

In decision problems involving asymmetric loss functions, the optimal decision should be based on a quantile of a density forecast, rather than simply given by an expected-value forecast. Also, the combination of forecasts produced by different models may improve forecasting accuracy, as much as the combination of decision proposals from different sources may reduce the expected regret. We thus investigate and compare two possible approaches: either inferring decisions from combined predictive estimates, or combining prescriptive solutions derived from different forecasting models.

#### 4 - Classification by Archipelago Subgraph

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An ideal clustering of stocks is that there are positively correlated ones in each cluster and among stocks of different clusters the correlation is negative. This state can be achieved only if correlations close to zero are neglected. The ideal case is an archipelago. Clustering is done by deleting edges from a signed graph to get an archipelago. Algorithms are provided to determine that how high weights must be deleted and to find an archipelago subgraph with maximal total weight. Joint work with P. L. Hammer, P. Majlender, and B. Simeone

#### ■ TD-19

Tuesday, 14:00-15:20  
1.3.20

### Dynamical Systems

Stream: Dynamical Systems and Game Theory

*Invited session*

Chair: *João Almeida*, Instituto Politécnico de Bragança, 5301-857, Bragança, jpa@ipb.pt

Chair: *Flávio Ferreira*, Mathematics, ESEIG - Instituto Politécnico do Porto, R. D. Sancho I, 981, 4480-876, Vila do Conde, Portugal, flavioferreira@eu.ipp.pt

#### 1 - Pinto's Golden Tilings

*João Almeida*, Instituto Politécnico de Bragança, 5301-857, Bragança, jpa@ipb.pt

We present the definition of a golden sequence. These golden sequences are Fibonacci quasi-periodic and determine a tiling of the real line. We prove the existence of a natural one-to-one correspondence between: (i) Golden sequences; (ii) Smooth conjugacy classes of circle diffeomorphisms with golden rotation number that are smooth fixed points of renormalization, and (iii) Smooth conjugacy classes of Anosov diffeomorphisms that are topologically conjugate to the toral automorphism  $G_A=(x+y,x)$ . The Pinto-Sullivan tilings of the real line relate smooth conjugacy classes of expanding circle maps with 2-adic sequences.

#### 2 - Dynamic Thresholds in Biology

*Alberto A. Pinto*, Departamento de Matematica, University of Minho, Escola de Ciências, Universidade do Minho, 4710-057, Braga, Portugal, aapinto1@gmail.com

#### 3 - Leadership in a differentiated and uncertain market

*Flávio Ferreira*, Mathematics, ESEIG - Instituto Politécnico do Porto, R. D. Sancho I, 981, 4480-876, Vila do Conde, Portugal, flavioferreira@eu.ipp.pt, *Fernanda A. Ferreira*, *Alberto A. Pinto*

We present a brief study of the effects of product differentiation in a Stackelberg model with demand uncertainty. We do an ex-ante and ex-post analysis, in terms of product differentiation and of the demand uncertainty, of the profits of the leader and of the follower firms. We show that even with small uncertainty about the demand, the follower firm can achieve greater profits than the leader, if their products are sufficiently differentiated.

#### 4 - Effects of Individual Dynamic Complexity Elements on the Overall Complexity of a Simulation Game

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System dynamics based simulation games are commonly used to assist learning about complex systems. Though, it's unclear whether players can acquire transferrable learning by playing games. The main goal of this research is to assess the extent of learning under different game complexity levels. As the first part of this research, this paper focuses on explaining the overall game complexity in terms of dynamic complexity factors: delay, nonlinearity, stock and feedback. Using a two-stage experimental procedure, a complexity measure is sought, based on player performances and their assessments

#### ■ TD-20

Tuesday, 14:00-15:20  
1.3.33A

### Cutting and Packing 8

Stream: Cutting and Packing

*Invited session*

Chair: *J. M. Valério de Carvalho*, Departamento de Produção e Sistemas, Universidade do Minho, 4710 053, Braga, Portugal, vc@dps.uminho.pt

#### 1 - A constructive Heuristic for the Minimization of Open Stacks Problem

*Marco Carvalho*, Computer Science Department, Technological Institute of Aeronautics, Praça Marechal Eduardo Gomes, 50, Vila das Acácias, CEP 12.228, São José dos Campos, São Paulo, Brazil, mamc@ita.br, *Nei Yoshihiro Soma*

We present a constructive heuristic for the minimization of open stacks, a sequencing problem related to cutting stock. The method uses a quantity of techniques: breadth-first search, permutations generation and an anticipatory closing stack heuristic rule. Computational experiments encompassed a benchmark and a random set of instances. The gap to the first set is of 1.82% over almost six thousand instances, and a comparison with two other heuristics from the literature using the second set shows that the constructive heuristic has a better performance, opening far fewer stacks on average.

#### 2 - Sequencing bidimensional guillotine cutting operations considering lateness and raw material utilization

*Felipe Lemos*, Production Engineering Department, Universidade de São Paulo, Av. Prof. Almeida Prado, Travessa 2, Nº 128, Cidade Universitária, 05508-070, São Paulo, São Paulo, Brazil, felipeklemos@gmail.com, *Miguel Cezar Santoro*

The paper analyses sequencing on guillotine cutting aiming to improve lateness and raw material utilization. It studies the unexplored intersection of 2 classic themes, cutting & packing and sequencing. Ten constructive heuristics were tested on different conditions of items sizes, lateness intensity and decision criteria weights. The results showed the advantage of probabilistic heuristics; the importance of the chosen bias; and also of coherency between initial order and the weights of the objectives aimed. The implantation on an aircraft factory resulted better raw material utilization.

#### 3 - Pattern Cutting and Sequencing in a Multi-Stage Production System

*Rifat Gürçan Özdemir*, Industrial Engineering Department, Istanbul Kültür University, Atakoy Campus, Atakoy-Bakirkoy, 34156, Istanbul, Turkey, rg.ozdemir@iku.edu.tr, *Tülin Aktin*

In this study, an integrated mathematical approach is proposed for the pattern cutting and sequencing problem in a multi-stage production system. The completion times of final products are dependent upon the cutting and sequencing of patterns based on which raw materials are cut in the first stage. The developed ILP model with the objective of minimizing WIP and tardiness costs, determines the number of hardboards that will be cut and obtains the sequence of these cutting patterns simultaneously. The model is then implemented in a furniture manufacturer operating on a make-to-order basis.

#### 4 - Sequencing cutting patterns in order to minimize the stack occupation

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