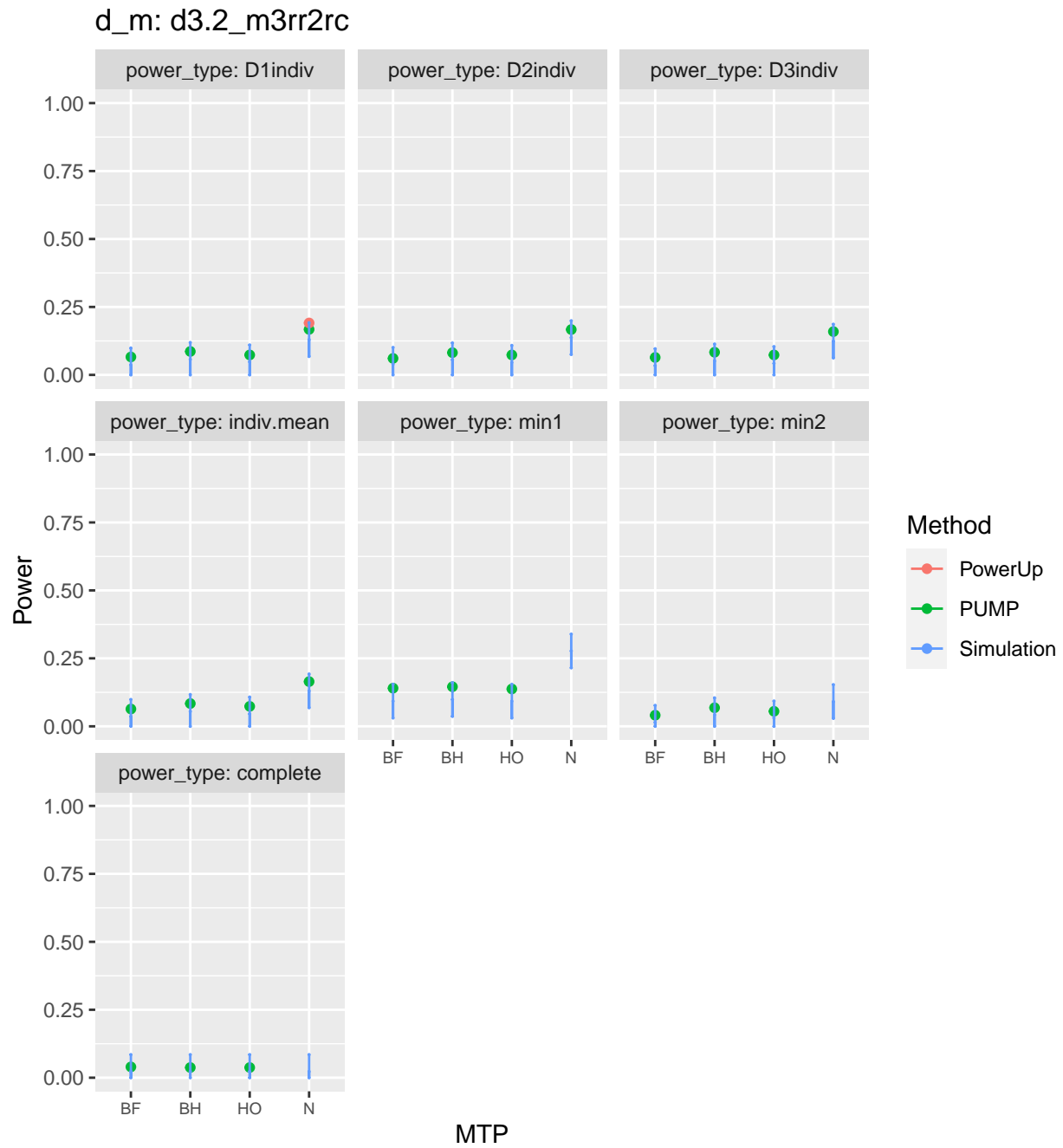
d_m: d3.2_m3rr2rc

ICC$_2$ = 0.2, 0.2, 0.2 ICC$_3$ = 0.7, 0.7, 0.7

d_m: d3.2_m3rr2rc
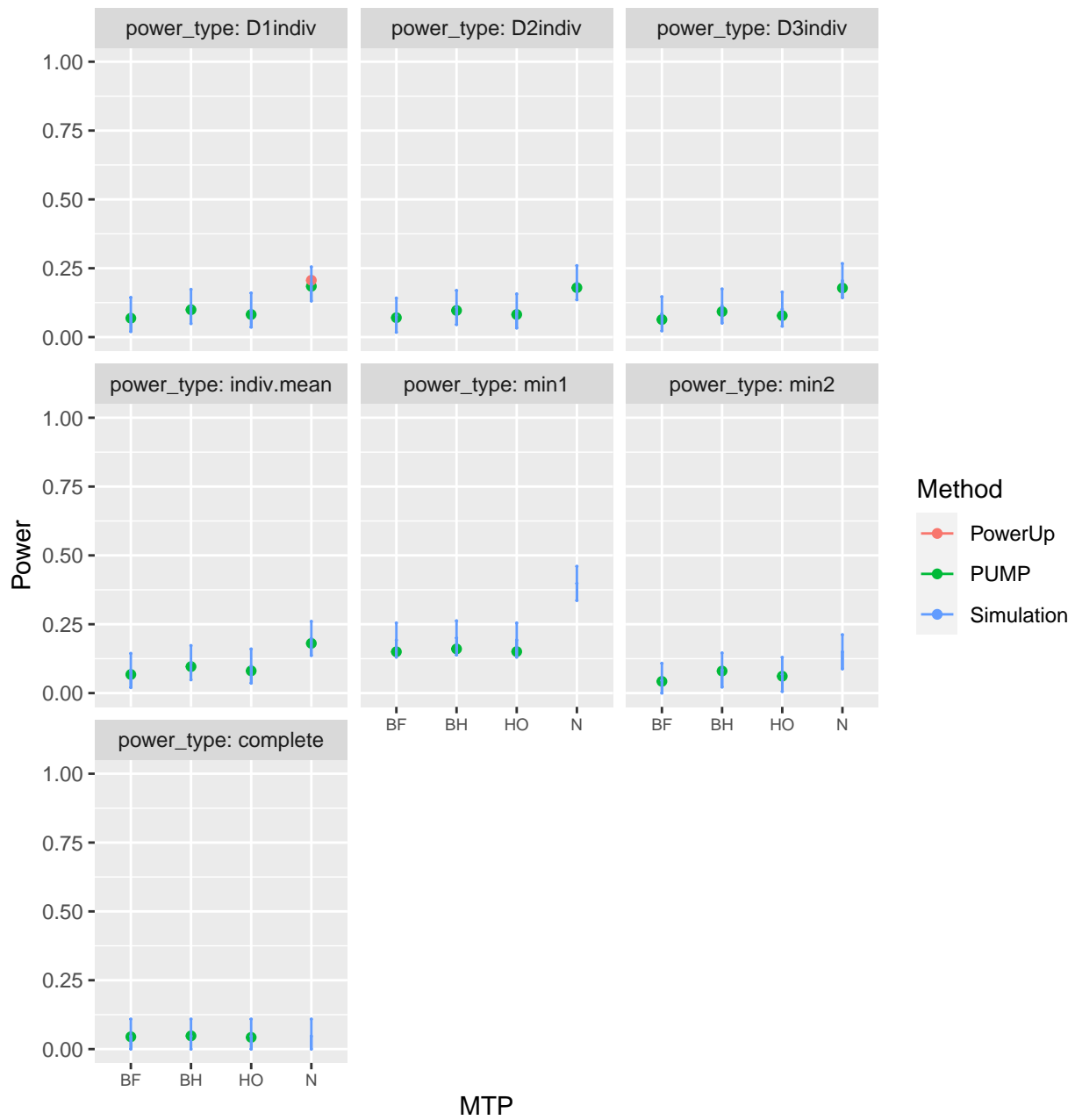
$\mathrm{ICC}_2 = 0,\ 0,\ 0\ \mathrm{ICC}_3 = 0.2,\ 0.2,\ 0.2$

d_m: d3.2_m3ff2rc
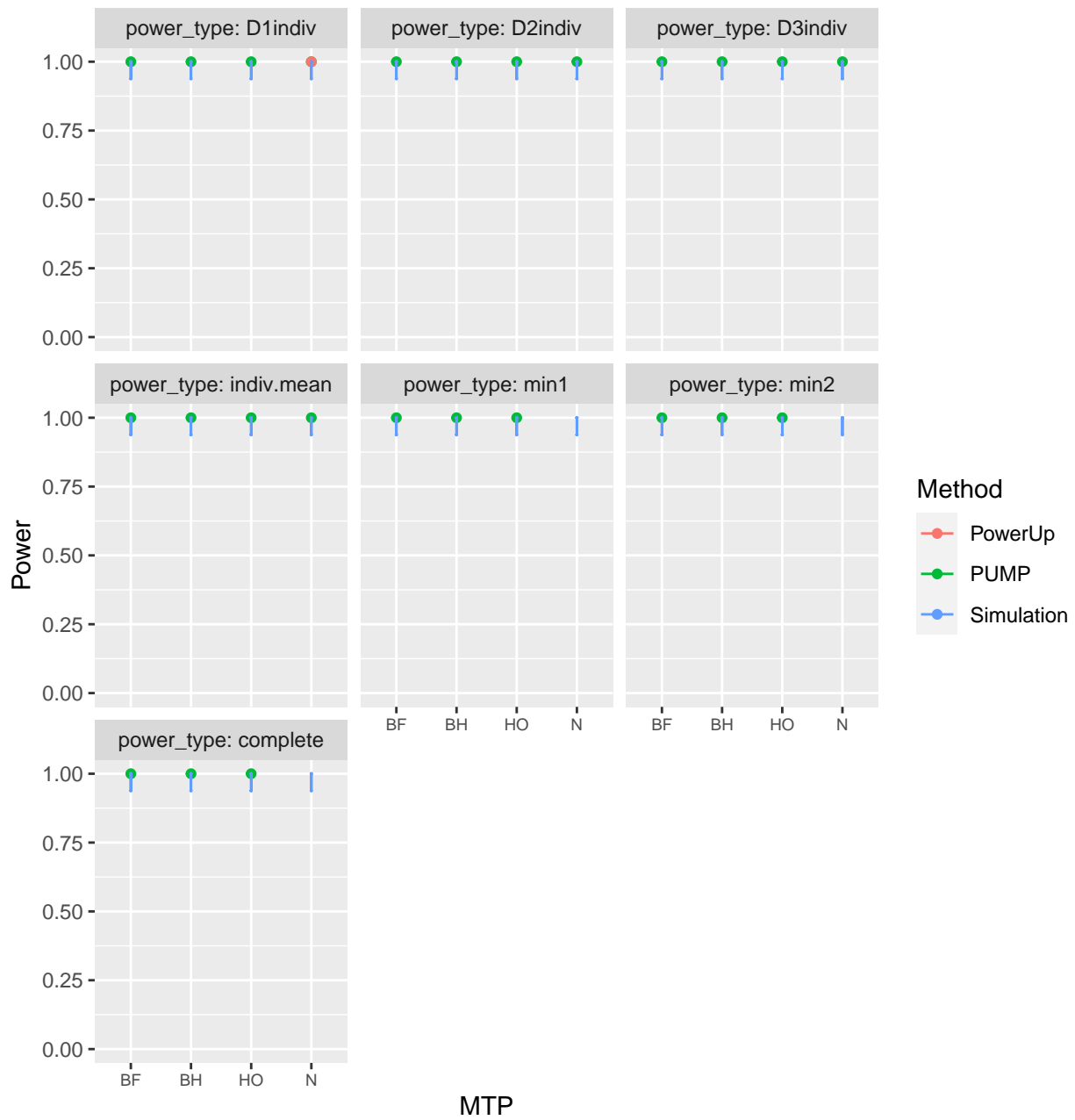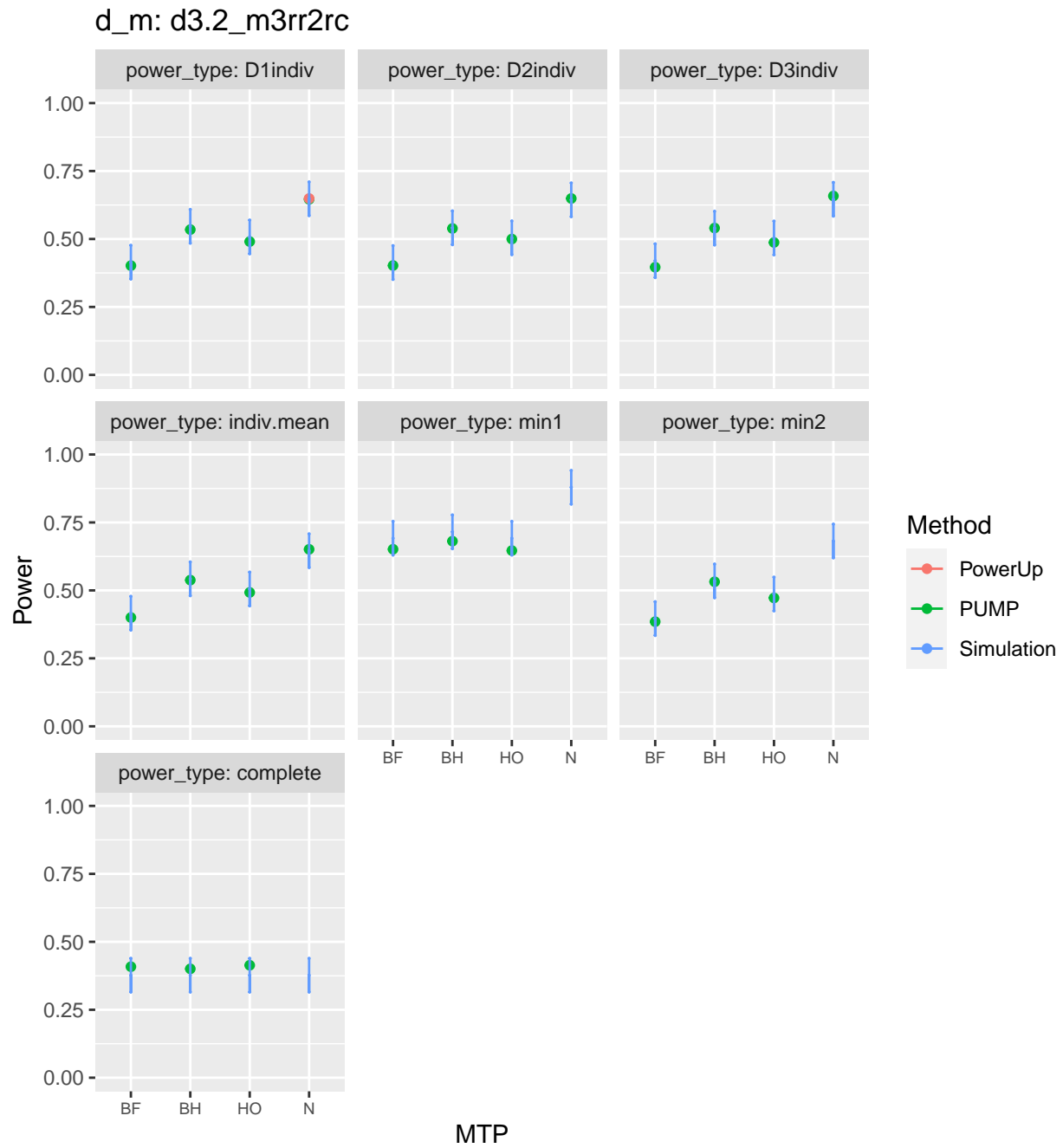
d_m: d3.2_m3rr2rc

$\text{ICC}_2 = 0.2, 0.2, 0.2 \ \text{ICC}_3 = 0, 0, 0$

d_m: d3.2_m3ff2rc
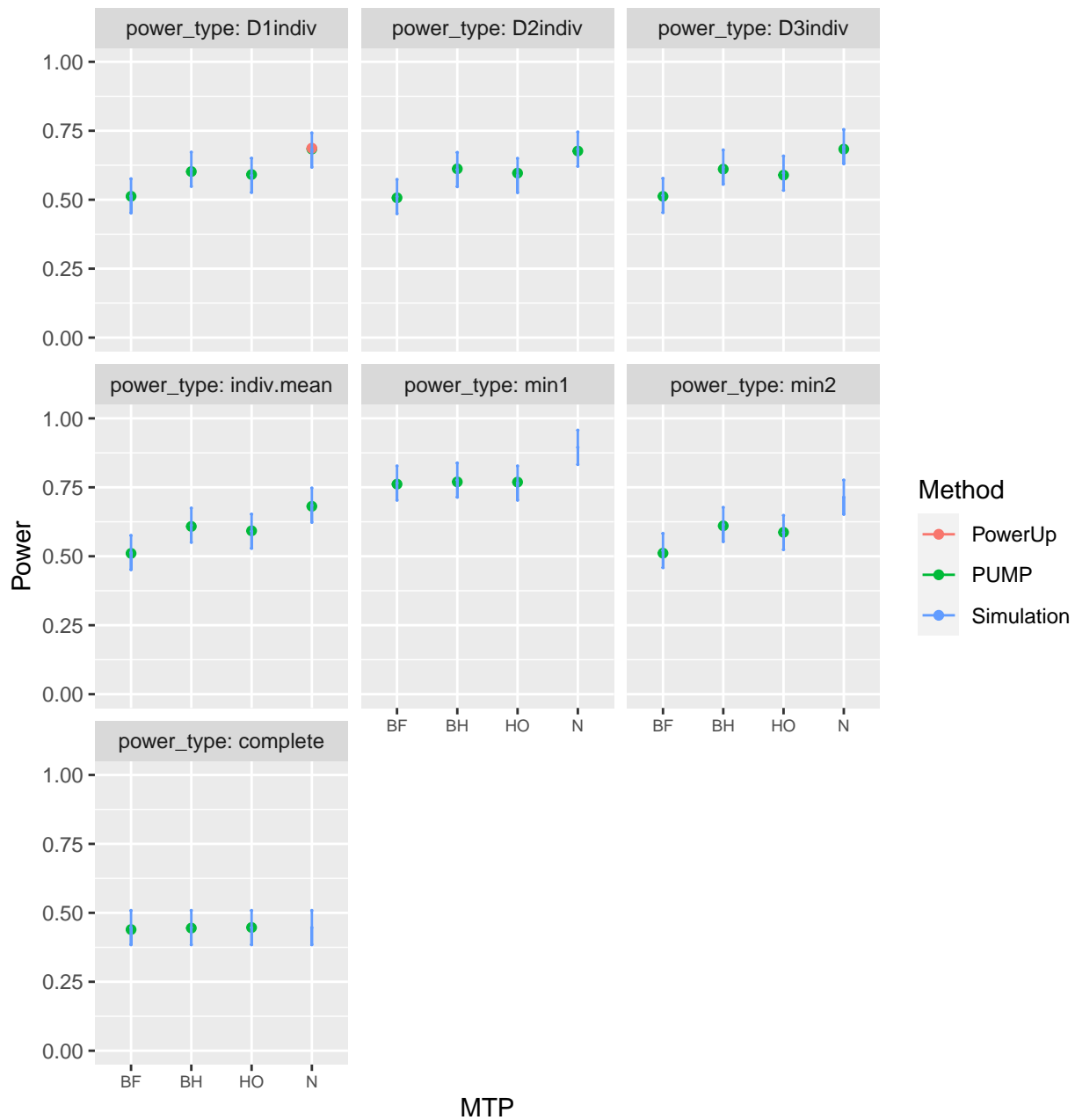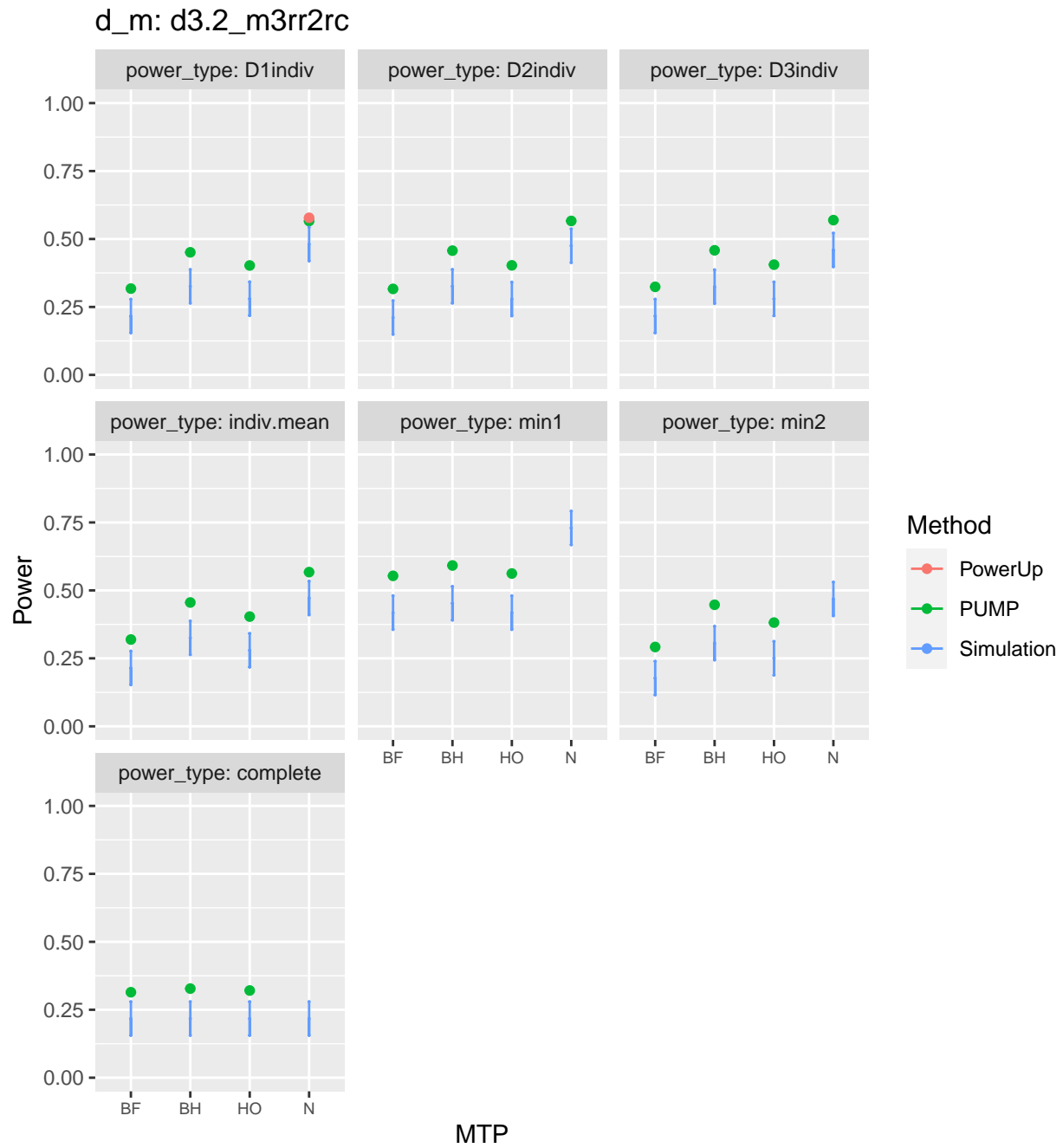
d_m: d3.2_m3rr2rc

Varying Omega

$\omega_3 = 0.8, 0.8, 0.8$

d_m: d3.2_m3rr2rc

$\omega_3 = 0, 0, 0 \; \mathrm{ICC}_3 = 0.2, 0.2, 0.2$

d_m: d3.2_m3rr2rc

$\omega_3 = 0.8,\ 0.8,\ 0.8\ \text{ICC}_3 = 0.7,\ 0.7,\ 0.7$

d_m: d3.2_m3rr2rc
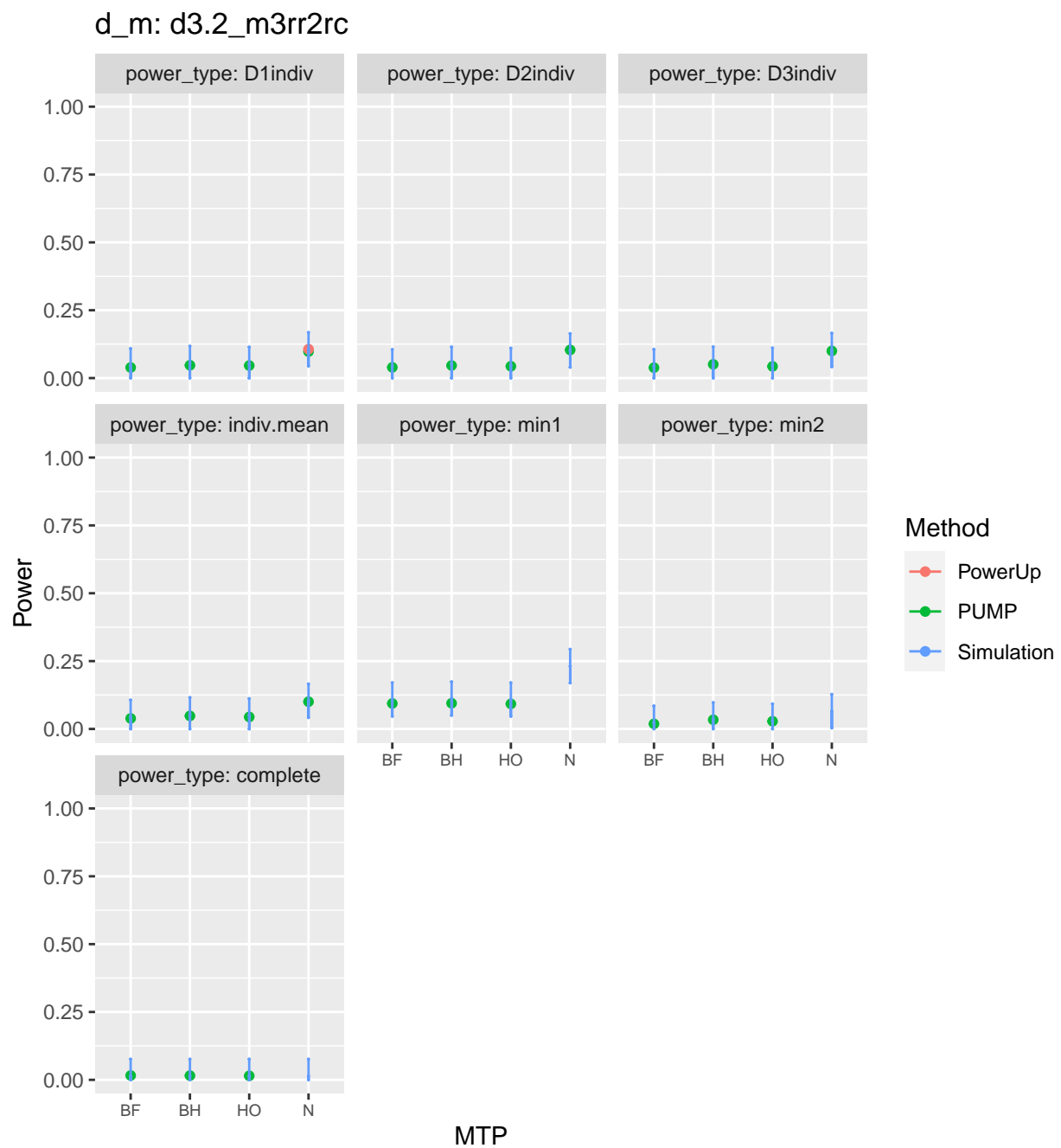
MDES validation

Target value: 0.125

```
##
##
## +------------+--------------+--------------+-------------+
## |    MTP     | Adjusted MDES | D1indiv Power | Target MDES |
## +============+==============+==============+=============+
## | Bonferroni |    0.125     |    0.529     |    0.125    |
## +------------+--------------+--------------+-------------+
## |     BH     |    0.124     |    0.621     |    0.125    |
## +------------+--------------+--------------+-------------+
## |    Holm    |    0.126     |    0.616     |    0.125    |
## +------------+--------------+--------------+-------------+
##
## Table: d3.2_m3ff2rc

##
##
## +------------+--------------+--------------+-------------+
## |    MTP     | Adjusted MDES | D1indiv Power | Target MDES |
## +============+==============+==============+=============+
## | Bonferroni |    0.125     |    0.156     |    0.125    |
## +------------+--------------+--------------+-------------+
## |     BH     |    0.125     |    0.222     |    0.125    |
## +------------+--------------+--------------+-------------+
## |    Holm    |    0.123     |    0.184     |    0.125    |
## +------------+--------------+--------------+-------------+
##
## Table: d3.2_m3rr2rc
```
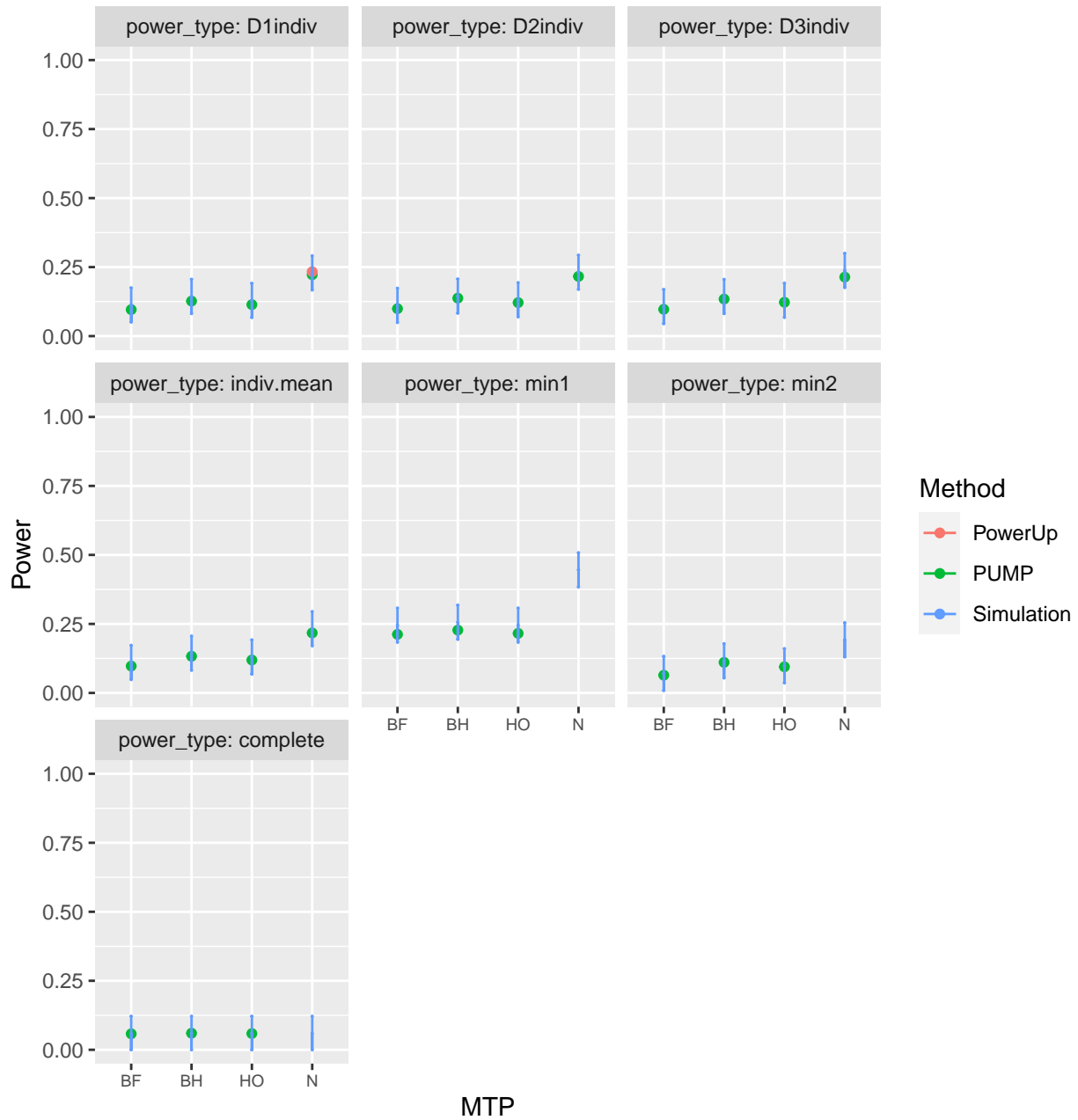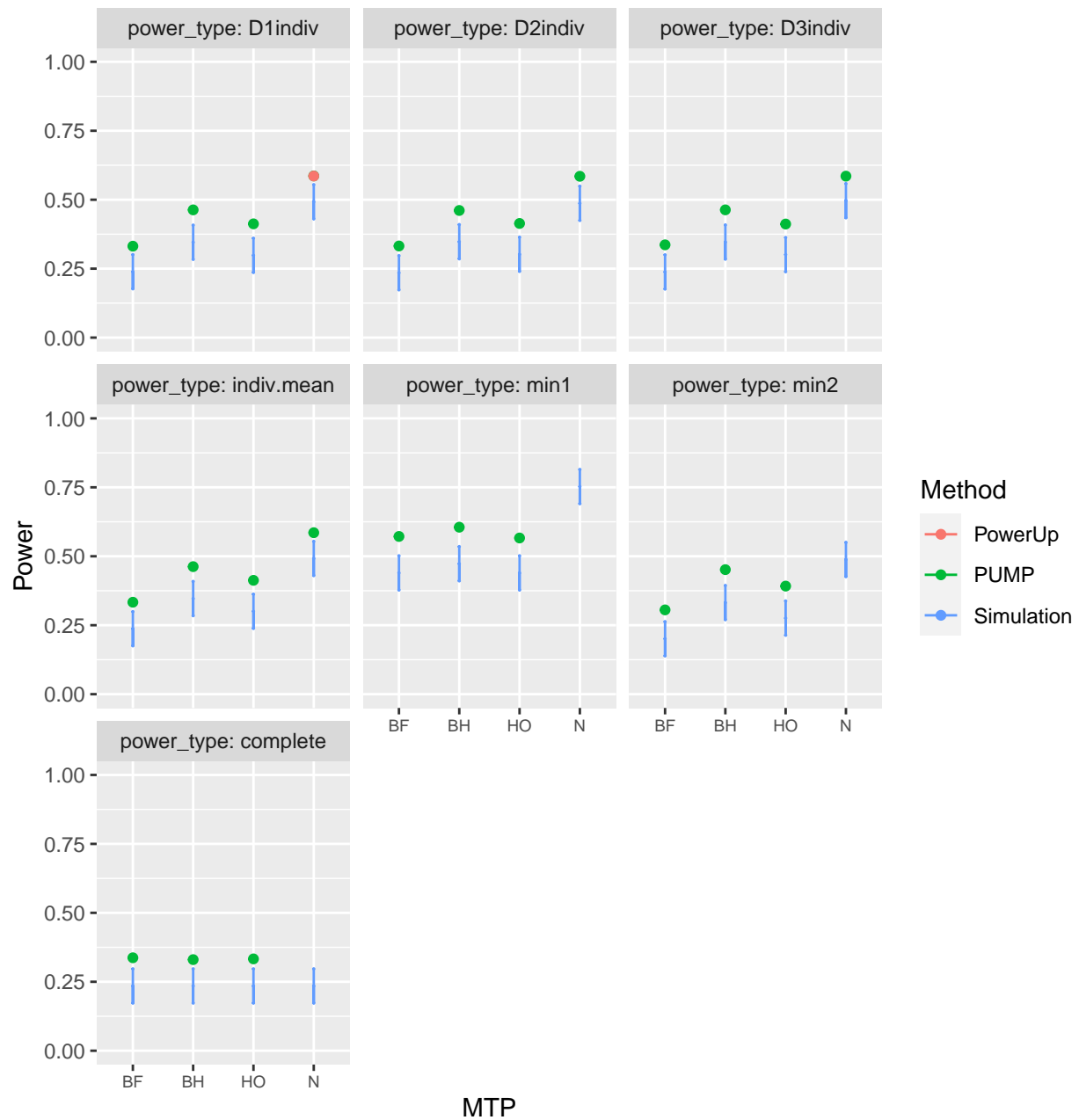
Sample size validation

Target value: 10

```
##
##
## +------------+-------------+-------------+---------------+
## |    MTP     | Sample.type | Sample.size | D1indiv.power |
## +============+=============+=============+===============+
## | Bonferroni |      K      |     10      |     0.529     |
## +------------+-------------+-------------+---------------+
## |     BH     |      K      |     10      |     0.619     |
## +------------+-------------+-------------+---------------+
## |    Holm    |      K      |     11      |     0.61      |
## +------------+-------------+-------------+---------------+
##
## Table: d3.2_m3ff2rc
```

Target value: 30

```
##
##
## +------------+-------------+-------------+---------------+
```

```
## |    MTP     | Sample.type | Sample.size | D1indiv.power |
## +===========+=============+=============+===============+
## | Bonferroni |      J      |     30      |     0.529     |
## +-----------+-------------+-------------+---------------+
## |     BH     |      J      |     31      |     0.624     |
## +-----------+-------------+-------------+---------------+
## |    Holm    |      J      |     30      |     0.605     |
## +-----------+-------------+-------------+---------------+
##
## Table: d3.2_m3ff2rc
```

Target value: 50

```
##
##
## +-----------+-------------+-------------+---------------+
## |    MTP     | Sample.type | Sample.size | D1indiv.power |
## +===========+=============+=============+===============+
## | Bonferroni |    nbar     |    53.25    |     0.529     |
## +-----------+-------------+-------------+---------------+
## |     BH     |    nbar     |     59      |     0.629     |
## +-----------+-------------+-------------+---------------+
## |    Holm    |    nbar     |     59      |     0.61      |
## +-----------+-------------+-------------+---------------+
##
## Table: d3.2_m3ff2rc
```

Target value: 10

```
##
##
## +-----------+-------------+-------------+---------------+
## |    MTP     | Sample.type | Sample.size | D1indiv.power |
## +===========+=============+=============+===============+
## | Bonferroni |      K      |     10      |     0.156     |
## +-----------+-------------+-------------+---------------+
## |     BH     |      K      |     11      |     0.229     |
## +-----------+-------------+-------------+---------------+
## |    Holm    |      K      |     11      |     0.202     |
## +-----------+-------------+-------------+---------------+
##
## Table: d3.2_m3rr2rc
```

Target value: 30

```
##
##
## +-----------+-------------+-------------+---------------+
## |    MTP     | Sample.type | Sample.size | D1indiv.power |
## +===========+=============+=============+===============+
## | Bonferroni |      J      |     30      |     0.156     |
## +-----------+-------------+-------------+---------------+
## |     BH     |      J      |     30      |     0.219     |
## +-----------+-------------+-------------+---------------+
## |    Holm    |      J      |     29      |     0.187     |
## +-----------+-------------+-------------+---------------+
##
```

Table: d3.2_m3rr2rc

Target value: 50

```
##
##
## +------------+-------------+-------------+----------------+
## |    MTP     | Sample.type | Sample.size | D1indiv.power  |
## +============+=============+=============+================+
## | Bonferroni |    nbar     |    62.71    |     0.156      |
## +------------+-------------+-------------+----------------+
## |     BH     |    nbar     |     666     |     0.229      |
## +------------+-------------+-------------+----------------+
## |    Holm    |    nbar     |    3016     |      0.2       |
## +------------+-------------+-------------+----------------+
##
## Table: d3.2_m3rr2rc
```