ABSTRACTS OF PAPERS

(Abstracts of papers presented at the Annual Meeting of the Institute, Seattle, Washington, June 14–17, 1961. Additional abstracts appeared in the June, 1961 issue.)

18. Tables for the Reliability of Repairable Systems with Time Constraints (Preliminary report). Roquez Bejarano and Ronald S. Dick, International Electric Corp., Paramus, N. J.

Tables have been prepared to solve for the reliability of systems composed of A similar subsystems of which at most N can be inoperable for periods exceeding t_0 time units. A second time constraint is introduced into the model so that for at least time t_1 following a return of the system from state $N + 1$ to N machines inoperative, the system is only in states 0 to N or the system fails.

The mixed difference-differential equations solved are of the forms:

$$P_j^1(t) = -[\mu_j + \lambda_j]P_j(t) + \lambda_{j-1}P_{j-1}(t) + \mu_{j+1}P_{j+1}(t) + \mu_{N+1}P_{(N)(j)}(t_1)[P_{N+1}(t - t_1)]$$

$$P_j^1(t) = -[\mu_j + \lambda_j]P_j(t) + \lambda_{j-1}P_{j=1}(t) + \mu_{j+1}P_{j+1}(t) - \lambda_N[P_N(t - t_0)]P_{(N+1)(j)}(t_0).$$

or

$$P_j^{*1}(t) = -\mu_{N+1}P_{(N)(j)}(t_1)[P_{N+1(t-t_1)}] - (\mu_j + \lambda_j)P_j^*(t) + \mu_{j+1}P_{j+1}^*(t) + \lambda_{j-1}P_{j-1}^*(t)$$

where appropriate boundary conditions are applied. Reliability is defined as $R(t) = \sum_{j=0}^{A} P_j(t) + \sum_{j=0}^{N} P_j^*(t)$. For $A = 1$ (1) 5, and $N = 0(1)A - 1$, the tables give for 81 combinations of λ and μ the approximate time at which $R(t) = .001, .005, .01, .05, .10$ as well as the MTBF. The Cornish-Fisher equation and Weibull approximations are used in finding the reliability points. The MTBF is found by evaluating the Laplace Transforms of the mixed-differential difference equations and is exact. Reference should be made to "The Reliability of Repairable Complex Systems, Part A: The Similar Machine Case" by R. S. Dick, *5th Mil-E-Con National Convention on Military Electronics*, 1961 for a complete set of equations solved in this paper and the details of the model.

19. Mutual Information and Maximal Correlation as Measures of Dependence. C. B. Bell, San Diego State College.

Kramer (1961) asks if Shannon's mutual information, C_P, is equivalent to Kramer's generalization (to arbitrary σ-algebras) of Gebelein's (1939) Maximal Korrelation, S_P, which satisfies Rényi's (1959) postulates for a dependence measure of pairs of random variables. It is found that for two normalizations C_P' and C_P'' of C_P : (1) $0 \leqq S_P, C_P', C_P'' \leqq 1$; (2) $S_P = 0$ iff $C_P = 0$ iff $C_P = 0$ iff the algebras are independent. For strictly positive probability spaces, (3) the algebras are set independent iff there exists a probability function P_1 such that $S_{P_1} = C_{P_1} = C_{P_1} = 0$; (4) $C_P' = 1$ iff one algebra contains the other; (5) $C_P'' = 1$ iff the algebras are equal; (6) $S_P = 1$ if the algebras have a non-trivial intersection; (in the finite case, the converse of (6) holds;) (7) there exists a probability space such that no two of the dependence measures are equivalent. *Open Problems*: Which of (3)–(6) are valid for (a) the Gelfand-Yaglom (1957) mutual information for non-atomic algebras generated by random variables; and (b) the Lloyd mutual information for arbitrary algebras?