11.4 Analysis of Mixture Experiments

In attempting to find a pesticide formulation that would spread evenly on the leaves of cotton plants, researchers experimented by combining a synthetic pyrethroid insecticide with a mixture of three Niagara emulsifiers. They used an SLD{3,2} design, augmented by an overall centroid and six axial points. The experimental runs and the measured surface tension from each mixture is shown in Table 11.1. The formulations were made and tested in a completely random order.

Table 11.1 *Data Pesticide Formulation Experiment*

Run	x_1	x_2	x_3	Surface Tension (dyne/cm)
1	1.00000	0.00000	0.00000	48.7
2	0.80000	0.10000	0.10000	49.5
3	0.60000	0.20000	0.20000	50.2
4	0.50000	0.00000	0.50000	52.8
5	0.50000	0.50000	0.00000	49.3
6	0.33333	0.33333	0.33333	51.1
7	0.30000	0.20000	0.50000	52.7
8	0.30000	0.50000	0.20000	50.3
9	0.10000	0.10000	0.80000	60.7
10	0.10000	0.80000	0.10000	49.9
11	0.00000	0.00000	1.00000	64.9
12	0.00000	0.50000	0.50000	53.5
13	0.00000	1.00000	0.00000	50.6

Figure 11.11 *Design Points of Pesticide Experiment*

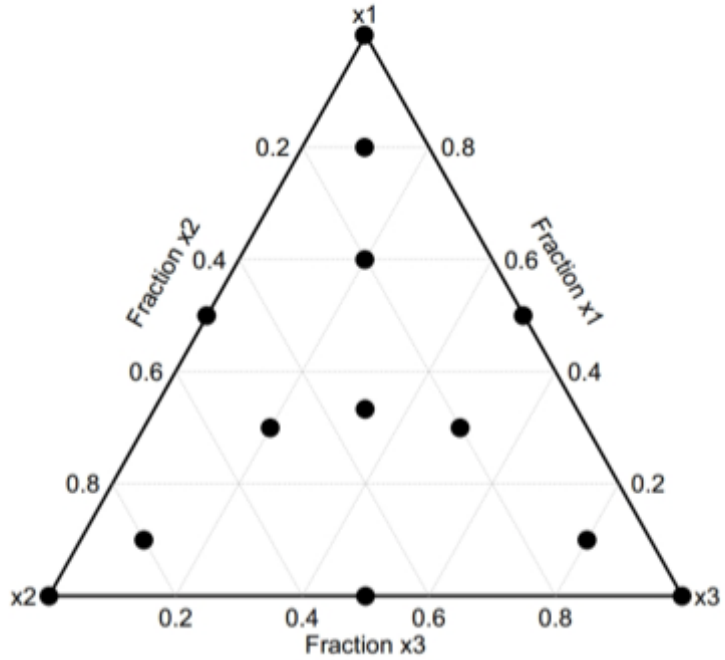
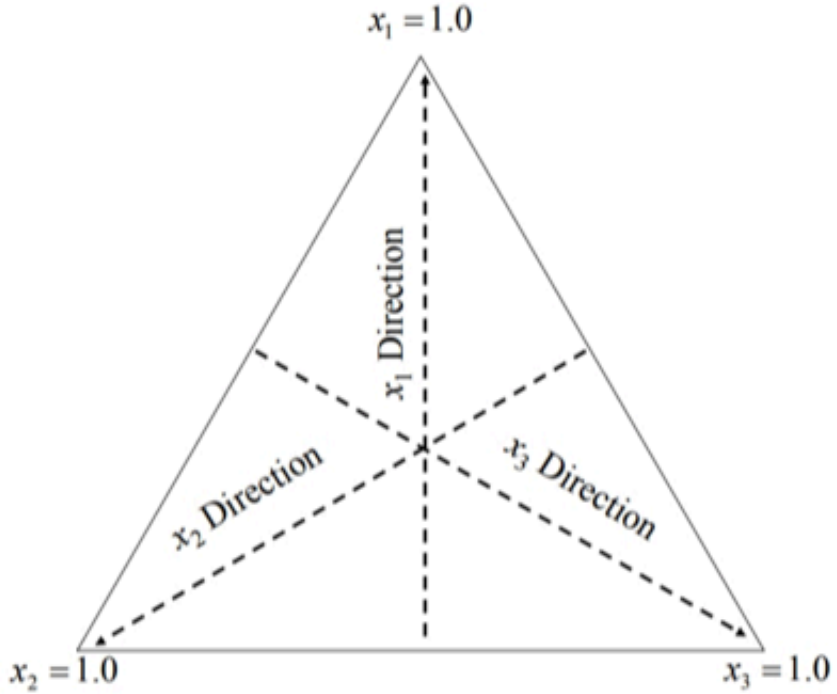
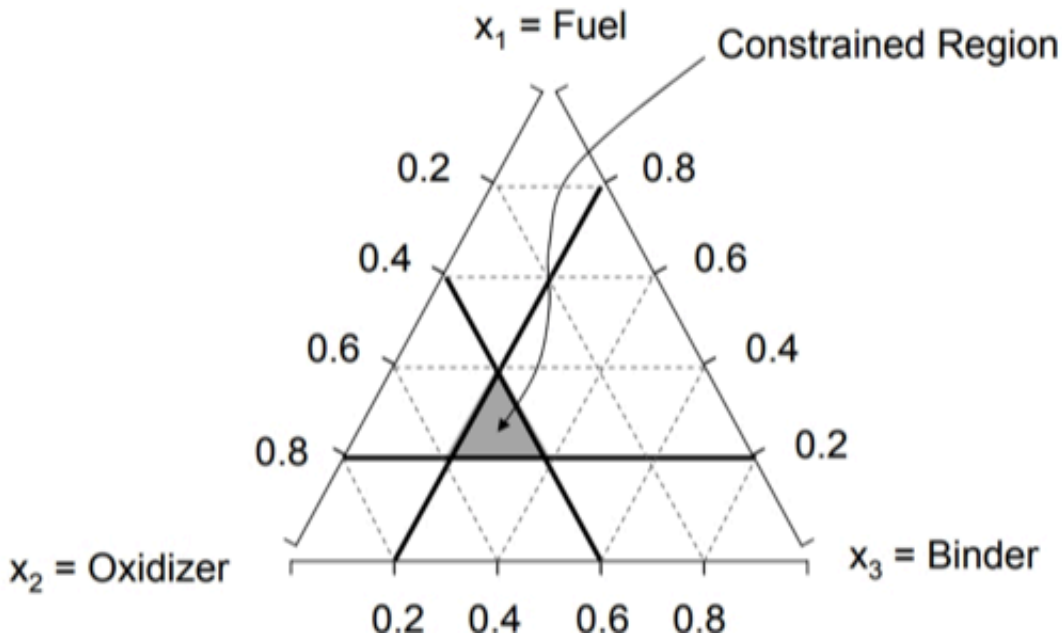


Figure 11.13 *Cox Directions through Three-Dimensional Simplex*



$$
\begin{aligned}
x_1 &\geq 0.20 \\
x_2 &\geq 0.40 \\
x_3 &\geq 0.20
\end{aligned} \tag{11.16}
$$

Figure 11.15 *Constrained Region for Rocket Propellant Experiment*



$$x_i' = \frac{x_i - l_i}{1 - \sum_{i=1}^{k} l_i}$$

Table 11.2 *Simplex-Lattice Design in Pseudo and Actual Components*

	Pseudo Component			Actual Component			Response
Run	x_1'	x_2'	x_3'	x_1=Fuel	x_2=Oxidizer	x_3=Binder	Elasticity
1	1	0	0	0.400	0.400	0.200	2350
2	0	1	0	0.200	0.600	0.200	2450
3	0	0	1	0.200	0.400	0.400	2650
4	$\frac{1}{2}$	$\frac{1}{2}$	0	0.300	0.500	0.200	2400
5	$\frac{1}{2}$	0	$\frac{1}{2}$	0.300	0.400	0.300	2750
6	0	$\frac{1}{2}$	$\frac{1}{2}$	0.200	0.500	0.300	2950
7	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	0.266	0.466	0.266	3000