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REPEATABILITY OF AFIS DISTRIBUTIONS

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Abstract

One hundred four bales representing a wide range of fiber properties were selected for this study. For the 104 bales considered, the distances between distributions show that for each parameter considered (i.e., length by number, length by weight, fineness and maturity) the distance between bales is much higher that the distances within-bales. Therefore, the distribution information produced by the AFIS could give us a tool to distinguish between cottons having the same average values. Obviously, the shape of a "good" distribution is still unknown. Textile processing efficiency tests should be undertaken in order to characterize the "ideal" distribution(s).

Materials and Methods

One hundred four bales representing a wide range of fiber properties were selected. From each bale, 70 pounds of lint were taken and processed into card web following the ICCS (International Calibration Cotton Standards) protocol for the creation of cotton standards. During the card web formation 10 samples were taken for HVI and AFIS analysis. The average, minimum and maximum values of the selected bales are shown Table 1.

Each fiber sample was tested on the Old AFIS (6,000 fibers per sample x 10 samples/bale = 60,000 fibers per bale). The samples will be also tested on the AFIS PRO in 2004. Two types of distance measurements were used in this study.

The first one, called (1 – r), is based on the Pearson coefficient of correlation. The calculation is as follows:

Distance (1-r) between 2 distributions

=

$$1-\frac{\frac{1}{n}\left[\sum_{i=1}^{n} x_i y_i - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right)\right]}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_i-\bar{x}\right)}\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(y_i-\bar{y}\right)}}$$

The second, called N, is based on the distance measurement between spectra used in infrared spectroscopy. Its calculation is as follows:

Distance N between 2 distributions

=

$$1-\frac{\sum_{i=1}^{n} x_i y_i}{\sqrt{\sum_{i=1}^{n} x_i^2}\sqrt{\sum_{i=1}^{n} y_i^2}}$$

In both cases a distance of zero means that the two distributions are exactly identical.

The comparisons were done the following way:

- For each cotton, the distances between the 10 replications were calculated (10*10 matrix). Then, the average distance between replications was calculated for each of the 104 matrixes obtained (Table 2).
- For each cotton, the average distribution was calculated. Then, a distance matrix was produced (104*104 matrix). Based on the 5,356 distances obtained ((104^2-104)/2), the histograms of the distances were produced.

For the intra-bale distributions, we compared the two distance measurements methods. Figures 1 through 4 show that the two methods are very well correlated. Nevertheless, the distance N has always a narrower dynamic range.

The histograms of the distances between bales are shown Figures 5 through 8. For each parameter considered, i.e., length by number, length by weight, fineness, and maturity, it is clear that the distance between bales is, in general, much higher than the distances within bales (dotted line on the charts). Therefore, the distribution information produced by the AFIS could give us a tool to distinguish between cottons having the same average values. Obviously, the shape of a "good" distribution is still unknown. Textile processing efficiency tests should be undertaken in order to characterize the "ideal" distribution(s).

Conclusion

The distribution information produced by the AFIS could give us a tool to distinguish between cottons having the same average values. A complete analysis of these results will be published in the near future.

Table 1. Average HVI properties of the 104 bales selected.

	Mean	Minimum	Maximum
Micronaire	4.22	2.60	5.65
UHML	1.080	0.956	1.308
UI%	81.9	78.6	84.5
Strength	29.4	21.6	41.3
Elongation	5.4	3.6	8.3
Rd	77.0	64.1	81.1
+b	10.8	8.4	15.8

Table 2. Average distances between AFIS distributions for the 104 bales

	Distance (1-r)				Distance N			
Bale	L(n)	L(w)	Fineness	MR	L(n)	L(w)	Fineness	MR
Average	0.0121	0.0076	0.0051	0.0089	0.0061	0.0045	0.0029	0.0041
Min	0.0066	0.0045	0.0025	0.0043	0.0035	0.0029	0.0015	0.0022
Max	0.0276	0.0127	0.0144	0.0320	0.0162	0.0088	0.0082	0.0160

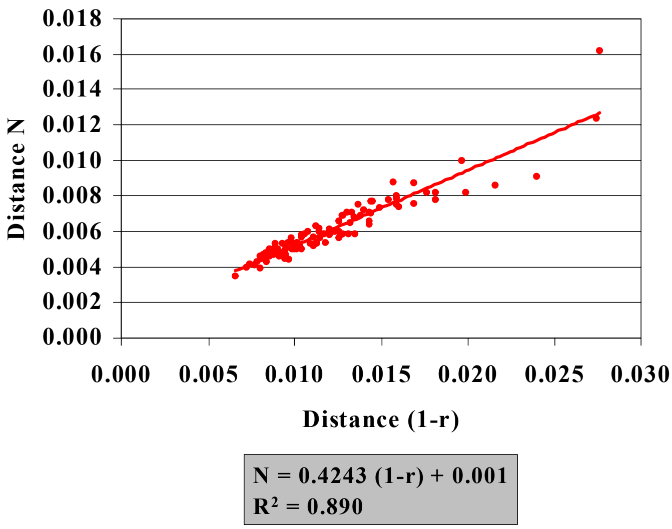

Figure 1. Average distance within bale: Distance N vs. Distance (1-r) for L(n).

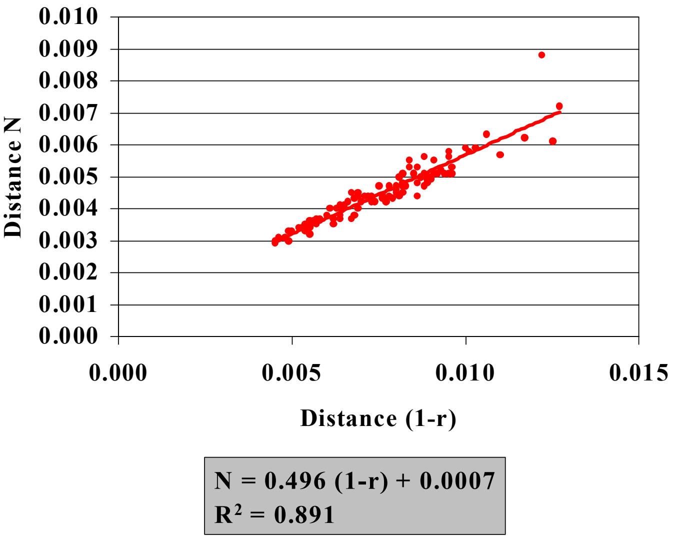

Figure 2. Average distance within bale: Distance N vs. Distance (1-r) for L(w).

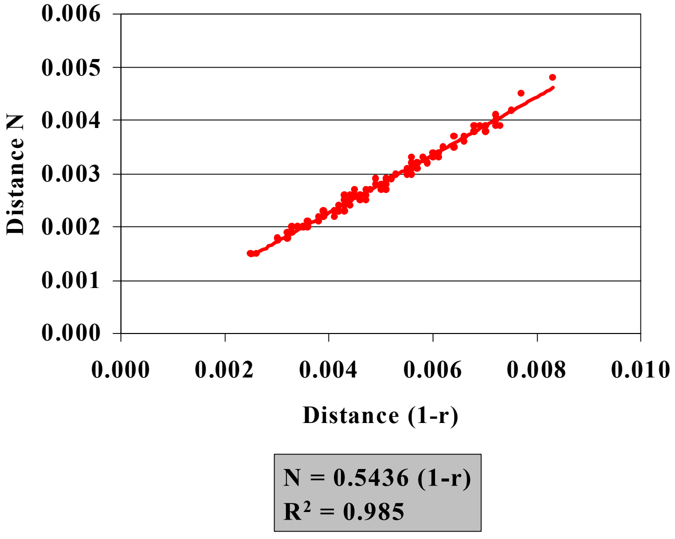

Figure 3. Average distance within bale: Distance N vs. Distance (1-r) for fineness (H).

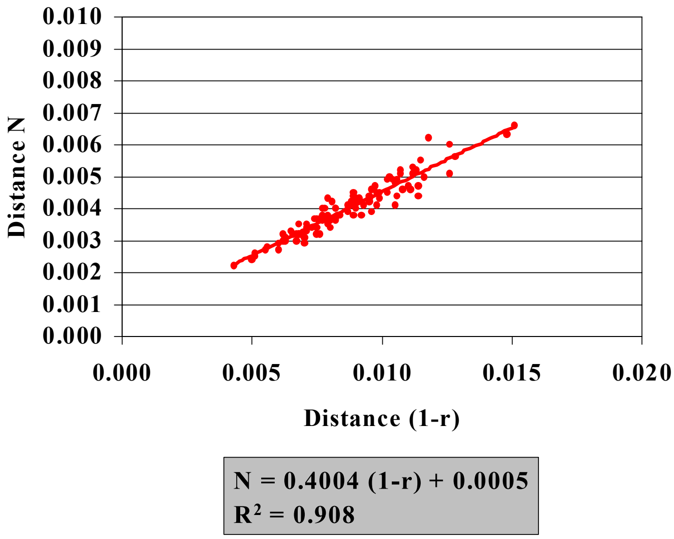

Figure 4. Average distance within bale: Distance N vs. Distance (1-r) for Maturity Ratio.

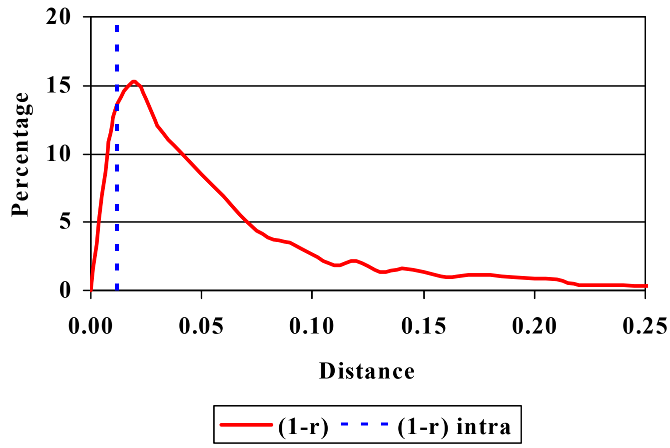

Figure 5. Histogram: Distances between bales for the Length by number (the dotted line represents the average distance between distributions within a bale).

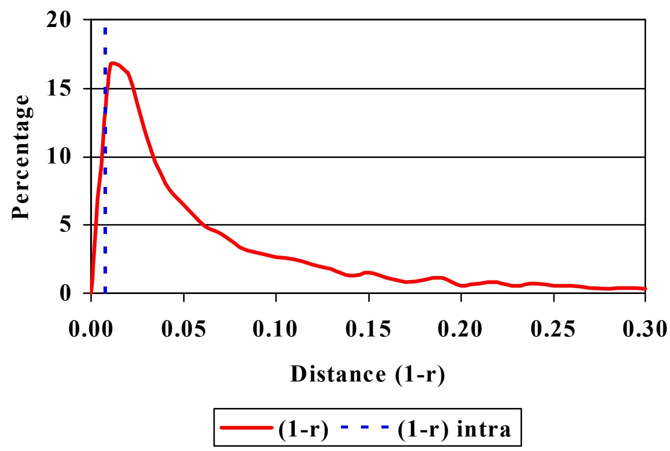

Figure 6. Histogram: Distances between bales for the Length by weight (the dotted line represents the average distance between distributions within a bale).

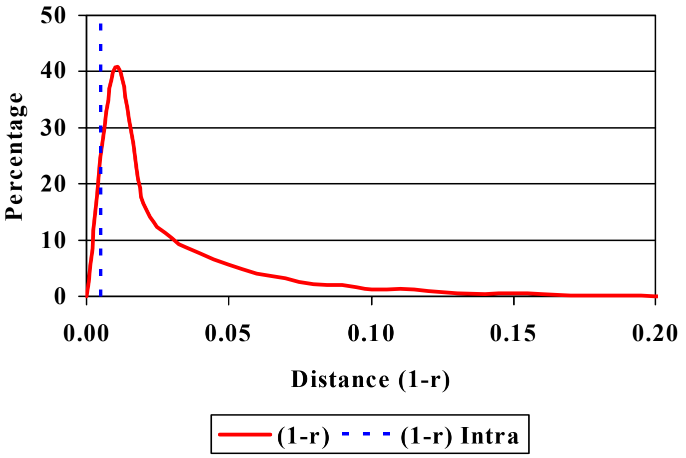

Figure 7. Histogram: Distances between bales for the fineness (the dotted line represents the average distance between distributions within a bale).

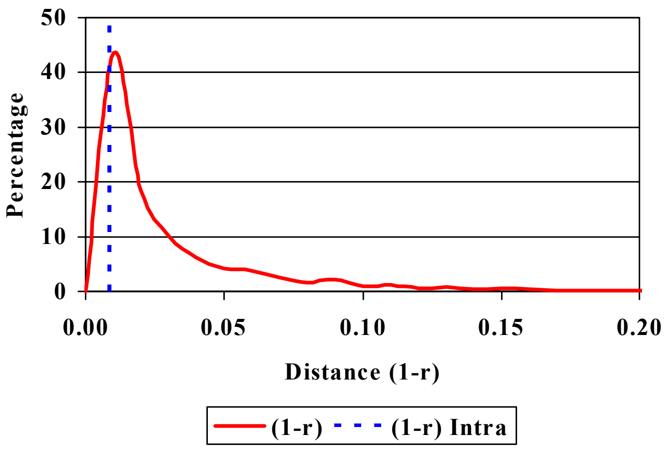

Figure 8. Histogram: Distances between bales for the maturity ratio (the dotted line represents the average distance between distributions within a bale).