Validate Power: d2.1

February 25, 2022

Design: Blocked RCT, with 2 levels, and randomization done at level 1 (individual level).

Models: Constant treatment effects, fixed treatment effects, and random treatment effects.

d_m codes: d2.1_m2fc, d2.1_m2ff, d2.1_m2fr

Note: we expect a discrepancy when ICC is not zero between powerup and pump.

Default parameters:

- M = 3
- J = 20
- $\rho = 0.5$
- MDES = 0.125, 0.125, 0.125
- $R_1^2 = 0.1$, 0.1, 0.1
- $ICC_2 = 0.2$, 0.2, 0.2

Parameters by model type:

- Omega: $\omega_2 = 0$ for constant effects, $\omega_2 = 0.1$, 0.1, 0.1 for fixed and random
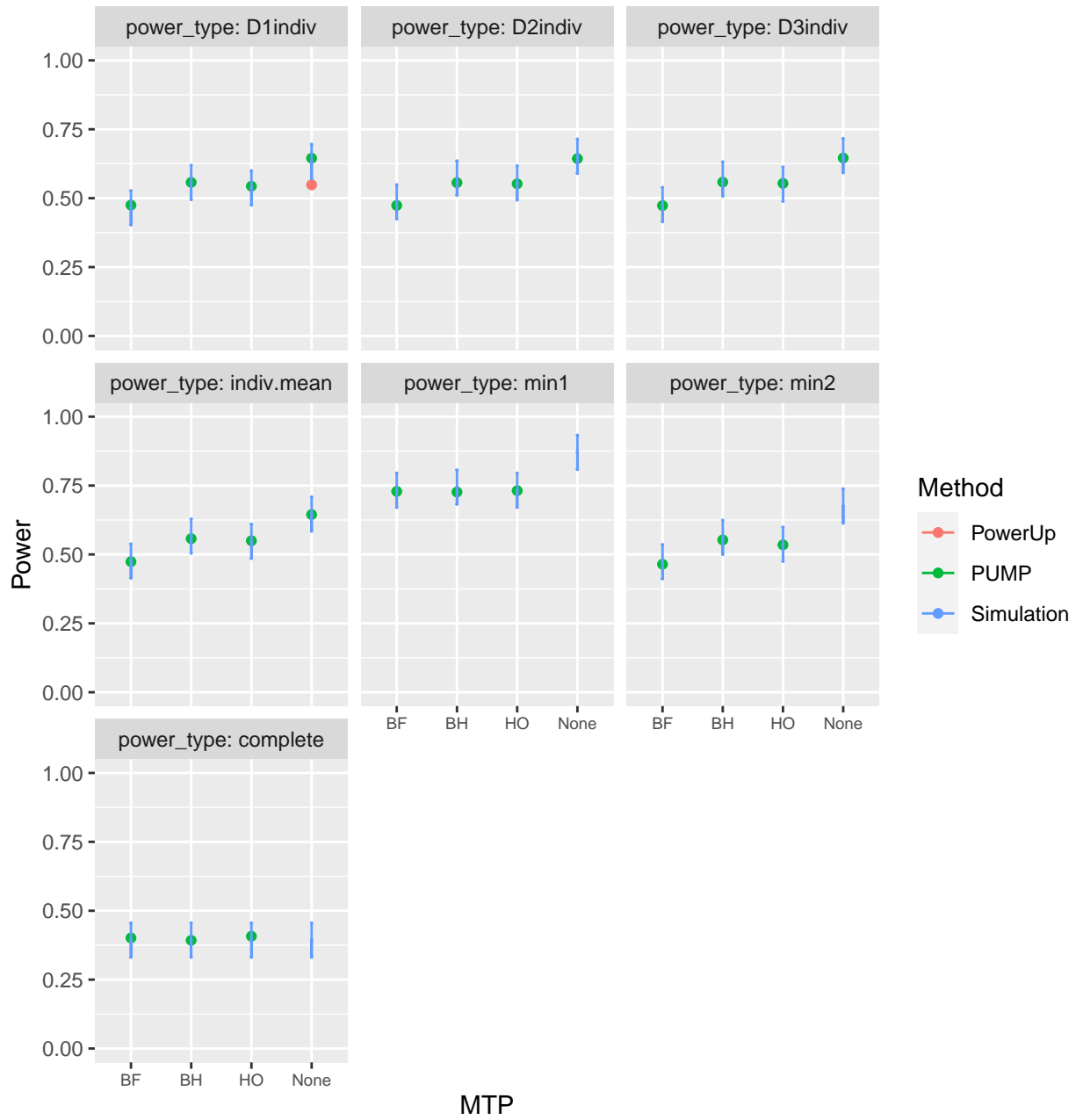
Assumptions:

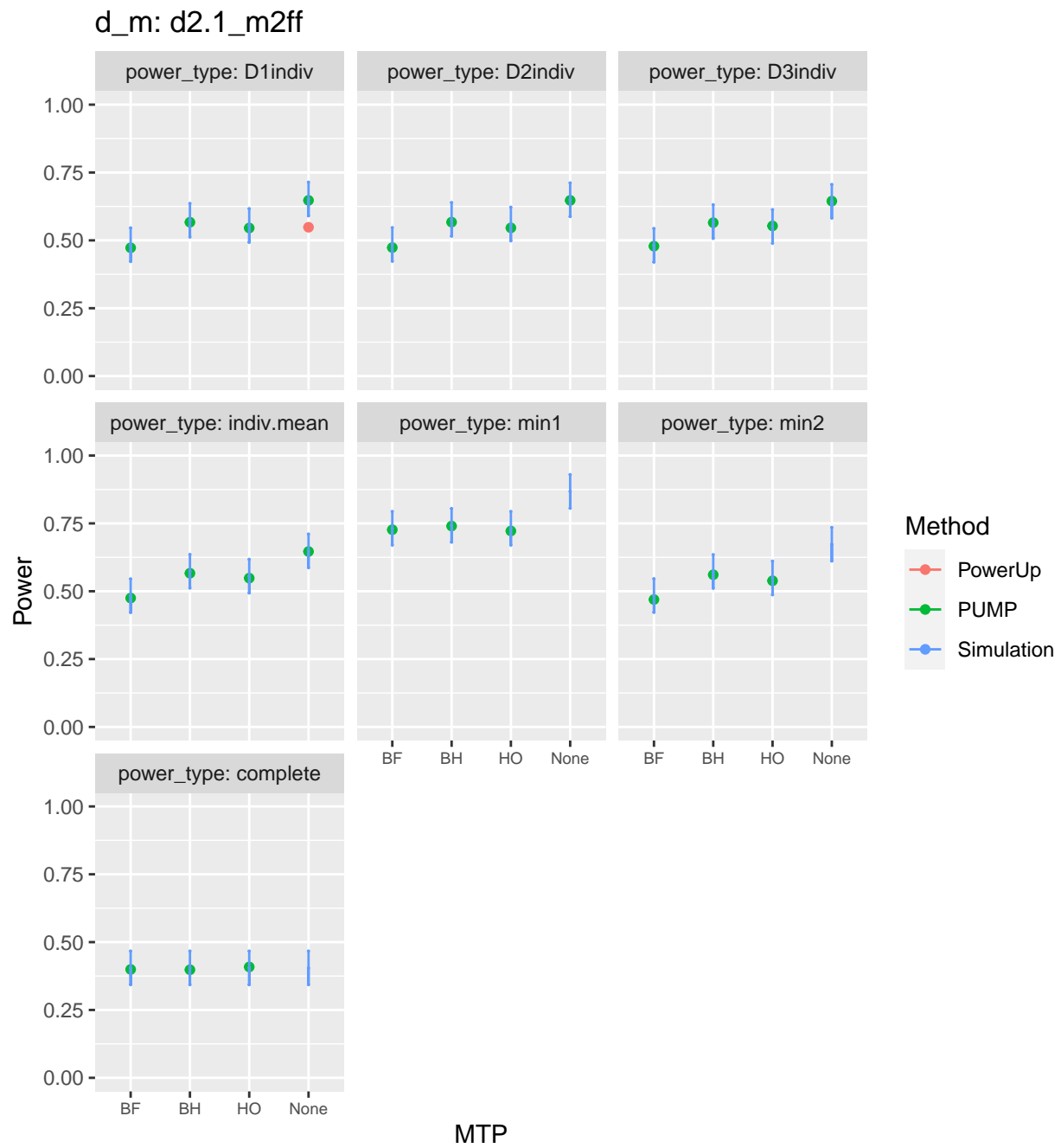- Two-level design: $ICC_3 = 0$, $\omega_3 = 0$, $K = 1$

Remark. For all $d2.1_m2fc$ and $d2.1_m2ff$ designs and models, PowerUpR! assumes $ICC.2 = 0$, but we do not make that assumption here. Thus, we expect to see a discrepancy between PUMP and Powerup except for the setting when we assume $ICC.2 = 0$ for these designs and models. PowerUpR! does allow for a non-zero `ICC.2` for $d2.1_m2fr$.

Power Validation

Base case

d_m: d2.1_m2fc

d_m: d2.1_m2ff
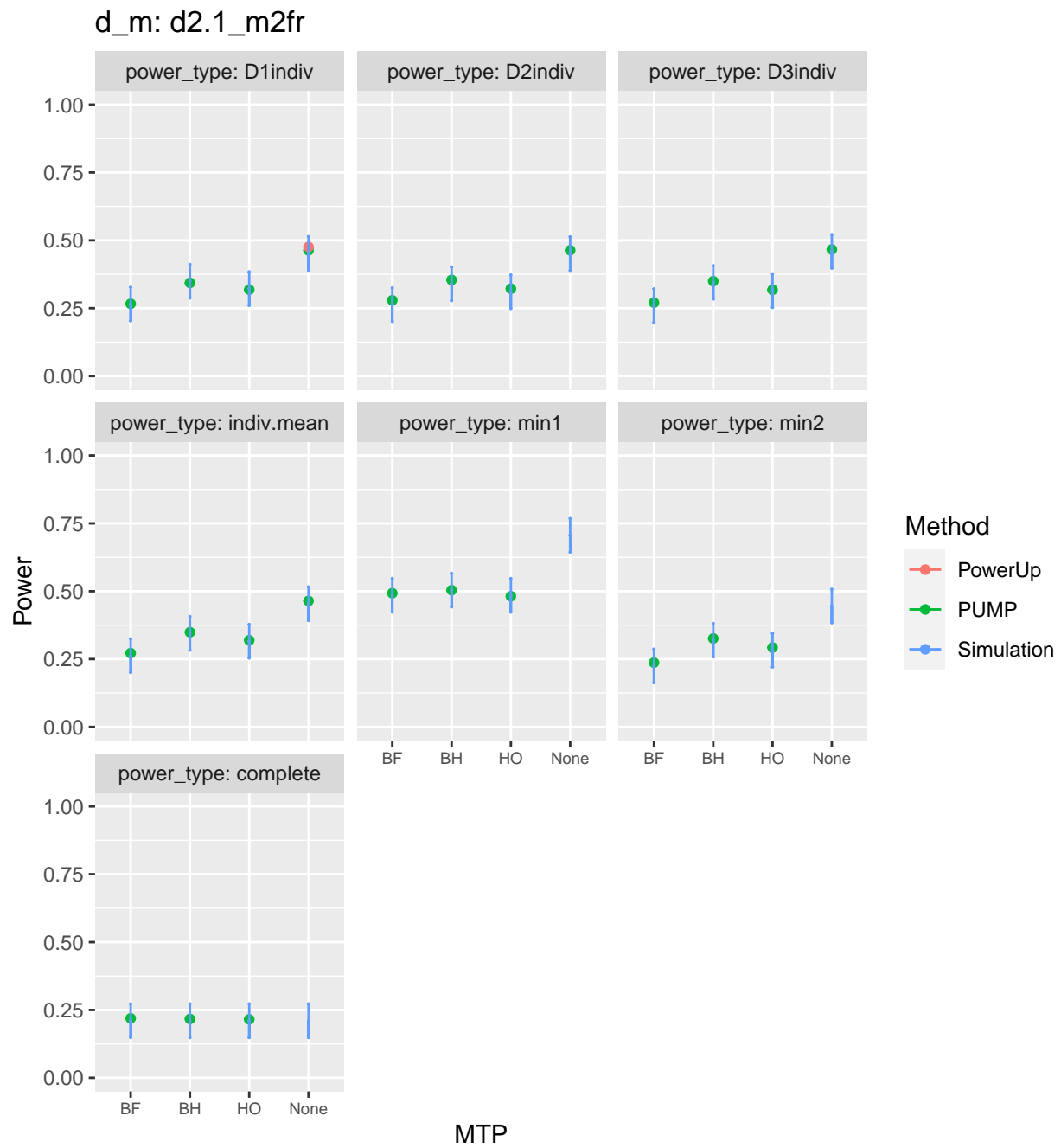
d_m: d2.1_m2fr

Varying school size

$\bar{n} = 100$

d_m: d2.1_m2fc

d_m: d2.1_m2ff

d_m: d2.1_m2fr
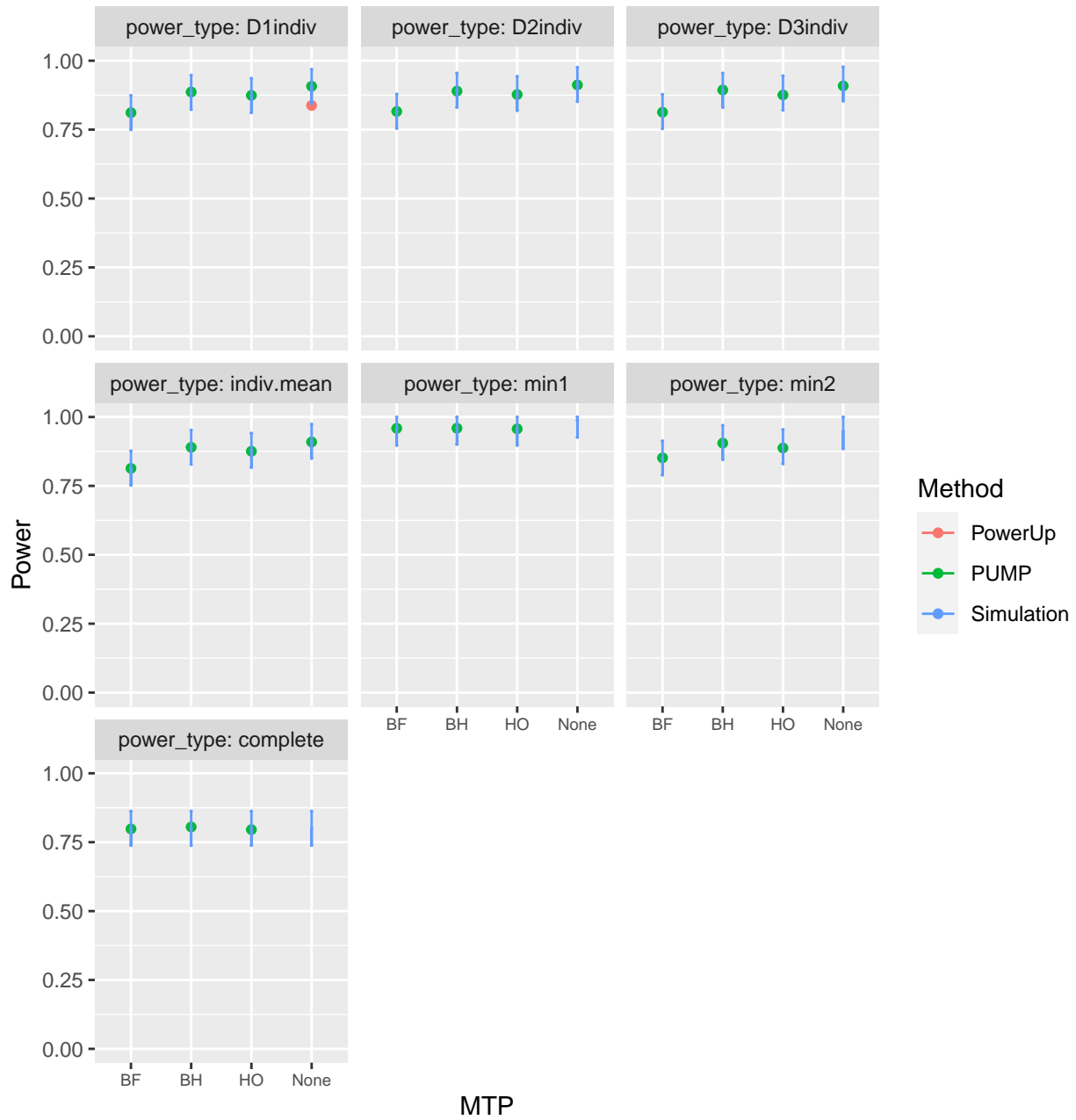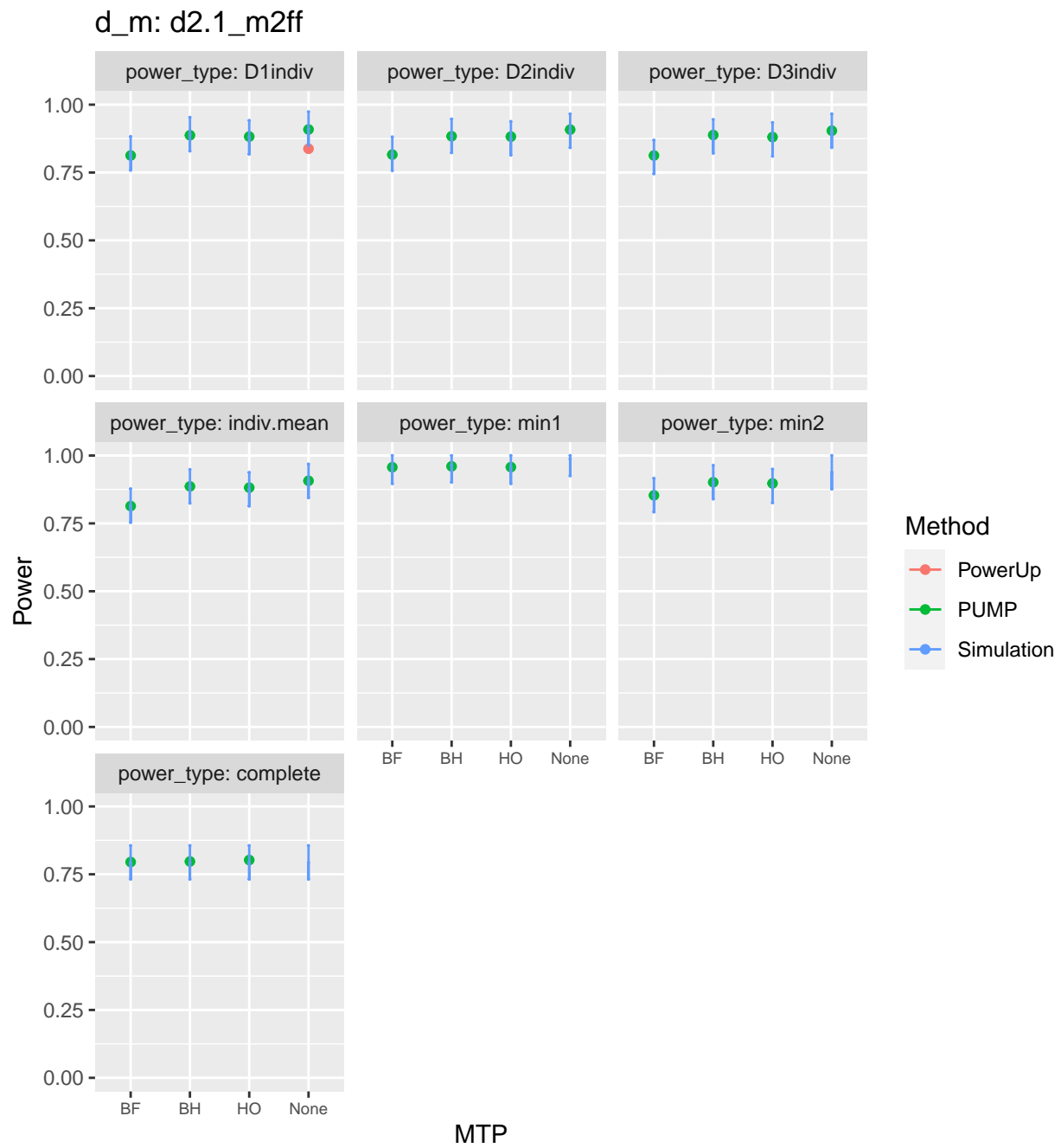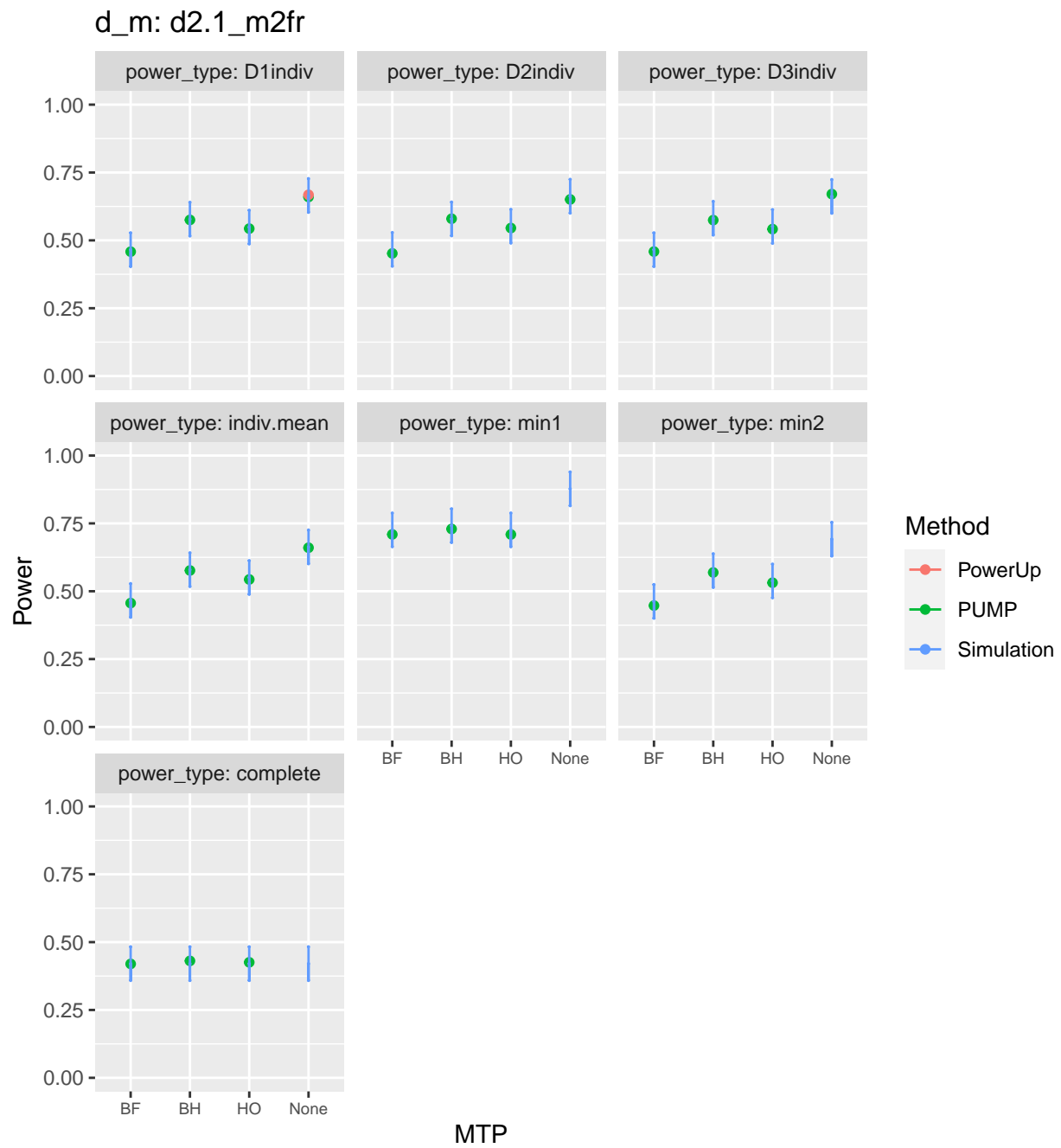
d_m: d2.1_m2fc

d_m: d2.1_m2ff
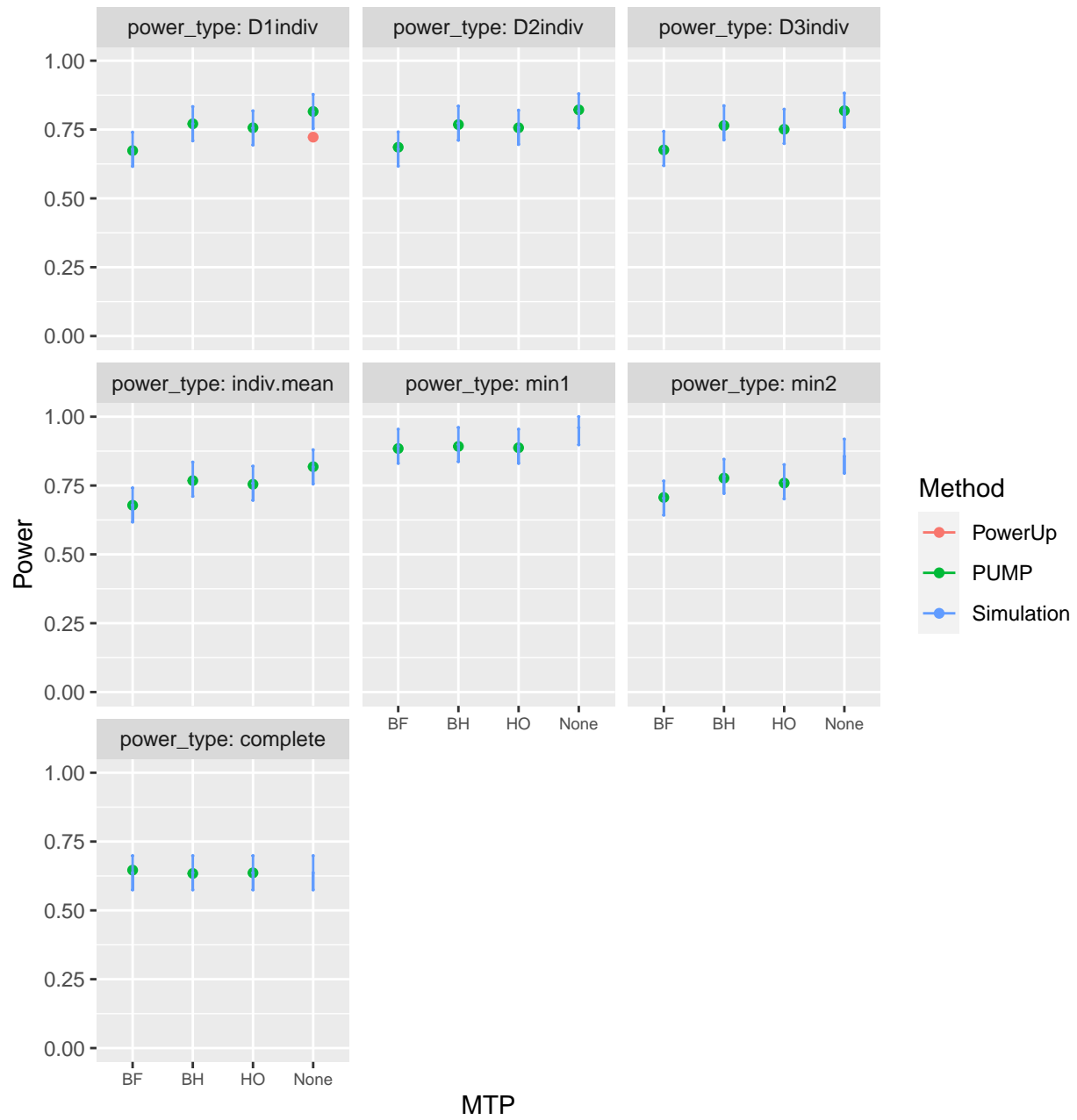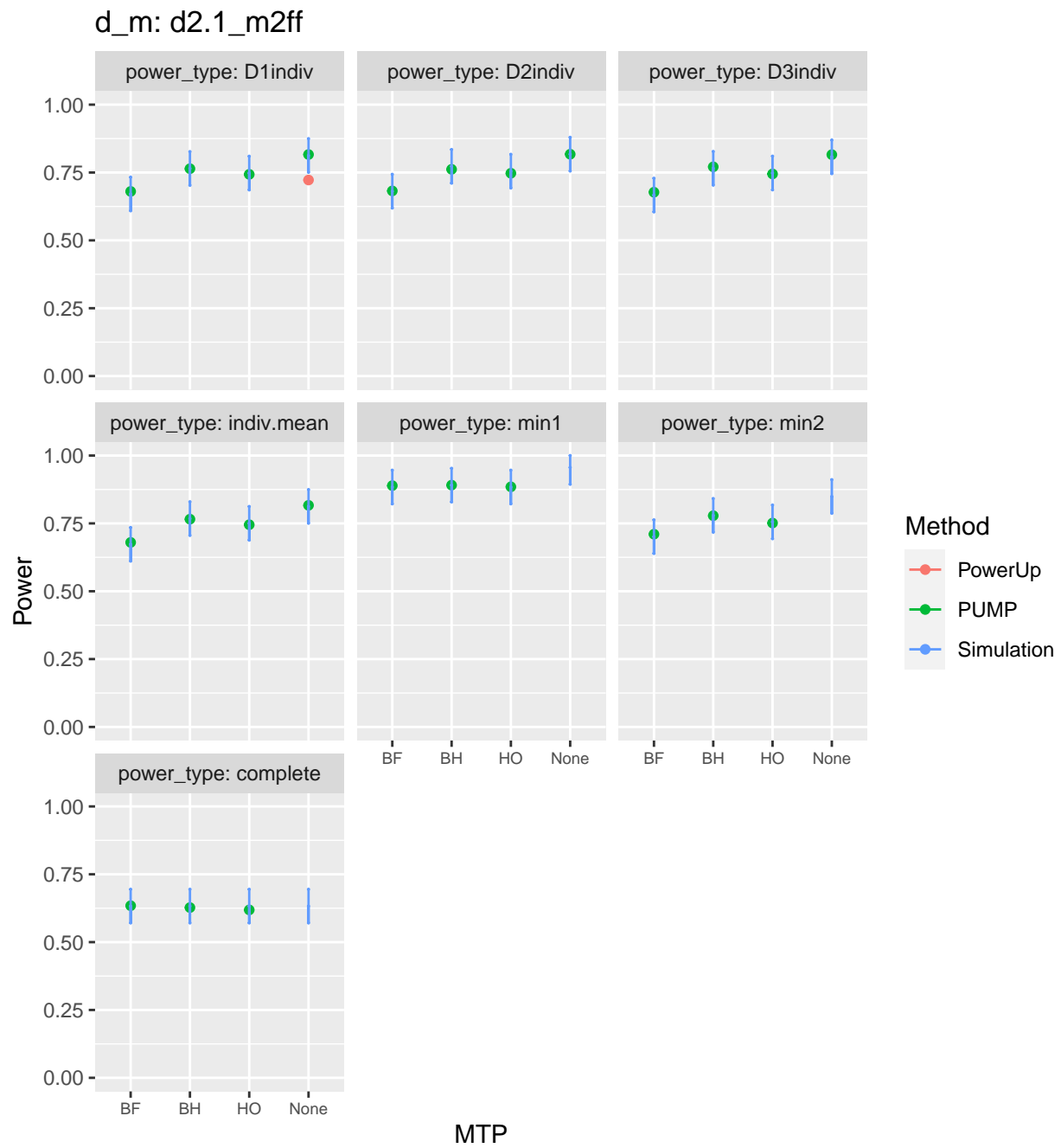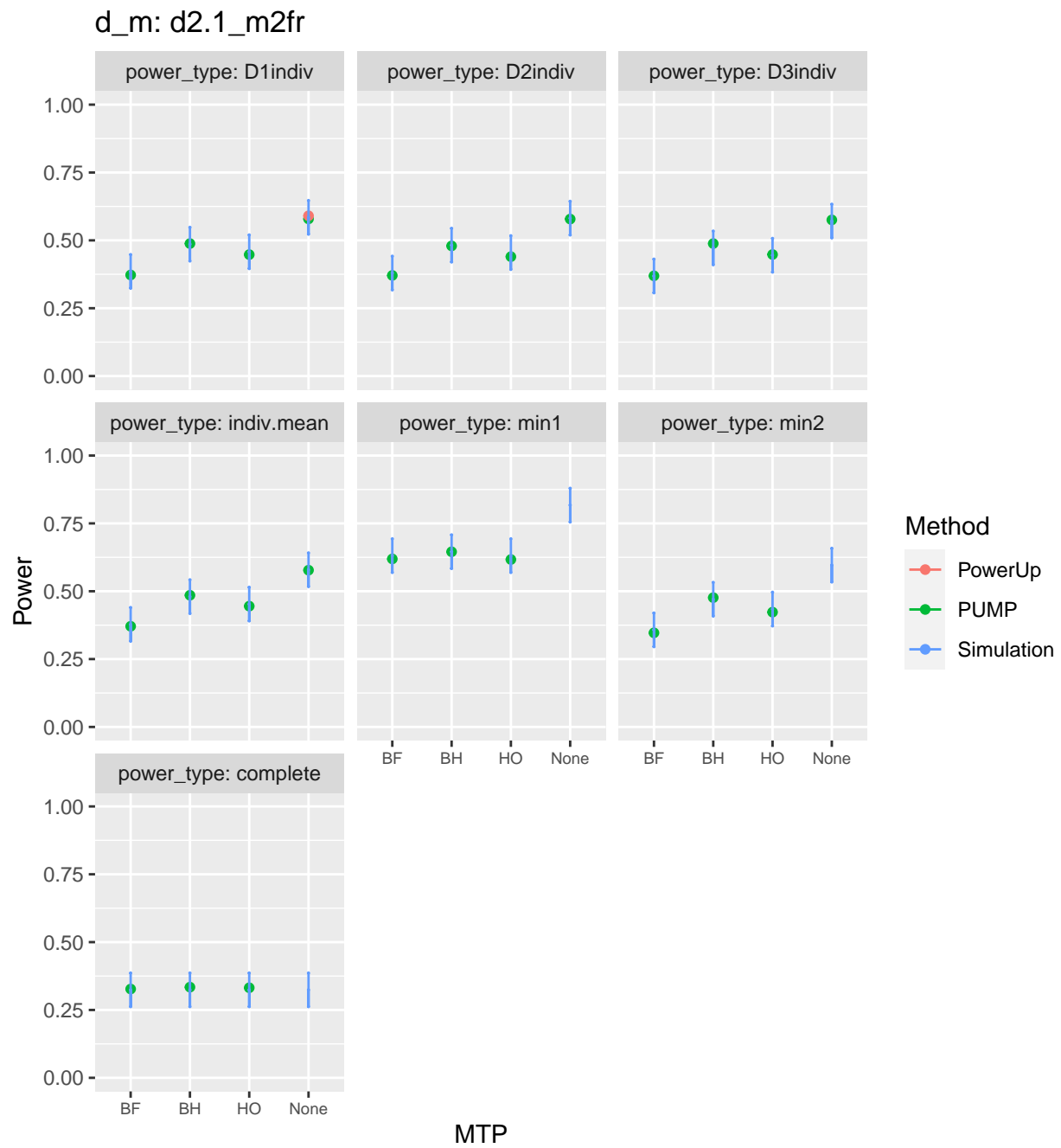
d_m: d2.1_m2fr

Varying R2

$R_1^2 = 0.6, 0.6, 0.6$
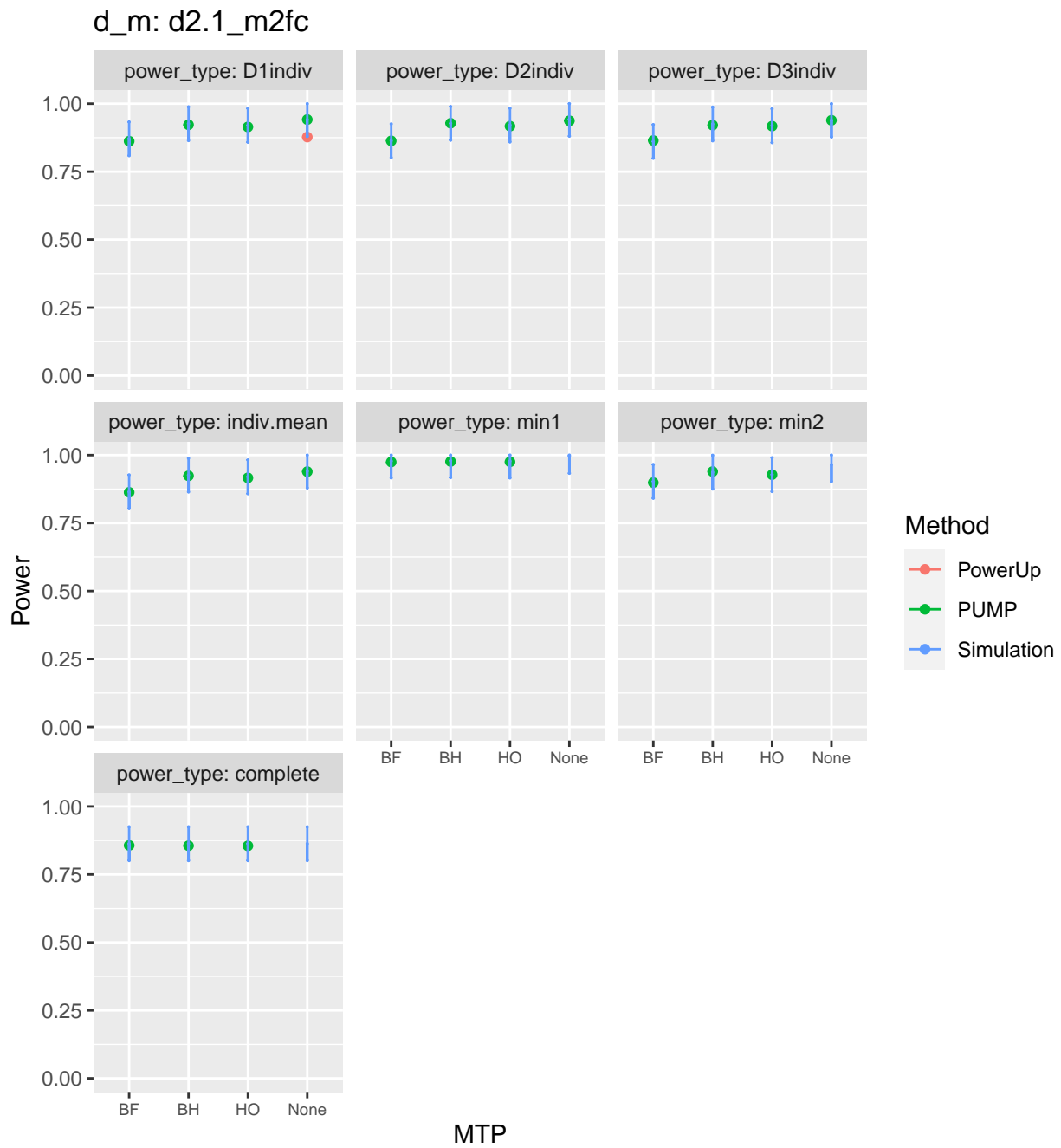
d_m: d2.1_m2fc

$R_1^2 = 0, 0, 0$
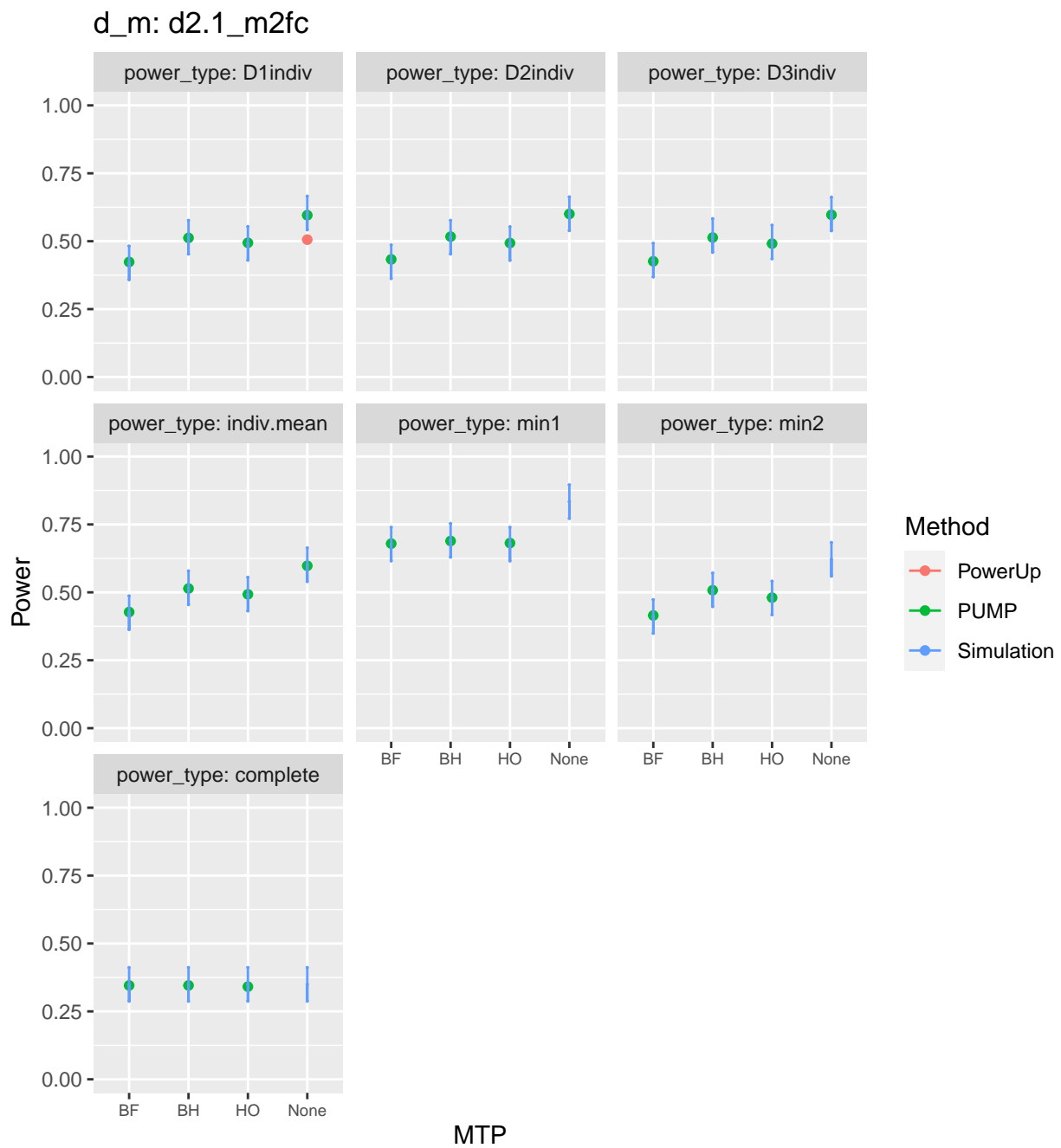
d_m: d2.1_m2fc

$\rho = 0.2$
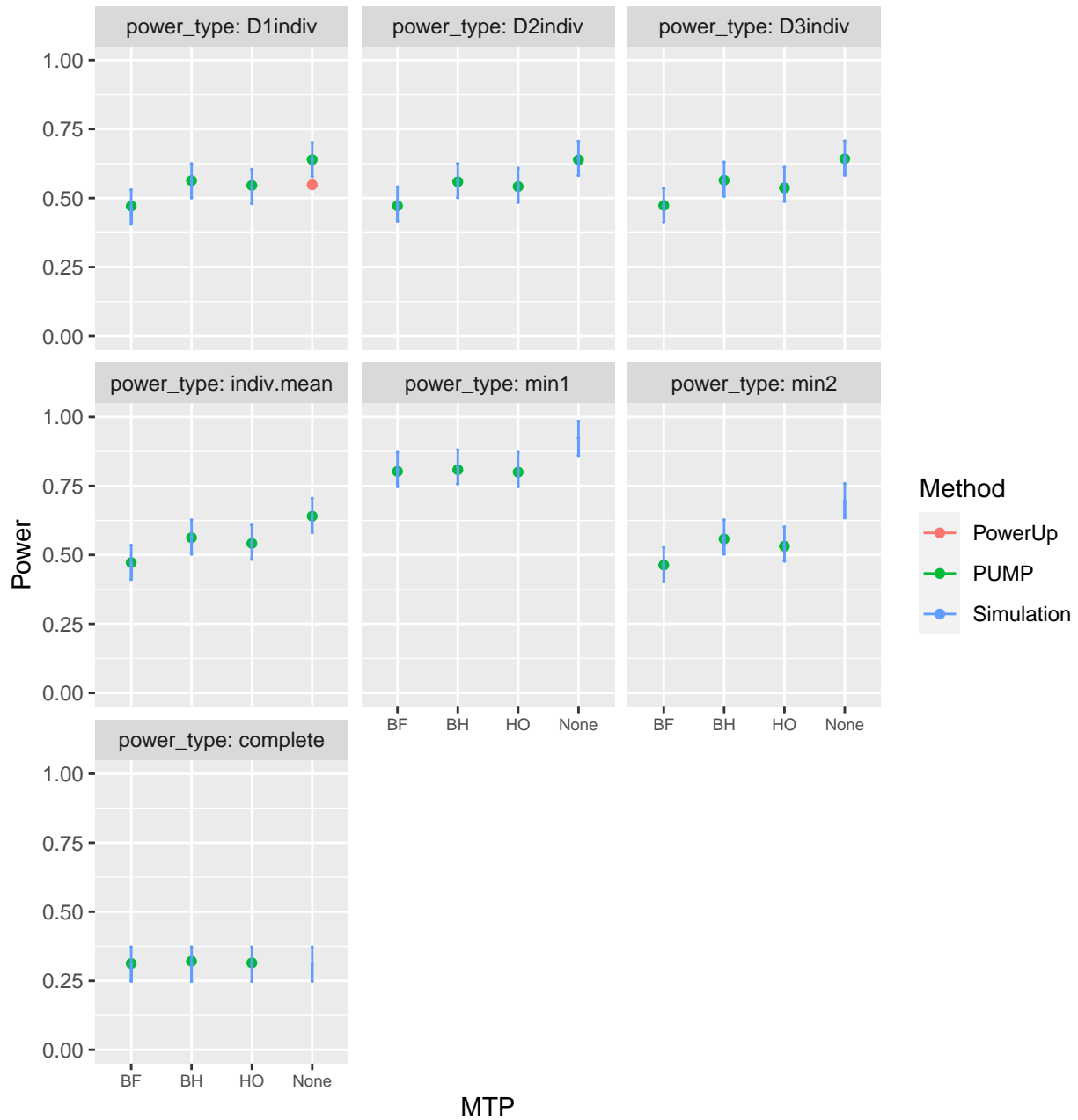
d_m: d2.1_m2fc

$\rho = 0.8$

d_m: d2.1_m2fc

Varying true positives

MDES = 0.125, 0, 0

d_m: d2.1_m2fc

Varying ICC

$\text{ICC}_2 = 0.7,\ 0.7,\ 0.7$

d_m: d2.1_m2fc
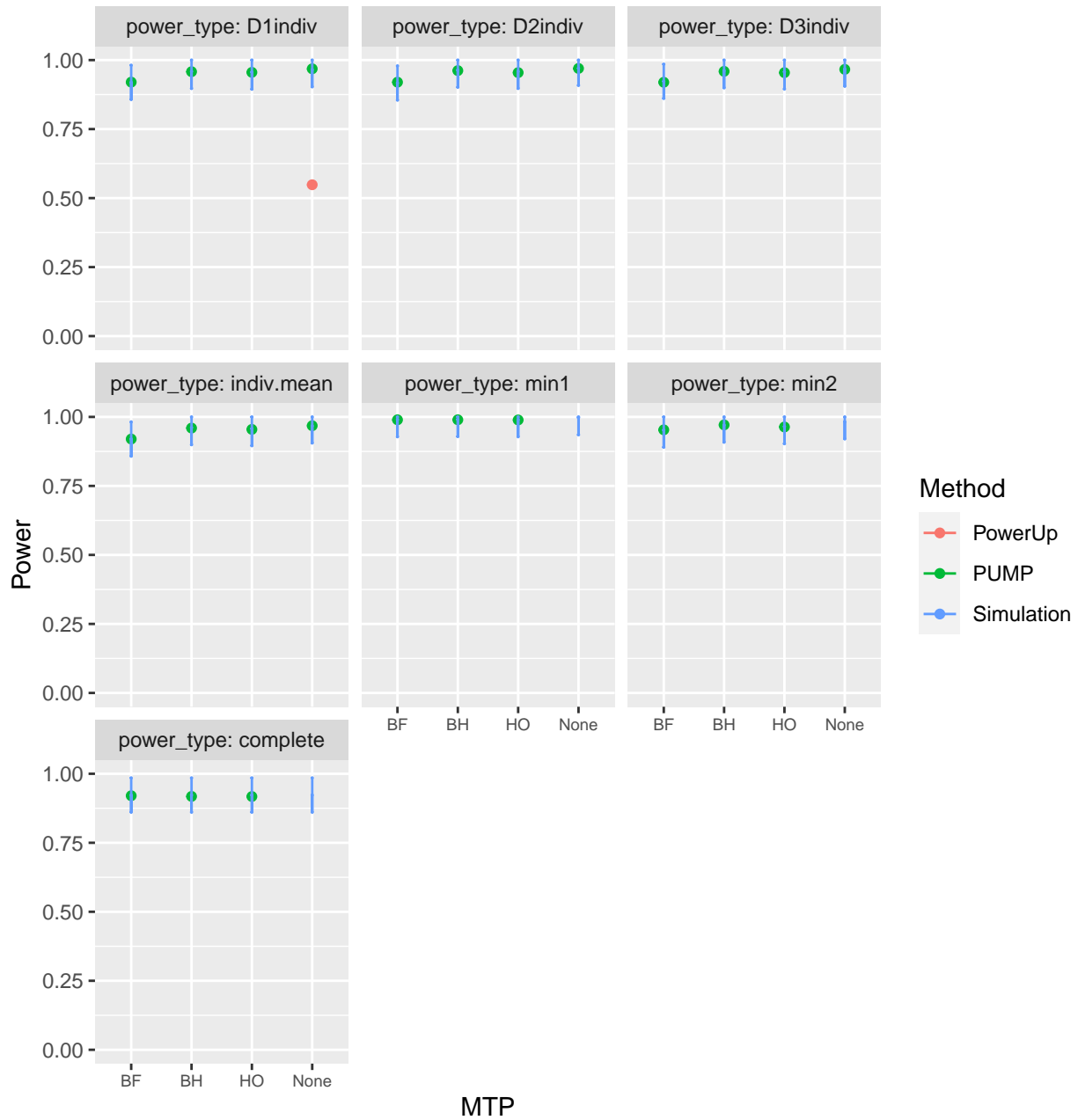
d_m: d2.1_m2ff
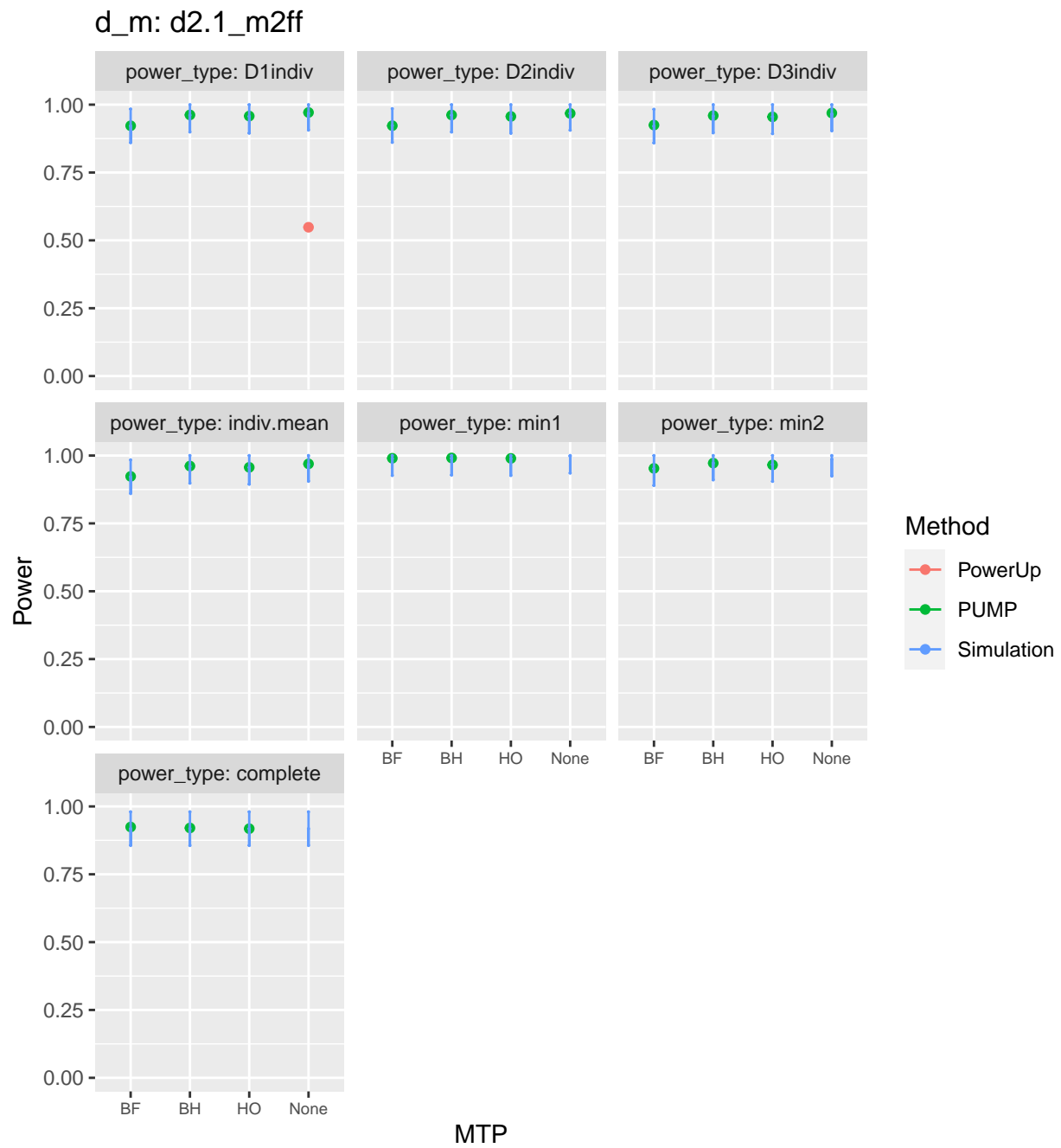
d_m: d2.1_m2fr

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

d_m: d2.1_m2fc

d_m: d2.1_m2ff
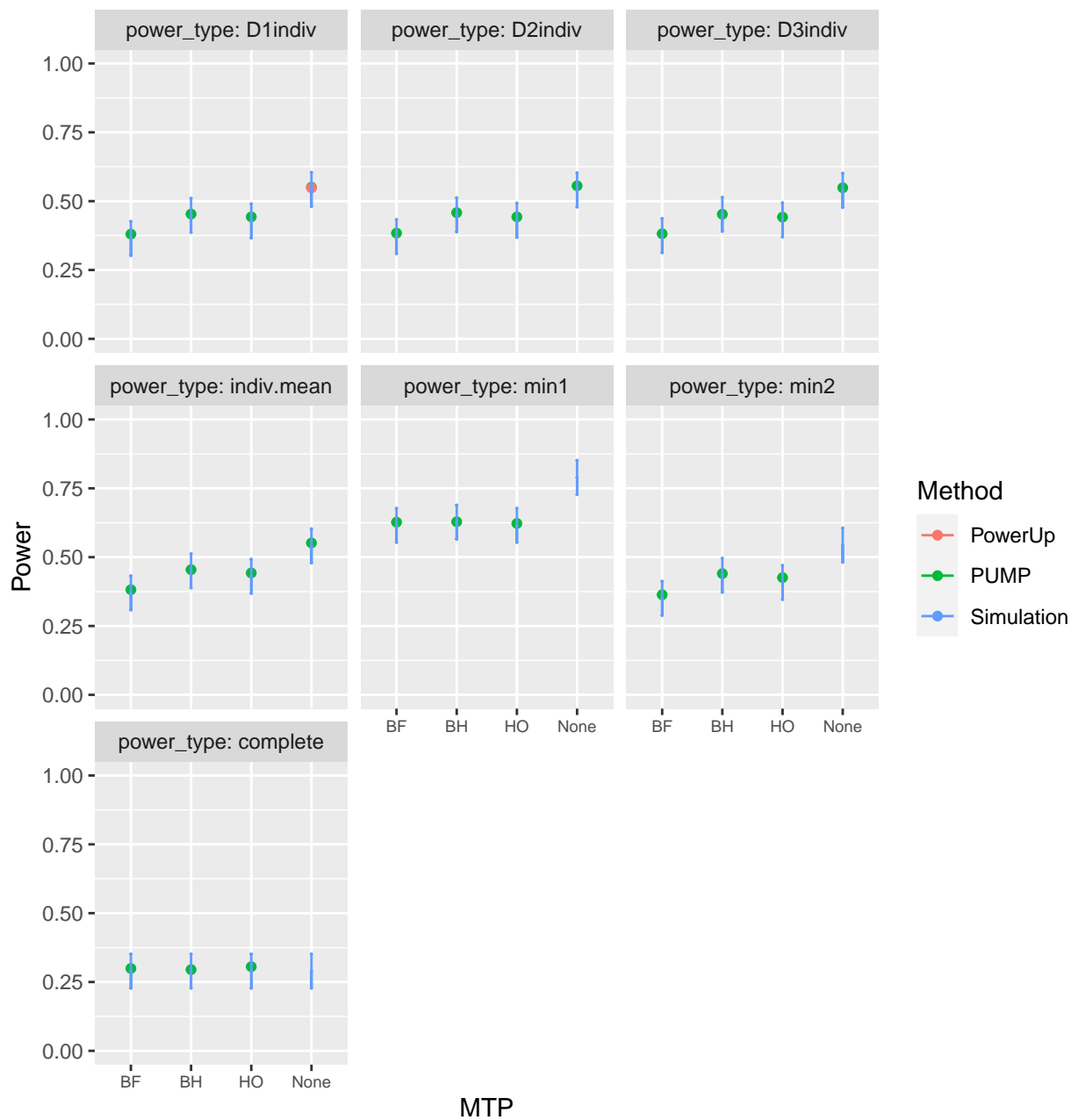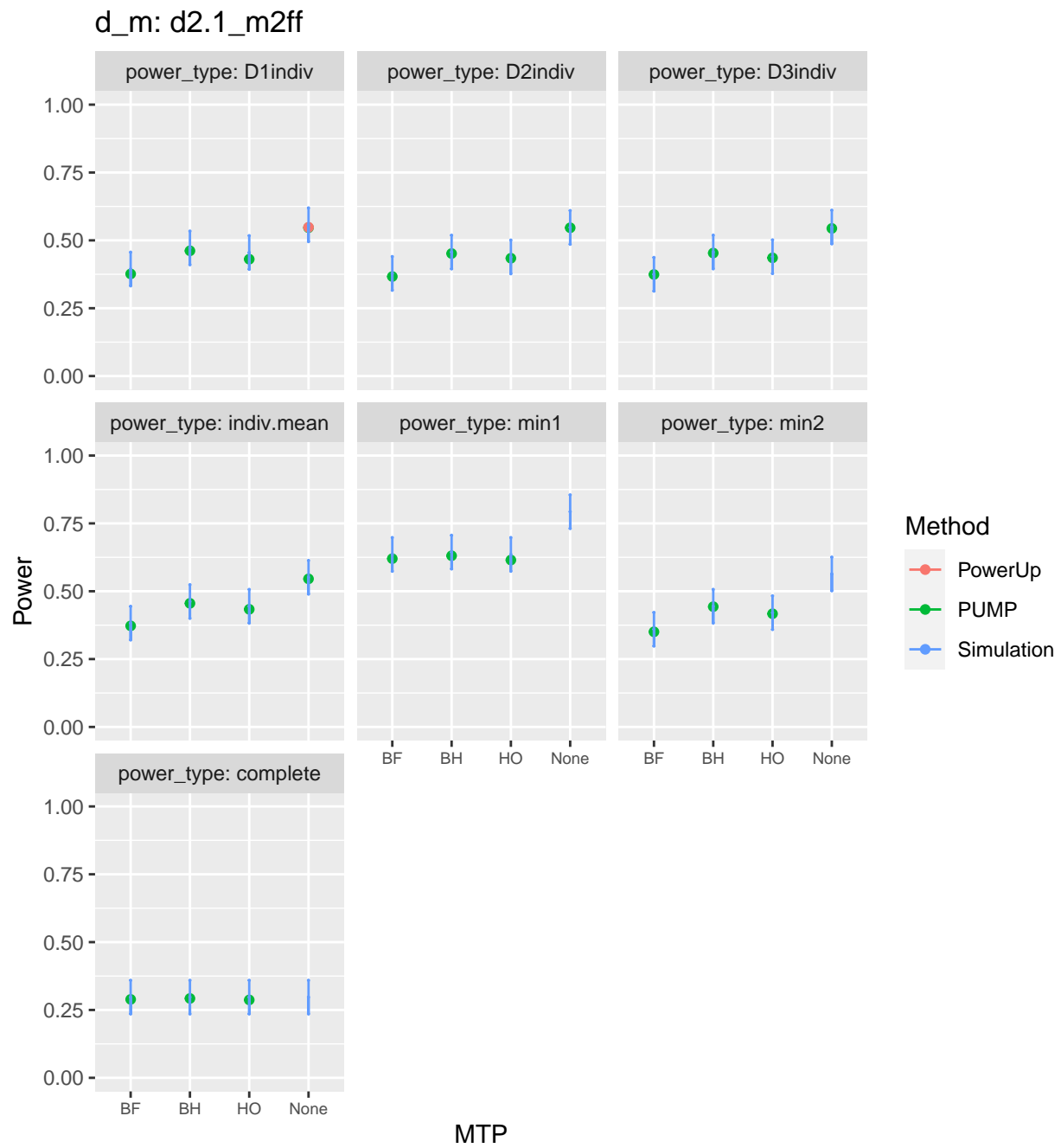
d_m: d2.1_m2fr

Varying Omega

$\omega_2 = 0.8, 0.8, 0.8$

d_m: d2.1_m2fr

$\omega_2 = 0, 0, 0$

d_m: d2.1_m2fr
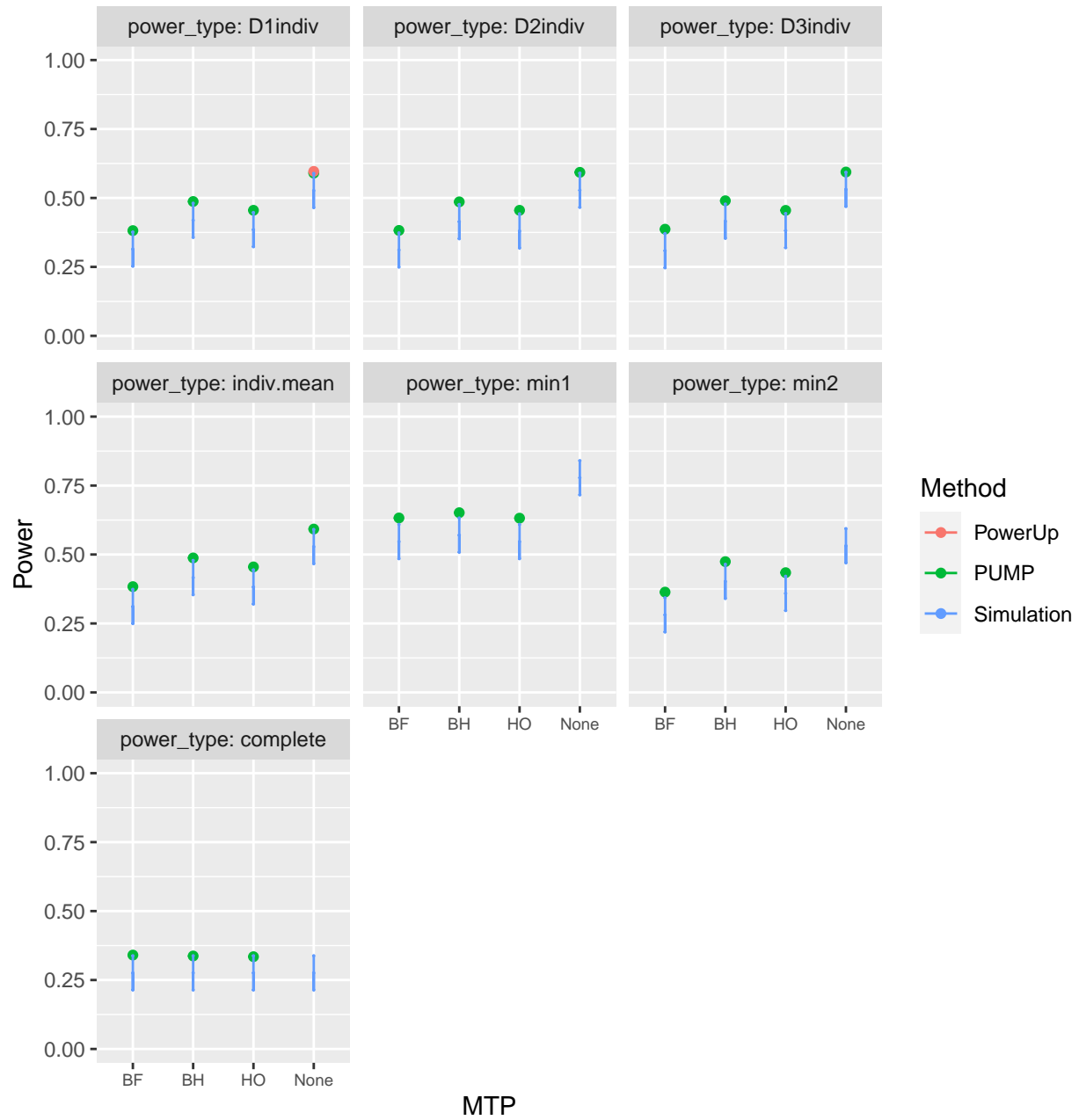
MDES validation

Target value: 0.125

```
##
##
## +-----+--------------+--------------+------------+----------+------+---+-------+
## | MTP | Adjusted MDES | D1indiv Power | Target MDES |   d_m    |  S   | M | MDES  |
## +=====+==============+==============+============+==========+======+===+=======+
## | BF  |    0.125     |    0.475     |   0.125    | d2.1_m2fc | 5000 | 3 | 0.125 |
## +-----+--------------+--------------+------------+----------+------+---+-------+
## | BH  |     NA       |     NA       |   0.125    | d2.1_m2fc | 5000 | 3 | 0.125 |
## +-----+--------------+--------------+------------+----------+------+---+-------+
## | HO  |    0.126     |    0.552     |   0.125    | d2.1_m2fc | 5000 | 3 | 0.125 |
## +-----+--------------+--------------+------------+----------+------+---+-------+
##
## Table: d2.1_m2fc (continued below)
##
##
##
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | numZero | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +=========+====+===+======+=====+=========+=========+======+======+======+=======+=======+
## |    0    | 20 | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## |    0    | 20 | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## |    0    | 20 | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
##
##
## +-----+--------------+--------------+------------+----------+------+---+-------+
## | MTP | Adjusted MDES | D1indiv Power | Target MDES |   d_m    |  S   | M | MDES  |
## +=====+==============+==============+============+==========+======+===+=======+
## | BF  |    0.125     |    0.473     |   0.125    | d2.1_m2ff | 5000 | 3 | 0.125 |
## +-----+--------------+--------------+------------+----------+------+---+-------+
## | BH  |    0.125     |    0.567     |   0.125    | d2.1_m2ff | 5000 | 3 | 0.125 |
## +-----+--------------+--------------+------------+----------+------+---+-------+
## | HO  |    0.126     |    0.555     |   0.125    | d2.1_m2ff | 5000 | 3 | 0.125 |
## +-----+--------------+--------------+------------+----------+------+---+-------+
##
## Table: d2.1_m2ff (continued below)
##
##
##
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | numZero | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +=========+====+===+======+=====+=========+=========+======+======+======+=======+=======+
## |    0    | 20 | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## |    0    | 20 | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## |    0    | 20 | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
```
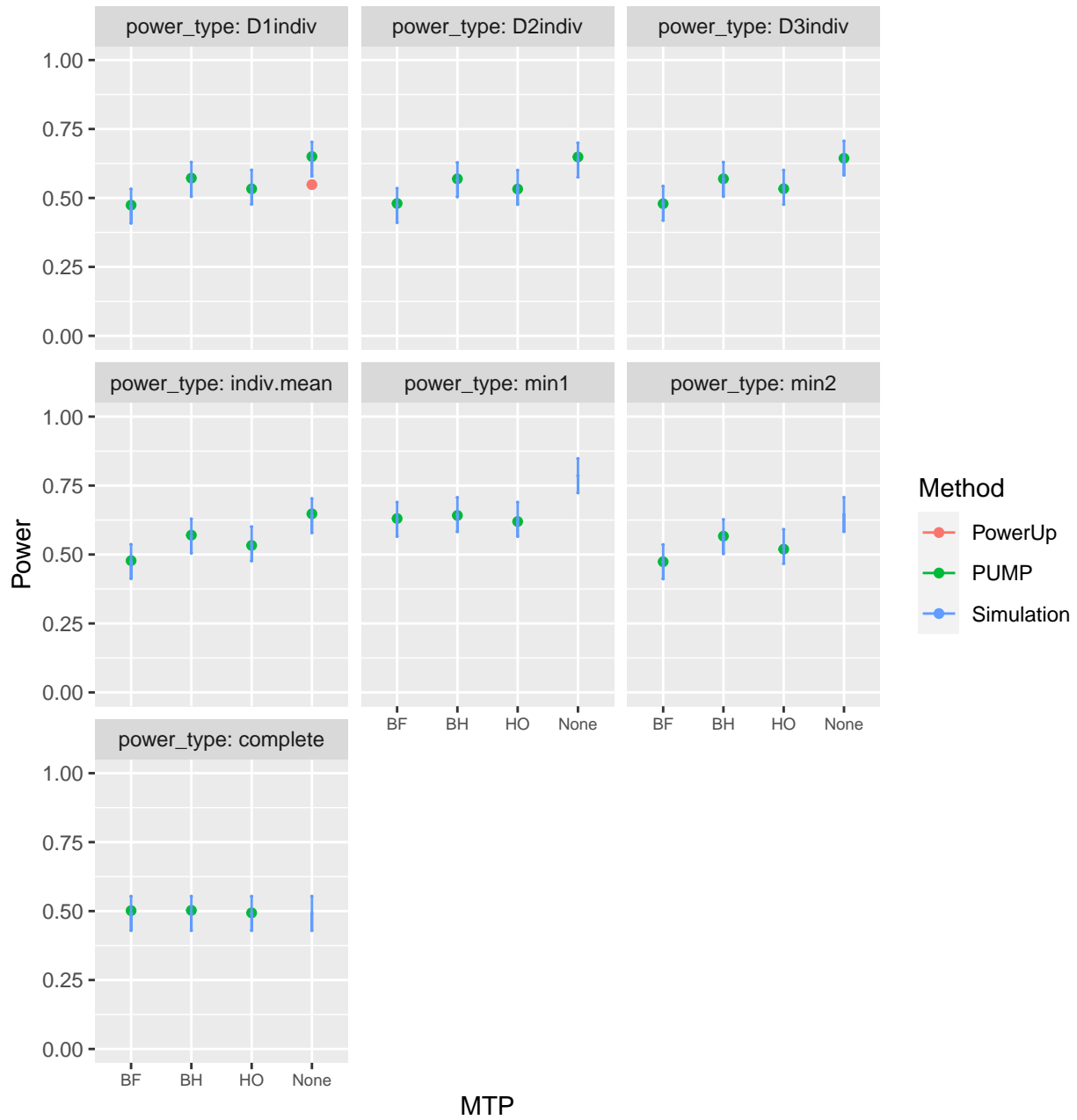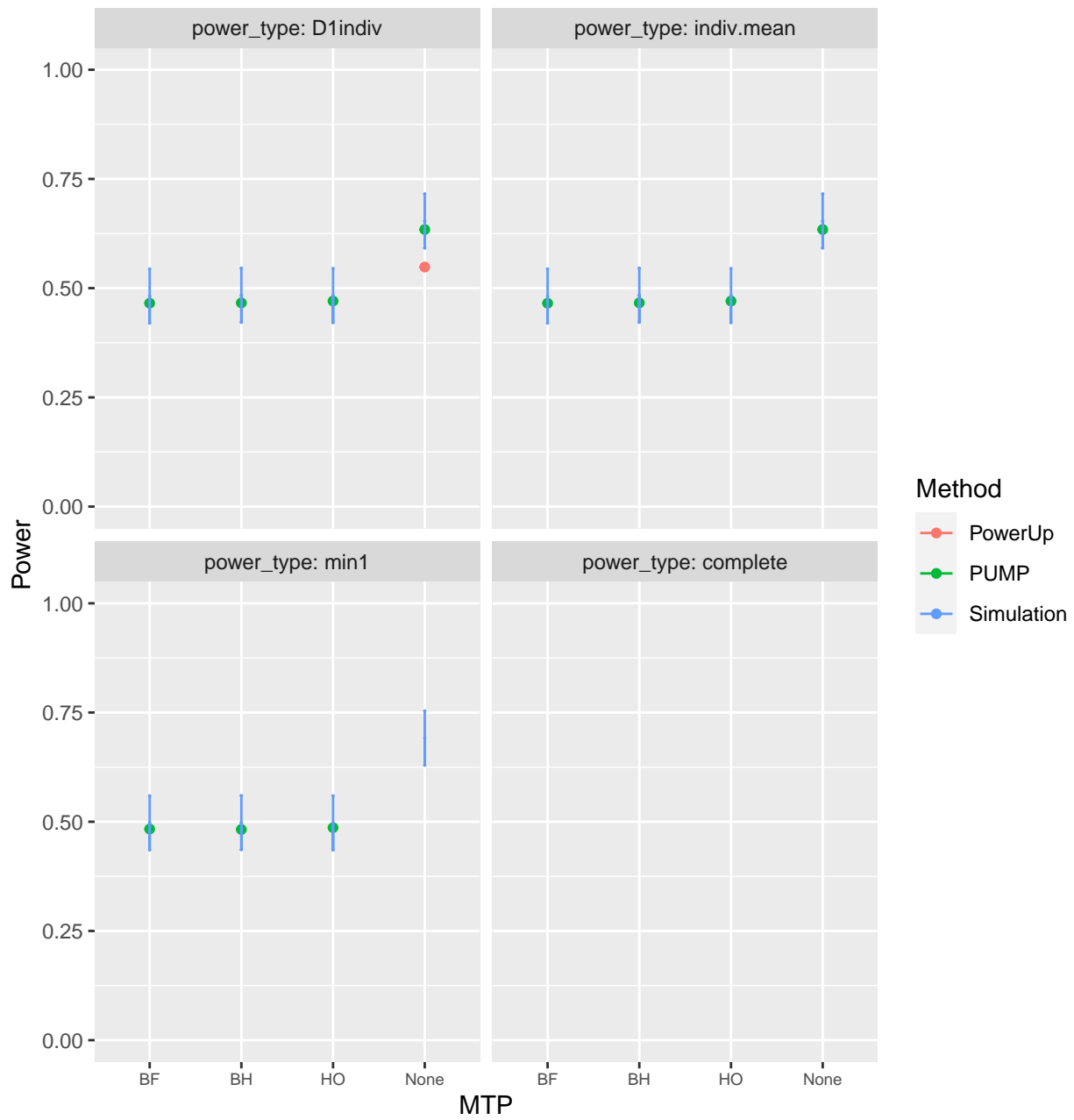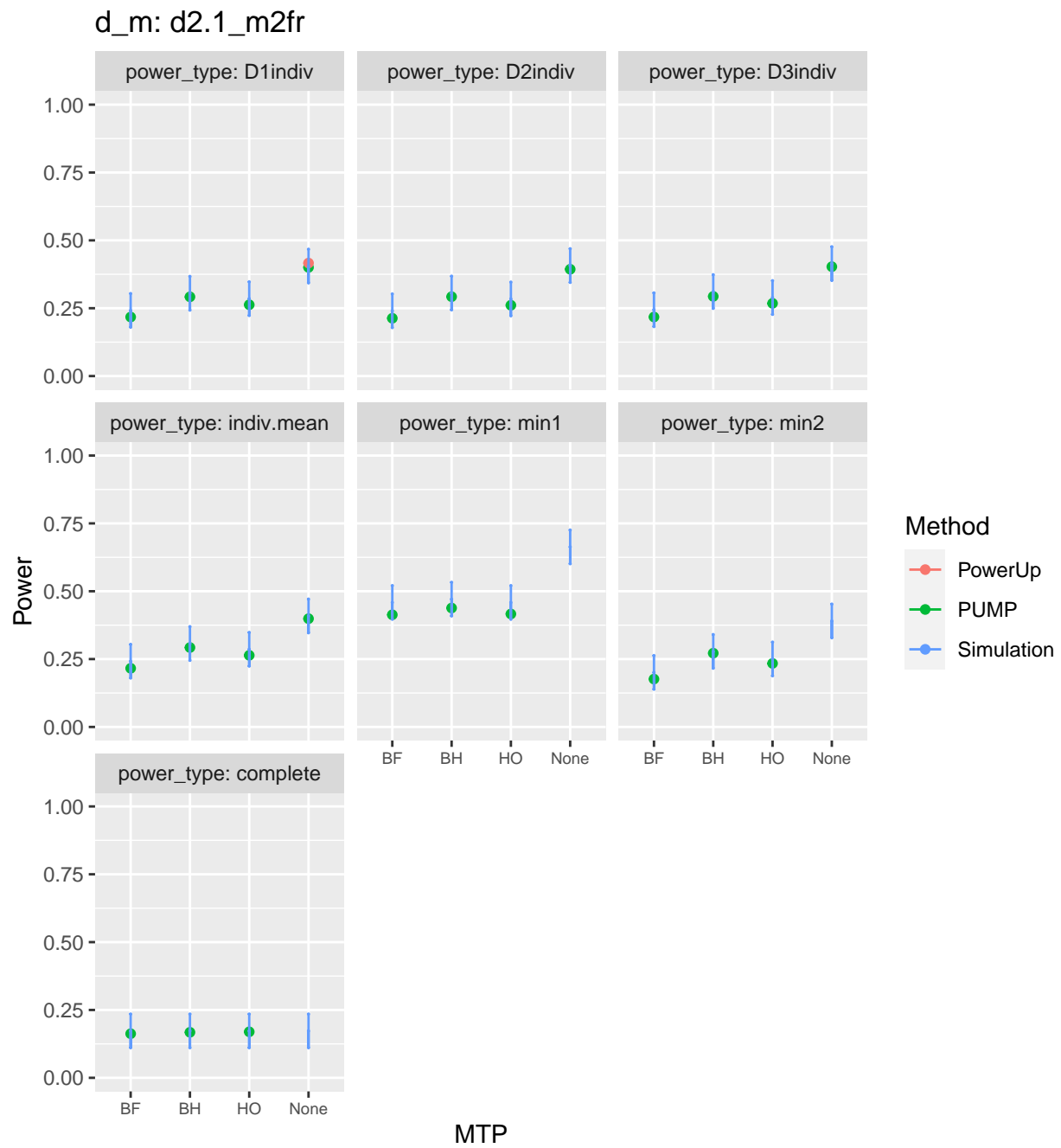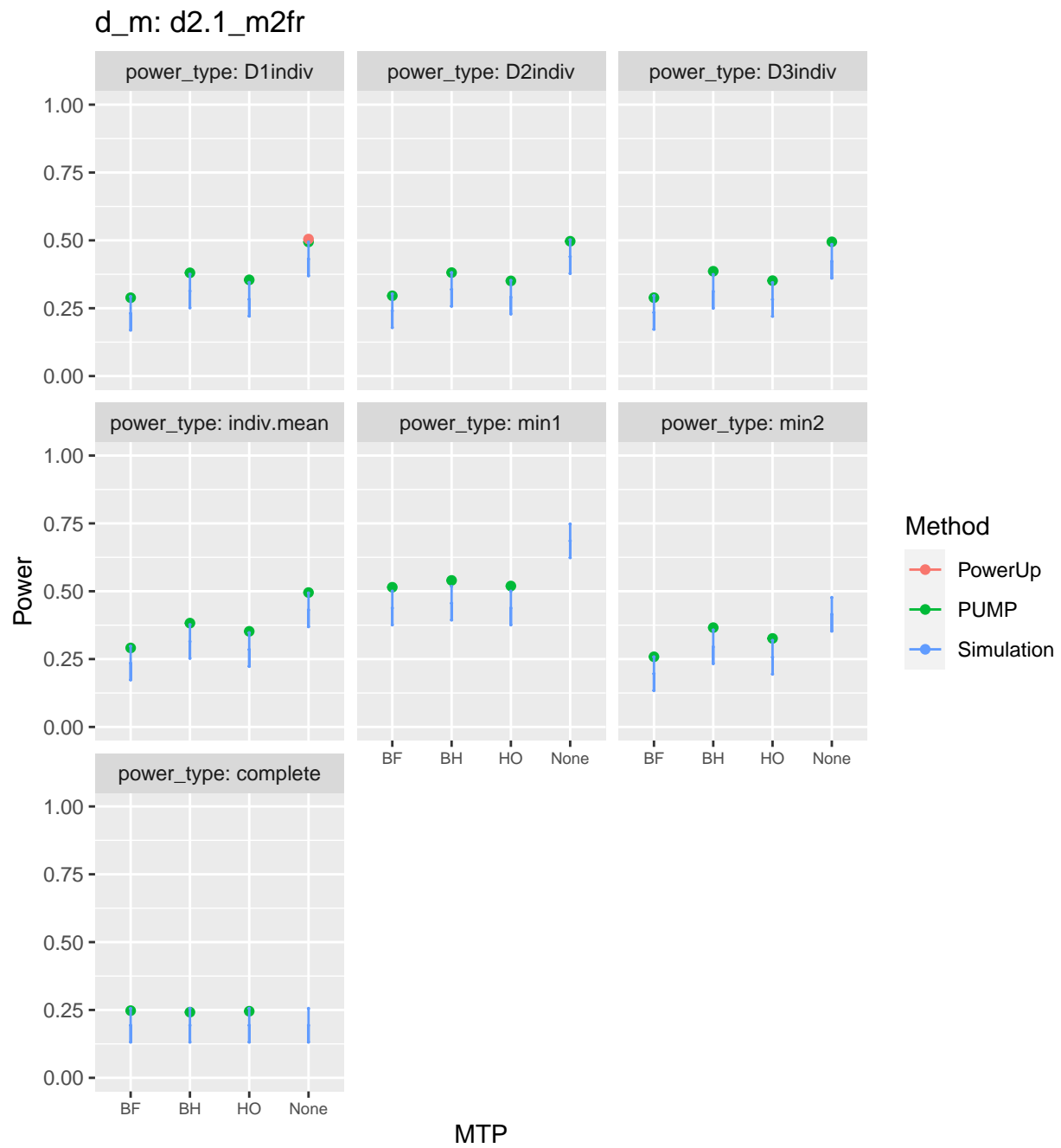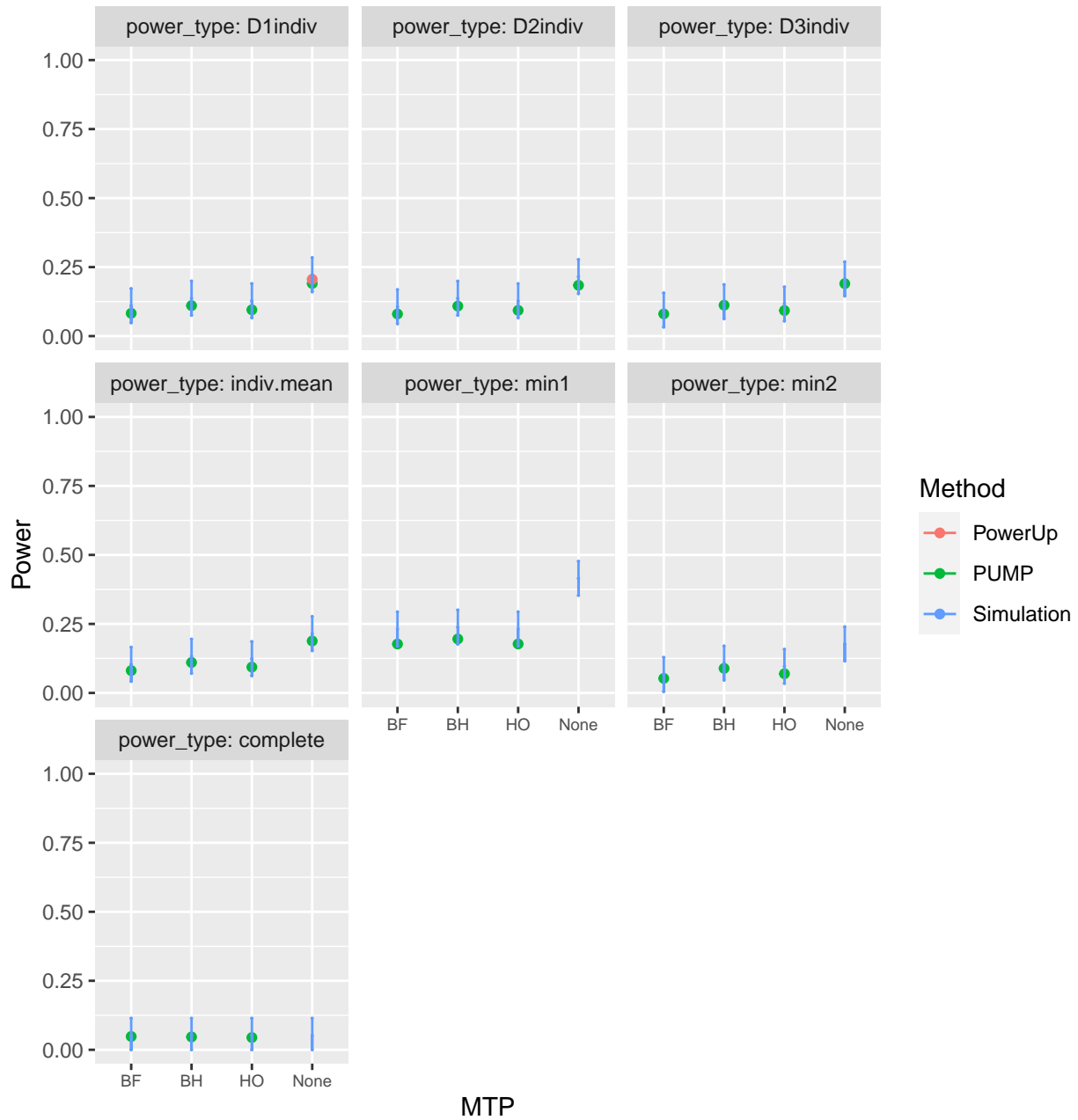
```
##
##
## +-----+--------------+---------------+------------+-----------+------+---+-------+
## | MTP | Adjusted MDES | D1indiv Power | Target MDES |    d_m    |  S   | M | MDES  |
## +=====+==============+===============+============+===========+======+===+=======+
## | BF  |    0.125     |     0.266     |   0.125    | d2.1_m2fr | 5000 | 3 | 0.125 |
## +-----+--------------+---------------+------------+-----------+------+---+-------+
## | BH  |    0.125     |     0.351     |   0.125    | d2.1_m2fr | 5000 | 3 | 0.125 |
## +-----+--------------+---------------+------------+-----------+------+---+-------+
## | HO  |    0.124     |     0.318     |   0.125    | d2.1_m2fr | 5000 | 3 | 0.125 |
## +-----+--------------+---------------+------------+-----------+------+---+-------+
##
## Table: d2.1_m2fr (continued below)
##
##
##
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | numZero | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +=========+====+===+======+=====+=========+=========+======+======+======+=======+=======+
## |    0    | 20 | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## |    0    | 20 | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
## |    0    | 20 | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +---------+----+---+------+-----+---------+---------+------+------+------+-------+-------+
```

Sample size validation

Target value: 20

```
## 
## 
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## | MTP | Sample.type | Sample.size | D1indiv.power |   d_m    |  S   | M | MDES  | numZero |
## +=====+=============+=============+==============+==========+======+===+=======+=========+
## | BF  |      J      |     20      |    0.475     | d2.1_m2fc | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## | BH  |      J      |     20      |    0.557     | d2.1_m2fc | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## | HO  |      J      |     20      |    0.537     | d2.1_m2fc | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## 
## Table: d2.1_m2fc (continued below)
## 
## 
## 
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +====+===+======+=====+=========+=========+======+======+======+=======+=======+
## | NA | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## 
## 
## 
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## | MTP | Sample.type | Sample.size | D1indiv.power |   d_m    |  S   | M | MDES  | numZero |
## +=====+=============+=============+==============+==========+======+===+=======+=========+
## | BF  |    nbar     |    51.07    |    0.475     | d2.1_m2fc | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## | BH  |    nbar     |     50      |    0.563     | d2.1_m2fc | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## | HO  |    nbar     |     50      |    0.536     | d2.1_m2fc | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+----------+------+---+-------+---------+
## 
## Table: d2.1_m2fc (continued below)
## 
## 
## 
## +----+---+-----+---------+---------+------+------+------+-------+-------+
## | J  | K | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +====+===+=====+=========+=========+======+======+======+=======+=======+
## | 20 | 1 | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+-----+---------+---------+------+------+------+-------+-------+
## | 20 | 1 | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+-----+---------+---------+------+------+------+-------+-------+
## | 20 | 1 | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+-----+---------+---------+------+------+------+-------+-------+
```

```
## 
## 
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## | MTP | Sample.type | Sample.size | D1indiv.power |    d_m    |  S   | M | MDES  | numZero |
## +=====+=============+=============+===============+===========+======+===+=======+=========+
## | BF  |      J      |     20      |     0.473     | d2.1_m2ff | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## | BH  |      J      |     21      |     0.565     | d2.1_m2ff | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## | HO  |      J      |     21      |     0.552     | d2.1_m2ff | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## 
## Table: d2.1_m2ff (continued below)
## 
## 
## 
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +====+===+======+=====+=========+=========+======+======+======+=======+=======+
## | NA | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   NA    |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
```

Target value: 50

```
## 
## 
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## | MTP | Sample.type | Sample.size | D1indiv.power |    d_m    |  S   | M | MDES  | numZero |
## +=====+=============+=============+===============+===========+======+===+=======+=========+
## | BF  |      J      |     20      |     0.266     | d2.1_m2fr | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## | BH  |      J      |     20      |     0.352     | d2.1_m2fr | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## | HO  |      J      |     20      |     0.316     | d2.1_m2fr | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+---------------+-----------+------+---+-------+---------+
## 
## Table: d2.1_m2fr (continued below)
## 
## 
## 
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +====+===+======+=====+=========+=========+======+======+======+=======+=======+
## | NA | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## 
```

```
## 
## +-----+-------------+-------------+--------------+-----------+------+---+-------+---------+
## | MTP | Sample.type | Sample.size | D1indiv.power |    d_m    |  S   | M | MDES  | numZero |
## +=====+=============+=============+==============+===========+======+===+=======+=========+
## | BF  |      J      |     20      |    0.266     | d2.1_m2fr | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+-----------+------+---+-------+---------+
## | BH  |      J      |     20      |    0.352     | d2.1_m2fr | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+-----------+------+---+-------+---------+
## | HO  |      J      |     20      |    0.316     | d2.1_m2fr | 5000 | 3 | 0.125 |    0    |
## +-----+-------------+-------------+--------------+-----------+------+---+-------+---------+
## 
## Table: d2.1_m2fr (continued below)
## 
## 
## 
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | J  | K | nbar | rho | omega.2 | omega.3 | R2.1 | R2.2 | R2.3 | ICC.2 | ICC.3 |
## +====+===+======+=====+=========+=========+======+======+======+=======+=======+
## | NA | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
## | NA | 1 |  50  | 0.5 |   0.1   |   NA    | 0.1  |  NA  |  NA  |  0.2  |  NA   |
## +----+---+------+-----+---------+---------+------+------+------+-------+-------+
```