

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 N.3

Model Fitting Information for

Ethanol (Bag 1)

This appendix summarizes model fitting for Bag-1 Ethanol. Model-fitting techniques and approaches summarized in Section 8.7. Features of the data and modeling for this compound are listed below.

Fuel-parameter matrix: FULL

Media contamination: YES

No. measurements: 913

No. censored values: 193

Modeling approach: TOBIT REGRESSION

Estimated Dependent Variable model: YES

Models fit for Ethanol, Bag 1 (all models include an intercept term)

Model Term	Notation	Model				
		Full	FM6	FM9	FM10	FM11
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 × T50	ZZ_{e5}	•	×			
etOH × T90	ZZ_{e9}	•	×			
etOH × RVP	ZZ_{er}	•	×			
Arom × T50	ZZ_{a5}	•	•	×		
Arom × T90	ZZ_{a9}	•	×			
T90 × T90	ZZ_{99}	•	•	•	×	
T50 × T90	ZZ_{59}	•	•	•	•	×
Arom × RVP	ZZ_{ar}	•	•	×		
RVP × T90	ZZ_{r9}	•	×			

Model Fitting History for Ethanol, Bag 1 (FM11 selected as best-fit model).

Fit Parameters				<i>Test with respect to Full</i>			<i>Test with respect to Previous Model</i>		
Model	p	-2lnL	BIC ¹	Dev. ¹	d	Pr> χ^2	Dev.	d	Pr> χ^2
Full	18	632.42	750.84						
FM6	12	633.33	712.28	0.9125	6	0.99			
FM9	9	634.97	694.18	2.5494	9	0.98	1.6369	3	0.65
FM10	8	635.10	687.74	2.6863	10	0.99	0.1369	1	0.71
FM11	7	637.88	683.93	5.4581	11	0.91	2.7719	1	0.095
¹ A lower value indicates a better fit.				¹ The deviation is the difference in the -2loglik statistics for the nested and reference models, respectively, per Equation 14.					

Coefficients and Tests of Effect for the Full and Best-Fit Models – Ethanol (Bag 1).

Effect	<i>Full Model</i>					<i>Best-Fit Model (FM11)</i>				
	Estimate	Std.Err.	d.f.	t-value	Pr>t	Estimate	Std.Err.	d.f.	t-value	Pr>t
Intercept ¹			15			-4.9081				
Z _e	1.4759	0.07240	15	20.38	<0.00001	1.4643	0.07115	15	20.56	<0.00001
Z _a	-0.0067	0.04327	15	-0.16	0.88					
Z _r	-0.05004	0.04316	15	-1.16	0.26	-0.05990	0.02940	15	-2.06	0.057
Z ₅	0.1050	0.03806	15	2.76	0.015	0.07188	0.02964	15	2.37	0.032
Z ₉	-0.1261	0.03701	15	-3.47	0.0034	-0.09990	0.03574	15	-2.78	0.014
ZZ _{ee}	-0.4787	0.06014	15	-7.96	<0.00001	-0.4967	0.05229	15	-9.51	<0.00001
ZZ ₅₅	0.1261	0.05018	15	2.51	0.024	0.1121	0.03826	15	2.90	0.011
ZZ _{ea}	-0.005952	0.03881	15	-0.15	0.88					
ZZ _{e5}	0.02820	0.05277	15	0.54	0.60					
ZZ _{e9}	0.0008509	0.06491	15	0.0090	0.99					
ZZ _{er}	0.03237	0.05103	15	0.64	0.53					
ZZ _{a5}	0.03318	0.03212	15	1.04	0.32					
ZZ _{a9}	-0.01143	0.03461	15	-0.33	0.74					
ZZ ₉₉	-0.5112	0.04523	15	-1.13	0.28					
ZZ ₅₉	0.05311	0.04341	15	1.22	0.24					
ZZ _{ar}	0.04136	0.02855	15	1.45	0.17					
ZZ _{r9}	-0.008676	0.04644	15	-0.20	0.85					
σ_{veh}^2 ¹						0.1283				
σ_{ε}^2	0.5697					0.05739				

¹ Not fit by the model, but manually recalculated from intercepts for individual vehicles.

Coefficients for Models (FM11) for individual Jackknife replicates used to calculate standard errors for model terms.

Jackknife Replicate ¹	Model Term					
	Z_{ϵ}	Z_7	Z_5	Z_9	$ZZ_{\epsilon\epsilon}$	ZZ_{55}
0	-4.8506	1.4627	-0.06054	0.07029	-0.09923	-0.4970
1	-4.8626	1.4866	-0.05001	0.07513	-0.11332	-0.5125
2	-4.8601	1.4818	-0.05465	0.07455	-0.10302	-0.5085
3	-4.8476	1.4604	-0.05593	0.06534	-0.10502	-0.4839
4	-4.8712	1.4855	-0.06136	0.05105	-0.08697	-0.5214
5	-4.8431	1.4519	-0.06168	0.07522	-0.09784	-0.4909
6	-4.8402	1.4494	-0.07195	0.07454	-0.10636	-0.4840
7	-4.8509	1.4662	-0.07770	0.07795	-0.09442	-0.4986
8	-4.8502	1.4562	-0.06759	0.06358	-0.08576	-0.4962
9	-4.8513	1.4686	-0.04527	0.07207	-0.09804	-0.4920
10	-4.8326	1.4269	-0.06142	0.06796	-0.10522	-0.4856
11	-4.8426	1.4439	-0.06196	0.06304	-0.10241	-0.4900
12	-4.8695	1.4961	-0.05393	0.07091	-0.10181	-0.5162
13	-4.8530	1.4596	-0.06064	0.06383	-0.11368	-0.5029
14	-4.8284	1.4361	-0.06240	0.08597	-0.07813	-0.4673
15	-4.9598	1.4732	-0.06077	0.07346	-0.09675	-0.5066
¹ The model for replicate 0 was calculated using all vehicles; models for jackknife replicates 1-15 were fit after removing a single vehicle in each replicate.						