FIGURE 11.3

Worksheet of the tensile strength for parachutes woven with synthetic fibers from four different suppliers, along with the sample mean and sample standard deviation

*Figure 11.3 displays the **DATA_SUMMARY** worksheet of the **Parachute** workbook. This worksheet contains formulas that use the **AVERAGE** and **STDEV** functions to compute the sample mean and sample standard deviation in the cell range B8:E9.*

	A	B	C	D	E
1		Supplier 1	Supplier 2	Supplier 3	Supplier 4
2		18.5	26.3	20.6	25.4
3		24.0	25.3	25.2	19.9
4		17.2	24.0	20.8	22.6
5		19.9	21.2	24.7	17.5
6		18.0	24.5	22.9	20.4
7					
8	Sample Mean	19.52	24.26	22.84	21.16
9	Sample Standard Deviation	2.69	1.92	2.13	2.98

$\bar{\bar{X}} = 21.945$

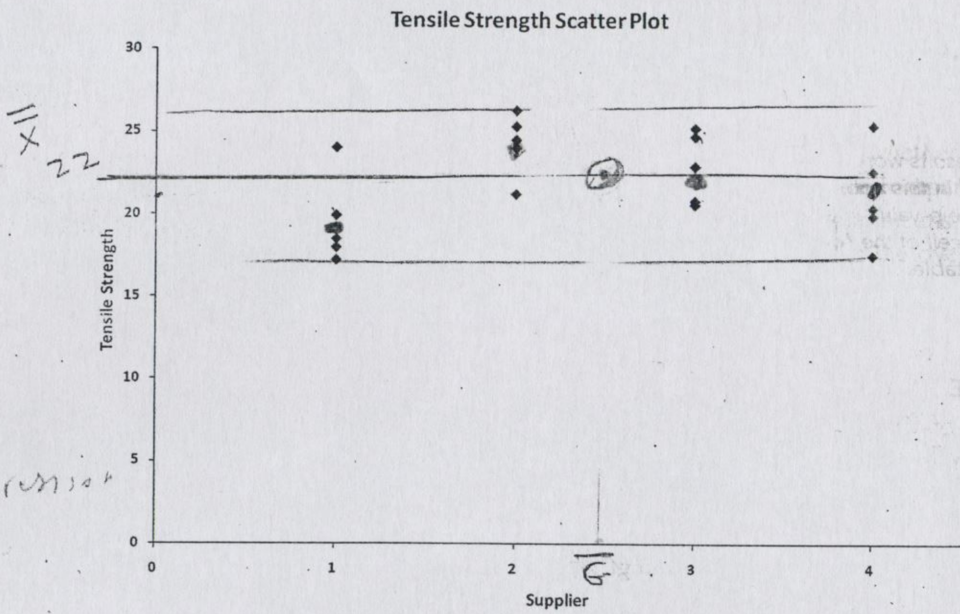
In Figure 11.3, observe that there are differences in the sample means for the four suppliers. For Supplier 1, the mean tensile strength is 19.52. For Supplier 2, the mean tensile strength is 24.26. For Supplier 3, the mean tensile strength is 22.84, and for Supplier 4, the mean tensile strength is 21.16. What you need to determine is whether these sample results are sufficiently different to conclude that the *population* means are not all equal.

The scatter plot shown in Figure 11.4 enables you to visualize the data and see how the measurements of tensile strength distribute. You can also observe differences among the groups as well as within groups. If the sample sizes in each group were larger, you could construct stem-and-leaf displays, boxplots, and normal probability plots.

FIGURE 11.4

Scatter plot of tensile strengths for four different suppliers

Create scatter plots using the instructions in Section EG2.7.



one may use regression Testing

H_0 slope = 0

H_a slope ≠ 0

The null hypothesis states that there is no difference in mean tensile strength among the four suppliers:

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$$

The alternative hypothesis states that at least one of the suppliers differs with respect to the mean tensile strength:

$$H_1: \text{Not all the means are equal.}$$

To construct the ANOVA summary table, you first compute the sample means in each group (see Figure 11.3 above). Then you compute the grand mean by summing all 20 values and dividing by the total number of values:

$$\bar{\bar{X}} = \frac{\sum_{j=1}^{c}\sum_{i=1}^{n_j} X_{ij}}{n} = \frac{438.9}{20} = 21.945$$

ANOVA: Analysis Of Variance

fact: Analysis of Sum of squars

Data	Mean
$x_{11}, x_{12}, \cdots, x_{1n_1}$	$\overline{x}_1$
$x_{21}, x_{22}, \cdots x_{2n_2}$	$\overline{x}_2$
	$\overline{\overline{x}}$

$$\begin{cases} H_0: \text{all } \mu\text{'s are equal} \\ H_a: \text{at least one is different} \end{cases}$$

$$\text{Grand mean} = \frac{\overline{x}_1 + \overline{x}_2}{2}$$

$$\boxed{\text{pure water}} \to H_2, \quad \boxed{\text{pure water}} \to O$$

$$\boxed{SST} \to SSW, \quad \boxed{SST} \to SSB$$

$$\boxed{T_{df}} \to SSW_{df}, \quad \boxed{T_{df}} \to SSB_{df}$$

Analys

	d.f
B	# of Groups −1
W	?
T	Total # of observation −1

- Computation of SST:
  Each observation x_{ij} − $\overline{\overline{x}}$, Then square The difference, Then Add Them UP

- Computation of SSW:
  For each group compute $x_{ij} - \overline{x}_i$, Then square The differences Then add Them UP

- $SS_B = SST - SSW$

- Connection with t-test for Two populations with Pooled variance
  The results will The same:

$$\text{ANOVA } F_{1, n_1+n_2-2, \alpha} = \text{T-test } t^2_{n_1+n_2-2, \alpha/2}$$

Question: why not extending The t-test pairwise to more Than 2-Population?

NO suppose you have 5 population, This gives $5(4)/2 = 10$ pairwise, say $\alpha = .1$, t-tests

Then The overal error is $10(.1) = 100\%$ error