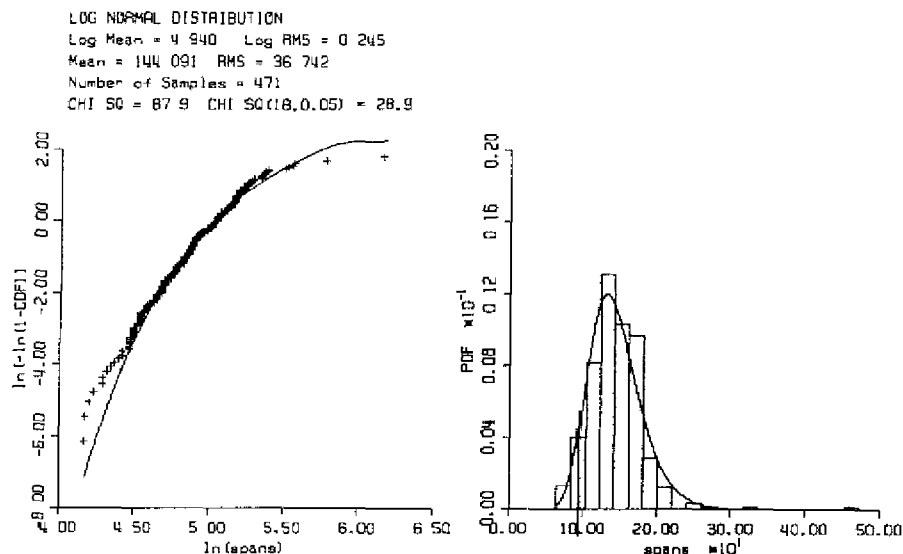


## 5.0 Geographic Distribution of Power Lines

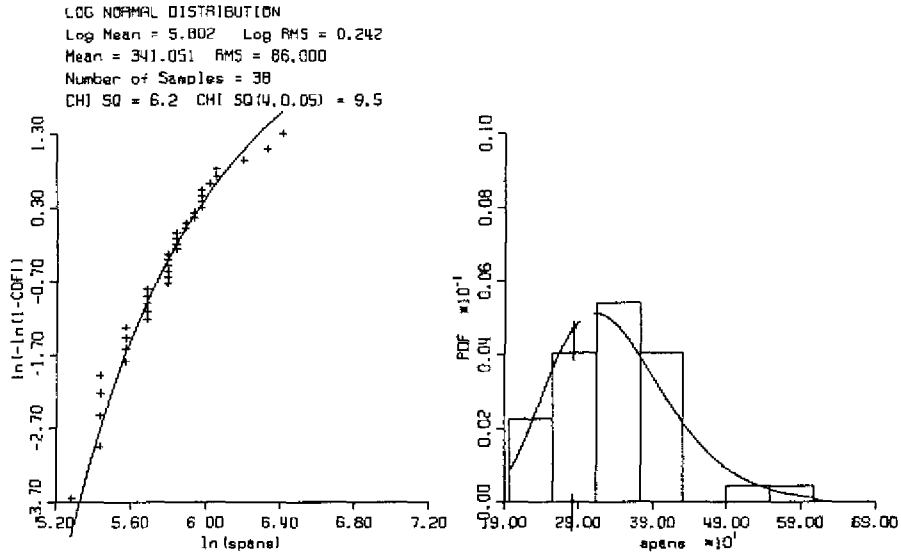
An important feature of the transmission/distribution system modeling procedure is obtaining a reasonably accurate estimate of the location of each pole on the Island. The information available from VINLEC does not allow for the precise positioning of every pole on the island and thus approximate methods are used. In this investigation a probabilistic model is used to ascertain the span length distributions and pole position information for each of the transmission and power distribution systems.

The probabilistic models adopted, are based on span lengths measured from detailed drawings of the layout of power lines for several different regions of St.-Vincent. In each case, the regions are representative of the transmission and power distribution systems throughout St.-Vincent. Using the drawings supplied by VINLEC samples of span length and line angle were obtained by hand. The resulting database of span lengths and line angles provides a sufficient sample space on which to fit probabilistic models of span lengths or line angles. Figures 5.1 through 5.3 show lognormal fits to the sampled span lengths for the 11 kV line, the 33 kV line and the low voltage lines. As indicated in Figures 5.1 through 5.3, the number of data points extracted for the 11 kV line, the 33 kV line and the low voltage lines are 471, 38, and 736 sample spans, respectively. In each case the log-normal distribution provides a reasonable fit to the span length data.

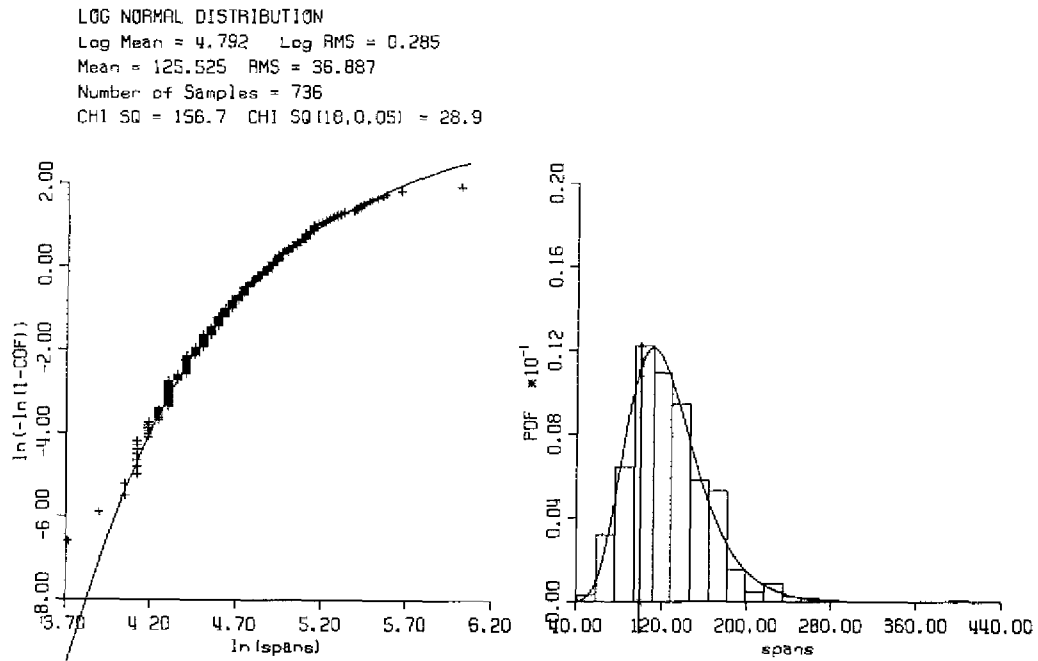
In the present study, high voltage transmission lines are approximated by a series of connected straight line segments. Line segments for the entire 11 kV (red) and 33 kV (cyan) high voltage transmission systems are shown in Figure 5.4. The start and end of each line segment is assigned a latitude and longitude. The start and end coordinates of each line were obtained by re-mapping the information given on the small scale maps and map segments provided by VINLEC onto a large 1:25000 scale map of the island.



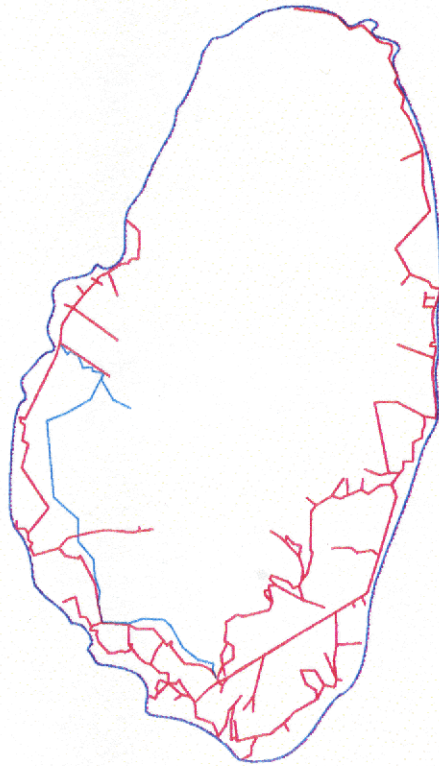
**Figure 5.1. High Voltage 11 kV Span Length (ft) Distribution.**



**Figure 5.2. High Voltage 33 kV Span Length (ft) Distribution.**



**Figure 5.3. Low Voltage Span Length (ft) Distribution.**



**Figure 5.4. High Voltage Transmission System.**

The plotted 11 kV line segments have a total length of approximately 100 miles versus an actual length of approximately 190 miles. In many areas of St.-Vincent, the 11 kV line follows roads which tend to meander rather than be constructed in the straight line segments as depicted in Figure 5.4. This following of the winding roads is thought to account for the discrepancy between the actual and plotted length of 11 kV line. Figure 5.5 is a schematic diagram depicting this discrepancy. As is clearly seen, a straight line approximation may not always capture the true length of the line, resulting in a significant reduction of the total length of plotted line. In this particular example, the ratio of actual line length to straight line approximation is  $\approx 1.7$ .

The length discrepancy found for the 11 kV line is taken into account by applying a length factor,  $L_f = 1.9$ , to each of the 11 kV line segments shown in Figure 5.5. This ensures that the proper amount of lines and poles are distributed throughout the island. Noting that the projected distance from the actual pole location to the straight line approximation (see Figure 5.5) is much less than the grid resolution used to compute hurricane wind speeds and wind speedup factors, application of a length factor does not affect the wind conditions that a utility pole would otherwise experience.

The total length of plotted 33 kV line is approximately 13 miles versus the actual 12 miles. Agreement between the plotted 33 kV line and the actual total length is not surprising since most of this line passes straight through undeveloped bush areas. In this case, a length factor  $L_f = 1.0$  is used. Leaving the 33 kV line segments unaltered results in a conservative overestimate of the total number of 33 kV utility poles.