Mathematics

1. A COMPARISON THEOREM FOR GREEN'S FUNCTIONS. Marvin C. Papenfuss, Loras College, Dubuque.

If the equations $y'' = a(t)y' + b_j(t)y$, $j=1,2$ are disconjugate on the interval $[0, T]$, then the Green's functions $G(t, s; b_j)$, $j = 1,2$ exist, and, if $b_1(t) \leq b_2(t)$ on $[0, T]$, then $G(t, s; b_2) \leq G(t, s; b_1)$ on $[0, T] \times [0, T]$. The non-linear two-point boundary value problem (BVP) $y'' = a(t)y' + f(t,y)$, $y(0) = A$, $y(T) = B$ is then considered in a quasi-linearized form. A sequence of successive approximations is defined for this new BVP, each member of which is defined in terms of a Green's function. The above comparison theorem is then employed to establish monotonic convergence of this sequence of successive approximations to a solution of the BVP.

2. A FINITE STONE-WEIERSTRASS THEOREM. S.E. Mosiman, Dubuque.

For any topological space, X, let C(X) denote the set of bounded real-valued continuous functions on X. Let S be a subalgebra of C(X) satisfying the following conditions: S separates points of X and for each point of X, S contains a function which does not vanish at that point. Stone's theorem (which has the Weierstrass approximation theorem as an easy corollary) asserts that the uniform closure of any such S is C(X). This paper is centered on the following finite analogy. Theorem. Let X be any topological space and S as above. Then the closure of S in the topology of pointwise convergence is C(X).

3. CONTINUITY OF A TWO-VARIABLE RATIONAL FUNCTION AT THE ORIGIN. George Bridgman, Waverly.

The function f defined by $f(X,Y) = XY/(X^2 + Y^2)$, for $(X,Y) \neq (0,0)$, and $f(0,0) = 0$, is not continuous at the origin. This is a standard example, found in many calculus books. On the other hand, the function g defined as $g(X,Y) = X^{1.1} Y / (X^2 + Y^2)$, $(X,Y) \neq (0,0)$, and $g(0,0) = 0$, is continuous at the origin. These functions suggest the problem: For what values of m, n, p, and q (all real and positive) is the function h continuous at the origin, where $h(X,Y) = X^m Y^n / (|X|^p + |Y|^q)$, for $(X,Y) \neq (0,0)$, and $h(0,0) = 0$. We state and prove a necessary and sufficient condition on $m, n, p, q > 0$ for which h is continuous at the origin.

4. MODULARIZATION OF PRE-CALCULUS COURSES
B. E. Gillam, Des Moines

At Drake University, the concepts and procedures dealt with in Pre-Calculus courses have been reduced to modules, each of which can be completed in one week of classes. The advantages and disadvantages of this method of presentation of Pre-Calculus courses are discussed.

5. GEOMETRY BEFORE EUCLID
J. Mathews, Ames

I will spend most of my time discussing Hippocrates' attempts to square the circle. My purpose is, however, to support two opinions on the uses of the history of mathematics in training secondary teachers. First, I believe that some knowledge of the evolution of a field of mathematics is useful to those who must choose a method of teaching that field. Secondly, I believe that teachers and students alike can be most stimulated by the writings of the men who helped to create the field. The work of Hippocrates is, I think, an excellent example of the work of a first-class mathematician on an interesting problem. I believe that knowledge of such examples can lead to more effective teaching.

6. MIXED METHOD NUMERICAL SOLUTIONS OF THE ADVECTION EQUATION. John M. Leone, Jr.* and Douglas N. Yarger, Ames.

Mixed methods involving finite element approximations of space derivatives and finite difference or Runge-Kutta approximations of time derivatives were applied to the two dimensional advection equation. The solutions were then matched with the analytic solution for method comparison. Results indicate that these methods may well be competitive to standard finite difference methods with advantages for certain problems.

7. ERROR ANALYSIS FOR PICARD-CHEBYSHEV ITERATIONS. Dennis R. Steele, Ph.D., Graceland College, Lamoni, IA.

An iterative technique based on Picard iterations and the Chebyshev polynomials finds its basic strength in the fact that it ignores completely the standard distinction between the linear and nonlinear initial value problem. It also produces a Chebyshev series solution which is easily evaluated. Its basic weakness lies in the fact that one must assume a finite series before computation can begin, and the accuracy of the solution depends completely on this assumption. This problem can be overcome by continuously repeating the solution with some arbitrary increase in the length of the series with each repetition until the accuracy desired is obtained. This proves, however, to be an extremely lengthy and time-consuming procedure.

A considerable improvement is obtained by specifying the accuracy desired as well as the length of the series. One can then calculate the interval from the initial independent variable over which the solution can be constructed which will provide the accuracy specified. This approach also has the added advantage that for certain problems a much larger interval than the standard Chebyshev intervals can be used.