Exposure–Spend Models Fit Comparison

Model   ●— lm   ●— nls

Exposure [fb_paid_total_impressions]

Spend [fb_paid_spend]

nls: AIC = 14700 | R2 = 0.956
lm: AIC = 14700 | R2 = 0.956

Exposure–Spend Models Fit Comparison

Model —●— lm —●— nls

Exposure [google_paid_total_impressions]

Spend [google_paid_spend]

nls: AIC = 15100 | R2 = 0.975
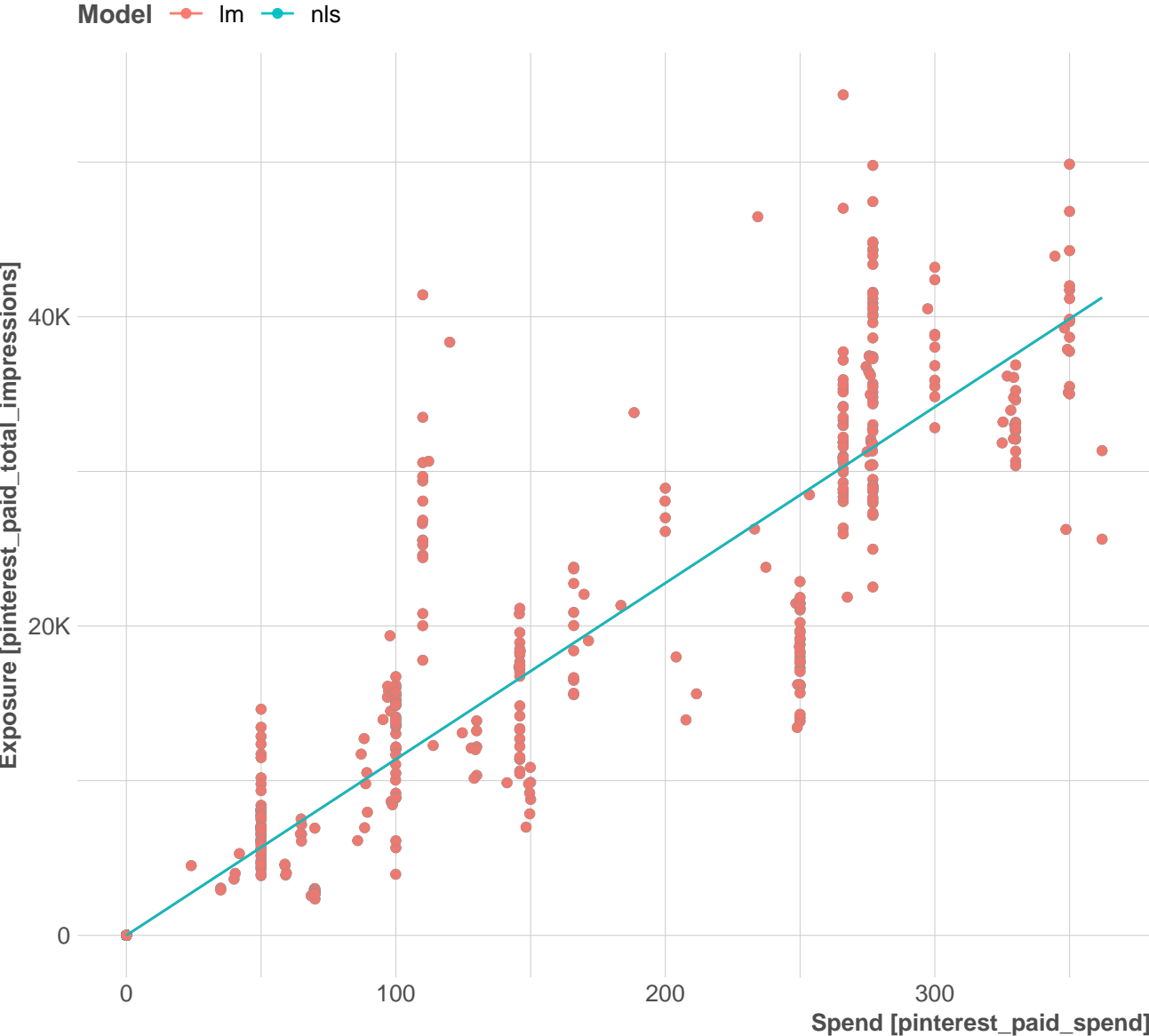lm: AIC = 15100 | R2 = 0.975

Exposure–Spend Models Fit Comparison

Model —●— lm —●— nls

Exposure [pinterest_paid_total_impressions] (y-axis): 0, 20K, 40K

Spend [pinterest_paid_spend] (x-axis): 0, 100, 200, 300

nls: AIC = 12800 | R2 = 0.93
lm: AIC = 12800 | R2 = 0.93

Exposure–Spend Models Fit Comparison

Model — lm — nls

nls: AIC = 10900 | R2 = 0.991
lm: AIC = 10900 | R2 = 0.991

Exposure–Spend Models Fit Comparison
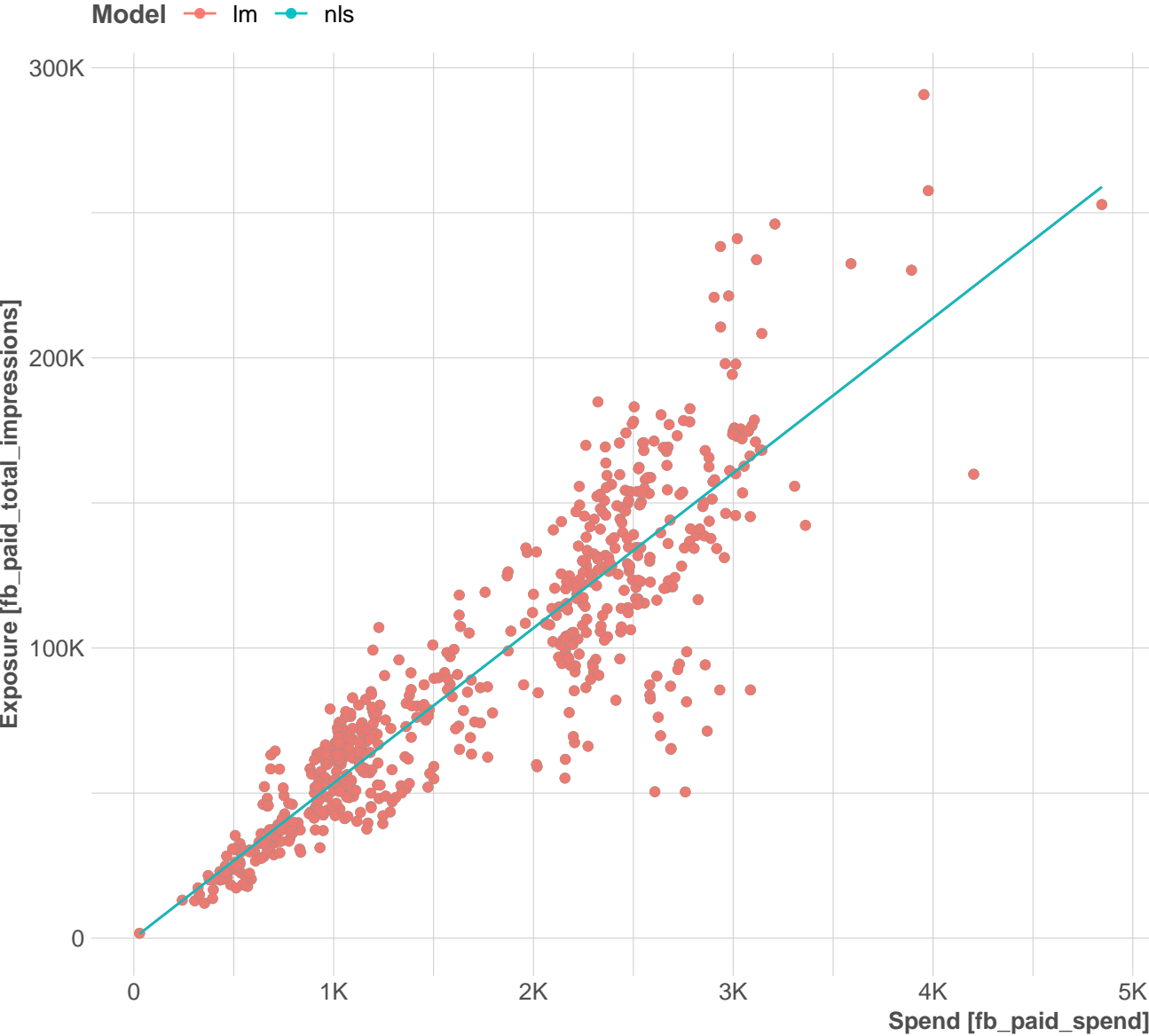
Model ● lm ● nls

Exposure [fb_paid_total_impressions]

Spend [fb_paid_spend]

nls: AIC = 14700 | R2 = 0.956
lm: AIC = 14700 | R2 = 0.956

Exposure–Spend Models Fit Comparison

Model — lm — nls

Exposure [google_paid_total_impressions]

Spend [google_paid_spend]

nls: AIC = 15100 | R2 = 0.975
lm: AIC = 15100 | R2 = 0.975

Exposure–Spend Models Fit Comparison

Model ● lm ● nls

Exposure [pinterest_paid_total_impressions] vs Spend [pinterest_paid_spend]

nls: AIC = 12800 | R2 = 0.93
lm: AIC = 12800 | R2 = 0.93

Exposure–Spend Models Fit Comparison

Model — lm — nls

Exposure [mountain_paid_total_impressions] vs Spend [mountain_paid_spend]

nls: AIC = 10900 | R2 = 0.991
lm: AIC = 10900 | R2 = 0.991
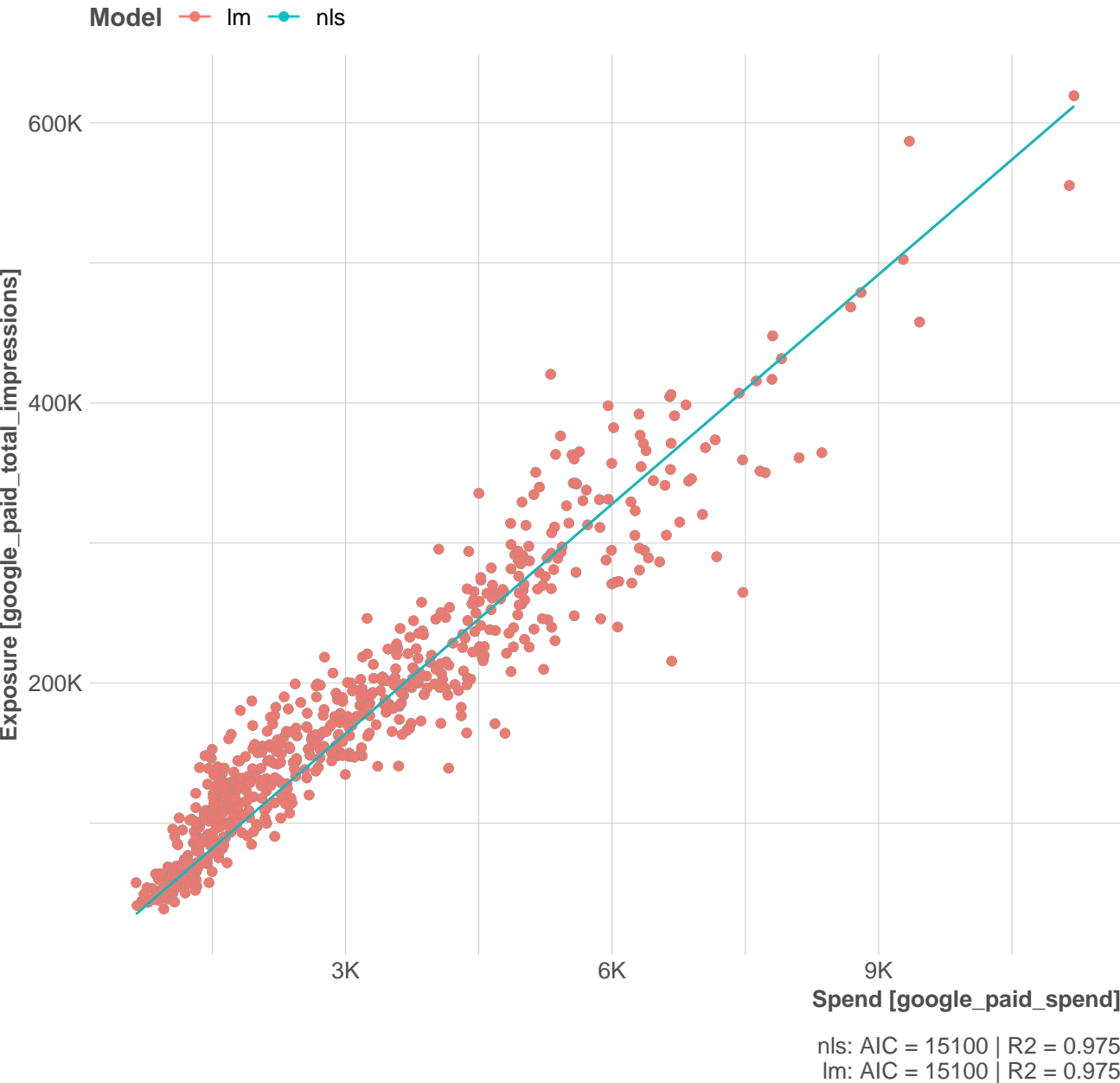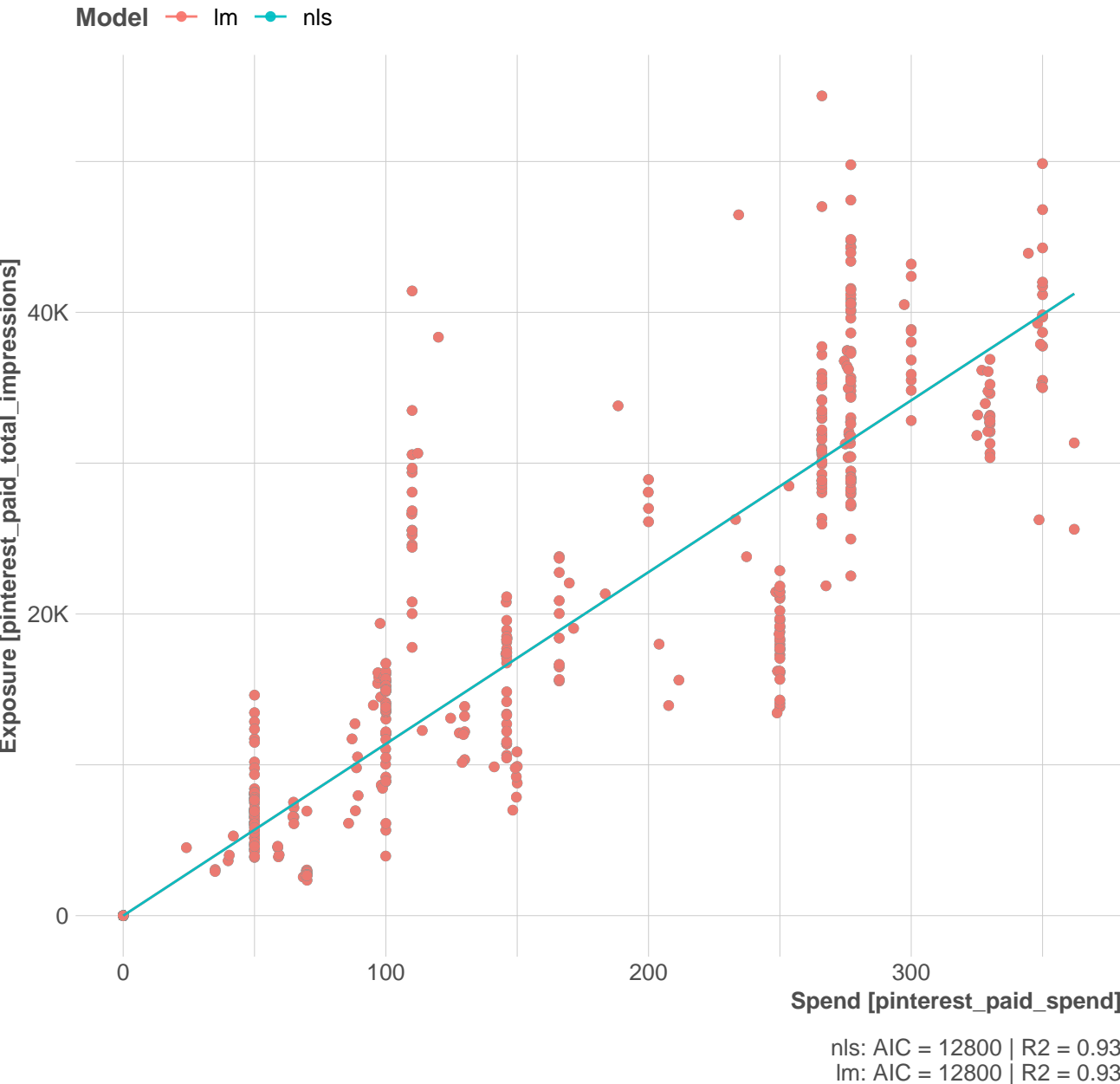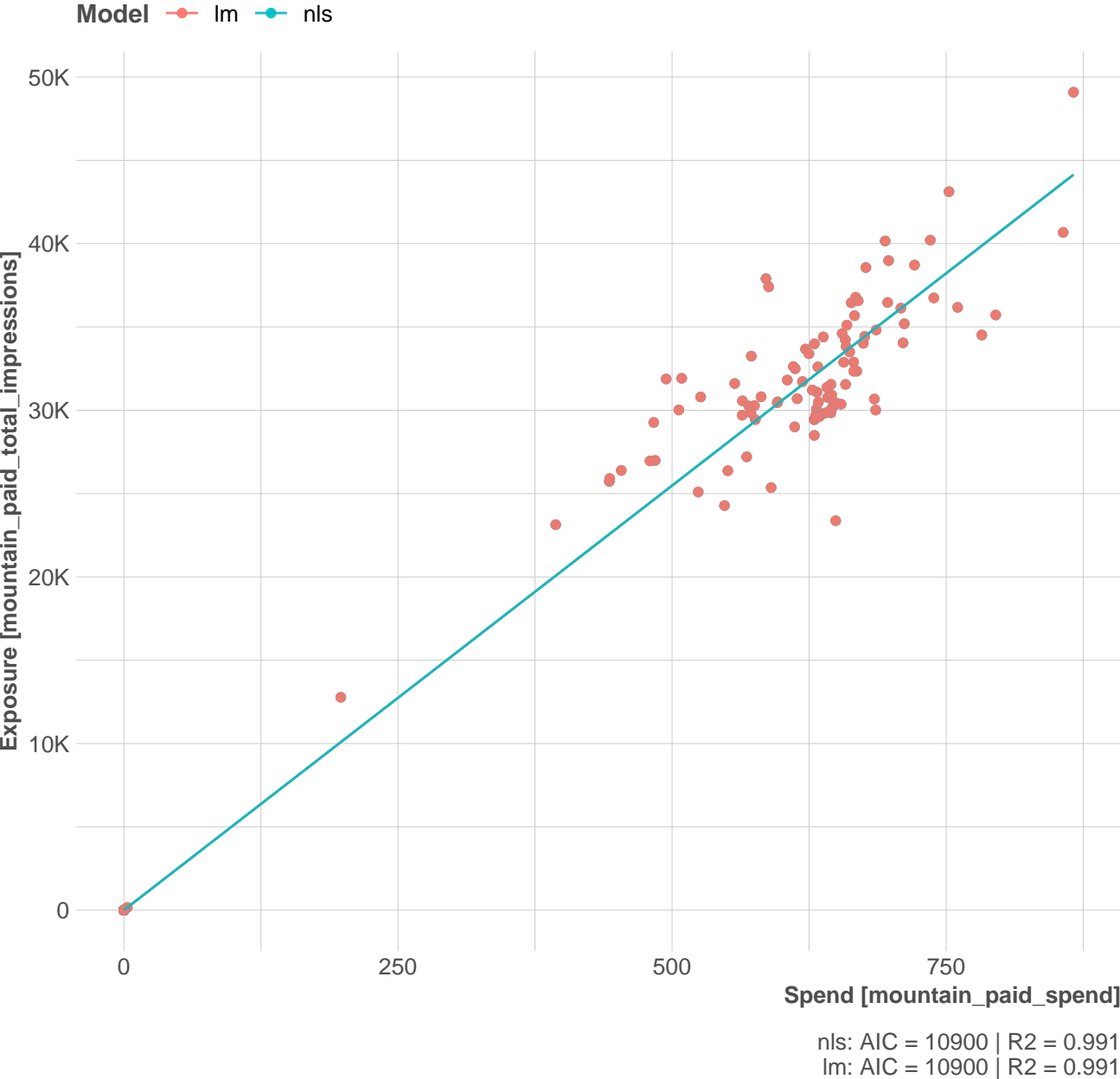
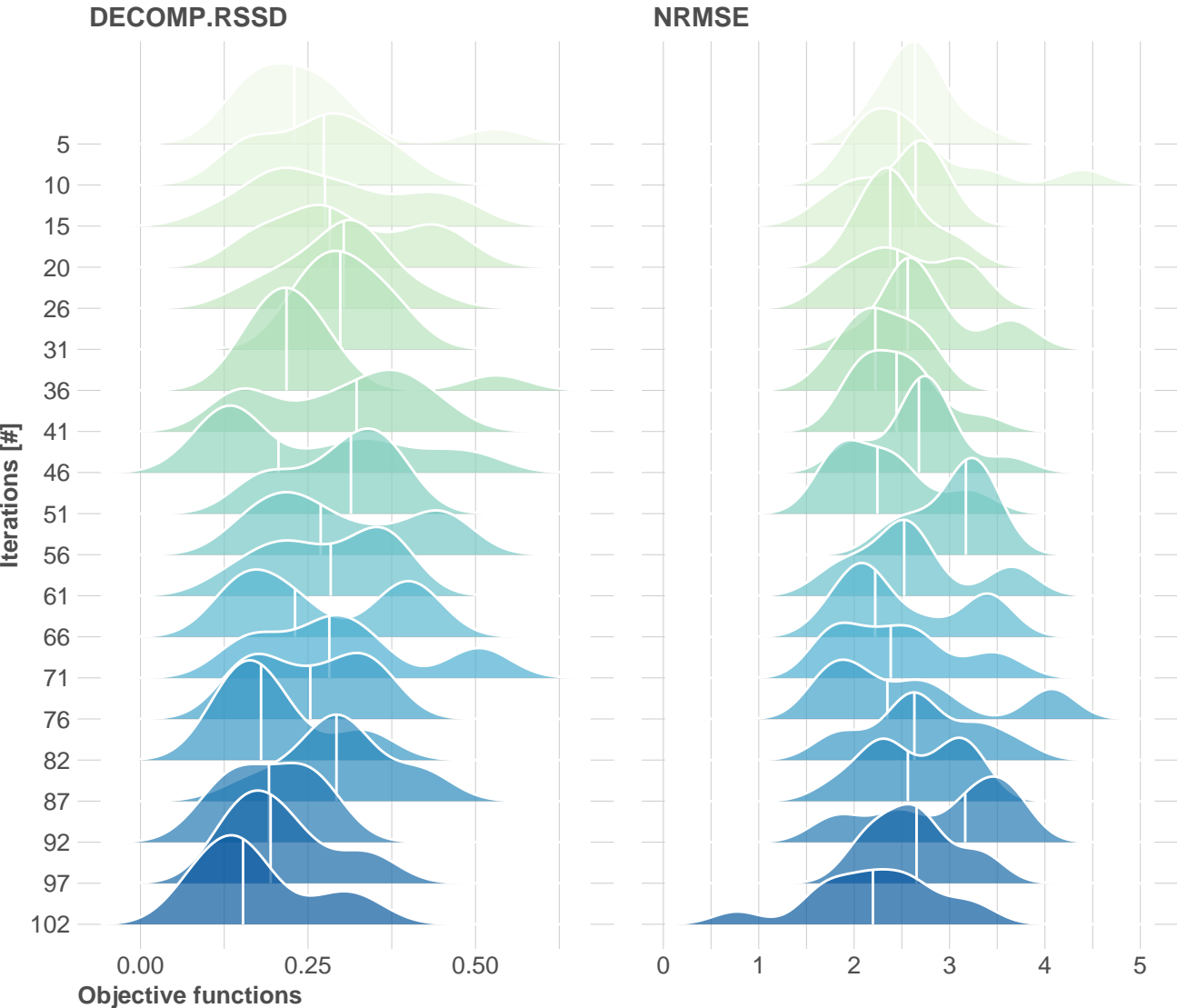# Objective convergence by iterations quantiles
2 trials with 102 iterations each using TwoPointsDE

DECOMP.RSSD NOT converged: sd@qt.20 0.086 <= 0.1 & |med@qt.20| 0.15 > 0.021
NRMSE NOT converged: sd@qt.20 0.69 > 0.51 & |med@qt.20| 2.2 > 1.6

Multi–objective evolutionary performance
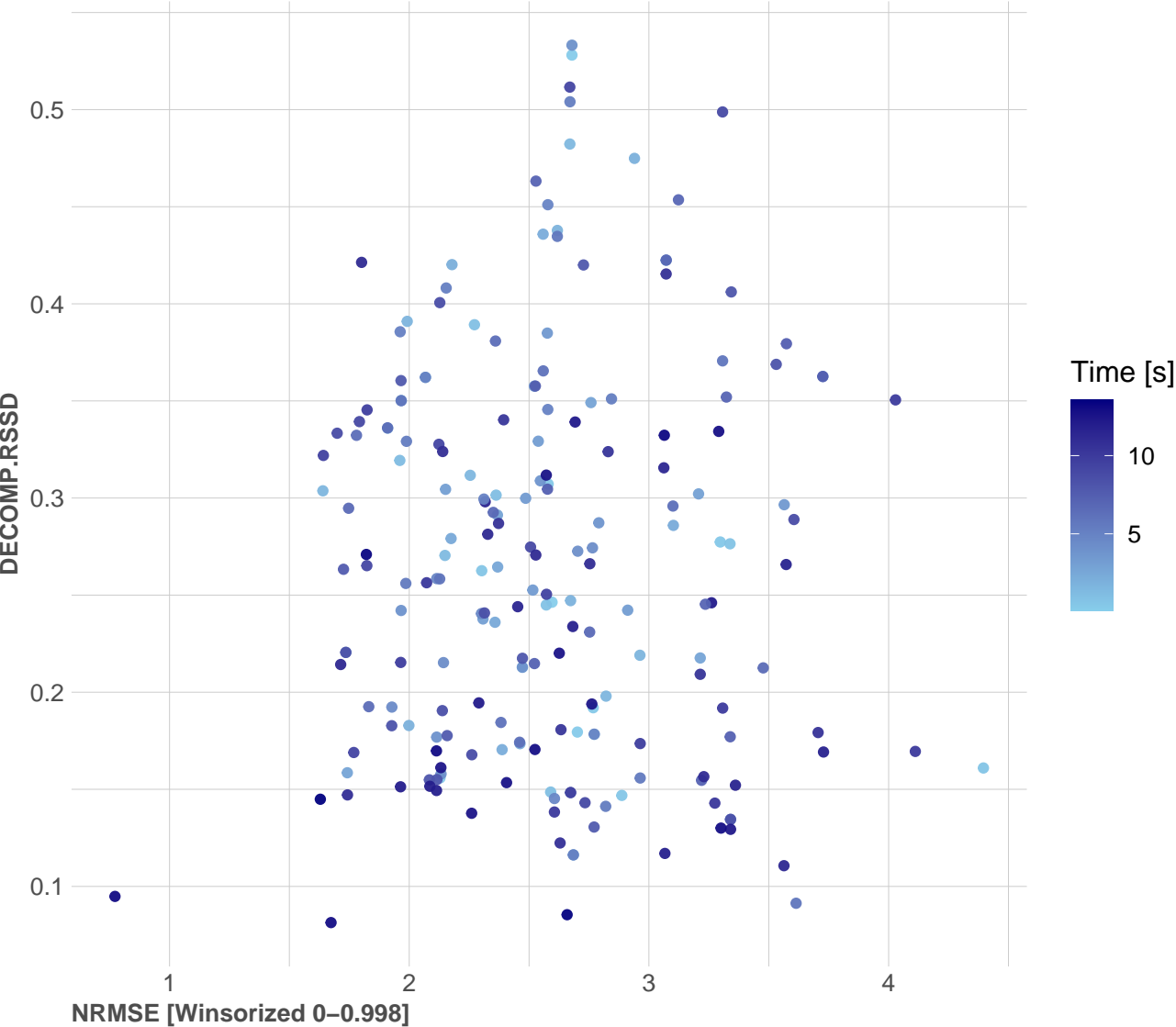
2 trials with 102 iterations each using TwoPointsDE

DECOMP.RSSD NOT converged: sd@qt.20 0.086 <= 0.1 & |med@qt.20| 0.15 > 0.021
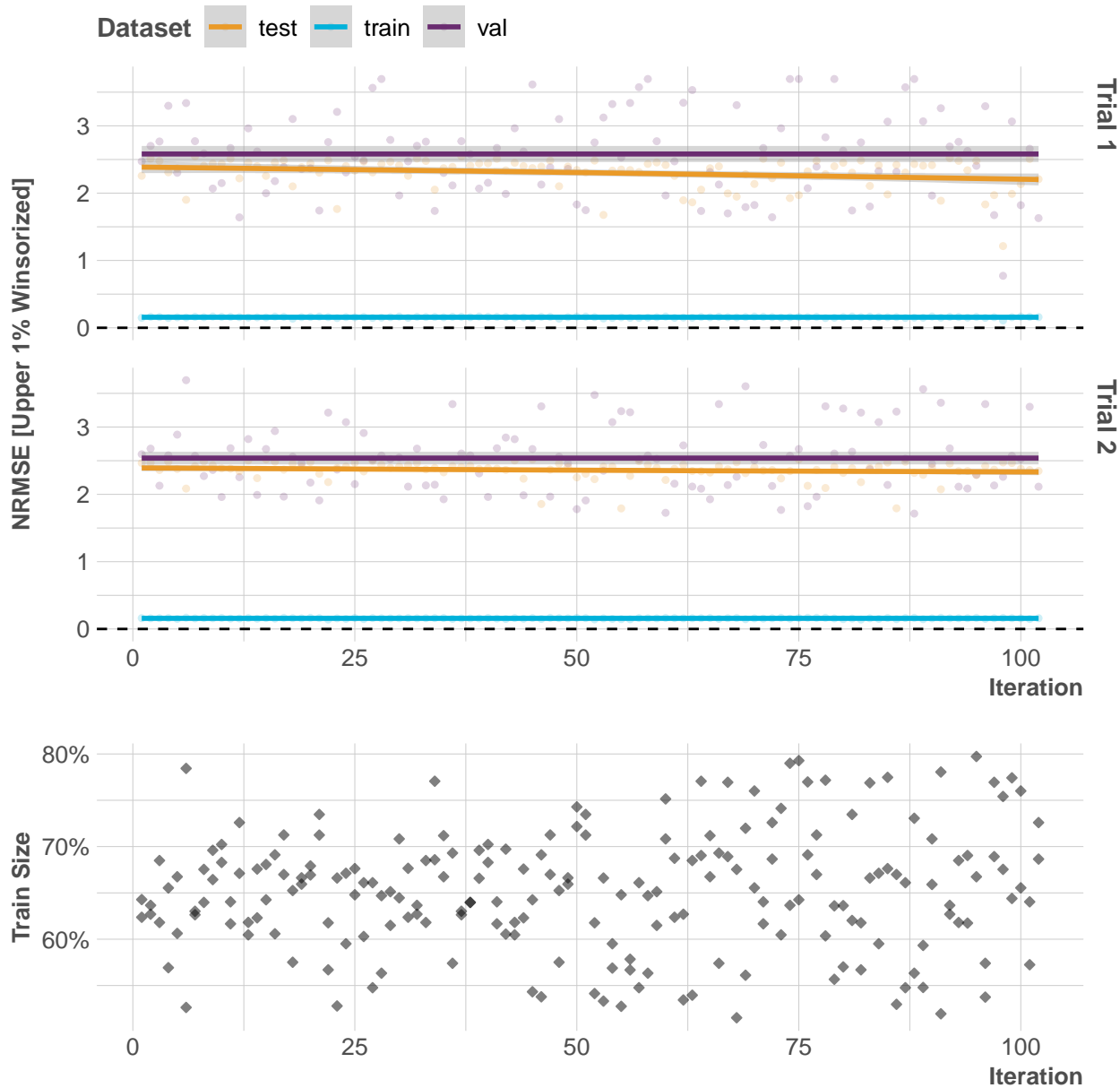NRMSE NOT converged: sd@qt.20 0.69 > 0.51 & |med@qt.20| 2.2 > 1.6

Time−series validation & Convergence
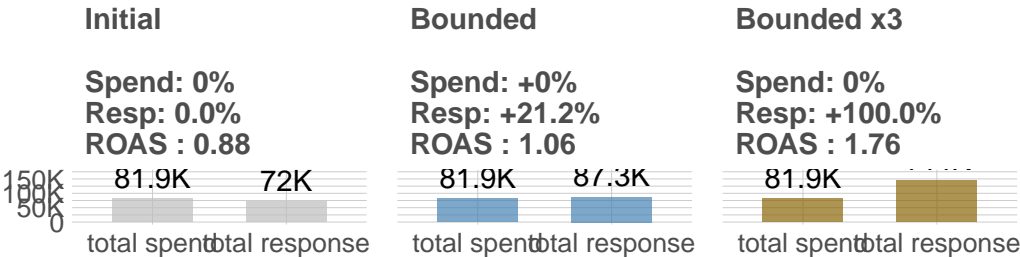
Dataset — test — train — val
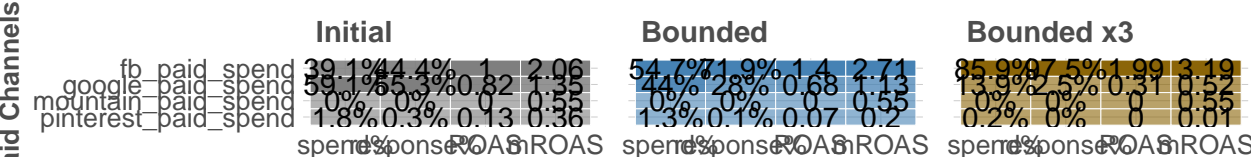
Budget Allocation Onepager for Model ID 1_98_1

Adj.R2: train = 0.6016, val = 0.7063, test = 0.4364 | NRMSE: train = 0.1091, val = 0.7
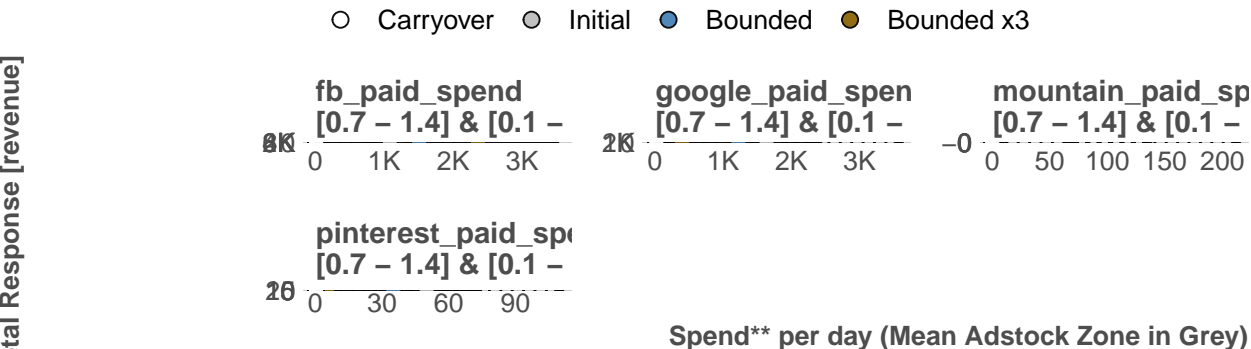*Simulation date range: 2023–12–31 to 2024–01–29 (30 days) | Scenario: max_resp*

Total Budget Optimization Result

Initial	**Bounded**	**Bounded x3**
Spend: 0%	**Spend: +0%**	**Spend: 0%**
Resp: 0.0%	**Resp: +21.2%**	**Resp: +100.0%**
ROAS : 0.88	**ROAS : 1.06**	**ROAS : 1.76**

150K 100K 50K 0

81.9K 72K   81.9K 87.3K   81.9K

total spent total response   total spent total response   total spent total response

Budget Allocation per Channel*

Paid Channels

	Initial				**Bounded**				**Bounded x3**		
fb_paid_spend	39.1%	44.4%	1	2.06	54.7%	71.9%	1.4	2.71	85.9%	97.5%	1.99	3.19
google_paid_spend	59.1%	55.3%	0.82	1.35	44%	28%	0.68	1.13	13.9%	2.5%	0.31	0.52
mountain_paid_spend	0%	0%	0	0.55	0%	0%	0	0.55	0%	0%	0	0.55
pinterest_paid_spend	1.8%	0.3%	0.13	0.36	1.3%	0.1%	0.07	0.2	0.2%	0%	0	0.01

spend %response ROAS mROAS   spend %response ROAS mROAS   spend %response ROAS mROAS

Simulated Response Curve for Selected Allocation Period

○ Carryover ◉ Initial ● Bounded ● Bounded x3

Total Response [revenue]

fb_paid_spend
[0.7 – 1.4] & [0.1 –

8K 0 1K 2K 3K

google_paid_spen
[0.7 – 1.4] & [0.1 –

2K 0 1K 2K 3K

mountain_paid_sp
[0.7 – 1.4] & [0.1 –

−0 0 50 100 150 200

pinterest_paid_sp
[0.7 – 1.4] & [0.1 –

20 0 30 60 90

Spend per day (Mean Adstock Zone in Grey)**

* ROAS = total response / raw spend | mROAS = marginal response / marginal spend
* When reallocating budget, mROAS converges across media within respective bounds
** Dotted lines show budget optimization lower–upper ranges per media