## REFERENCES

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# ABSTRACTS OF PAPERS

*(Abstracts of papers presented at the Berkeley meeting of the Institute, July 14–16, 1955)*

### 1. **Nonparametric Mean Estimation of Percentage Points and Density Function Values.** JOHN E. WALSH, Lockheed Aircraft Corporation.

Consider a sample of size $n$ from a statistical population with probability density function $f(x)$ and $100p$ per cent point $\theta_p$. The function $f(x)$ is of an analytic nature. Some methods are presented for approximate nonparametric expected value estimation of $\theta_p$ and of $1/f(\theta_p)$. A nonparametric estimate whose expected value differs from $\theta_p$ by terms of order $n^{-7/2}$ can be obtained. For $1/f(\theta_p)$, an estimate whose expected value is accurate to terms of order $n^{-3}$ can be obtained. The estimates developed consist of linear functions of specified order statistics of the sample. The order statistics used are sample percentage points with percentage values which are near $100p$. Let $m$ be the number of order statistics appearing in an estimate ($m \leqq 7$). Coefficients for the linear estimation function are obtained by solving a specified set of $m$ linear equations in $m$ unknowns. All estimates derived for $\theta_p$ have variances of the form $p(1 - p)/nf(\theta_p)^2 + 0(n^{-3/2})$. Without additional information, all that can be determined about the variances of the estimates derived for $1/f(\theta_p)$ is that they are $0(n^{-1/2})$. Thus both types of estimates are consistent but the estimates for $\theta_p$ are more efficient than those for $1/f(\theta_p)$.

### 2. **On the Concept of Probability in Quantum Mechanics.** A. O. BARUT, Stanford.

Some mathematical consequences of the following particular probability measure are discussed: Consider the one to one correspondence between the elements of the sample space $\Omega$ and the linearly independent elements of a unitary space $\bigvee$ (in general a Hilbert space). The probability measure of sets in $\Omega$ is defined by $p(S) = (P_S x, x) = \| P_S x \|^2$, where $(x, x) = 1$ and $P_S$ is the projection operator on the manifold spanned by vectors corresponding to the points in $S$. The vector $x$ characterizes the system or the experiment. It follows from $p(S)$ that random variables are represented by linear Hermitian operators. These random variables may have an intrinsic correlation coefficient even though they are independent in the ordinary sense; they apply to a larger class of phenomena.

### 3. **Two-Sample Estimates of Prescribed Precision. (Preliminary Report.)** ALLAN BIRNBAUM, Columbia University and Stanford University.

Let $x_1, x_2, \cdots$ be independent observations on a random variable $X$ with density (or discrete probability) function $f(x, \theta)$, with $\theta$ unknown, $\theta \in \Omega$, $E(X) = \mu = \mu(\theta)$, Var $(X) = \sigma^2(\theta)$. Suppose an unbiased estimate of $\mu$ is required, with variance not exceeding a given