tion of power efficiencies, so that little error in power efficiencies would be expected if the approximation were used for $n = 6$, $\alpha = .01$ or $n = 4$, $\alpha = .05$, the efficiencies given in Table II for $n = 4$, $\alpha = .05$ and $n = 4, 6$, $\alpha = .01$ were obtained from the exact values by graphical interpolation and cross-interpolation.

Power efficiencies were not considered for $n < 4$ because of the difficulties of interpolation and the inexactness of the normal approximation in this range.

For $n = \infty$, t_1 and t_2 both have a normal distribution with zero mean and unit variance. Thus the power efficiency is 100% at all significance levels for this case.

These computations furnish approximate power efficiencies for $n = 6, 8, 10, 15, 25, \infty$ at $\alpha = .05, .025, .01$, and for $n = 4$ at $\alpha = .05$ and .01. The other approximate power efficiencies listed in Table II were obtained by graphical interpolation from these values.

The results of this note can be roughly summarized for $n \leq 15$ by stating that of the $2n$ sample values

(i). approximately 1.6 values are lost at the 5% significance level,

(ii). approximately 2.1 values are lost at the 2.5% significance level,

(iii). approximately 2.8 values are lost at the 1% significance level, if the tests based on t_1 are used instead of the corresponding tests based on t_2. Examination of Table I shows that the number of sample values lost decreases as n increases for $n > 15$.

REFERENCES

[1] JOHN E. WALSH, "On the power function of the sign test for slippage of means", *Annals of Math. Stat.*, Vol. 17 (1946), pp. 360, 361.

[2] N. L. JOHNSON AND B. L. WELCH, "Applications of the non-central t-distribution", *Biometrika*, Vol. 31 (1940), p. 376.

[3] J. NEYMAN, "Statistical problems in agricultural experimentation", *Roy. Stat. Soc. Suppl.*, Vol. 2 (1935), pp. 131, 132.

NOTE ON THE LIAPOUNOFF INEQUALITY FOR ABSOLUTE MOMENTS

BY MAURICE H. BELZ

The University of Melbourne

For a variate x measured from the mean of the population, the absolute moment of order r is defined by

$$\nu_r = \int_{-\infty}^{\infty} |x|^r \, dF(x),$$

where $F(x)$ is the cumulative distribution function. Treating r as continuous, we have

$$\frac{d\nu_r}{dr} = \int_{-\infty}^{\infty} |x|^r \log_e |x| \, dF(x),$$

the integral on the right existing if ν_{r+1} exists.

Write $y = \log_e \nu_r$. Then we have

$$\nu_r \frac{dy}{dr} = \int_{-\infty}^{\infty} | x |^r \log_e | x | \, dF(x),$$

$$\nu_r^2 \frac{d^2y}{dr^2} = \int_{-\infty}^{\infty} | x |^r \, dF(x) \cdot \int_{-\infty}^{\infty} | x |^r \log_e^2 | x | \, dF(x) - \left\{ \int_{-\infty}^{\infty} | x |^r \log_e | x | \, dF(x) \right\}^2$$

$$\geqq 0, \text{ by Schwarz's inequality.}$$

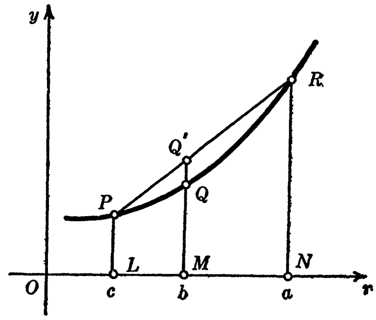

FIG. 1

It follows that the function y is convex (or exceptionally a straight line), and, on referring to the figure, it appears that

$$(1) \qquad MQ \leqq MQ'$$

for all chords PR. If the abscissae of the points L, M, N are c, b, a, respectively, where $c \leqq b \leqq a$, the inequality (1) leads at once to the relation

$$\log_e \nu_b \leqq \frac{a - b}{a - c} \log_e \nu_c + \frac{b - c}{a - c} \log_e \nu_a .$$

Hence

$$\nu_b^{a-c} \leqq \nu_c^{a-b} \nu_a^{b-c},$$

which is the usual form of the Liapounoff Inequality.

REMARK ON THE NOTE "A GENERALIZATION OF WARING'S FORMULA"

BY T. N. E. GREVILLE

U. S. Public Health Service

Before submitting for publication the note "A generalization of Waring's formula," *Annals of Math. Stat.*, Vol. 15 (1944), pp. 218–219 the author made a diligent effort to ascertain, through correspondence with mathematicians and