Approved For Release 2001/03/07 : CIA-RDP96-00789R003000180010-9

V REVIEW OF STATISTICAL POWER

The power of a statistical measure is defined as the probability of a significant observation *given* that an effect hypothesis (H_1) is true. Define the value of a dependent variable as X. Then, given that the null hypothesis (H_0) is true, a significant observation, x, is defined as one in which the probability of observing

$$x \geq \mu_0 + 1.645\sigma_0,$$

where μ_0 and σ_0 are the mean and standard deviation of the parent H_0 distribution, is less than or equal to 0.05.

Figure 3 shows these definitions in graphical form under the assumption of normality. The *Z-Score* is a normalized representation of the dependent variable and is given by:

$$z = \frac{(x - \mu_0)}{\sigma_0},$$

where x is the value of the dependent variable and μ_0 and σ_0 are the mean and standard deviation, respectively, of the parent distribution under H_0, and z_c is the minimum value (i.e., 1.645) required for significance (one-tailed). The mean of z under H_0 is zero. The mean and standard deviation of z under H_1 are μ_{AC} and σ_{AC}, respectively.

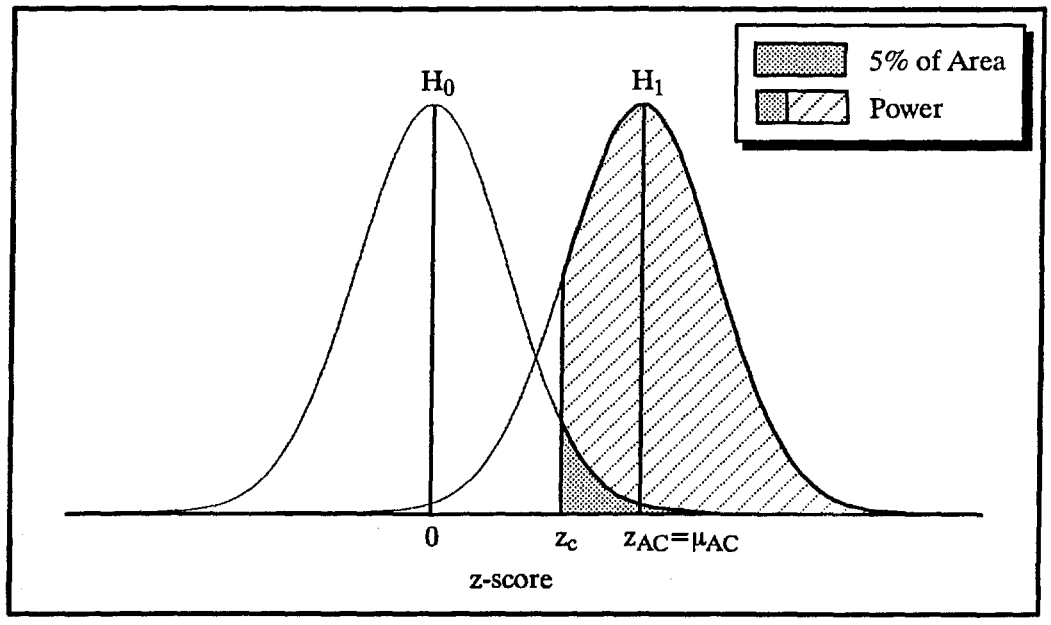

Figure 3. Normal Representation of Statistical Power

Approved For Release 2001/03/07 : CIA-RDP96-00789R003000180010-9

This document is made available through the declassification efforts
and research of John Greenewald, Jr., creator of:

The Black Vault

The Black Vault is the largest online Freedom of Information Act (FOIA) document clearinghouse in the world. The research efforts here are responsible for the declassification of hundreds of thousands of pages released by the U.S. Government & Military.

Discover the Truth at: **http://www.theblackvault.com**

In general the effect size, ε, may be defined as:

$$\varepsilon = \frac{z}{\sqrt{n}}, \tag{3}$$

where n is the sample size. Let ε_{AC} be the empirically derived effect size for anomalous cognition (AC). Then $z_{AC}=\mu_{AC}$ in Figure 3 is computed from Equation 3. From Figure 3 we see that power is defined by:

$$\text{Power} = \frac{1}{\sigma_{AC}\sqrt{2\pi}} \int_{z_C}^{\infty} e^{-0.5\left(\frac{\zeta-\mu_{AC}}{\sigma_{AC}}\right)^2} d\zeta . \tag{4}$$

Let

$$z = \frac{\zeta - \mu_{AC}}{\sigma_{AC}}.$$

Then Equation 4 becomes

$$\text{Power} = \frac{1}{\sqrt{2\pi}} \int_{z'_c}^{\infty} e^{-0.5z^2} dz, \quad \text{where } z'_c = \frac{z_c - \mu_{AC}}{\sigma_{AC}}. \tag{5}$$

For planning purposes, it is convenient to invert Equation 5 to determine the number of trials that are necessary to achieve a given power under the H_1 hypothesis. If we define z(P) to be the z-score associated with a power, P, then the number of trials required is given by:

$$n = \frac{4z^2(P)}{\varepsilon_{AC}^2}, \tag{6}$$

where ε_{AC} is the estimated mean value for the effect size under H_1. Figure 4 shows the power, calculated from Equation 5, for various effect sizes for $z_c = 1.645$.

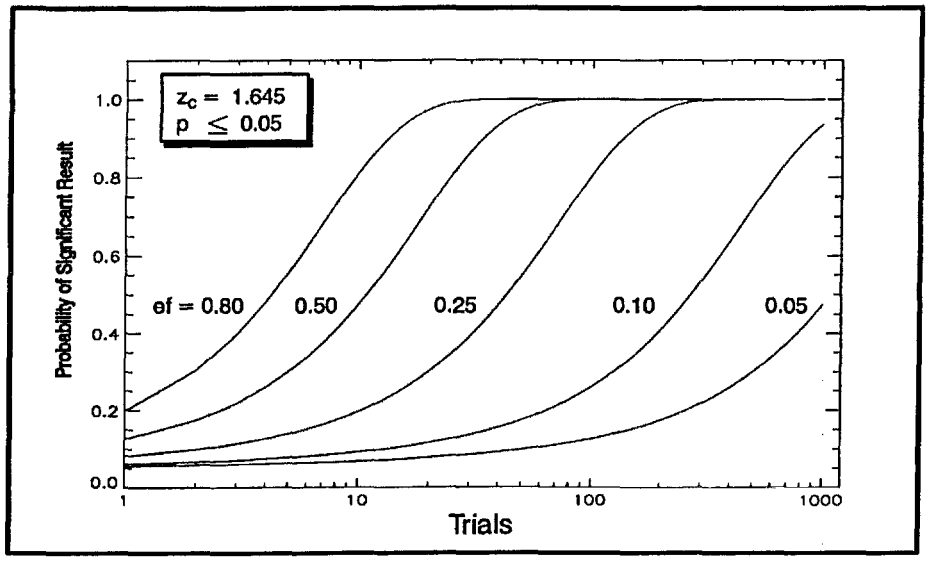

Figure 4. Statistical Power for Various Effect Sizes