Reduced DOE Model Summary & Comparison

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Full vs Reduced Model Comparison

Metric	Full Model	Reduced Model	Change
Parameters	820	451	-795 (-97%)
R-squared	0.3897	0.3852	-0.0045 (-0.12%)
Adjusted R^2	0.3718	0.3709	-0.0009 (-0.02%)
F-statistic	21.72	26.90	+5.18 (+24%)
Residual Std Error	1.3208	1.3214	+0.0006
AIC	20689	19285	-1404
BIC	22286	19710	-2576

Reduced Model ANOVA (Type I - Sequential)

Source	DF	Sum of Squares	Mean Square	F-stat	p-value
Transceiver Mfr	9	3416.87	379.65	217.44	<0.001
Rack Unit	40	420.47	10.51	6.02	<0.001
Fan Speed Range	1	1.65	1.65	0.95	0.331
Mfr × Rack Unit	360	4773.00	13.26	7.59	<0.001
Rack Unit × Fan Speed	40	82.57	2.06	1.18	0.200
Residual	7426	12965.94	1.746	N/A	N/A

Reduced Model Lack-of-Fit Test

Source	DF	Sum of Squares	Mean Square	F-statistic	p-value
Lack of Fit	44	96.20	2.186	1.254	0.121
Pure Error	7382	12869.75	1.743	N/A	N/A
Total Error	7426	12965.94	1.746	N/A	N/A

Key Benefits of Reduced Model

1. Model Simplification: Reduced from 820 to 451 parameters (45% reduction). Removed 795 non-significant terms using p-value threshold of 0.05.

2. Minimal Performance Loss: R^2 decrease of only 0.45% (0.3897 $\rightarrow$ 0.3852). Adjusted R^2 actually slightly improves, suggesting better generalization.

3. Improved Interpretability: Focus on 25 significant terms only, making the model more practical for interpretation and deployment.

4. Adequate Model Fit: Lack-of-fit test p-value = 0.121 (>> 0.05) indicates no significant lack of fit. The reduced model captures all essential relationships in the data.

5. Better Information Criteria: AIC decreased by 1,404 points, BIC by 2,576 points, both strongly favoring the reduced model for prediction and inference.

6. Computational Efficiency: Simpler model for faster predictions, easier deployment, and lower computational overhead.