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A Review of “Linear Programming Computation” by Ping-Qi Pan

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A Review of "Linear Programming Computation" by Ping-Qi Pan

The book consists of two parts. Part I (Chapters 1-10) presents the fundamental and rich materials of LP, including simplex methods, interior point methods and many relevant issues. Deduced in a fresh and rather brisk way, this part is written at the undergraduate level and is very attractive to the newcomer to LP as algorithms are usually accompanied and illustrated by easy-to-follow examples. Part II (Chapters 11-25) contains advanced topics, which mainly cover Ping-Qi Pan's contributions to LP. It is Part II that makes this monograph ``a landmark work on LP'' and is of interests to researchers in LP community. The following of this note is mainly to review Part II and to introduce several notable contributions of Ping-Qi Pan.

The Advanced Topics of Part II begins with one of Ping-Qi Pan's significant contributions: the creation of the "largest distance rule", the "nested rule" and a combination of them. These column pivot rules are described in Chapter 11 [1, pp.304-310; 3, 4]. In order to see how column rules affect the behavior of the simplex method, extensive computational experiments were conducted on 80 large-scale sparse test problems, including the 47 largest Netlib problems, the 16 Kennington problems and 17 largest BPMPD problems. All tested codes were yielded from MINOS 5.51 by changing its column rule only. The Devex rule, an approximation to the steepest-edge rule, was taken as a baseline in comparison as it outperformed other major existing rules, including Dantzig's original rule, its partial pricing variants, and the steepest-edge rule [1, 709-725]. Numerical results show that the largest-distance rule and the nested rule defeated the Devex with time ratio 3.24 and 5.73 [3,4], respectively. Furthermore, a combination of the two rules outperformed the Devex with time ratio as high as 7.27 [2]! Therefore, we conclude that the combination of the largest distance and the nested rules would be the best column rules at present, bringing the simplex method to its highest performance ever.

Another important contribution of Ping-Qi Pan was the generalization of the simplex method. He created a pair of column and row pivot rules together with a flexible step-length, and embedded them within the conventional simplex framework, so as resulting in the so-called "feasible-point simplex method" presented in Chapter 24 [1, pp.639-646]. Starting from any feasible point, consequently, the new method generates a sequence of feasible points, not confined to vertexes only; that is, it goes across the relative interior of the feasible region. Depending on the starting point and step-length taken, it can be equivalent to the simplex method or a pure interior-point method, building a bridge between the two types of methods. A code, yielded from MINOS 5.51 by only changing its rules, step-length and termination criteria, was tested on a set of 31 test problems (the 16 Kennington and 15 BPMPD problems). Numerical results showed that the new code beat MINOS 5.51 with time ratio 6.6 with approximate interior-point solutions obtained, just like a normal interior-point code. This code along with an extra purification procedure out-per formed MINSO 5.51 with time ratio 3.4 with optimal vertex solutions reached [1, pp.

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