

Appendix I

Statistics on 1998 Gasoline Property Values and Limits

Analysis of All 1998 Data on Flat Limits and DALs

The available data consist of flat limits with associated volumes (from companies that report limits *and* volumes for each batch), flat limits without associated volumes (from companies that report only when they change limits and companies that do not report volumes), and Designated Alternative Limits (DALs¹). Most flat-limit data are not associated with volume data. There are about 2550 records.

The purpose of the analysis is to estimate distributions of *gallons* versus limit values. This requires dealing with the lack of volume data corresponding to many of the flat limits. We have assumed that, for a given refinery, the frequency distribution of gallons versus limits is the same (in percents) as is the frequency distribution of reported limits. This method would be exact if both the gasoline production and the reporting of new limits were (1) uniformly distributed through 1998 or (2) varied with a common temporal pattern *and* the values of limits were independent of the reporting frequency. Since most gasoline is produced by refiners that do not report or estimate all their volumes, this method has been used for *all* refineries.

To help ensure that the temporal pattern of flat-limit reporting is acceptable for this method, the time intervals between reports were plotted though the year for each refinery. Where an actual interval is much longer² than is typical for the refinery, each long interval has been “filled” with “pseudo-reports” for each property, to provide a more uniform set of intervals. The inserted limit values equal those reported at the beginning of the interval. This practice inserts limit values that are rigorously correct for any gasoline produced during the interval. If that gasoline was actually produced (as assumed), this practice makes the frequency distributions of the augmented sets of limits closer to the actual volume distributions. The number of pseudo-reports is at most two percent of the total reports for any refinery.

Once the frequency distributions (as percents) of limit values for a property were established for a refinery, the frequencies were weighted by that refinery’s fraction of total CaRFG production in 1998 (over all refineries). The adjusted frequencies in each “bin” have been added over all refineries. These weighted sums add to unity and are the estimated overall distributions of volume (in percent) versus limit values.

¹ A “DAL” is a batch limit set by a refiner that complies via averaging; each DAL greater than the averaging limit must be offset by a low DAL.

² “Much longer” means that the interval $> (\text{mean} + 2 \cdot \text{std.dev.})$ of that refinery’s intervals *and* that the running 3-interval average $> (\text{mean} + 2 \cdot \text{std.dev.})$ of those running averages. (The running average is the mean of the interval, its immediate predecessor, and its successor.) The number of “pseudo-reports” for any refinery is at most 2% of the number of actual reports.

Also, the refiners' mean limits have been weighted by the same annual production fractions to yield overall volume-weighted mean property limits. Tables 1 and 2 give some statistics from the analysis.

Table 1. Mean 1998 Predictive Model Limits* -- All Data

	Arom. (v.%)	Benz. (v.%)	Olef. (v.%)	Sulf. (ppm)	T50 (°F)	T90 (°F)	Oxygen (wt.%) min. max.	
Entire Year	24.8	.72	5.8	25	201	312	1.8	2.2
RVP season **	24.9	.70	5.8	23.6	203	312	not calculated	
Non-RVP seas.	24.4	.73	5.8	27.2	199	312		
SF Bay Area	25.8	.72	5.6	26	200	309	1.6	2.0
So. Coast	24.0	.71	6.1	25	202	316	1.9	2.3

* Volume-weighted mean: sum of refinery averages weighted by fractions of total production

** April - October

Table 2. Mean 1998 Predictive Model Limits*, by Limit Type

	Volume Weighted Average of All Limits	Volume-Weighted Average of Flat Limits	RVP Season *Volume-Weighted Average of Flat Limits
Aromatic HC, vol.%	24.8	24.6	24.8
Benzene, vol%	0.72	0.81	0.78
Olefin, vol%	5.8	7.1	7.3
Sulfur, ppm	25	31	28
T50, degrees F	201	204	205
T90, degrees F	312	318	317
Oxygen, wt% (max)	2.2	2.1	2.1
(min)	1.8	1.7	1.7
RVP, psi	7.0	7.0	7.0

* April - October

1999 Data

The data available by mid-September indicate that, despite two severe refinery problems in 1999, the limits set by the Predictive Model in 1999 are generally similar to those in 1998. Table 3 compares the arithmetic (not volume-weighted) means across refineries of each refinery's mean limits in 1998 and 1999.

Table 3. Mean Limits (simple means of refinery means)

	Arom	Benz	Olef	Sulf	T50	T90	Max. Ox	Min. Ox
1998	24.9	.78	6.1	27	203	314	2.2	1.8
1999*	24.5	.75	6.8	25	206	314	2.1	1.7

* thru mid-September