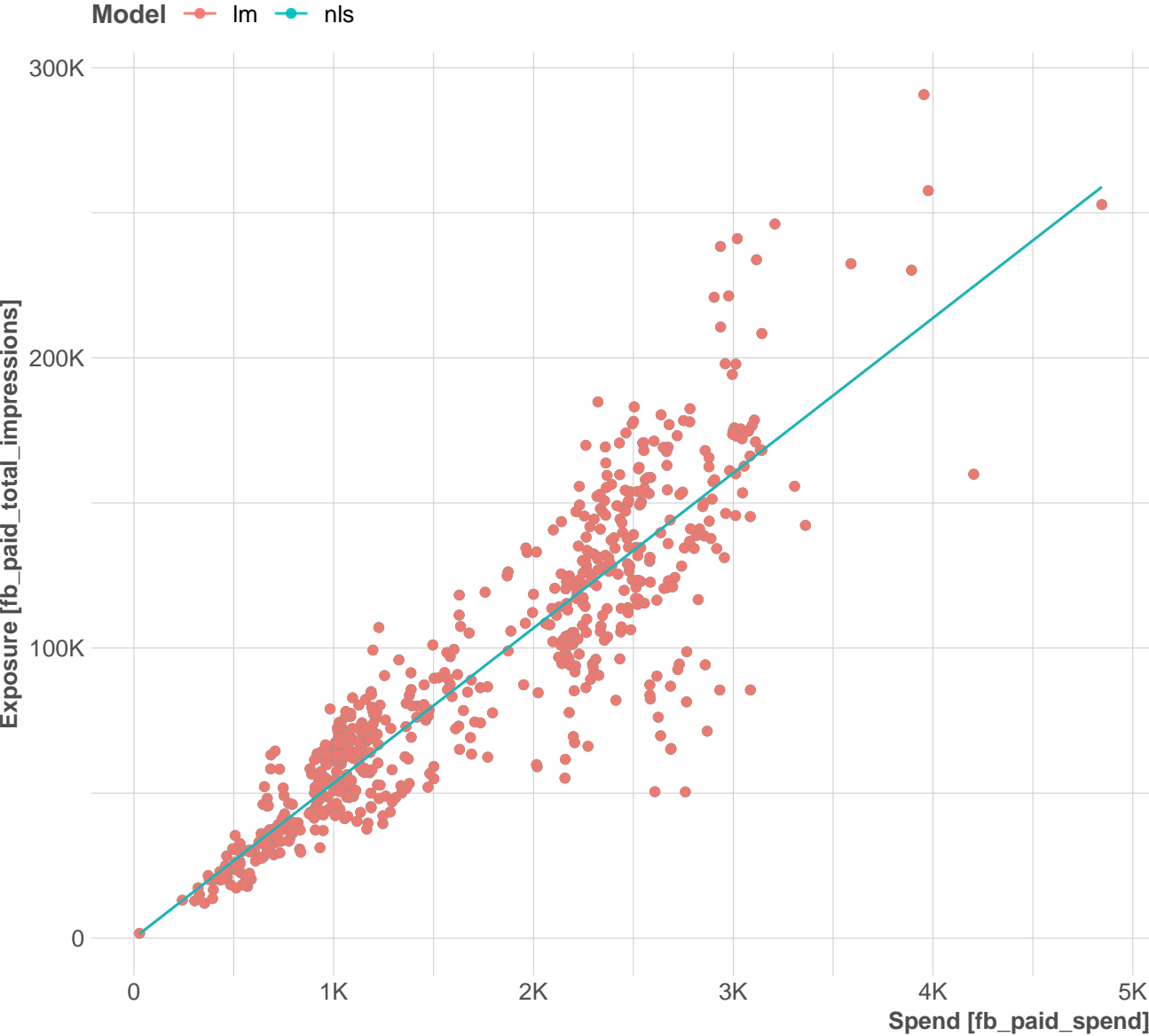
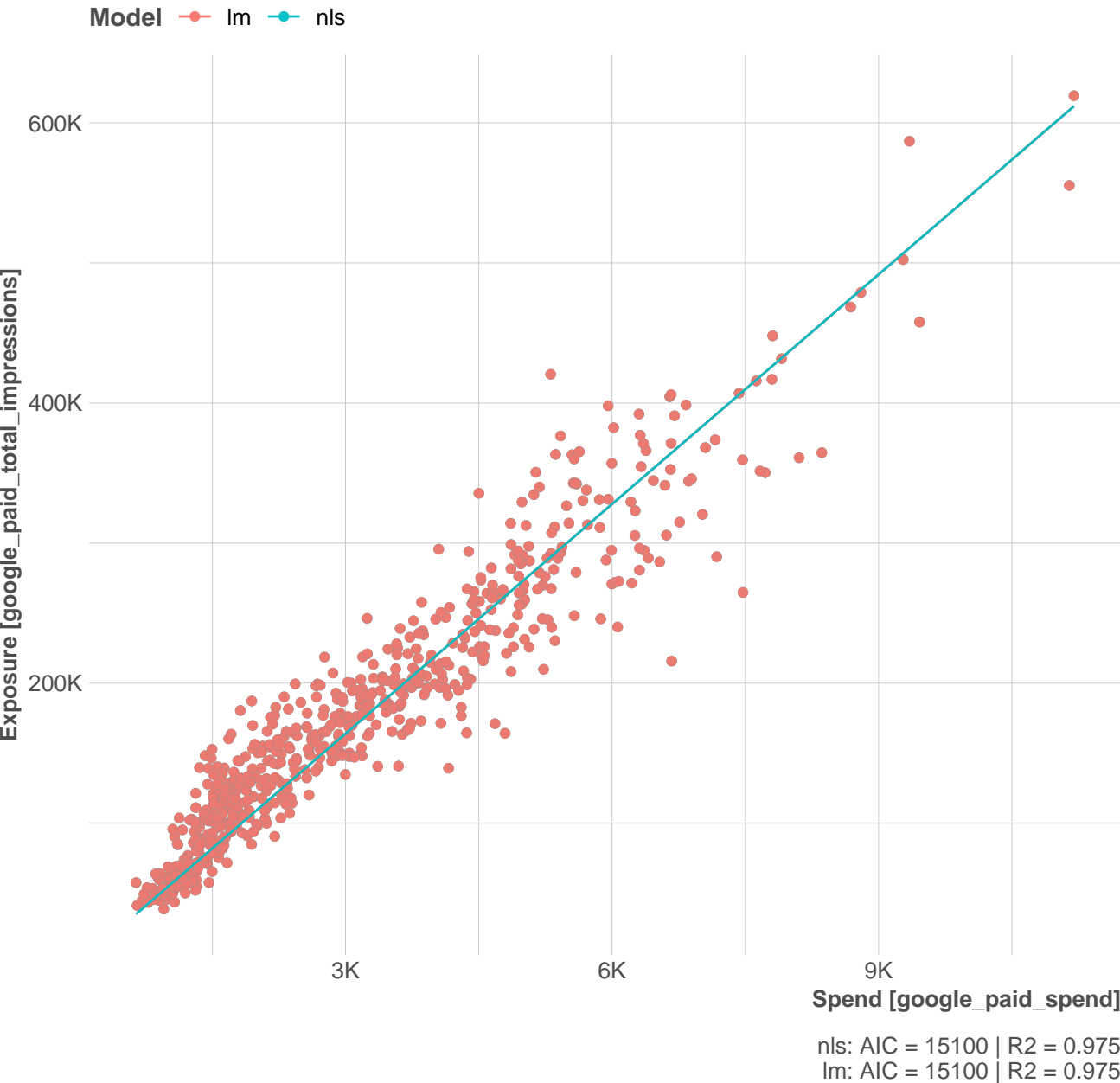


Exposure–Spend Models Fit Comparison

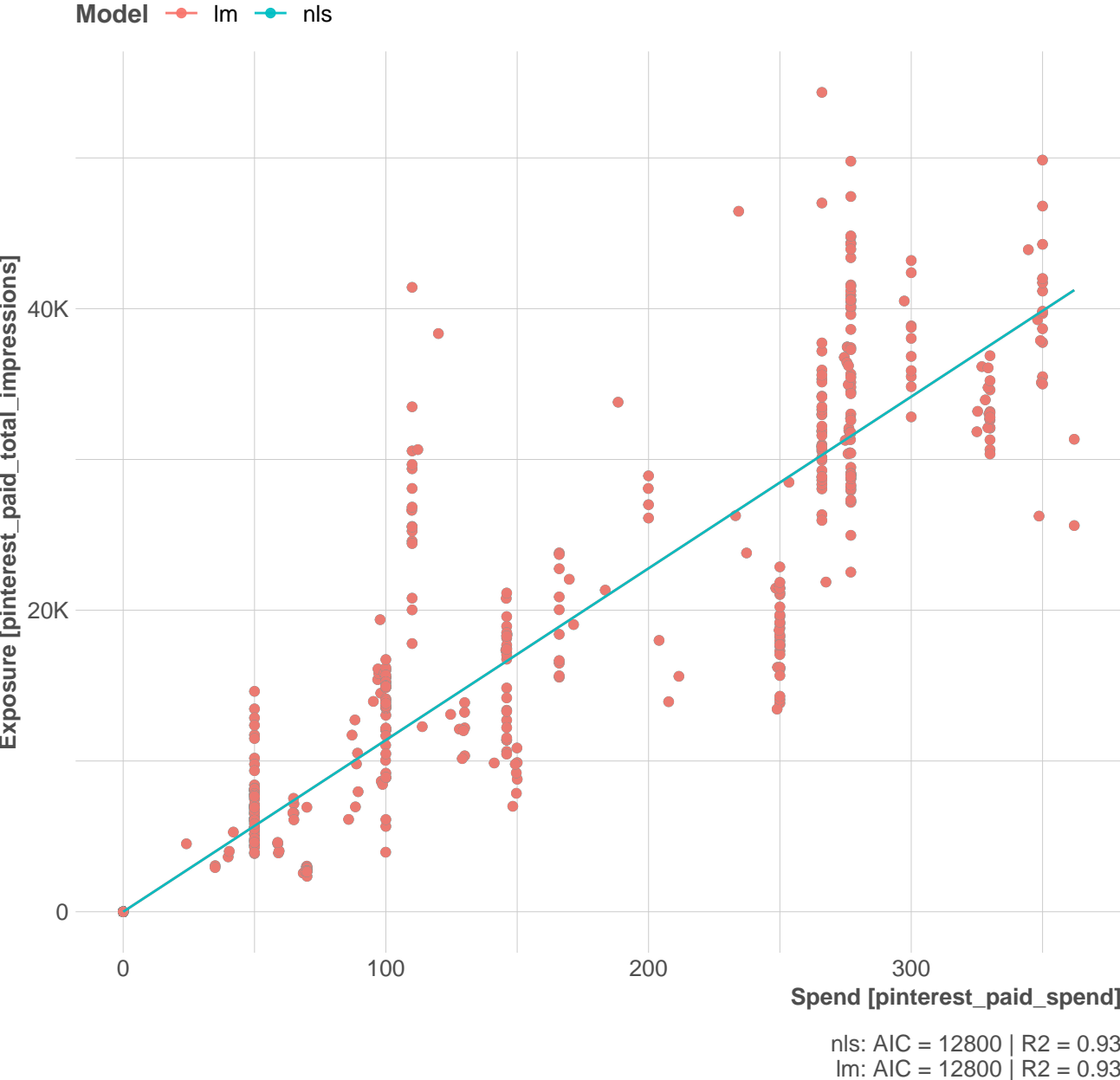


nls: AIC = 14700 | R2 = 0.956
Im: AIC = 14700 | R2 = 0.956

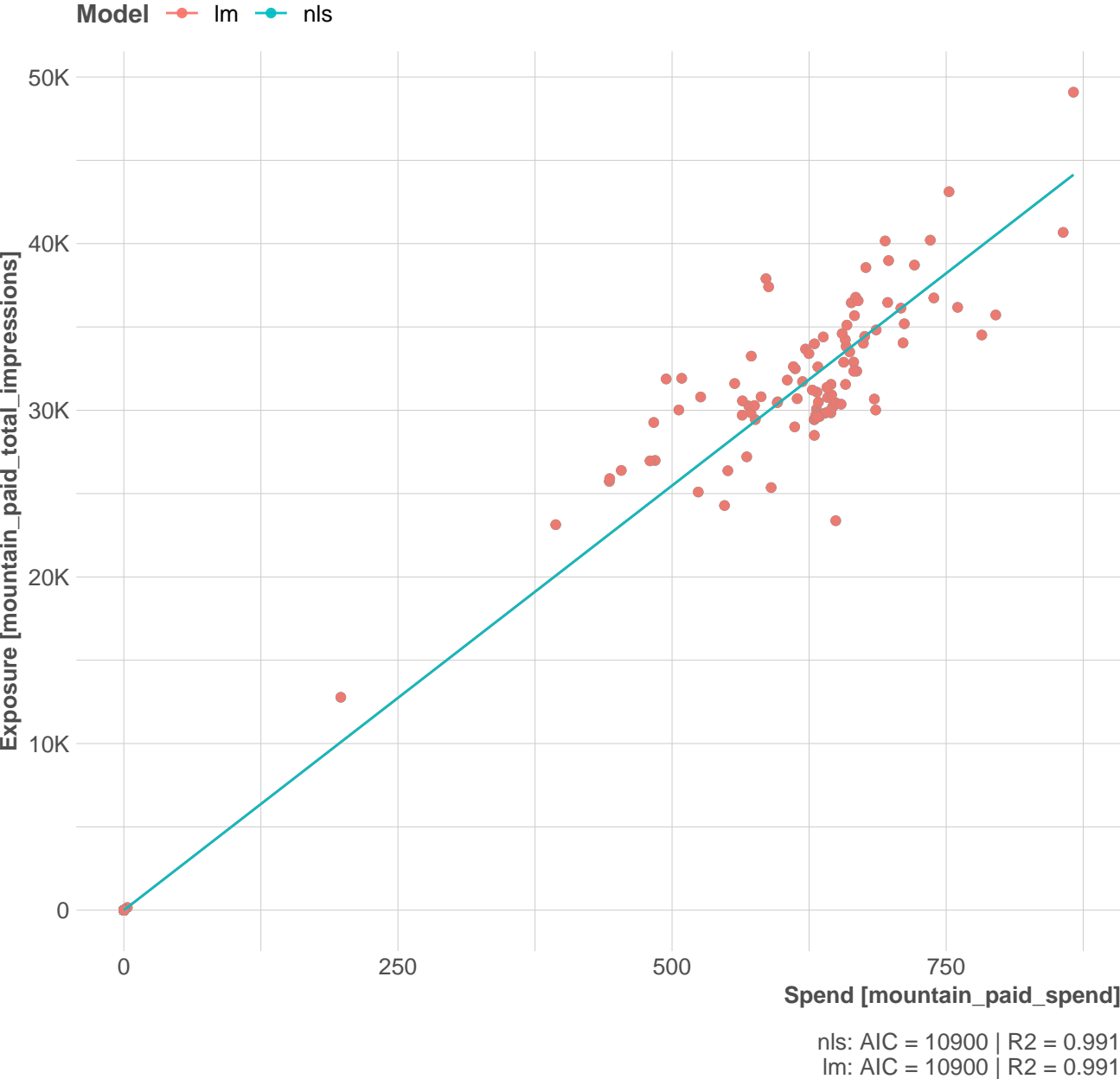
Exposure–Spend Models Fit Comparison



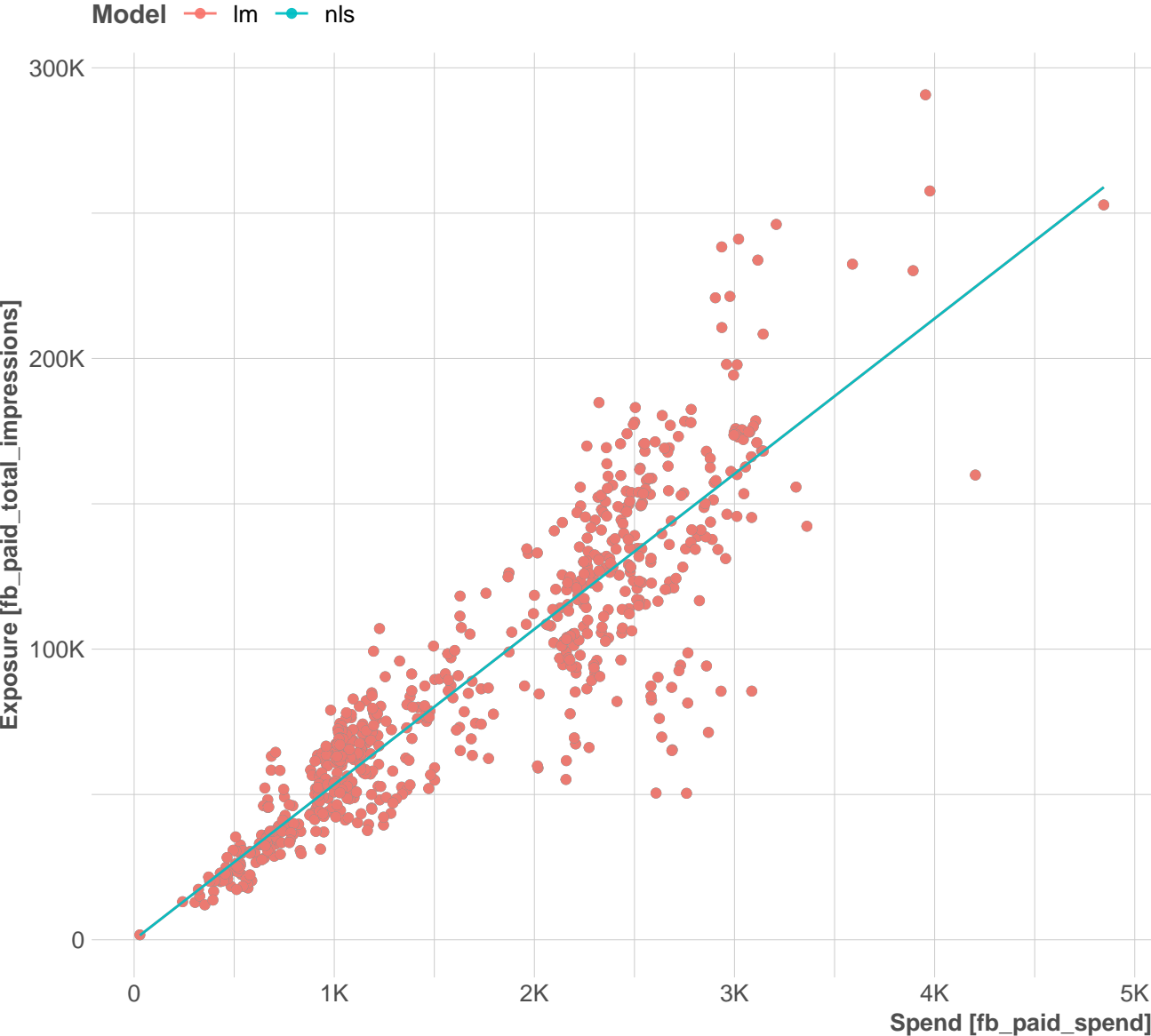
Exposure–Spend Models Fit Comparison



Exposure–Spend Models Fit Comparison

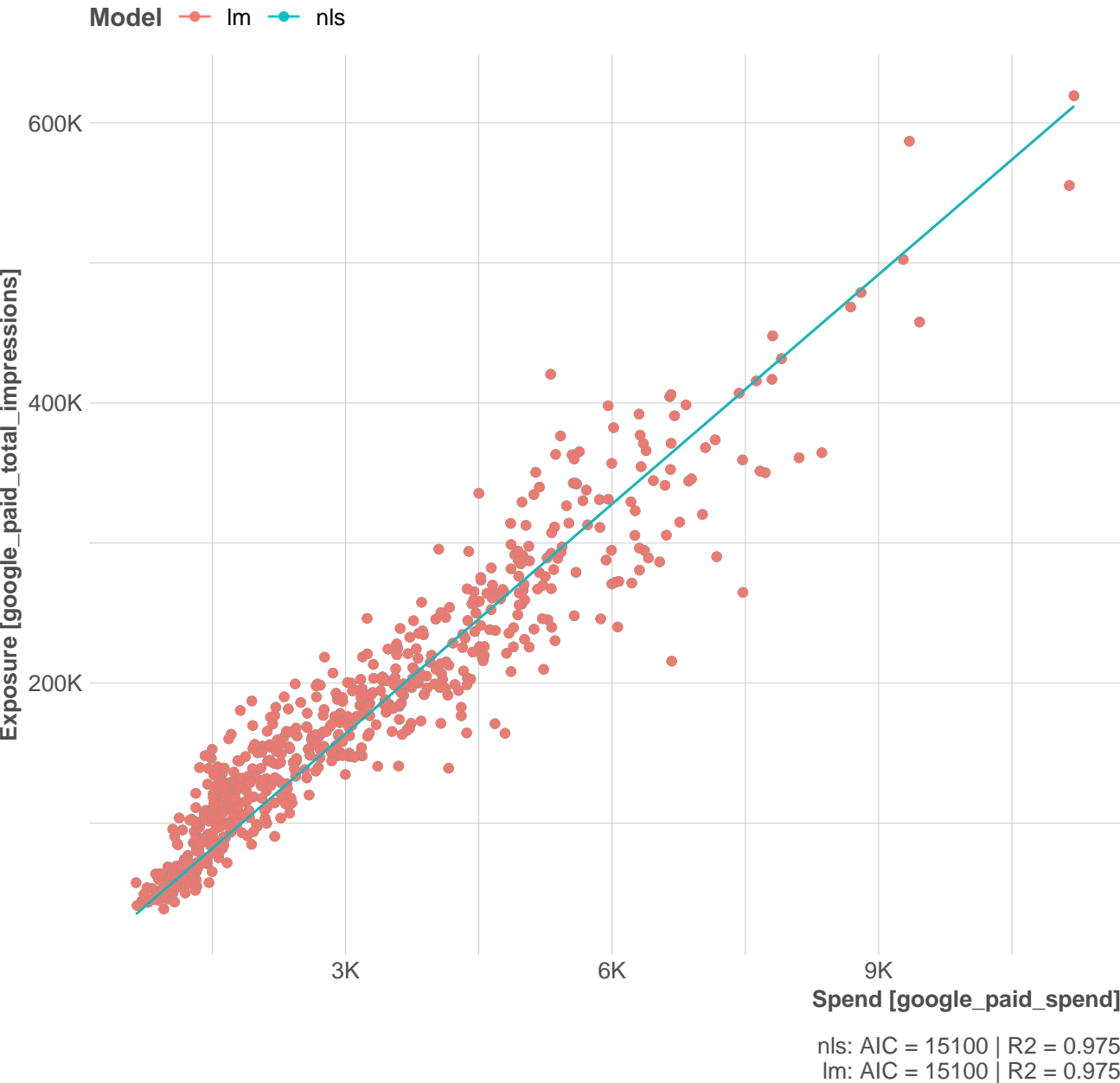


Exposure–Spend Models Fit Comparison

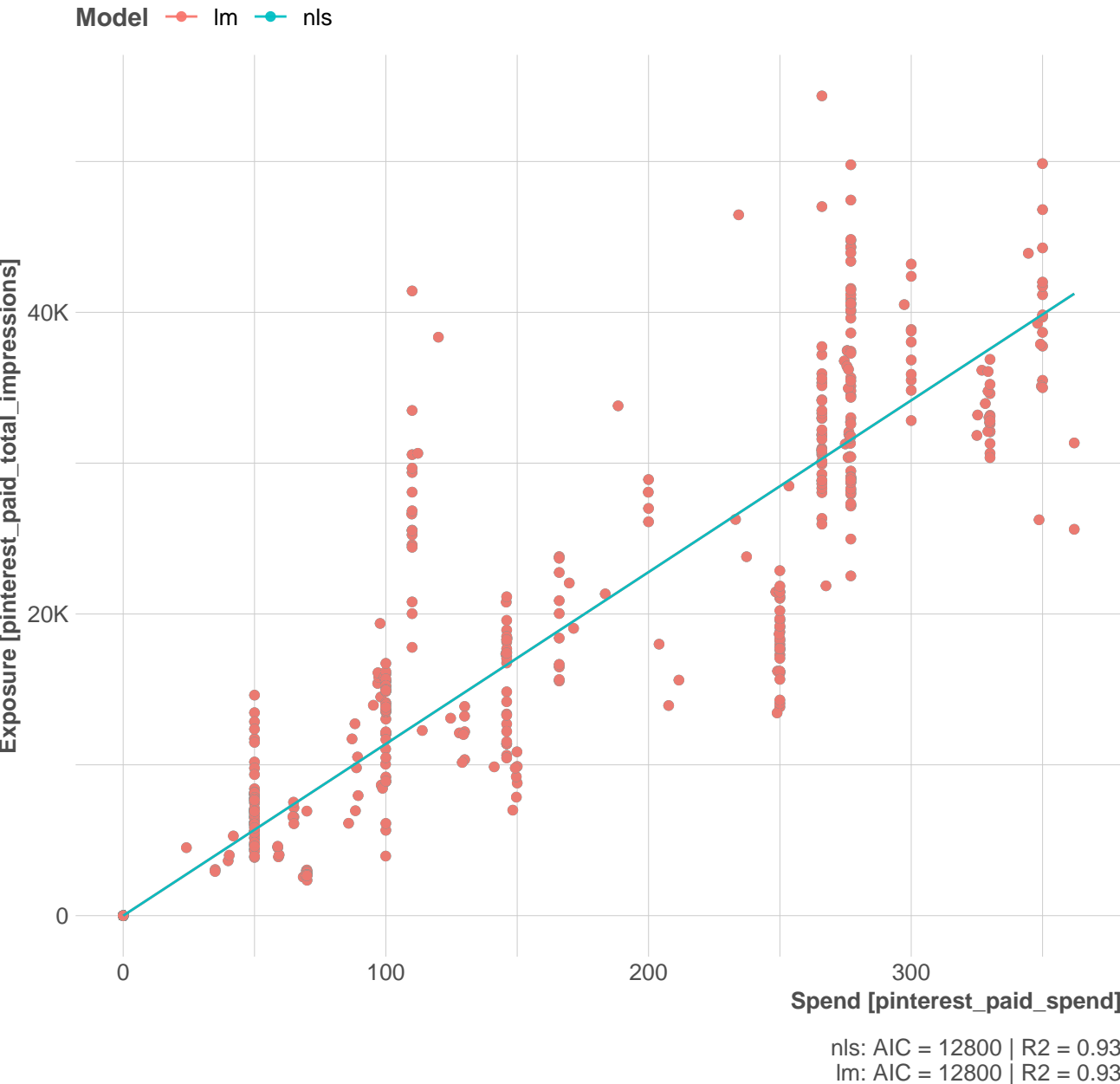


nls: AIC = 14700 | R2 = 0.956
Im: AIC = 14700 | R2 = 0.956

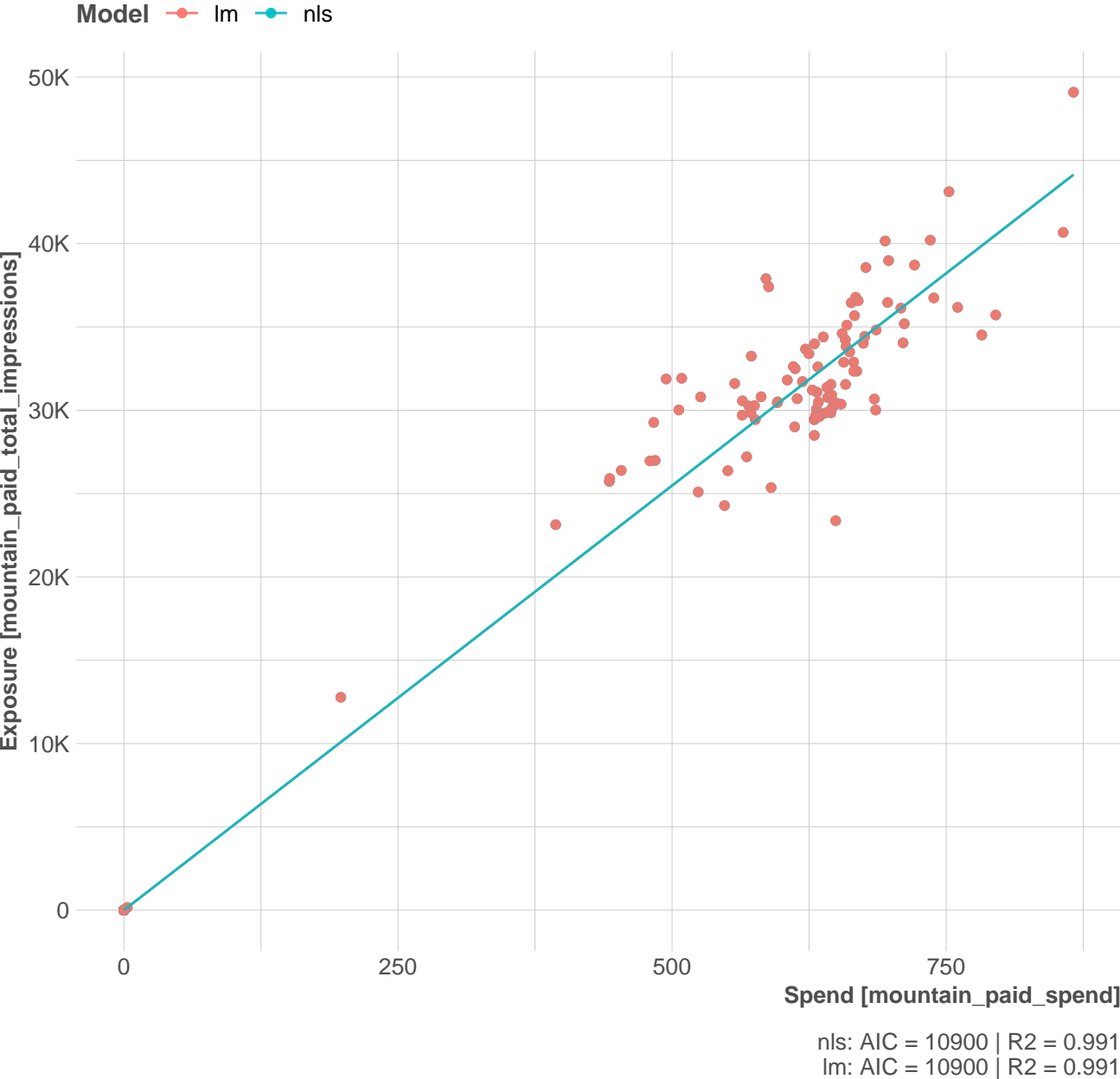
Exposure–Spend Models Fit Comparison



Exposure–Spend Models Fit Comparison

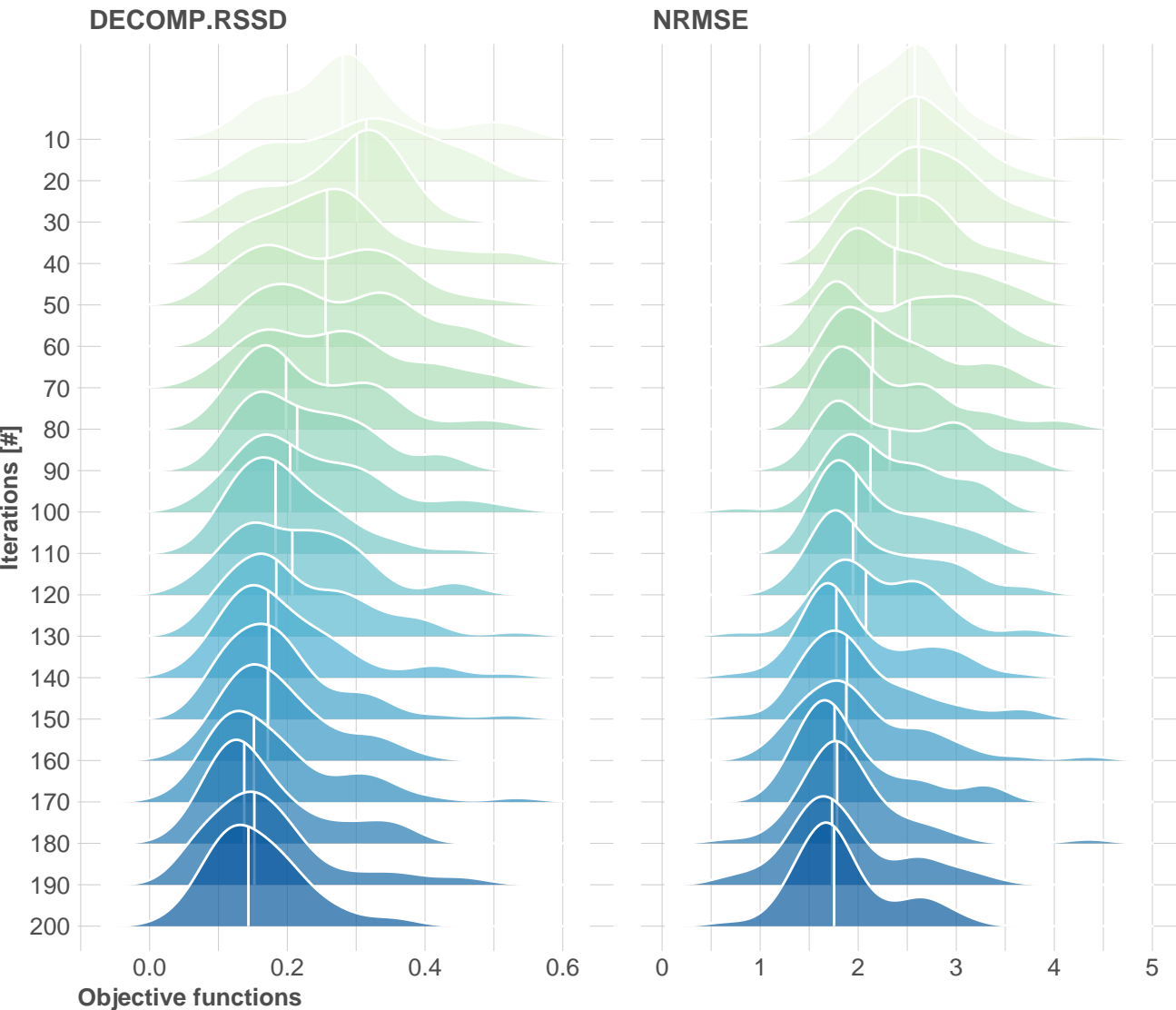


Exposure–Spend Models Fit Comparison



Objective convergence by iterations quantiles

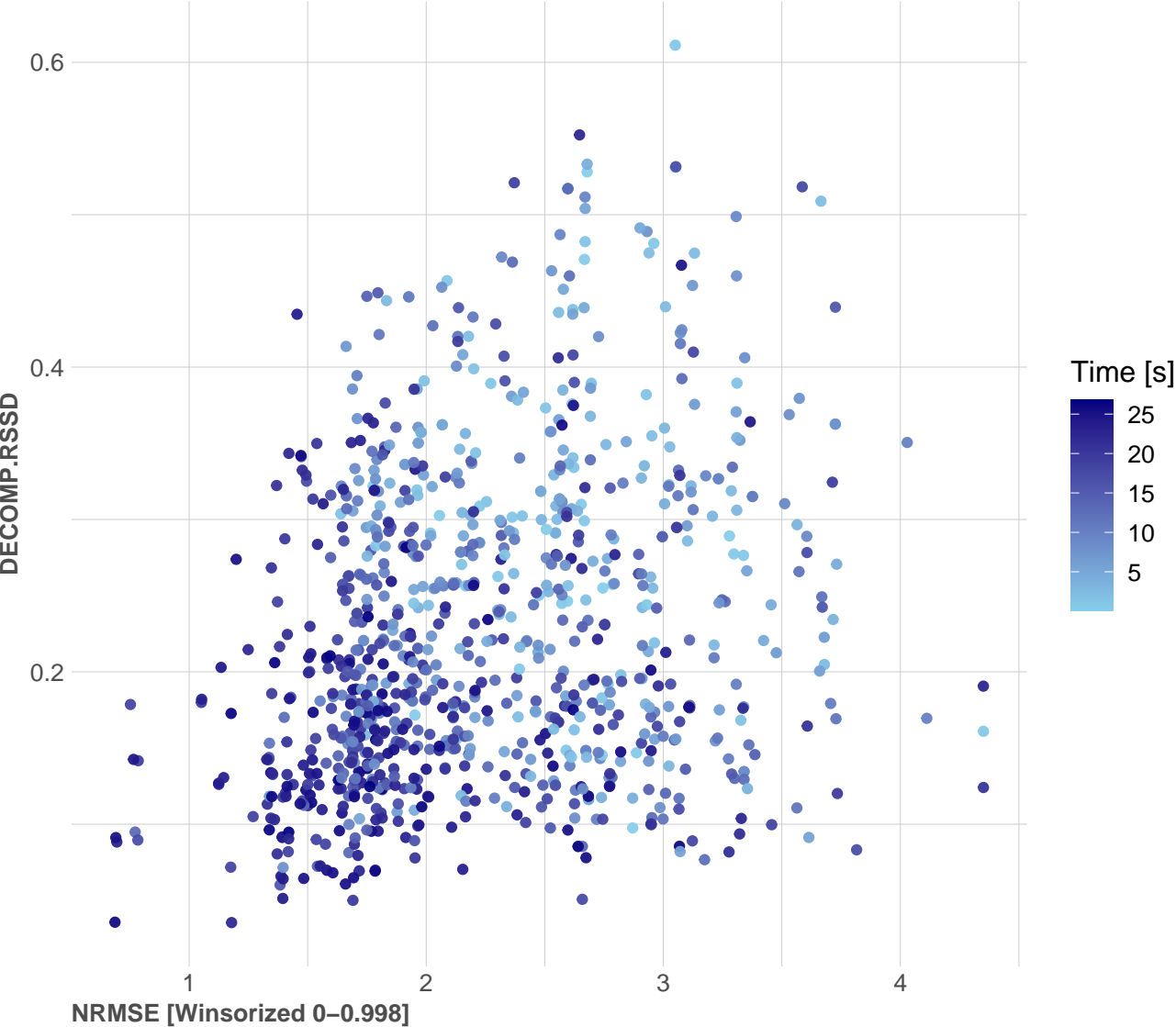
5 trials with 200 iterations each using TwoPointsDE



DECOMP.RSSD NOT converged: $sd@qt.20 \ 0.068 \leq 0.096$ & $|med@qt.20| \ 0.14 > 0.088$
NRMSE NOT converged: $sd@qt.20 \ 0.5 > 0.48$ & $|med@qt.20| \ 1.8 > 1.6$

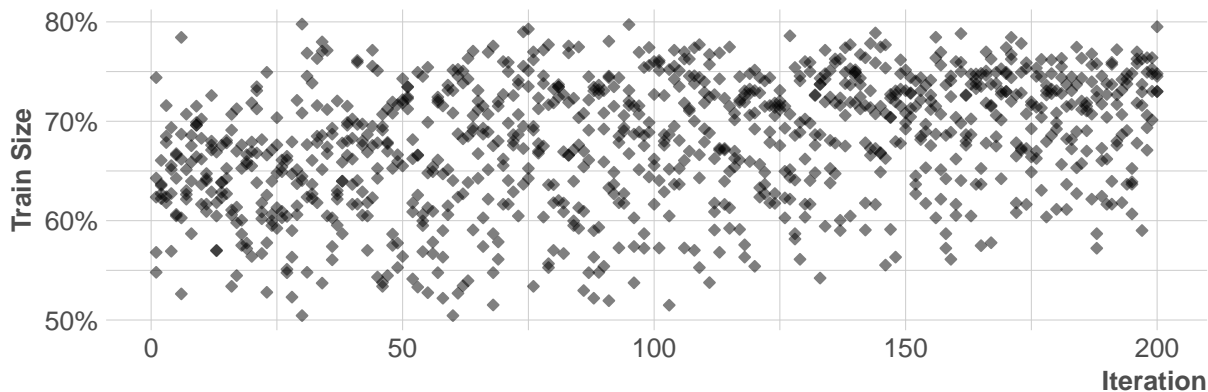
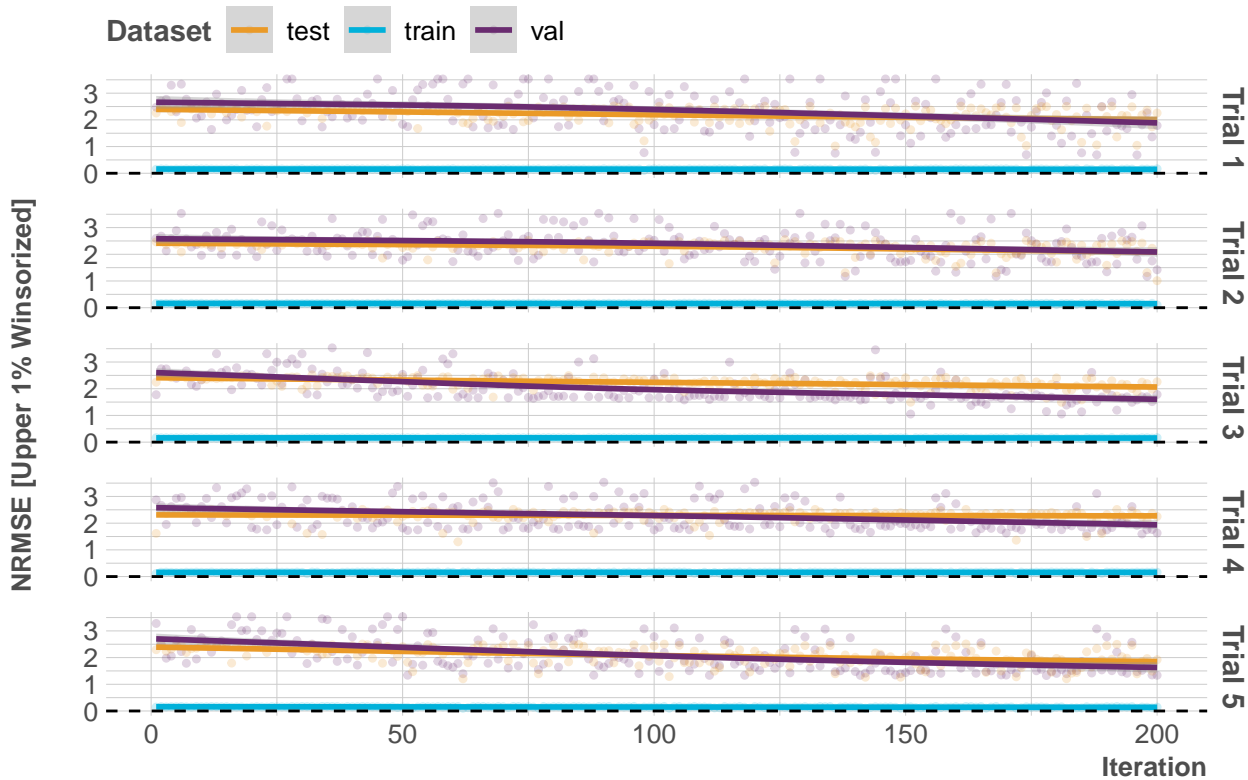
Multi-objective evolutionary performance

5 trials with 200 iterations each using TwoPointsDE



DECOMP.RSSD NOT converged: $\text{sd@qt.20 } 0.068 \leq 0.096$ & $|\text{med@qt.20}| 0.14 > 0.088$
NRMSE NOT converged: $\text{sd@qt.20 } 0.5 > 0.48$ & $|\text{med@qt.20}| 1.8 > 1.6$

Time-series validation & Convergence

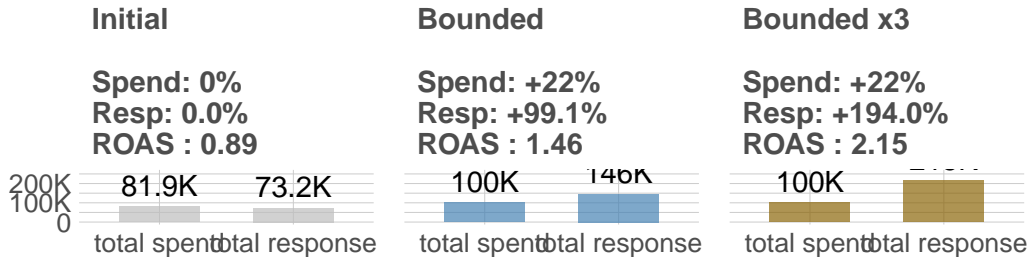


Budget Allocation Onepager for Model ID 1_196_1

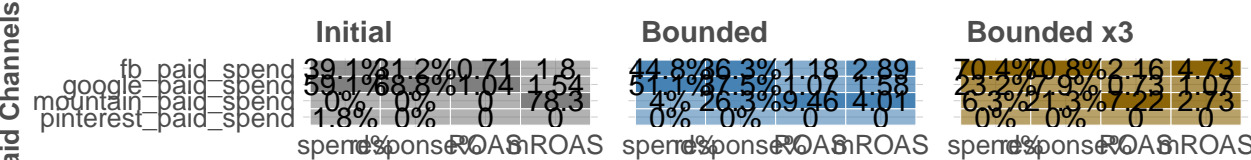
Adj.R2: train = 0.6549, val = 0.7617, test = 0.5733 | NRMSE: train = 0.1014, val = 0.6104, test = 0.6104

Simulation date range: 2023-12-31 to 2024-01-29 (30 days) | Scenario: max_response

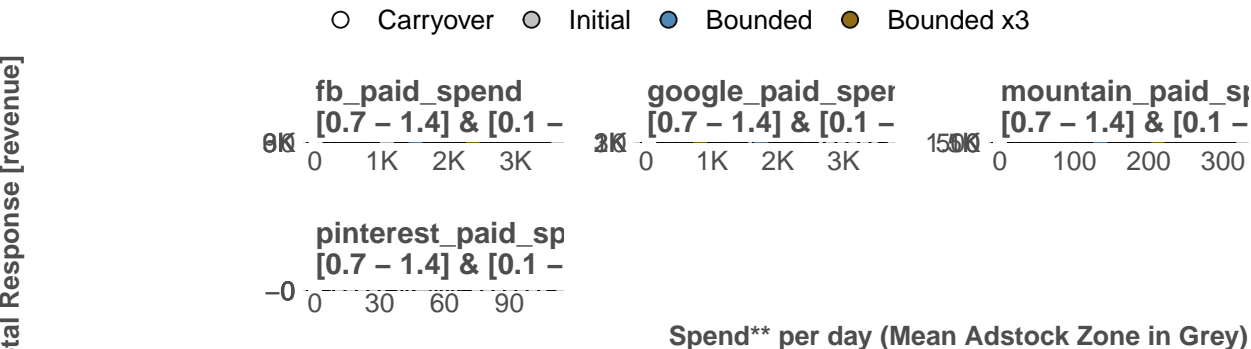
Total Budget Optimization Result



Budget Allocation per Channel*



Simulated Response Curve for Selected Allocation Period



* 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