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A NOTE ON THE POWER OF THE SIGN TEST

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1. Introduction. Let us consider a set of N non-zero differences, of which x are positive and $N - x$ are negative; and suppose that the hypothesis tested, H_0, implies, in independent sampling, that x will be distributed about an expected value of $N/2$ in accordance with the binomial $(\frac{1}{2} + \frac{1}{2})^N$. As a quick test of H_0, we may choose to test the hypothesis h_0 that x has the above probability distribution. Defining r to be the smaller of x and $N - x$, the test consists in rejecting h_0 and therefore H_0 whenever $r \leq r(\epsilon, N)$, where $r(\epsilon, N)$ is determined by N and the significance level ϵ.

2. Power of a test. In applying such a test it is of interest to know how frequently it will lead to a rejection of H_0 when H_0 is false and the situation H implies that the probability law of x is $(q + p)^N$, with $p \neq \frac{1}{2}$, thereby indicating an expectation of an unequal number of $+$ and $-$ differences. The probability of rejecting H_0 when H_1 implying $p = p_1$ is true, is termed the *power* of the test of H_0 relative to the alternative H_1.[1] Thus, from the point of view of experimental design the power (P) of the test of H_0 may be considered a function of the alternative hypothesis H_1, the significance level ϵ, and N. As such, the following observations may be noted:

1. The power P_2, for an assumed ϵ, N, and H_2 implying $p = p_2$ is greater than or equal to the power P_1 for ϵ, N and H_1 implying $p = p_1$ where $| p_2 - .50 | > | p_1 - .50 |$.

[1] For an extensive discussion of the power of a test, the reader is referred to J. Neyman and E. S. Pearson, *Statistical Research Memoirs*, Vol. 1 (1936), pp. 3–6.