multiplier $k \gg \sqrt{p}$, which satisfies the equation $k^3 = 2 \bmod(p)$ where the modulus $p = 99707$. Hence we would expect this generator to fail the serial test with lags 3 and 6. Other large multipliers have also been tested and most of them appeared satisfactory. The last 2 generators in Table 1 use a small multiplier k, and as will be seen from the results of the serial test with lag 1 and Test 6—Runs up and down, these generators cannot be considered as acceptable. Test 6 was found to be a very useful and sensitive test and it is surprising that it has so rarely been used.

Acknowledgement

The second named author wishes to express his thanks to the Science Research Council for their financial support during the preparation of this paper.

References

Coveyou, R. R. (1960). "Serial Correlation in the generation of pseudo-random numbers", *J. Assoc. Comp. Mach.*, Vol. 7, p. 72.
Good, I. J. (1953). "The serial test for sampling numbers and other tests for randomness", *Proc. Camb. Phil. Soc.*, Vol. 49, p. 276.
Greenberger, M. (1961). "An *a priori* determination of serial correlation in computer generated random numbers", *Math. Comp.*, Vol. 15, p. 383.
Gruenberger, F., and Mark, A. M. "The d^2 test of random digits", *Math. Tables Other Aids Comp.*, Vol. 5, p. 109.
Hardy, G. H., and Wright, E. M. (1960). *The Theory of Numbers*, 4th ed. Oxford: Clarendon Press.
Herrman, R. G. (1961). "The statistical evaluation of random number generating sequences for digital computers", Washington D.C.: Office of Technical Services, U.S. Dept. of Commerce, APEX-635.
Hull, T. E., and Dobell, A. R. (1964). "Mixed congruential random number generators for binary machines", *J. Assoc. Comp. Mach.*, Vol. 11, p. 31.
Kuehn, H. G. (1961). "A 48-bit pseudo-random number generator", *Comm. A.C.M.*, Vol. 8, p. 350.
Pike, M. C., and Hill, I. D. (1965). "Pseudo-Random Numbers", *Comm. A.C.M.*, Vol. 8, p. 605.
Roberts, F. D. K. (1966). "Pseudo-random number generators for digital computers", M.Sc. thesis, Liverpool.
Rotenberg, A. (1960). "A new pseudo-random number generator", *J. Assoc. Comp. Mach.*, Vol. 7, p. 75.
Tocher, K. D. (1963). *The Art of Simulation*, London: English Universities Press.

Book Review

The Matrix Analysis of Vibration, by R. E. D. Bishop, G. M. L. Gladwell and S. Michaelson, 1965; 404 pages. (London: *Cambridge University Press*, 100s.)

The material in this book may be divided into two main parts. The first part gives an elementary exposition of matrix theory and its use in the formulation of vibrational problems. The second part deals with the solution of the fundamental problems of matrix algebra by computational methods.

In Chapter 1 the matrix concept is introduced, and matrix addition, multiplication and inversion and the determinant of a square matrix are defined. Chapter 2 discusses the vibration of a conservative system with a finite number of degrees of freedom while Chapter 3 covers the theory of linear equations and discusses such problems as rank and linear dependence. Chapter 4 takes up the theory of free vibration again, and covers change of co-ordinates and the effect of constraints, and gives a more rigorous treatment of natural frequencies and principal modes. In Chapter 5 the problem of damped systems is taken up, starting with a simple one-dimensional model and continuing with systems with many degrees of freedom. Chapter 6, easily the longest, concludes the first part of the book with a very comprehensive treatment of methods for reducing continuous systems to approximating systems having a finite number of degrees of freedom.

The second half consists of three chapters. Chapter 7 describes the solution of linear equations by a number of variations of triangular decomposition and includes a discussion of the effect of rounding errors. Chapters 8 and 9 deal with the solution of the algebraic eigenvalue problem, the first covering iterative methods and the second covering direct methods. Included in the last chapter is Householder's reduction of a symmetric matrix to tridiagonal form, and the calculation of the eigenvalues of the latter by the Sturm sequence methods and of the eigenvectors by inverse iteration. For unsymmetric matrices, Lanczos' method for the reduction to tridiagonal form is described, and the use of Muller's method for calculating the eigenvalues is discussed.

The book contains a very large amount of information and will undoubtedly be of great value to engineers who wish to make a serious study of vibrational problems. It includes a valuable collection of exercises. The main weaknesses are such as might be expected in a book written by three different authors with somewhat different backgrounds. The fundamental mathematical problem is the determination of values of λ for which $Ax = \lambda Bx$ has non-trivial solutions. This problem is treated several times during the course of the book by arguments of varying sophistication. It is possible that engineers prefer this piecemeal approach but I am not convinced of its effectiveness. Surely it would have been simpler to deal once and for all with the relevant canonical forms associated with $A-\lambda B$? I found the second half of the book much the more satisfying though unfortunately Chapters 8 and 9 were written at a time when new techniques for solving the eigenvalue problem were still advancing rapidly. At the present moment most unsymmetric matrix problems are solved either by reduction to Hessenberg form followed by the QR algorithm or Parlett's version of Laguerre's method, or by the application of Eberlein's method; but none of these techniques is mentioned.

The standard of production of the book is remarkably high and the price is very reasonable for such a handsome volume.

J. H. Wilkinson