論文誌掲載論文概要

TIME BOUNDS OF BASIC STEEPEST DESCENT ALGORITHMS FOR M-CONVEX FUNCTION MINIMIZATION AND RELATED PROBLEMS

Norito Minamikawa, Akiyoshi Shioura
（Tokyo Institute of Technology）

The concept of M-convex function gives a unified framework for discrete optimization problems with nonlinear objective functions such as the minimum convex cost flow problem and the convex resource allocation problem. M-convex function minimization is one of the most fundamental problems concerning M-convex functions. It is known that a minimizer of an M-convex function can be found by a steepest descent algorithm in a finite number of iterations. Recently, the exact number of iterations required by a basic steepest descent algorithm was obtained. Furthermore, it was shown that the trajectory of the solutions generated by the basic steepest descent algorithm is a geodesic between the initial solution and the nearest minimizer. In this paper, we give a simpler and shorter proof of this claim by refining the minimizer cut property. We also consider the minimization of a jump M-convex function, which is a generalization of M-convex function, and analyze the number of iterations required by the basic steepest descent algorithm. In particular, we show that the trajectory of the solutions generated by the algorithm is a geodesic between the initial solution and the nearest minimizer.

NUMERICAL IMPLEMENTATION OF THE AUGMENTED TRUNCATION APPROXIMATION TO SINGLE-SERVER QUEUES WITH LEVEL-DEPENDENT ARRIVALS AND DISASTERS

Masatoshi Kimura, Tetsuya Takine
（Osaka University）

This paper considers the computation of the stationary queue length distribution in single-server queues with level-dependent arrivals and disasters. We assume that service times follow a general distribution and therefore, we consider the stationary queue length distribution via an imbedded Markov chain. Because this imbedded Markov chain has infinitely many states, level dependence, and bidirectional jumps of levels, it is hard to compute the solution of the global balance equation exactly. We thus consider the augmented truncation approximation. In particular, we focus on the computation of the truncated state transition probability matrix of the imbedded Markov chain, assuming that the underlying continuous-time absorbing Markov chain during a service time is not uniformizable. Under some stability conditions, we develop a computational procedure for the truncated transition probability matrix, where the upper bound of errors owing to truncation can be set in advance. We also provide some numerical examples and demonstrate that our procedure works well.

EGALITARIAN SOLUTION FOR GAMES WITH DISCRETE SIDE PAYMENT

Takafumi Otsuka
（Tokyo Institute of Technology）

In this paper, we study the egalitarian solution for games with discrete side payment, where the

characteristic function is integer-valued and payoffs of players are integral vectors. The egalitarian solution, introduced by Dutta and Ray in 1989, is a solution concept for transferable utility cooperative games in characteristic form, which combines commitment for egalitarianism and promotion of indivisual interests in a consistent manner. We first point out that the nice properties of the egalitarian solution（in the continuous case）do not extend to games with discrete side payment. Then we show that the Lorenz stable set, which may be regarded as a variant of the egalitarian solution, has nice properties such as the Davis–Maschler reduced game property and the converse reduced game property. For the proofs we utilize recent results in discrete convex analysis on decreasing minimization on an M-convex set investigated by Frank and Murota.

GENERATING DECISION SUPPORT INFORMATION FOR NURSE SCHEDULING INCLUDING EFFECTIVE MODIFICATIONS OF SOLUTIONS

Masaya Hasebe（Seikei University）
Koji Nonobe（Hosei University）
Wei Wu（Shizuoka University）
Naoaki Katoh（Seikei University）
Takahito Tanabe
（NTT DATA Mathematical Systems Inc.）
Atsuko Ikegami（Seikei University）

When dealing with real-world problems, optimization models generally include only important structures and omit latent considerations that cannot be practically specified in advance. Therefore, it can be useful for optimization approaches to provide a "solution space" or "many solutions" containing a solution that the decision-maker is likely to accept. The nurse scheduling problem is an important problem in hospitals to maintain their quality of health care. Nowadays, given an instance, mathematical models can be applied to find optimal or near-optimal schedules within realistic computational times. However, even with the help of modern mathematical optimization systems, decision-makers must confirm the quality of obtained solutions and need to manually modify them into an acceptable form. Therefore, general optimization algorithms that provide insufficient information for effective modifications remain impractical for use in many hospitals in Japan.

To improve this situation, we propose a method for a pattern-based formulation to generate information helpful in most practical cases in hospitals and other care facilities in Japan. This approach involves generating many optimal solutions and analyzing their features. Computational results show that the proposed approach provides useful information within a reasonable computational time.

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人間社会的流行における数理モデルの提案 —イノベータ理論と時間遅れの方程式を用いて—

大田　靖，水谷直樹（岡山理科大学）

本研究では，ファッションや映画，食品などの人間社会的流行に対して，先行研究で提案された数理モデルを基に，疫学的流行を記述する数理モデルの基礎となったSIRモデル，及びマーケティングにおけるイノベータ理論を考慮し，新しい形の流行モデルを提案した．また，一過性で終わるような流行（以下，一過性タイプの流行），及び再び盛り上がりをみせるような流行（以下，再起タイプの流行）の実データを用いて，ベイズ推定のアプローチによる提案モデルのパラメータ推定を行い，さらに，実データへのフィッティングを行った．本研究で提案されたモデルによって，再起や微細な振動を表現することが可能となり，先行研究で提案された数理モデルに比べて実データへのフィッティングにおいて，その精度を大幅に高めることができた．特に，再起タイプの流行であるKitKatや本麒麟のSNSへの投稿データにおいては，多少のずれはみられるものの，明らかに先行研究のモデルでは表現できていなかった再起や微細な振動が再現された．これらの結果から，提案モデルは人間社会的流行の変遷を説明するための便利なツールであることが結論づけられた．