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| ***Guest Lecture***  **Mid Sweden University,**  **Department of Economics, Geography, Law and Tourism (EJT),**  **Sundsvall,**  **Thursday 2020-01-16, 13.00-14.30**  **RECENT ADVANCES IN GENERAL GAME THEORY AND APPLICATIONS**  **By Peter Lohmander** | **C:\Users\demo\Desktop\MIUN PL seminar 191214\Peter_Lohmander_picture.jpg** |

**Abstract:**

In part 1 of this presentation, the two player zero sum games with diagonal game matrixes, TPZSGD, are analyzed. Many important applications of this particular class of games are found in military decision problems, in customs and immigration strategies and police work. Explicit functions are derived that give the optimal frequences of different decisions and the expected results of relevance to the different decision makers. Arbitrary numbers of decision alternatives are covered. It is proved that the derived optimal decision frequency formulas correspond to the unique optimization results of the two players. It is proved that the optimal solutions, for both players, always lead to a unique completely mixed strategy Nash equilibrium. For each player, the optimal frequency of a particular decision is strictly greater than 0 and strictly less than 1. With comparative statics analyses, the directions of the changes of optimal decision frequences and expected game values as functions of changes in different parameter values, are determined. The signs of the optimal changes of the decision frequences, of the different players, are also determined as functions of risk in different parameter values. Furthermore, the directions of changes of the expected optimal value of the game, are determined as functions of risk in the different parameter values. Finally, some of the derived formulas are used to confirm earlier game theory results presented in the literature. It is demonstrated that the new functions can be applied to solve common military problems.

In part 2 of this presentation, four military decision problems, common and relevant to typical army and ranger units, at platoon, company and battalion levels, are described and analysed. It is found that fundamental game theory and methods can be used to determine optimal decisions. The optimal decisions are derived as mixed strategy Nash equilibria, via manual methods. It is found that considerable improvements of the expected outcomes of typical decisions can be obtained in a way that does not require high investment costs. It is argued that the methodology to some degree should be included in the education of all Swedish military officers, in particular in the army and ranger units intended for special operations.

In part 3, stochastic dynamic extensions of part 1 will be defined.

*References with links:* Page 2.

**References**

Lohmander, P., Optimal decisions and expected values in two player zero sum games with diagonal game matrixes, - Explicit functions, general proofs and effects of parameter  
estimation errors, ***International Robotics & Automation Journal***, Volume 5, Issue 5, 2019, pages 186-198. Citation: Lohmander P. Optimal decisions and expected values in two player zero sum games with diagonal game matrixes-explicit functions, general proofs and effects of parameter estimation errors. Int Rob Auto J. 2019;5(5):186-198.  
<https://medcraveonline.com/IRATJ/IRATJ-05-00193.pdf>  
[http://www.Lohmander.com/PL\_files\_191114.zip](http://www.lohmander.com/PL_files_191114.zip)

Lohmander, P., Four central military decision problems, General methods and solutions, ***The Royal Swedish Academy of War Sciences, Proceedings and Journal***, No. 2/2019, pages 119-134.  
[http://www.Lohmander.com/PLRSAWS\_19\_sum.pdf](http://www.lohmander.com/PLRSAWS_19_sum.pdf)  
[http://www.Lohmander.com/PLRSAWS\_19\_jpg.zip](http://www.lohmander.com/PLRSAWS_19_jpg.zip)

Lohmander, P., Applications and Mathematical Modeling in Operations Research, In: Cao BY. (ed) Fuzzy Information and Engineering and Decision. IWDS 2016. ***Advances in Intelligent Systems and Computing***, vol 646. Springer, Cham, 2018 Print ISBN 978-3-319-66513-9, Online ISBN 978-3-319-66514-6, eBook Package: Engineering

Lohmander, P., Applications and mathematical modeling in operations research, ***KEYNOTE***, ***International Conference on Mathematics and Decision Science***, International Center of Optimization and Decision Making & Guangzhou University, Guangzhou, China, September 12-15, 2016 <http://www.Lohmander.com/PL_KEYNOTE_MATH_2016.jpg> <http://www.Lohmander.com/PL_ICODM_2016_KEY.pptx> <http://www.Lohmander.com/PL_ICODM_2016_KEY.pdf> <http://www.Lohmander.com/PL_ICODM_2016_KEY_PAPER.pdf> <http://www.Lohmander.com/PL_ICODM_2016_KEY_PAPER.docx> <http://icodm2020.com/en/>

**References on related topics**

<http://www.lohmander.com/Information/Ref.htm>

**Presentation of Peter Lohmander**

Bauer, M., Peter Lohmander, IIASA,  
International Institute for Applied Systems Analysis,  
<http://www.iiasa.ac.at/web/home/about/alumni/News/20181204_lohmander.html>  
[http://www.Lohmander.com/PL\_IIASA\_18.pdf](http://www.lohmander.com/PL_IIASA_18.pdf)