

Assessing the Effect of Five Gasoline Properties on Exhaust Emissions from Light-Duty Vehicles certified to Tier-2 Standards

Analysis of Data from EPA Phase 3

(EPAct/V2/E-89)

Appendix I.2f

Final Model Fitting

Non-Methane Organic Gases (NMOG) (Bag 3)

No. Observations:	837
No. Vehicles:	15
No. censored measurements:	119
No. missing measurements:	0
No. measurements removed:	0
Model Type:	Tobit regression

Models fit for NMOG (Bag 3): (Grand Intercept not fit by Tobit models).

Model Term	Notation	Model							
		Full	FM4 ¹	FM5	FM6	FM7	FM8	FM9	FM10
etOH	Z_e	•	•	•	•	•	•	•	•
Arom	Z_a	•	•	•	•	•	•	•	×
RVP	Z_r	•	•	•	•	•	•	•	•
T50	Z_5	•	•	•	•	•	•	•	•
T90	Z_9	•	•	•	•	•	•	•	•
etOH × etOH	ZZ_{ee}	•	×						
T50 × T50	ZZ_{55}	•	•	•	•	×			
etOH × Arom	ZZ_{ea}	•	•	×					
etOH × RVP	ZZ_{er}	•	•	•	•	•	•	•	•
etOH × T50	ZZ_{e5}	•	•	•	•	•	•	•	•
etOH × T90	ZZ_{e9}	•	×						
Arom × RVP	ZZ_{ar}	•	•	•	•	•	×		
Arom × T50	ZZ_{a5}	•	×						
Arom × T90	ZZ_{a9}	•	•	•	×				
T50 × T90	ZZ_{59}	•	×						
RVP × T90	ZZ_{r9}	•	•	•	•	•	•	×	

¹ denotes “Full minus 4, etc.”

NMOG (Bag 3): Model fitting history, starting with the 16-term extended model.

Fit Parameters			Test with respect to Previous Model		
Model	$p-I^1$	$-2\ln L$	Dev.	d	$\Pr > \chi^2$
Full Model	16	2605.071			
FM4	12	2605.748	0.677	4	0.954
FM5	11	2605.753	0.005	1	0.944
FM6	10	2606.328	0.575	1	0.448
FM7	9	2607.179	0.851	1	0.356
FM8	8	2607.668	0.489	1	0.484
FM9	7	2608.221	0.553	1	0.457
FM10 ²	6	2608.338	0.117	1	0.732

¹ Total number of terms excludes the intercept, as the Tobit Models do not fit intercepts.
² Best fit with respect to the 16-term extended model.

NMOG (Bag 3): Coefficients and Tests of Effect for the Full and Reduced Models, with respect to the 16-term extended model (NOTE: model fitting with respect to the 11-term design model gives the same results).

Effect	Full Model (Extended)				
	Estimate	Std. Err.	d.f.	χ^2 value	$\text{Pr} > \chi^2$
Intercept					
Z_e	-0.0088	0.0603	1	0.0200	0.8841
Z_a	-0.0158	0.0378	1	0.17	0.6757
Z_r	-0.0824	0.0509	1	2.62	0.1058
Z_5	0.0207	0.0672	1	0.090	0.7585
Z_9	0.1406	0.0391	1	12.9	0.0003
ZZ_{ee}	-0.0122	0.0702	1	0.030	0.862
ZZ_{55}	-0.0510	0.0573	1	0.79	0.3732
ZZ_{ea}	-0.0307	0.0569	1	0.29	0.5893
ZZ_{er}	0.0804	0.0386	1	4.33	0.0374
ZZ_{e5}	-0.0802	0.0742	1	1.17	0.2798
ZZ_{e9}	0.0119	0.0456	1	0.070	0.7934
ZZ_{ar}	-0.0601	0.0615	1	0.95	0.3285
ZZ_{a5}	-0.0435	0.0689	1	0.40	0.5279
ZZ_{a9}	-0.0303	0.0386	1	0.62	0.4319
ZZ_{59}	0.0256	0.0514	1	0.25	0.6182
ZZ_{r9}	0.0521	0.0435	1	1.43	0.2313
σ_{veh}^2					
σ_{ε}^2	1.0095				

<i>Reduced Model (FM10)</i>				
Estimate	Std. Err.	d.f.	χ^2 value	Pr> χ^2
-5.4889 ¹				
0.0339	0.0438	1	0.60	0.44
		1		
-0.0572	0.0384	1	2.22	0.14
0.0783	0.0466	1	2.82	0.093
0.1467	0.0345	1	18.1	<.0001
0.0707	0.0337	1	4.4000	0.036
-0.0728	0.0344	1	4.4800	0.034

4.4989 ²	
1.0109	

¹ Not fit by the Tobit model; calculated as mean of intercepts for individual vehicles.

² Not fit by Tobit model; calculated as variance of intercepts for individual vehicles.