Wang Dan Wei (Prof)

收件人: #LI ZONGZE#

周六 2024/11/30 17:57

My replies are in highlighted texts.

From: #LI ZONGZE# <LI0005ZE@e.ntu.edu.sg>
Sent: Saturday, 30 November 2024 12:50 pm
To: Wang Dan Wei (Prof) <EDWWANG@ntu.edu.sg>
Subject: Request for Clarification on NLP Problems and Lagrange Multipliers

Dear Professor Wang Danwei,

I am writing to seek your guidance on a few questions related to solving optimal minimum cost problems in NLP using Lagrange multipliers. Specifically, I have questions regarding the K-T sufficient theorem and Hessian matrix properties as mentioned on slide 84 and 92 of the PPT, which outlines the use of the K-T sufficient theorem to determine whether X* is an optimal solution.

我写信是为了寻求您的指导，关于使用拉格朗日乘子解决NLP中最优最小成本问题的几个问题。
具体来说，我对PPT第84页和第92页提到的K-T充分定理和Hessian矩阵性质有疑问，它概述了如何使用K-T充分定理来确定X*是否是最优解。

Here are my questions:

1. K-T Sufficient Theorem and Hessian Matrix
   - Does the K-T sufficient theorem inherently include the condition that the Hessian matrix must be positive definite or positive semi-definite? K-T充分定理是否固有地包含了Hessian矩阵必须是正定或正半定的条件？
The Hessian matrix must be positive definite in the M-space. 黑森矩阵在m空间中必须是正定的。

2. Local vs. Global Minimum with Positive (Semi-)Definiteness 当K-T充分定理条件和正定（或正半定）Hessian矩阵条件同时满足时，是否保证Z*是局部极小值还是全局极小值？
   - When both the K-T sufficient theorem conditions and the positive definite (or positive semi-definite) Hessian matrix condition are satisfied, does this guarantee that Z* is a local minimum or a global minimum?
If there are multiple stationary points, then the obtained minimum must be a local. If there is only one stationary point and Hessian matrix is globally PD (ND) on M space, then the stationary point is a global optimum.
如果有多个平稳点，那么得到的最小值必须是局部的。
如果只有一个驻点，且Hessian矩阵在M空间上是全局PD (ND)，则驻点是全局最优。

3. Negative (Semi-)Definiteness of Hessian Matrix -如果Hessian矩阵是负定或负半定的，X*还能是最优解吗？
   - If the Hessian matrix is negative definite or negative semi-definite, can X* still be an optimal solution?
   - Under such conditions, is Z* a local minimum, a global minimum, or not a minimum at all? 在这种情况下，Z*是局部最小值，还是全局最小值，或者根本不是最小值？
   - If X* is not the optimal solution but the problem requires finding one, what approach can be used to identify the optimal solution (e.g., referencing 23-S1-Q2)? -如果X*不是最优解，但问题需要找到一个，可以使用什么方法来确定最优解（例如，参考23-S1-Q2）？
Again, the sufficient conditions require Hessian matrix to be positive/negative definite on M-space.
同样，在m空间上，充分条件需要Hessian矩阵是正定/负定。

4. Indefiniteness of Hessian Matrix 如果Hessian矩阵是不定的，X*可以被认为是最优解吗？
   - If the Hessian matrix is indefinite, can X* be considered an optimal solution? No
   - Under these conditions, is Z* a local minimum, a global minimum, or not a minimum at all? Not an optimum.
在这些条件下，Z*是局部最小值，还是全局最小值，或者根本不是最小值？ 不是最优的。

5. Nonlinear h(x) 如果h(x)是非线性的，并且K-T充分定理不能用于确定最优性
   - If h(x) is nonlinear and the K-T sufficient theorem cannot be applied to determine optimality: Your question is not well formulated. I guess you meant the convexity and sufficient conditions. 你的问题是没有很好地表述。
我猜你指的是凹性和充分条件。
   - Can X* still be considered an optimal solution? All the theorems are sufficient conditions and not necessary conditions. X*还能被认为是最优解吗？
所有的定理都是充分条件而不是必要条件。

• • •

Thank you! | See comments below. | Got it, thanks!