Appendix K

The F Distribution

The F distribution is an asymmetric distribution that has a minimum value of 0, but no maximum value. The curve reaches a peak not far to the right of 0, and then gradually approaches the horizontal axis the larger the F value is. The F distribution approaches, but never quite touches the horizontal axis.

The F distribution has two degrees of freedom, $d_1$ for the numerator, $d_2$ for the denominator. For each combination of these degrees of freedom there is a different F distribution. The F distribution is most spread out when the degrees of freedom are small. As the degrees of freedom increase, the F distribution the F distribution is less dispersed.

Figure 1.1 shows the shape of the distribution. The F value is on the horizontal axis, with the probability for each F value being represented by the vertical axis. The shaded area in the diagram represents the level of significance $\alpha$ shown in the table.

There is a different F distribution for each combination of the degrees of freedom of the numerator and denominator. Since there are so many F distributions, the F tables are organized somewhat differently than the tables for the other distributions. The three tables which follow are organized by the level of significance. The first table gives F values for that are associated with $\alpha = 0.10$ of the area in the right tail of the distribution. The second table gives the F values for $\alpha = 0.05$ of the area in the right tail, and the third table gives F values for the $\alpha = 0.01$ level of significance. In each of these tables, the F values are given for various combinations of degrees of freedom.

In order to use the F table, first select the significance level to be used,
Figure K.1: The F distribution
and then determine the appropriate combination of degrees of freedom. For example, if the $\alpha = 0.10$ level of significance is selected, use the first F table. If there are 5 degrees of freedom in the numerator, and 7 degrees of freedom in the denominator, the F value from the table is 2.88. This means that there is exactly 0.10 of the area under the F curve that lies to the right of $F = 2.88$.

When the significance level is $\alpha = 0.05$, use the second F table. If there are 20 degrees of freedom in the numerator, and 5 degrees of freedom in the denominator, then the critical F value is 4.56. This could be written

$$F_{20,5;0.05} = 4.56$$

That is, for 20 and 5 degrees of freedom, the F value that leaves exactly 0.05 of the area under the F curve in the right tail of the distribution is 4.56.

For the $\alpha = 0.01$ level of significance, the third F table is used. Suppose that there is 1 degree of freedom in the numerator and 12 degrees of freedom in the denominator. Then

$$F_{1,12;0.01} = 9.33.$$

An F value of 9.33 leaves exactly 0.01 of area under the curve in the right tail of the distribution when there are 1 and 12 degrees of freedom.
F Values for $\alpha = 0.10$

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