

Mathematical Surveys

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APPROXIMATION BY POLYNOMIALS WITH INTEGRAL COEFFICIENTS

Le Baron O. Ferguson

Results in the approximation of functions by polynomials with coefficients which are integers have been appearing since that of Pál in 1914. The body of results has grown to an extent which seems to justify the present book. The intention here is to make these results as accessible as possible.

The book addresses essentially two questions. The first is the question of what functions can be approximated by polynomials whose coefficients are integers and the second question is how well are they approximated (Jackson type theorems). For example, a continuous function f on the interval $-1, 1$ can be uniformly approximated by polynomials with integral coefficients if and only if it takes on integral values at $-1, 0$ and $+1$ and the quantity $f(1) + f(0)$ is divisible by 2. The results regarding the second question are very similar to the corresponding results regarding approximation by polynomials with arbitrary coefficients. In particular, nonuniform estimates in terms of the modulus of continuity of the approximated function are obtained.

Aside from the intrinsic interest to the pure mathematician, there is the likelihood of im-

portant applications to other areas of mathematics; for example, in the simulation of transcendental functions on computers. In most computers, fixed point arithmetic is faster than floating point arithmetic and it may be possible to take advantage of this fact in the evaluation of integral polynomials to create more efficient simulations. Another promising area for applications of this research is in the design of digital filters. A central step in the design procedure is the approximation of a desired system function by a polynomial or rational function. Since only finitely many binary digits of accuracy actually can be realized for the coefficients of these functions in any real filter, the problem amounts (to within a scale factor) to approximation by polynomials or rational functions with integral coefficients.

This book should make the task of finding out what is known in this field significantly easier as it presents an introduction to most of the known results in the area of approximation by polynomials with integral coefficients and pointers to the literature for the rest. It is accessible to students at the graduate level and above.

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O. T. O'Meara

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