ORSIS 2012 PROGRAM

Sunday		Monday	
8:30 on	*Registration open from 8:30* *Coffee and muffins*	8:30 on	*Registration open from 8:30* *Coffee and muffins*
9:15-9:30	*Opening Session*	9:15-9:30	*Prize Award Ceremony*
9:30-10:10	***Naor Lecture: Martin Grötschel***	9:30-10:10	***Plenary Lecture: Yoav Benjamini***
10:15-11:30	**Parallel Session S1** 1ש:**Military OR 1: in memory of Uriel Rothblum** 2ש: **Supply Chain Management 1** 3ש:**Transportation Science 1** א: **Scheduling**	10:15-11:30	**Parallel Session M1** 1ש:**Algorithms 1** 2ש:**Queuing 3** 3ש:**Data Mining** א:**Water Management**
11:30-11:45	*break*	11:30-11:45	*break*
11:45-1:00	**Parallel Session S2** 1ש:**Military OR 2** 2ש: **Game Theory 1** 3ש:**Transportation Science 2** א: **Queuing 1**	11:45-1:00	**Parallel Session M2** 1ש:**Algorithms 2** 2ש:**Queuing 4** 3ש:**Financial Engineering 1** א:**Military OR5**
1:00-2:15	*lunch*	1:00-2:15	*lunch* & *ORSIS board meeting from 2:00*
2:15-2:55	***Tutorials:*** 1ש:Mordecai Henig: Multi-criteria decision making 2ש:Offer Kella: Stochastic Networks	2:15-2:55	***Tutorials***: 1ש:Ella Segev: Game Theory 2ש:Amir Beck: Non-linear Optimization
3:00-4:15	**Parallel Session S3** 1ש:**Military OR 3** 2ש: **Game Theory 2** 3ש:**Data Envelopment Analysis** א: **Queuing 2**	3:00-4:15	**Parallel Session M3** 1ש:**Algorithms 3** 2ש:**Queuing 5** 3ש:**Financial Engineering 2** א:**Combinatorial Optimization 2**
4:15-4:30	*Break*	4:15-4:30	*Break*
4:30-5:10	***Plenary Lecture: Yossi Aviv***	4:30-5:10	***Plenary Lecture: Michael Pinedo***
5:15-5:55	**Parallel Session S4** 1ש: **Military OR 4** 2ש: **Decision Theory** 3ש: **Supply Chain Management 2** א: **Combinatorial Optimization 1** ב: **Classic O.R.**	5:15-5:55	**Parallel Session M4** 1ש:**Prize Winners** 2ש:**Health Care Management** 3ש:**Financial Engineering 3** א:**Combinatorial Optimization 3**
	Evening with Eugene Kandel	6:00-6:15	*Closing Session*

סימון החדרים: שקד 1 (ש1), שקד 2 (ש2), שקד 3 (ש3), אתרוג (א), ברוש (ב). כל הרצאות המליאה יהיו בשקד 1. כל דובר מתבקש לשלוח את המצגת לראש המושב המתאים לפני הכנס. ראשי המושב מתבקשים להעלות את המצגות למחשב בתחילת היום. בסוף היום הראשון ניפגש בקפטריה בשעה 18:00 לסיור מודרך קצר סביב קיבוץ מעלה החמישה ומיד לאחר מכן, בשעה 19:30 נתכנס לארוחת ערב באולם שקד. לאחר הארוחה נשמע את הרצאתו של פרופ' יוג'ין קנדל בנושאים אקטואליים כגון מחירי הגז והדיור וקרן ההון הממשלתית החדשה.

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Plenary Speakers

Martin Grötschel, ZIB, TU and Matheon Berlin. Mathematics, operations research, and modern industry

This lecture discusses the relationship of mathematics and operations research with modern industry. It describes the contributions of these areas to the industrial creation of value and the key position of mathematics and OR in the handling of complex systems, in other words, the role of math and OR as a production factor and amplifier for innovations. The lecture outlines the "application driven approach" to solve industrial problems based on a combination of mathematical modeling, simulation, and optimization. Numerous examples of projects (of my own research group and from a few other colleagues in Berlin) with industry demonstrate successes (and some failures) of this methodology. A wide range of real applications will be covered including problems in transport, traffic and logistics, telecommunication, manufacturing, and infrastructure design. Math and OR do not suffice, though. Close and faithful cooperation with engineers, management and computer scientists, as well as researchers and practitioners in various other fields are fundamental for significant success in practice.

Yossi Aviv, Washington University. Strategic consumer behavior in dynamic pricing systems

When implementing dynamic pricing processes, retailers must account for the fact that consumers may time their purchases in anticipation of future discounts. Such strategic consumer behavior might lead to severe consequences on the retailers' performance. In recent years, this topic has engendered a large body of Management Science research. In this talk, we will briefly survey key insights from selected research papers, and discuss current research directions on this subject.

Yoav Benjamini, Tel Aviv University. (2012 Israel Prize Winner). Selective inference in large modeling efforts

Selective inference is the practice of drawing inference only on a subset of the parameters, which is selected after viewing the data because the parameters within seem interesting. The inference can be in the form of hypotheses testing, point estimation or interval estimation. I shall address the problem of selective inference during and after model selection, a practice both common and unavoidable in large problems involving data mining. I shall discuss the False Discovery Rate (FDR) and the False non-Coverage Rate (FCR) as two examples of "assessing performance on the average over the selected", thereby addressing selective inference. I shall then present FDR based model selection procedures, and discuss the problem of assessing the uncertainty in the value of the parameters. The latter is especially important for the sensitivity analysis of the optimality of solutions based on the selected models.

Michael Pinedo, New York University. Planning and scheduling in the service industries

This talk focuses on current research directions in planning and scheduling in the service industries. The planning and scheduling models in services as well as the solution methodologies tend to be different from those used in manufacturing environments. We describe five classes of models and the current status quo. The first class considered includes interval scheduling models and reservation systems. The second class involves timetabling and tournament scheduling. The third class consists of transportation models (tanker scheduling, aircraft routing and scheduling and train timetabling). The fourth class of models concern planning and scheduling in health care. The fifth and last class are the workforce scheduling models. We conclude with a summary of the similarities and the differences between the model formulations and solution techniques that are used in these various different areas.

Tutorials

Moredecai Henig, Tel Aviv University. Multiple criteria decision making

מספר (<1 של) קריטריונים או תכונות (attributes) מאפיין בעיות אופטימיזציה רבות. בכל שנה מתפרסמים כ1000 מאמרים בתחום (כ 2% מהם ב *ManageSci* ו *OperRes* וכ 10% ב*EJOR* לפי Wallenius J, Dyer JS, Fishburn PC, Steuer RE, Zionts S, Deb K. Multiple Criteria Decision Making, Multiattribute Utility Theory: Recent Accomplishments and What Lies Ahead. Management Science. 2008; 54(7):1336–1349). ההרצאה מיועדת להקנות לחוקרי ביצועים ידע הכרחי בתחום על מנת לזהות בעיות כאלו ולהתייחס אליהן. ידע זה חיוני לאלו המתעניינים בתחומי מחקר סמוכים כמו DEA, ranking, planning, designing. הנושאים:

- מה בין קריטריון לתכונה?
- מקומה של MCDM לצד OR וDA.
- האם ריבוי קריטריונים קיים רק בחברות שאינן למטרת רווח או ב OR אסטרטגי?
- האם בOR טקטי נישא שם ה MCDM לשווא?
- האם MCDM הוא יותר מאגרגציה של קריטריונים?
- גישות כלליות בניסוח ופתרון.
- מה מאפיין את החוקרים והמחקרים בתחום ואת האגודה הבינלאומית ל MCDM, http://mcdmsociety.org, והכנסים שהיא מארגנת?
- מהן המטרות של "קבלת החלטות"? האם יש "התקדמות" בהשגת המטרות האלו?

ההרצאה תלווה במספר דוגמאות בניהול התפעול וכן שני יישומים: אחת בחברה ל"מטרת רווח" והשנייה בנושאי סביבה שלא למטרת רווח.

Offer Kella, The Hebrew University of Jerusalem. Reflected networks on the nonnegative orthant

As a motivating model consider a network of stations where the cumulative external input to each station is some nondecreasing function (=process when there is an underlying probabilistic structure). Each station processes its content at some rate. A fixed ratio of each processed unit of material is routed to each of the stations and a fixed ratio leaves the networks entirely. The routing ratios matrix is chosen such that each unit of material that enters the station eventually leaves. This assumption will be made precise in the tutorial. Such a network can be modeled as a reflected process on the nonnegative orthant (even though there is no actual reflection going on, but the name stuck anyway) and is also often called a solution to a Skorohod problem on the nonnegative orthant. Such reflected processes are also limits in distribution (weak limits) of generalized Jackson queuing networks, in which case the limiting net-input or driving process is a multivariate Brownian motion. In this talk the defining relations of such a Skorohod problem with respect to some underlying driving process and a given routing matrix will be described. The assumptions on the driving process and routing matrix under which these defining relations have a unique solution and the solution itself will be discussed. For driving processes (right continuous with left limit) having stationary (but not necessarily independent) and ergodic increments it turns out that under a simple and natural sufficient condition, for every initial (possibly random) condition, the reflected process has a limiting distribution which is independent of this initial condition even though it is not Markovian and it also has a unique stationary version. Special cases are driving processes which have stationary and independent increments (Lévy processes) or even more generally Markov additive processes, which will be described if time permits.

Amir Beck, The Technion. First-Order Methods for Convex Minimization

Many fundamental scientific and engineering problems of recent interest arising in signal recovery, image processing, compressive sensing, machine learning and other fields can be formulated as well structured optimization problems, but which are typically very large scale, and often nonsmooth and nonconvex. This leads to challenging difficulties for their solutions, precluding the use of most well established sophisticated algorithms, such as interior point methods. Elementary first order methods then often remain our best alternative to tackle such problems. This talk surveys classical as well as recent results on the design and analysis of gradient-based algorithms for some generic optimization models arising in a wide variety of applications, highlighting the ways in which problem structures can be beneficially exploited to devise simple and efficient algorithms.

Ella Segev, Ben-Gurion University of the Negev. Game Theory and Operations Research – Is it the beginning of a beautiful friendship?

A short survey of five of the top journals in OR discovers that about 10% of the papers have the words "game theory", "game" or "strategic" in their title or abstract. I strongly believe that this number will grow in the next few years. In this tutorial I will first define the basic game theoretic concepts that have been adopted in OR studies. Then, I will review the topics in OR that are being addressed with game theoretic tools. I will discuss the advantages and difficulties of incorporating strategic players into OR problems and the new insights that we can get from doing so. Finally, I will use the historical perspective offered by the interplay between game theory and computer science to speculate on the directions to which the interaction between game theory and OR is headed.

Sessions [grouped by subject]

Algorithms

A1 [*Parallel Session M1*]: Challenges in Continuous Optimization: Efficient Algorithms and Modern Applications I *Chair: Amir Beck* [Invited]

1. Shtern S.*, Ben-Tal A. Robust Optimization Approach for Tracking under Bounded Uncertainty
2. Drori Y.*, Teboulle M. Performance of first-order methods for smooth convex minimization: a novel approach
3. Beck A.*, Eldar Y. Sparsity Constrained Nonlinear Optimization: Optimality Conditions and Algorithms

A2 [*Parallel Session M2*]: Challenges in Continuous Optimization: Efficient Algorithms and Modern Applications II. *Chair: Luba Tetruashvili* [Invited]

4. Vaisbourd Y.*, Beck A. The Chebyshev Center Approach for Image Deblurring Applications
5. Sabach S.*, Beck A. An Improved Ellipsoid Method for Convex Differentiable Problems.
6. Tetruashvili L.*, Censor Y., Gholami M., Ström E. The Parallel Projections Method for the Cooperative Sensor Network Positioning Problem

A3 [*Parallel Session M3*]: Optimization for Machine Learning. *Chair: Elad Hazan* [Invited]

7. Hazan E., Koren T.*, Srebro N. Linear Regression with Limited Observation
8. Garber D.*, Hazan E. Approximating Semidefinite Programs in Sublinear Time
9. Hazan E., Karnin Z.* A poly-log pivot steps simplex algorithm for classification

Classic O.R. [*Parallel Session S4*]: *Chair: Reuven Rubinstein*

10. Dreyfuss M.*, Posner M.J.M. Customer delay in an Exchangeable MB/G/∞ Repair System with Spares
11. Rubinstein R.*, Vaisman R. Fast splitting algorithm for networks reliability estimation

Combinatorial Optimization

CO1 [*Parallel Session S4*]: *Chair: Boris Kricheli*

12. Bodinger E.*, Elalouf A., Perlman Y. Dynamic repair priority for a transfer line with a finite buffer
13. Kricheli B.*, Levner E. Search and Detection of Clustered Failed Components in Unreliable Complex Systems

CO2 [*Parallel Session M3*]: *Chair: Ephraim Korach*

14. Ibraheem W.*, Goren L. Automating Chip Assembly using Constraint Programming
15. Rochman Y.*, Levy H., Brosh E. Max Percentile Replication for Peer-based VoD Systems
16. Korach E.* 2-Steiner-subgraph Blocking Pair of Clutters with the MAX-FLOW MIN-CUT Property in Series Parallel Graphs

CO3 [*Parallel Session M4*]: *Chair: Gideon Weiss*

17. Levin A., Yovel U.* Non-oblivious 2-opt heuristics for the Traveling Salesman Problem
18. Shindin E.*, Weiss G. Full symmetric duality and structure of solution for a continuous linear program with constant coefficients

Data Envelopment Analysis [*Parallel Session S3*]: *Chair: Ekaterina Yazhemsky* [Invited]

19. Sinuany-Stern Z.*, Kristal N., Shachak H., Chernichovsky D., Friedman L. Hospital's Efficiency in Israel over time.
20. Adler N.*, Martini G., Volta N. Moving towards a greener fleet: A DEA estimation of the aircraft environmental production frontier.
21. Adler N., Ulku T., Yazhemsky E.* Benchmarking the implementation path to efficiency: The case of small regional airports.

Data Mining [*Parallel Session M1*]: *Chair: Jacob Zahavi* [Invited]

22. Sela A.*, Ben-Gal I. On Information Flow and Percolation Through Social Networks
23. Kaufman S.*, Rosset S., Perlich C., Stitleman O. Leakage in Data Mining: Formulation, Detection, and Avoidance
24. Geva T.*, Zahavi J. Integrating Data Mining and Text Mining Methods for Intraday Forecasting of Stock Returns

Decision Theory [*Parallel Session S4*]: *Chair: Eran Hanany* [Invited]

25. Chernonog T.*, Avinadav T., Henig M. Price setting in a single selling period with various risk criteria
26. Baliga S., Hanany E.*, Klibanoff P. Polarization and Ambiguity

Financial Engineering

FE1 [*Parallel Session M2*]: *Chair: Doron Kliger* [Invited]

27. Gil O.*, Zahavi G. On-line Learning of Market Making Strategy.
28. Rosenstein Y., Zahavi G*. Nonlinear dynamical systems theory in weather derivatives pricing

29. Kliger D., Gurevich G.*, Haim A. When Chronobiology Met Economics –Seasonal Affective Disorder and the Demand for IPOs

FE2 [*Parallel Session M3*]: Credit and Interest Rate Risk. *Chair: Koresh Galil* [Invited]

30. Geidman D., Perry T.*, Zahavi G. Extraction of Economy's Aggregate Expectations, Using a Modified Yield Spread Approach.
31. Galil K., Sher N.* Predicting financial distress more accurately: The choice of the dependent variable
32. Afik Z., Arad O., Galil K.* Using Merton model: an empirical assessment of alternatives

FE3 [*Parallel Session M4*]: Behavioral Finance. *Chair: Gal Zahavi* [Invited]

33. Kliger D. Kudryavtsev A.* Out of the Blue: Mood Maintenance Hypothesis and Seasonal Effects on Investors' Reaction to News
34. Gilad D., Kliger D.* Priming the Risk Attitudes of Professionals in Financial Decision Making
35. Yechiam E.*, Zahavi G. Agitated Losses and Relaxed Gains.

Game Theory

G1 [*Parallel Session S2*]: *Chair: Shoshana Anily* [Invited]

36. Granot D., Hanany E.* Subgame Perfect Consistent Stability.
37. Segev E.*, Sela A. Sequential all-pay contests with n players - mechanism design questions.
38. Anily S.*, Haviv M. Capacity sharing: allocation of capacity or allocation of labor?

G2 [*Parallel Session S3*]: *Chair: Ella Segev* [Invited]

39. Fibich G., Gavious A.*, Solan E. The averaging principle
40. Gavious A.*, Minchuk Y. Revenue in Contests with Many Participants
41. Amador S.*, Gavious A., Segev E. Analysis of Gender Differences in a Model of Multistage Bargaining

Health Care Management [*Parallel Session M4*]: *Chair: Arieh Gavious*

42. Prisman E., Prisman E.*, Freeman J. A New Stochastic Approach to the Analysis of the Rapid Intraoperative Parathyroid Hormone.
43. Solnik E.*, Gavious A., Davidovitch N., Pliskin J., Yamin D. Innovative Influenza Vaccination Policy Targeting Last Season's Patients.

Military Operations Research

M1 [*Parallel Session S1*]: Resource Allocation in Defence and Homeland Security: In Memory of Uriel Rothblum *Chair: Moshe Kress* [Invited]

44. Deutsch Y.*, Golany B., Goldberg N., Rothblum U. Non Monotonicity in inspection games: modification of the Braess paradox
45. Canbolat P.*, Rothblum U. Constant Risk Aversion in Stochastic Contests with Exponential Completion Times
46. Golany B., Kress M.*, Penn M., Rothblum U. Network Optimization Models for Resource Allocation in Developing Military Countermeasures

M2 [*Parallel Session S2*]: Session in honor of Adam Shefi *Chair: Israel David* [Invited]

47. Altman Y.* Contributions of Adam Shefi to Ballistics at the IDF.
48. Feldman I.* Contributions of Adam Shefi to War Gaming at the IDF.
49. Shefi A.* Is nature elegant?

M3 [*Parallel Session S3*]: *Chair: Israel David* [Invited]

50. David I.* Simple Approximations to Submunition Trajectories, Gliding and Sky-diving.
51. Kress M., Talmor I.* A New Look at the 3:1 Rule of Combat through Markov Stochastic Lanchester Models
52. David I., Eben-Chaime M.* Approximate Explicit Formulas for the Required Sample Size to Estimate Dispersion.

M4 [*Parallel Session S4*]: *Chair: Irit Talmor*

53. Laufer A.* Optimization of Spare Parts Allocation by Hybrid Monte Carlo – Analytic Approach and its Implementation to Iron Dome system
54. Korabelnikov M.* Analysis of Communication Network Performance Using Monte Carlo Simulation

M5 [*Parallel Session M2*]: *Chair: Stas Khoroshevsky*

55. Levav B.* On the Vulnerability of Infantry Soldiers
56. Boni O.*, Fournier F., Mashkif N., Naveh Y., Sela A., Shani U., Lando Z., Modai A. Utilizing Constraint Programming for Complex Systems Engineering
57. Khoroshevsky S.* Optimal Spare Parts Allocation for Complex Military Systems subject to Performance and Budget Constraints using Monte Carlo Simulation

Prize Winners [*Parallel Session M4*]: *Chair: Yale Herer*

58. Buchbinder N.* A Primal-Dual Approach to Online Optimization Problems
59. Avrahami A.* Value of perfect and imperfect information in a multi-location inventory system

Queuing

Q1 [*Parallel Session S2*]: Tandem and Retrial Queues *Chair: Iddo Eliazar* [Invited]

60. Yechiali U.*, Reed J. Queues in tandem with customer deadlines and retrials.
61. Reuveni S*, Eliazar I., Yechiali U. The asymmetric inclusion process: A showcase of complexity.
62. Eliazar I.*, Reuveni S., Yechiali U. Limit laws in the asymmetric inclusion process.

Q2 [*Parallel Session S3*]: Polling Systems and Alternating Servers *Chair: Nir Perel* [Invited]

63. Avissar O.*, Yechiali U. Polling systems with two alternating weary servers.
64. Perel E.*, Yechiali U. Two finite-buffer queues with alternating server.
65. Perel N.*, Vlasiou M., Yechiali U. Cyclic-type polling models with preparation times.

Q3 [*Parallel Session M1*]: Optimal Arrival, Stay or Switch, and Separate Orbit Queues *Chair: Uri Yechiali* [Invited]

66. Boosi R.*, Shaki Y. Optimal and equilibrium arrival in a single server queue, in the presence of travel costs.
67. Roet-Green R.*, Hassin R. Stay or switch: Information acquisition in a two-queue system.
68. Yechiali U.*, Avrachenkov K., Nain P. A service system with two input stream, common buffer and separate orbit queues

Q4 [*Parallel Session M2*]: Queuing Theory and its Applications *Chair: Yair Shaki* [Invited]

69. Kerner Y.*, Afeche P., Baron O. Pricing Time-Sensitive Services Based on Realized Performance
70. Haviv M.*, Randhawa R.S. Pricing in queues without demand information
71. Haviv M., Shaki Y.* Deterministic retrial rate for an M/M/1 queueing system with retrials

Q5 [*Parallel Session M3*]: *Chair: Rachel Ravid*

72. Raz D.*, Katan S. A Fairness Oriented Fuzzy Logic Queueing Policy
73. Haviv M., Ravner L.* Equilibrium and Optimal Arrival to a Loss System
74. Ravid R.*, Boxma O., Perry D. Sojourn Times in the Longest Queue System with Exchangeable Items

Scheduling [*Parallel Session S1*]: *Chair: Dvir Shabtay* [Invited]

75. Gerstl E.*, Mosheiov G. Due-window assignment with lead-time cost
76. Mor B.*, Mosheiov G. Due-date assignment problems with common flow-allowance
77. Karhi S.*, Shabtay D. On the Optimality of the TLS Algorithm for Solving Online Scheduling Problems on Multipurpose Machines.

Supply Chain Management

SCM1 [*Parallel Session S1*]: *Chair: Michal Tzur* [Invited]

78. Gerchak Y.*, Schwarz G. Coordination with Multiple Retailers and Non-Linear Production Costs
79. Noham R.*, Tzur M. The Single and Multi-Item Transshipment Problem with Fixed Transshipment Costs
80. Bendavid I.*, Herer Y., Yücesan E. Inventory Management under Working Capital Constraints

SCM2 [*Parallel Session S4*]: *Chair: Yigal Gerchak*

81. Gonen A.* Selecting Optimal Response to Project Risks
82. Kalikhman D.*, Gerchak Y. Inventory Sharing via Circular Chaining

Transportation Science

TS1 [*Parallel Session S1*]: *Chair: Tal Raviv* [Invited]

83. Freund S.*, Bar-Gera H. Optimization Framework for Travel Pattern Interpretation of Cellular Data
84. Adler N.*, Pita J. Welfare-based Schedule Design and Fleet Assignment with an Application to a Norwegian Network
85. Pesach D., Raviv T.*, Tzur M. Dynamic Repositioning in Bike Sharing Systems

TS2 [*Parallel Session S2*]: *Chair: Hillel Bar-Gera* [Invited]

86. Blumberg Nitzani M.*, Bar-Gera H. Solution Stability of Dynamic Traffic Assignment with Traffic Signals
87. Penn M., Strichman O., Drucker N.* Cyclic Routing of Unmanned Air Vehicles.
88. Eichler D., Bar-Gera H.*, Blachman M. Vortex-Based Zero-Conflict Design of Urban Road Networks

Water Management [*Parallel Session M1*]: *Chair: Gideon Oron* [Invited]

89. Cohen A.*, Jan S., Oron G. Restoration of the Dead-Sea: Selecting Optimal Alternative by Implementing the Analytic Hierarchy Process
90. Bick A.*, Rockman J., Oron G., Raveh A., Kenig S. Conceptual maps of professional training for the design, operating and managing staff of desalination plants: Core courses and educational programs
91. Kalson P.A., Prigan I., Nissimpor D., Oron G., Bick A.* Sustainable industrial water management through membrane processes- the case of Rutenberg power plant

BOOK OF ABSTRACTS (GROUPED BY SESSIONS)

Sunday: Session S1

Military OR 1 (שקד 1)

Ron Rothblum and Moshe Haviv will first talk about Uriel Rothblum, ex-president of ORSIS, who passed away unexpectedly in March.

Deutsch Y.*, Golany B., Goldberg N., Rothblum U. Non Monotonicity in inspection games: modification of the Braess paradox

We address an inspection game between an inspector and a violator, where there are multiple sites in which they can act. Both players decide on the allocation of their limited resources towards inspecting/violating these sites. In addition to the resource availability, the inspector is subject to upper bounds on the quantity of resource s/he can allocate to individual sites. For this two-person non-zero-sum game, we provide explicit representation of all Nash equilibrium allocations and payoffs together with an efficient method to compute them. We then analyze the sensitivity of these allocations and payoffs to changes in the quantity of resource available to the inspector and demonstrate the existence of non-monotonicity in the inspector's payoff.

Canbolat P.*, Rothblum U. Constant Risk Aversion in Stochastic Contests with Exponential Completion Times

Motivated by resources allocation problems in military conflicts and homeland security, we study of a class of games with several players that compete over the completion of a task. The player that completes the task first earns a reward while the remaining players earn nothing. The players' actions are the amounts of effort that they invest in completing the task. The completion time of the task for a particular player is a random variable having exponential distribution with rate linear in its own action and the completion times of different players are stochastically independent. We prove that there exists a unique Nash equilibrium when the contest involves at least two players and each player has risk-averse exponential utility. We provide explicit representations of equilibrium investments and utilities together with an efficient method to compute them. Based on these expressions, we conduct sensitivity analysis with respect to the degree of risk aversion. We also provide an approximate Nash equilibrium for the one-player contest and an approximately optimal solution for a centralized version of the contest.

Golany B., Kress M.*, Penn M., Rothblum U. Network Optimization Models for Resource Allocation in Developing Military Countermeasures

A military arms race is characterized by an iterative development of measures and countermeasures. An attacker attempts to introduce new weapons in order to gain some advantage, whereas a defender attempts to develop countermeasures that can mitigate or even eliminate the effects of the weapons. This paper addresses the defender's decision problem: given limited resources, which countermeasures should be developed and how much should be invested in their development so as to minimize the damage caused by the attacker's weapons over a certain time horizon. We formulate several optimization models, corresponding to different operational settings, as constrained shortest path problems and variants thereof. We then demonstrate the potential applicability and robustness of this approach with respect to various scenarios.

Scheduling (שקד 2)

Gerstl E.*, Mosheiov G. Due-window assignment with lead-time cost

A classical due-date assignment technique, known in the literature as DIF, consists of assigning job-dependent due-dates based on acceptable lead-times. In this paper we extend this model to a more general setting, where a lower bound on the interval of acceptable lead times is assumed as well. Thus, the total cost function contains earliness/tardiness of the due-dates (if assigned outside a given interval of acceptable lead times), and the earliness/tardiness of the jobs (related to their assigned due-dates). The problem is shown to be NP-hard, and an efficient pseudo-polynomial dynamic programming algorithm is introduced and tested.

Mor B.*, Mosheiov G. Due-date assignment problems with common flow-allowance

We study a due-date assignment problems with a common flow-allowance. The scheduler has the option to perform a maintenance activity which is rate modifying, i.e., it improves the processing times of the following jobs. We consider a number of versions of this setting, including the case that the maintenance duration is position-dependent, and the job processing times are position-dependent. We also study the minmax version of the problem.

Karhi S.*, Shabtay D. On the Optimality of the TLS Algorithm for Solving Online Scheduling Problems on Multipurpose Machines.

We study the optimality of the TLS algorithm for solving the online scheduling problem of minimizing the makespan on a set of m multipurpose machines, where there are two different job types and each job type can only be processed on a unique subset of machines. The literature shows that the TLS algorithm is optimal for the special case where

m=2. We show that the TLS algorithm is optimal also for the special cases where (i) all processing times are restricted to unity (ii) the job processing times are job type dependent (and machine independent) and (iii) the job processing times are machine set dependent and job type independent. For all three cases, the optimality of the TLS algorithm is proven by showing that its competitive ratio matches the lower bound for any processing set and processing time parameters.

Transportation Science 1 (שקד 3)

Freund S.*, Bar-Gera H. Optimization Framework for Travel Pattern Interpretation of Cellular Data

Collection of travel data by traditional survey methods is costly, thus limiting the amount of data being collected, as well as their frequency and coverage. Recent technologies offer new types of data collection options. In particular, cellular systems generate substantial amounts of data, including records regarding the connection between handsets (phones) and base stations (antenna). These records, collected by cellular service providers for various internal purposes, may provide an excellent source of information regarding travel, with several critical advantages relative to traditional travel surveys: low cost, large sample, long duration, and high response rate. Cellular data has some limitations too, particularly with respect to accuracy and traveler identity; therefore, such data cannot provide a complete replacement for traditional surveys, but it can complement and enhance them. This paper explores methods for identifying travel patterns from cellular data. A primary challenge in this research is to provide an interpretation of the raw data that distinguishes between activity durations and travel durations. A novel framework is proposed for this purpose, based on a grading scheme for candidate interpretations of the raw data. A genetic algorithm is used to find interpretations with high grades, which are considered as the most reasonable ones. The proposed method is tested on a dataset of records covering 9454 cell-phone users over a period of one week. Preliminary evaluation of the resulting interpretations is presented.

Adler N.*, Pita J. Welfare-based Schedule Design and Fleet Assignment with an Application to a Norwegian Network

We present an approach which evaluates the social welfare of an air transportation network run under public support systems, such as the Public Service Obligation in Europe or the Essential Air Service in the U.S. Such a framework may prove valuable to governments responsible for designing public support systems, whose objective is to increase accessibility to sparsely populated regions yet minimize public expenditure over the air transport network. Our approach is based on a welfare based integrated flight schedule and fleet assignment optimization model (WFSFA) which determines the network configuration that minimizes the social costs of the network. From the results of the optimization model we calculate the social welfare of the air transportation network, distinguishing between passenger, airline and government surpluses. Airport surplus are included in the government surplus, as most of the local and regional airports are publicly owned. We apply the formulation to the Norwegian PSO network, which is the largest in Europe, and identify the social welfare improvements attainable under this analysis as compared to the current equilibria outcome.

Pesach D., Raviv T.*, Tzur M. Dynamic Repositioning in Bike Sharing Systems

Dynamic repositioning in a bike sharing system is the problem of routing trucks and deciding on the quantities of bicycles to load/unload at the stations to ensure availability of bicycles and vacant lockers to the users of the system. The repositioning operation should be carried out while the system faces fluctuating demand for bicycles and for vacant lockers, as its state continuously changes. In addition, the forecasted demand should be considered. We developed several heuristics for the problem, which can be viewed as dispatching rules, at varying levels of sophistication. We then represent a deterministic version of the problem by a mathematical programming formulation, which is an extension of the formulation suggested for the static case. The latter refers to the case in which no demand occurs during the repositioning operation. A rolling horizon approach is used to apply the solution of the mathematical problem, while adjusting it to the real state of the system when implementing it. The mathematical programming formulation was further enhanced based on considerations designed to reduce the solution time and adapt it to a real time environment. The devised methods were tested with real data from the bike sharing system in Tel Aviv. We demonstrate the opportunity to improve the service level significantly using the same repositioning resources, compared to the current situation where the repositioning decisions are made manually by the dispatchers. The mathematical programming based heuristic appears to outperform all the other devised methods.

Supply Chain Management 1 (אתרוג)

Gerchak Y.*, Schwarz G. Coordination with Multiple Retailers and Non-Linear Production Costs

Operations Management models typically assume that the production costs are proportional to the amount produced. One consequence of that assumption is that a (wholesale) price only contract is impractical since the only coordinated solution will leave the supplier with zero profit. But in the Production Economics Literature, production costs are typically non-linear, and, indeed, the marginal costs are usually assumed to be increasing in the relevant range. When a supplier with non-linear costs sells to multiple retailers, the model is no longer separable by retailer, as non-linear costs create cost, and thus operational, dependencies. We thus wish to incorporate non-linear production costs into supply chains with multiple retailers which differ in their demand distributions and retail prices, whether exogeneous or endogeneous. As a baseline, we start by analyzing a two-retailers centralized system. For general production costs function and demand distribution, we derive the optimality conditions and perform comparative statics with respect to prices. We then provide additional insights by specializing the production costs to a power function (e.g., quadratic). We then consider a one-retailer price-setting firm for both additive and multiplicative demand uncertainty, and extend it to two retailers. We then explore decentralized systems with wholesale price

contracts, one allowing price discrimination and one that does not. Subsequently, we generalize the decentralized models to allow retailers to set prices. We also consider competing retailers that constitute a Cournot duopoly.

Noham R.*, Tzur M. The Single and Multi-Item Transshipment Problem with Fixed Transshipment Costs

Our study deals with inventory systems in which lateral transshipments are allowed. For a system with two-retailers facing stochastic demand, we relax the assumption of negligible fixed transshipment costs, thus extending existing results for the single item case and introducing a new model with multi items. The goal is to determine optimal transshipment and replenishment policies, such that the total centralized expected profit of both retailers is maximized. We first formulate the single-item problem with fixed transshipment costs, analyze the expected system profit function and find the optimal policy. We show that in general, the expected profit function is not concave, however we prove concavity for several special cases. A numerical study examined the influence of the fixed transshipment costs on the expected system profit and on the system behavior. We extend our analysis to a problem with multi-items with a joint fixed transshipment cost, which has not been investigated in the literature. For two items we show how the optimality conditions may be extended. Then we generalize our model to consider any number of items. Due to the complexity involved, we suggest a simple heuristic to solve the problem, which is based on the single item results, and show that it performs very well.

Bendavid I.*, Herer Y., Yücesan E. Inventory Management under Working Capital Constraints

The objective of inventory management models is to determine effective policies for managing the trade-off between customer satisfaction and the cost of service. Over the years, these models have become increasingly sophisticated, incorporating many complicating factors that are relevant in practice such as demand uncertainty, finite supplier capacity, and yield losses. Curiously absent from these models are the financial constraints imposed by working capital requirements (WCR). In practice, however, many firms are self-financing, i.e., their ability to replenish their own inventories is directly affected not only by their current inventory levels, but also by their receivables and payables. Such constraints have gained added significance during the persistent economic crisis, which made external financing increasingly difficult to secure. In this paper, we analyze the materials management practices of a self-financing firm whose replenishment decisions are constrained by cash flows, which are updated periodically following purchases and sales in each period. In particular, we investigate the interaction between the financial and operational parameters as well as the impact of WCR constraints on the long-run average cost.

Sunday: Session S2

Military OR 2 (1 שקד)

Altman Y.* Contributions of Adam Shefi to Ballistics at the IDF.

This talk will portray a few ballistics problems whose solutions by Adam Shefi were original in this science as a whole. In particular, we discuss the ingenious flat-fire model, and the means developed to compute safety distances. We describe the widespread use of these models over the years, some of them are extant to date(!). In the presentation we try to emphasize the elegance and simplicity characteristics of the ballistics solutions.

Feldman I.* Contributions of Adam Shefi to War Gaming at the IDF.

The talk presents the background to computerized war gaming at the IDF, and highlights Adam as a pioneer in this field, internationally. We discuss the prototypical failure points of computerized war gaming which Adam had detected, and his contribution to an appropriate model that was developed as a result, a model which is unique to the IDF. The notion of a Decay Model will be explained as a key notion for "reward and punishment" mechanism in all sub-models of the current training IDF war simulator. Finally, the contribution of Adam to the Artillery module of the current IDF war simulators will be touched.

Shefi A.* Is Nature Elegant?

Operations Research has known some path-breaking models which are based on aesthetic considerations and structural elegance. In this talk, a number of these models will be reviewed. We shall portray and analyze the circumstances that forced such considerations on these models, as well as on their results. The general question regarding the validity of the aesthetic factor in building an OR model will be discussed.

Queuing 1 (2 שקד)

Yechiali U.*, Reed J. Queues in tandem with customer deadlines and retrials.

We consider a system comprised of two Markovian queues in tandem, where the first queue has an un-limited buffer capacity while the second has a finite capacity. Each arriving job carries with it a time deadline such that, if its processing at the first queue does not start by the time its deadline expires, the job is fed back to the end of the queue. Upon its service completion at the first queue, the job proceeds to the second queue. If it is blocked there, because the buffer is full, the job is fed back to the end of the first queue. Same applies if the job is admitted to the second queue but its waiting time there exceeds its deadline. We apply both Probability Generating Function (PGF) approach, as well as Matrix Geometric analysis, obtain the condition for stability of the system and give it an intuitive interpretation. Based on this interpretation we consider a more general 2-queue system with general arrival and service processes and apply diffusion approximation to obtain the stability condition of the system.

Reuveni S*, Eliazar I., Yechiali U. The asymmetric inclusion process: A showcase of complexity.

The Asymmetric Inclusion Process (ASIP) was recently introduced [1] as a model of queues in tandem with unlimited batch service. That is, when service is completed at queue k, all particles present at that queue move simultaneously to queue k+1. In this talk we will briefly review the model and some analytic results before moving on to demonstrate that the ASIP is a showcase of complexity. Combining together probabilistic and Monte-Carlo analyses, we shall delineate the ASIP's rich statistical complexity, which ranges from 'mild' to 'wild' displays of randomness: (i) Gaussian load (total number of particles in the system); (ii) Gaussian draining time (elapsed time from an arbitrary moment when the arrival stream stops until the first moment the system becomes empty); (iii) Rayleigh outflow with linear aging; (iv) Inverse-Gaussian particle coalescence in the circular ASIP (elapsed time from an initial moment in which all sites are occupied to the first moment in which all particles have coalesced to a single site); (v) intrinsic power-law scaling of occupation probabilities and power-law occupancy fluctuations. [1] S. Reuveni , I. Eliazar and U. Yechiali, Asymmetric Inclusion Process. Physical Review E 84, 041101 pp. 1-16 (2011).

Eliazar I.*, Reuveni S., Yechiali U. Limit laws in the asymmetric inclusion process.

The Asymmetric Inclusion Process (ASIP) was recently introduced [1] as a model of queues in tandem with unlimited batch service. That is, when service is completed at queue k, all particles present at that queue move simultaneously to queue k+1. In this talk we consider the stochastic asymptotic behavior of the ASIP model in three different limiting regimes: (i) heavy-traffic limit – in which the particles' arrival rate tends to infinity; (ii) large-system limit – in which the system size (i.e., the number of tandem queues) tends to infinity; (iii) balanced-system limit – in which both the system size and the service rate of each queue tend to infinity, while keeping the ratio between the two fixed. For each of the abovementioned limiting regimes we establish limit laws regarding the probability distributions of the following key observables: (i) traversal time – the time it takes a particle to traverse the system; (ii) load – the total number of particles in the system (in steady state); (iii) busy period – the time elapsing from the instant a particle arrives at an empty system, till the first instant the system is empty once again; (iv) first non-empty queue – the position of the first non-empty queue; (v) draining time – the elapsed time from an arbitrary instant at which the arrival stream is stopped (in steady state), till the first instant the system empties. Our results apply for ASIP systems with both homogeneous and heterogeneous queues' service rates. [1] S. Reuveni , I. Eliazar and U. Yechiali, Asymmetric Inclusion Process. Physical Review E 84, 041101 pp. 1-16 (2011).

Transportation Science 2 (שקד 3)

Blumberg Nitzani M.*, Bar-Gera H. Solution Stability of Dynamic Traffic Assignment with Traffic Signals

This paper examines a continuous-flow analytic dynamic traffic assignment (DTA) model with consideration of uncoordinated traffic signals. The dynamic network loading component of the DTA model relies on trajectories and anticipated arrival order to nodes in order to achieve consistency between flow propagation along routes and kinematic waves (physical queue) representation of single link traffic behavior. We compare results between a model where random queues are captured by non-stationary cycle-to-cycle Markov chains, and a model where only exit capacity effects of traffic signals are considered. Numerical examples illustrate that overall the model with Markov chains behaves properly, and captures interesting impacts of random queuing traffic signal delays on route choice and network level DTA solutions. A particular focus of this paper is the issue of solution stability and its relationship to model specification and discretization. We discuss the connection between DTA models and general finite element models in this respect, particularly regarding lag options in the discrete form of the equilibrium condition. Our results regarding these options, known as "forward" vs. "backward" Euler method, or as "reactive" vs. "predictive" user-equilibrium, confirm previous findings. In addition, the results show that the model specification with Markov chain representation of traffic signals enhances solution instability, and exhibits spurious oscillations even if backward Euler method is used. The results suggest that longer route choice intervals reduce oscillations, contrary to the typical behavior in finite element models where stability generally improves when the resolution is refined.

Penn M., Strichman O., Drucker N.* Cyclic Routing of Unmanned Air Vehicles.

Developing monitoring systems and cameras for Unmanned Aerial Vehicles (UAVs), which facilitate scanning and monitoring targets of interest on the ground is of growing interest in security and defense organizations. In most cases the routing of each UAV is done in real time by a ground operator. Automating the process, while supporting complex tasks that include multiple targets, is of much importance. The expected scenario is one in which one or more UAVs monitor multiple distant predefined targets. Since in most cases, unlike combat-time activation, there is no need to deviate from the preplanned route, and manual planning of the routes is not likely to result in optimal routes and minimal UAVs in the air, automating the process is needed. We will define the Cyclic Routing UAVs problem, we will explore its characteristics and will suggest three different methods and technologies for solving it:

- Using Timed Automata (based on UPPAAL)
- Using SMT formulation of the problem.
- Using an explicit clock based model.

We will compare the different methods and demonstrate its numerical results.

Eichler D., Bar-Gera H.*, Blachman M. Vortex-Based Zero-Conflict Design of Urban Road Networks

A novel approach is suggested for reducing traffic conflicts in at-grade (2D) urban networks. Intersections without primary vehicular conflicts are defined as zero traffic conflict (ZTC) designs. Complete classification of maximal ZTC designs is presented, including designs that combine driving on the right side in some streets and driving on the left side in other streets. It is shown that there are 9 four-way and 3 three-way maximal ZTC intersection designs, to within mirror, rotation, and arrow reversal symmetry.

Vortices are used to design networks where all or most intersections are ZTC. Increases in average travel distance, relative to unrestricted intersecting flow, are explicitly calculated for grid-networks of sizes 10 by 10, 10 by 20 and 20 by 20 nodes with evenly distributed origins and destinations. The exact increases depend primarily on various short-range conditions, such as the access to the network. The average distance increase in most cases examined is up to four blocks. These results suggest that there is a potential for the new designs to be relevant candidates in certain circumstances, and that further study of them is worthwhile.

Game Theory 1 (אתרוג)

Granot D., Hanany E.* Subgame Perfect Consistent Stability

Farsighted game theoretic solution concepts have been shown to provide insightful results in many applications. However, we provide simple examples demonstrating that the existing solution concepts are not sufficiently farsighted, and in this paper we propose a new farsighted solution concept, the Subgame Perfect Consistent Set (SPCS). Based on von Neumann Morgenstern type stability and subgame perfect equilibrium, this solution is shown to lead to more satisfactory predictions in many situations as compared to existing myopic or farsighted solution concepts. Strikingly, the SPCS is shown to always achieve Pareto efficiency in farsighted normal form games. This result is demonstrated in various competitive settings, and is shown to imply, for example, that in contrast with existing farsighted solution concepts, players who follow the SPCS reasoning are always able to share the monopolistic profit in Bertrand and Cournot competition settings, and are always able to achieve coordination and Pareto efficiency in decentralized supply chain settings, even when they are unable to form coalitions.

Segev E.*, Sela A. Multi-Stage Sequential All-Pay Auctions

We study multi-stage sequential all-pay contests (auctions) where heterogeneous contestants are privately informed about a parameter (ability) that affects their cost of effort. In each stage a new contestant joins. He observes the efforts of all the contestants in the previous periods and then exerts an effort. He wins if his effort is larger than or equal to the efforts of all the contestants in the previous periods and strictly larger than the efforts of all the contestants in the following periods. We characterize the sub-game perfect equilibrium of these multi-stage sequential all-pay contests and analyze the effect of the number of contestants, their types, and their order on the expected highest effort.

Anily S.*, Haviv M. Capacity sharing: capacity or labor division? A cooperative game approach

In this talk we discuss two types of capacity sharing approaches to model various service/production systems as cooperative games with transferrable utility, and we analyze their core. The literature on cooperative games usually assumes that total capacity is divisible and allocable additively. This premise is reasonable in some settings, but in others it may yield unacceptable solutions. We suggest another approach, which is aligned with the concept of division of labor, where total processing time, rather than total capacity over all resources, is allocated additively.

Sunday: Session S3

Military OR 3 (1 שקד)

David I.* Simple Approximations to Submunition Trajectories, Gliding and Sky-diving.

New analytical formulas are presented to approximate trajectories of artillery sub-munitions. If one point in this trajectory, beside the initial (ejection) point is given – an excellent accuracy is attained. Otherwise, the model uses the basic drag features of the sub-munition, and makes an appropriate weighting between candidate approximations.

Kress M., Talmor I.* A New Look at the 3:1 Rule of Combat through Markov Stochastic Lanchester Models

The 3:1 rule of combat states that in order that for the attacker to win the battle, his forces should be at least three times the force of the defender. This somewhat vague statement has resulted in numerous interpretations and discussions from historical and military science points of view. In this paper we attempt to examine this rule by utilizing a number of Markov Stochastic Lanchester models that correspond to various basic combat situations and to draw some conclusions from their implementations. We identify general combat situations where the 3:1 rule is reasonable as well as situations where the force ratio should be either smaller or larger. Since the analysis is performed in the formal and somewhat `sterile' setting of (pure) mathematical modeling, the results should be appropriately interpreted as reasoning of a certain abstraction of the battlefield.

David I., Eben-Chaime M.* Two explicit formulas for the required sample-size in estimating dispersion of a normal population

All the numerous introductory statistics books deal with the computation of the required sample size when establishing a confidence interval for the mean. Generally, however, the same books avoid this issue when establishing a confidence interval for the dispersion – the standard deviation. The reason for this avoidance is computational difficulty. Some references present tables or graphic tools for this purpose. In this talk, two explicit approximate formulas are presented for the required sample-size in estimating the standard-deviation of a normal population, based on two known approximation of the $\chi 2$ distribution. Surprisingly, while the calculations involved are elementary and rather straightforward, the accuracy of the outcome is very high – the required sample sizes are the same or very close to the accurate numbers found by search methods.

Queuing 2 (2 שקד)

Avissar O.*, Yechiali U. Polling systems with two alternating weary servers.

We introduce and study cyclic polling systems in which service times of customers increase after the completion of

each cycle due to increased tiredness of the server. To prevent the system from exploding, the server must be deactivated to regain (some or all of) its efficiency while another server takes its place. Performing a "change of guard" takes some additional random time. This requires the determination of a "swapping policy" between the two servers. We model such systems under the gated, exhaustive and globally-gated service regimes. In the case of swapping policies which call for a swap at the end of every fixed number of cycles, we show that contrary to classical polling systems, the stability condition for the exhaustive regime differs from its counterpart for the gated regime. A single queue case with identical servers is further studied and analyzed. Assuming stability, we show that in the latter case, the maximal number of consecutive cycles a server can serve without resting under the gated regime is approximately double than under the exhaustive regime. In addition, we construct an algorithm to obtain an optimal swapping policy for the case where two identical servers alternate every fixed number of cycles in a system operating under the exhaustive service regime.

Perel E.*, Yechiali U. Two finite-buffer queues with alternating server.

We study a system with two non-identical and separate finite-buffer M/M/1 queues served by a single server. If the server attends Q1 (respectively, Q2) and the number of customers L2 (respectively, L1) in the other queue reaches the buffer size N (respectively, K) the server immediately switches to Q2 (Q1). If at a called-for switching moment from Q1 (Q2) to Q2 (Q1) the number of customers in Q1 (Q2) is still L1 = K (respectively, L2 = N), the server remains in Q1 (Q2) until the first moment thereafter when L1 (L2) reduces to K-1 (N-1). We present a probabilistic analysis of this system and investigate the effects of the buffer sizes and the arrival (or service) rates on the system's performance.

Perel N.*, Vlasiou M., Yechiali U. Cyclic-type polling models with preparation times.

We consider a queueing system involving N service stations and a single server visiting the stations in a cyclic order. At any time, only one customer can be served in a station. However, each customer needs to go through a preparation process before being ready for the service. This preparation process starts immediately as the customer enters the service station, and it does not require the server's attendance. We assume that whenever service in station i is completed and the server moves on to the next station (station i+1 (Module N)), a new customer enters station i (i=1,2,…,n) and immediately starts the preparation process. After completion at station i, service by the server is delayed at station i+1 only if the customer there has not finished his preparation. Our goal is to analyze the time-dependant, as well as the long-run, probabilistic behavior of this system. We form a Markov chain that describes, for each room, whether the preparation process ended there or not. Under the assumption that preparation times are Exponentially distributed, we calculate the one-step transition probability matrix of the process. For the case with N=3 stations we calculate the covariance function between two different waiting times of the server, and the cycle length (the time between 2 successive zero-waiting times of the server).

Data Envelopment Analysis (שקד 3)

Sinuany-Stern Z.*, Kristal N., Shachak H., Chernichovsky D., Friedman L. Hospital's Efficiency in Israel over time

This study examines the relative efficiency of general hospitals in Israel using "Data Envelopment Analysis" (DEA). DEA measures the efficiency utilizing the ratio between the weighted output and the weighted input of each hospital. In our case, the inputs are number of standard beds, and the outputs are: number of hospitalization days and number of discharges. The calculation of the efficiency is based on linear programming. 21 hospitals were selected for this research, over the period 1999-2009 (utilizing Malmquist analysis). In the second phase, we have used linear regression,- Hospitals' efficiency was examined as a function of size, and type of ownership. The group of efficient hospitals consists of: "Hadassah – Har Hatzofim", "Rambam", "Shaare Zedek", "Laniado" and partially "Sheba". Hospitals tend to keep their relative efficiency rank throughout the period of the study. The relatively efficient Hospitalization categories were: Internal Medicine and Surgery at "Soraski", Intensive Care at "Hagalil Hamaaravi", Pediatrics at "Rabin-Belinson" and Day Care at "Rambam". Relatively, efficient hospitals are not necessarily efficient in all hospitalization categories, but often tend to belong to the efficient group in a certain category. In contrast, most of the inefficient hospitals tend to be inefficient in all terms of hospitalization category. General efficiency of hospitals was highly correlated with the categories "Day Care" and "Intensive Care", and less correlated (sometimes up to negative relation) with the category "Internal Medicine". An evidence of return to scale was found in hospitals. In addition, a connection was found between the type of ownership and the general efficiency of the hospital in a way that the most efficient hospitals are the independent hospitals, followed by the governmental hospitals and the GHS hospitals, as expected.

Adler N.*, Martini G., Volta N. Moving towards a greener fleet: A DEA estimation of the aircraft environmental production frontier

Like most transportation modes, aviation contributes to the environmental pollution at various levels. Two of the most important negative externalities generated from aviation include noise nuisance and aircraft engine emissions. Of these two, noise has the largest impact on the community surrounding airports, while engine emissions have both local and global impacts. In spite of this, there has been no attempt to date to analyse the aircraft engine combinations given the current state of aeronautical technology. This paper applies a DEA directional distance profit function to a data set consisting of current engine aircraft combinations. The objective is to analyze the aircraft market from the perspective of airlines, government agencies and the environment in order to establish an environmental and operational efficient frontier. The results of the DEA models are then applied in order to substitute the fleets flown at Schipol, Amsterdam and Arlanda, Stockholm airports in June 2010 with the benchmark aircraft. Thus, we analyze the necessary incentive schemes that will encourage airlines to choose a fleet that is both profitable and environmentally aware. Furthermore, this research identifies the trade-off among pollutants and noise for the aircraft and engine

manufacturers involved in developing new aircraft combinations.

Adler N., Ulku T., Yazhemsky E.* Benchmarking the implementation path to efficiency: The case of small regional airports

Small and regional airports suffer from limited traffic, large fixed facilities and insufficient revenues to cover their costs. The question is how these airports should be structured, managed and financially supported in order to survive. Efficient operations contribute to decreasing the financial dependency of airports on subsidies. According to a DEA-based, bound adjusted measure, the efficiency levels of 89 European airports are determined. Due to heterogeneity across the sample, multiple ideal points are applied to identify implementation paths and to highlight managerial best practices.

Game Theory 2 (אתרוג)

Fibich G., Gavious A.*, Solan E. The averaging principle

Mathematical modeling is a powerful tool in scientific research. Typically, the mathematical model is merely an approximation of the actual problem. Therefore, when choosing the model to work with, one has to strike a balance between complex models that are more realistic, and simpler models that are more amenable to analysis and simulations. This dilemma arises, for example, when the model contains a heterogeneous quantity. In such cases, a huge simplification is usually achieved by replacing the heterogeneous quantity with its average value. The natural question that arises is whether this approximation is ``legitimate'', i.e,. whether the error that is introduced by this approximation is sufficiently small. In this study we show that any outcome of a heterogeneous model that satisfies the two properties of differentiability and interchangibility, is $O(\varepsilon^2)$ equivalent to the outcome of the corresponding homogeneous model, in which the heterogeneous quantity is replaced with its average, where ε is the level of heterogeneity. Roughly speaking, the accuracy of replacing heterogeneous model with the symmetric model for a 10% heterogeneity level is $O(1\%)$. We then use this averaging principle to obtain new results in queuing theory, game theory (auctions), and social networks (marketing).

Gavious A.*, Minchuk Y. Revenue in Contests with Many Participants

We show that in a contest with many participants and a single prize, the expected effort (or resources) made by a participant whose evaluation of the prize is ranked as the κ^{th} highest valuation obeys an exponential rule in the limit and is equal to $1-2^{-\kappa}$ of the total expected effort made by all of the participants. Thus, even if the contest's organizer can recover only κ of the highest effort, the total losses caused in the limit by the lost efforts is $1-2^{-\kappa+1}$ of all of the efforts. We also extend our results to contests with μ prizes and with risk averse participants.

Amador S.*, Gavious A., Segev E. Analysis of Gender Differences in a Model of Multistage Bargaining

Whether men and women bargain differently is a timeless question. This paper aims to shed some light on this issue by experimentally testing the behavior of men and women in an incomplete information bargaining game. In our bargaining game the seller is the only one to make offers and the buyer can either accept or reject them. Similar to the model proposed by Sobel and Takahashi (1983), this model assumes the existence of asymmetric information with regards to the object's value for the buyer. Only the buyer knows his\her valuation of the object, while the seller knows only the distribution from which this valuation is drawn. We use a discrete distribution with three possible values. In order to validate the model and to examine the hypotheses about gender differences, two different experiments were designed. Both experiments took place in a computer lab, and simulated the bargaining described in the model. Unlike participants in the first experiment, those in the second one knew the gender of their opponent. The purpose was not only to examine whether women bargain differently than men, but also to examine whether knowing the gender of the opponent influences the bargainer's behavior. The results of the first experiment (in which the bargainers did not know the gender of their opponent) support the hypothesis that men bargain differently than women. On average men earned strictly more than women, but they had less patience than women. Women started out offering higher prices but lowered their prices much quicker than men. From the second experiment we learned that men were more cooperative when they knew that they are bargaining with a woman than when they knew they are bargaining with a man. They reached agreement faster when they bargained with women and they enjoyed greater profits. By comparing the two experiments we found that knowing the opponent's gender has a negative effect on men. On average this information arouses the competitive nature in men and causes them to become aggressive, uncooperative and ultimately to reach lower achievements. The same information has the opposite effect on women.

Sunday: Session S4

Military O.R. 4 (1 שקד)

Laufer A.* Optimization of Spare Parts Allocation by Hybrid Monte Carlo – Analytic Approach and its Implementation to Iron Dome system

The system's availability in Israeli Air Force (IAF) is an important measure of effectiveness and it depends, among others, on the spare parts quantities. The increase of the investment in spares always leads to the increase in system availability. However, in the real world there are budget constraints. For this reason IAF is interested to purchase the optimal number of spare parts that will achieve the required availability for minimal cost or to achieve maximal availability for a given budget constraint. IAF availability predictions are done using Monte Carlo (MC) simulation technique which is based on sampling of stochastic events. The advantage of the MC method is the ability to deal with complex systems or problems which are very hard or impossible to assess by analytical methods. Despite this, MC disadvantage is that it may require a large computational effort. This deficiency makes the MC simulation not

practical for the optimization purposes since a large number of calculations are required. The proposed solution for this problem is the Hybrid MC/Analytic method which utilizes the parameters derived from a small number of MC calculation in order to perform an analytical approximation of the system availability. The analytical approximation is then used to find the best spare part purchase strategy at each step which is validated by the next MC calculation. The process continues until the optimization criterion is reached (availability threshold or budget constraint). One of the most important systems in the IAF is the Iron Dome system. Iron Dome is a mobile air defense system designed to intercept and destroy short-range rockets and artillery shells fired from distances of 4 to 70 kilometers away whose trajectory would take them to a populated area. Iron Dome was declared operational and initially deployed on March 2011 near Beersheba. On 7 April 2011, the system successfully intercepted a Grad rocket launched from Gaza for the first time. There is no doubt that the system is critical to the security sense of the south population and reduces the personal and property damage. For this reason the system availability should be very high. The method for achieving this goal and increasing the availability at minimal cost is the Hybrid method as aforesaid.

Korabelnikov M.* Analysis of Communication Network Performance Using Monte Carlo Simulation

The increasing use of Monte Carlo (MC) simulation method for reliable analysis of systems in the fields of operations research, reliability engineering and logistics becomes a standard for complex military applications. In this paper we present a parametric study of a model that simulates an actual infrastructure of a computer network connecting multiple bases. The main objective of the analysis is to evaluate network performance, i.e. the probability of successfully initiating and finishing conversations at different stages of mission time, and its dependence upon various characteristics of system design, such as the physical structure of the network, failure and repair distributions of system components, and some maintenance aspects like inventory allocation efficiency and system logistic layout. A parametric study revealed some cases with intuitively unexpected results. Namely, increasing failure rates of system components led to an increase in the probability of successfully initiating new conversations. Further investigation of the phenomena led to several conclusions regarding the system design and insights regarding the robustness of system's performance measures.

Decision Theory (שקד 2)

Chernonog T.*, Avinadav T., Henig M. Price setting in a single selling period with various risk criteria

We consider a risk-sensitive monopolistic supplier who is facing a single period stochastic demand. The realized demand depends on the price determined by the supplier. It is assumed that supply is unlimited and marginal production cost is constant. It is desired to find the price that maximizes the expected utility of the profit. When the utility function is unknown we use other criteria for maximization: expected profit, probability of achieving a target profit, profit for given a percentile. We consider two specific forms of stochastic demand: multiplicative and additive. We prove that in the multiplicative form stochastic dominance exist so that the stochastic element does not affect the optimal price. Such dominance cannot exist in the additive form, so different criteria will yield different prices. In this case a non-dominated frontier can be calculated to aid the decision maker in selecting the preferred price.

Baliga S., Hanany E.*, Klibanoff P. Polarization and Ambiguity

We offer a theory of polarization as an optimal response to ambiguity. Suppose individual A's beliefs first-order stochastically dominate individual B's. They observe a common signal. They exhibit polarization if A's posterior dominates her prior and B's prior dominates her posterior. We show a sense in which polarization is impossible under Bayesian updating or after observing extreme signals. However, we also show that polarization after intermediate signals can arise from the efforts of ambiguity averse individuals to implement their optimal prediction strategies. We explore when polarization of this kind will occur and the logic underlying it.

Supply Chain Management 2 (שקד 3)

Gonen A.* Selecting Optimal Response to Project Risks

With the increase in project risk management usage, it is becoming increasingly more important to develop methods on how to select risks responses budgets among the possible mitigation, avoidance or transfer plans. Today, risk management plans usually rank the risks and recommend how to handle those with high rankings. Neither their response plan nor response feasibility are considered. Out of five possible response categories to an identified risk, only three require a significant budget investment. This study proposes three heuristic algorithms to select a good response plan under a budget constraint. In order to apply the heuristic algorithm, the savings ratio is defined as the amount of savings, in expected damage, per each unit of investment in the response. Examples with fifteen risks and three possible response plans per risk are demonstrated. This study proposes also an integer linear programming approach to budget allocation and demonstrates the budget constraint method, including sensitivity analysis to the risk budget. The most important lesson learned from the examples tested in the study is that the solution is mainly influenced by the response plan, and not only by the expected damage of the risk, as most of the ranking methods recommend. Moreover, it shows that ranking is not needed at all and risks should be handled through their response. The results contribute to defining rules about risk management budgeting and finding the optimal response plan for a given budget.

Kalikhman D.*, Gerchak Y. Inventory Sharing via Circular Chaining

The purpose of this study is to compare the performance of different "lean" configurations of lateral inventory sharing among retailers or warehouses located at the same echelon of a supply chain. Each retailer faces uncertain demand, and we wish to minimize procurement, shortage and transshipment costs. A circular chain is a configuration in which all retailers are connected in a closed loop, such that each retailer cooperates with exactly two others, either uni or bi-directionally, and a retailer who receives units from

one "neighbor" is not allowed to send any units to the other "neighbor". This "minimalistic" policy was inspired by the idea of limited manufacturing flexibility ("chaining") proposed by Jordan and Graves 1995. For unidirectional chaining, it turns out that if demands at all nodes are identically distributed and the unit costs are identical across nodes, the expected cost per node can be found by considering only two adjacent nodes at a time. The optimal stocking is solved analytically, and analytical Comparative Statics with respect to cost parameters and demand distributions are provided. In bidirectional chains, optimal transshipment for certain demand realizations is not obvious, and need to be found by solving a transportation problem. Thus the stocking and transshipment problem is a stochastic program with recourse. Due to the special structure, however, we provide a very simple method for finding the optimal transshipment. Problems with many nodes can be solved within seconds. A large computational study, with normally distributed demands, is conducted. We find by simulation the optimal order quantities and resulting expected costs of uni-directional chaining, bi-directional chaining and complete-pooling, and compare the optimal values found to those of no inventory pooling. Based on the numerical experiment, comparative statics are provided. Generally, bi-directional chaining is found to be very effective. Unidirectional chaining is found to be effective as well.

Combinatorial Optimization 1 (אתרוג)

Bodinger E.*, Elalouf A., Perlman Y. Dynamic repair priority for a transfer line with a finite buffer

We present a continuous-time Markov chain model of a transfer line in which there are two unreliable machines separated by a single finite buffer. Due to limited repair resources, simultaneous repairs are not possible in cases where both machines fail, and therefore a repair priority rule is defined according to the number of work-pieces present in the buffer. Each machine is characterized by three random variables: processing cycle time, time to failure, and time to repair; these random variables are exponentially distributed. We provide a stochastic model for finding an optimal repair priority rule and an efficient algorithm accompanied by easy-to-use Matlab software. Finally, an extensive numerical study is performed to test the sensitivity of the proposed dynamic repair priority rule.

Kricheli B.*, Levner E. Search and Detection of Clustered Failed Components in Unreliable Complex Systems

We consider a problem of plannming the search-and-detection activities in complex technological and organizational systems like large-scale transportation systems or supply chains in which a decision maker has to find failed, weak or risky groups of components linked by precedence relations. The objective is to minimize the expected losses or expected risk value. Given a chance to overlook the failures during the search process, the problem is formulated as a stochastic scheduling problem whose possible solution may be an indefinitely long sequence of components with repetitions. Using combinatorial techniques like generalized pairwise exchanges, fast on-line algorithms are developed. The optimality conditions are found that define when the local search procedure provides a global optimum. Practical examples of finding weak links in complex systems are provided.

Classic O.R. (ברוש)

Dreyfuss M.*, Posner M.J.M. Customer delay in an Exchangeable MB/G/∞ Repair System with Spares

We consider an MB/G/∞ exchangeable-item repair system with spares and ample servers to which arriving customers bring groups of random size B identical items for repair. An exact formula for the waiting time distribution and a computationally efficient approximation are presented for this system. Its solutions can be used for a one echelon system, but for multi-echelon systems as well where the waiting-time distribution obtained for any echelon k is used to calculate the repair-time distribution of lower echelon k-1, until the customer delay at level 1 is determined. Finally, some numerical examples are added to show the sensitivity of its various system parameters to variations in the number of spares for different forms of bulk size B.

Rubinstein R.*, Vaisman R. Fast splitting algorithm for networks reliability estimation

We show how the classic splitting method can be efficiently used for estimating static networks reliability. In our method we adopt Elperin, Gerstbakh and Lomonosov approach of replacing the original static model by an auxiliary dynamic one. The simulated sample performance (unreliability) of the auxiliary dynamic networks is obtained using the BFS (breath first search) algorithm. This sample is incorporated into the splitting method, which in turn uses an MCMC (Markov chain Monte Carlo) and in particular the Gibbs sampler. We show numerically that our splitting method is capable to estimate accurately networks reliability with the size of order of tens of thousands of edges and to the best of our knowledge it is the fastest so far method for static networks reliability.

Monday: Session M1

Algorithms 1 (שקד 1)

Shtern S.*, Ben-Tal A. Robust Optimization Approach for Tracking under Bounded Uncertainty

Classical dynamic control theory assumes that the system is inflicted with white noise and minimizes estimation mean square estimation error, usually by applying the Kalman filter (KF). In some applications, such as tracking, the assumption of white, unbounded noise is unrealistic. In these cases a worst case analysis, specifically the maximal error norm, might be a better measure of performance. In tracking applications ignoring worst case occurrences might have grave implications, since large errors decrease the probability of successfully tracking an object, especially in presence of clutter or when tracking multiple objects. In order to analyze the worst case scenario for a general dynamic control problem, given the filter, we need to solve a non-convex Quadratic Constrained Quadratic Problem. Since this problem is generally NP-hard we try to utilize the problem's block characteristics in order to find upper and lower bounds. We find these bounds through Semidefinite

Programming and Block-wise Optimal Ascent. We compared the KF results to a greedy worst case filter (UBK) and found that, in most cases, UBK indeed performs better in regard to worst case analysis.

Drori Y.*, Teboulle M. Performance of first-order methods for smooth convex minimization: a novel approach

We introduce a novel approach for analyzing the performance of first-order black-box optimization methods. Following the seminal work of Nemirovski and Yudin (1983) in the complexity analysis of convex optimization methods, we measure the computational cost based on the oracle model of optimization. Building on this model, our approach relies on the observation that by definition, the worst case behavior of a black-box optimization method is by itself an optimization problem, which we call the Performance Estimation Problem (PEP). We analyze the properties of the resulting PEP for various black-box first order schemes. This allows us to prove a new tight analytical bound for the classical gradient method, as well as to derive numerical bounds that can be efficiently computed for a broad class of first order schemes. Moreover, we derive an efficient procedure for finding step sizes which produces a first-order black-box method that achieves best performance.

Beck A.*, Eldar Y. Sparsity Constrained Nonlinear Optimization: Optimality Conditions and Algorithms

This talk treats the problem of minimizing a general continuously differentiable function subject to sparsity constraints. We present and analyze several different optimality criteria which are based on the notions of stationarity and coordinate-wise optimality. These conditions are then used to derive three numerical algorithms aimed at finding points satisfying the resulting optimality criteria: the iterative hard thresholding method and the greedy and partial sparse-simplex methods. The first algorithm is essentially a gradient projection method while the remaining two algorithms are of coordinate descent type. The theoretical convergence of these methods and their relations to the derived optimality conditions are studied. The algorithms and results are illustrated by several numerical examples.

Queuing 3 (שקד 2)

Boosi R.*, Shaki Y. Optimal and equilibrium arrival in a single server queue, in the presence of travel costs.

This work deals with another variation of the Naor's model (1969). The Naor's model considers control of an M/M/1 system. Naor shows how to deal with social welfare and individual welfare. Gilboa-Freedman, Hassin, Kerner show the behavior of Price of Anarchy (PoA) in the Naor's model as a function of the parameters ρ and the value of service. We relax an assumption in Naor's model (1969) and allow customers to appear on line segment which creates a linear entry cost, depending to the distance between a customer's location and the server. We consider social welfare and individual welfare and Price of Anarchy of this model.

Roet-Green R.*, Hassin R. Stay or switch: Information acquisition in a two-queue system.

When a customer makes an appointment at the doctor, calls the plumber or reserves flight tickets, he joins a queue. By making the reservation, the customer can learn where he is located in the service provider's queue. If the customer is unsatisfied with his location, he might consider calling an alternative service provider, to get a better position. In our model, the service is provided by N identical parallel servers. Upon arrival to the system, each customer chooses one server and inspects it. Then, he decides whether to join its queue, or inspect another queue. If he inspects another queue, he can join the shorter one, or continue his search and inspect another queue. We assume that each inspection is associated with a constant non-negative cost. The solution of this model is not straightforward, even when N=2, and is characterized by cascades. In equilibrium, there exist isolated queue lengths (holes) at which customers inspect the other queue, while in all other queue lengths customers join the first queue that they observed immediately, without inspecting the other queue.

Yechiali U.*, Avrachenkov K., Nain P. A service system with two input stream, common buffer and separate orbit queues

Two independent Poisson stream of jobs flow into a single-server service system having a common limited-buffer queue that can hold at most one job. If an arriving type-k job (k=1,2) finds the server busy, it is routed to a dedicated type-k retrial (orbit) queue that attempts to dispatch its jobs at a Poisson rate. This creates a system with three dependent queues. We study the system using probability generating functions leading to a two-dimensional functional equation which we examine and analyze.

Data Mining (שקד 3)

Sela A.*, Ben-Gal I.On Information Flow and Percolation Through Social Networks

We model and analyze information diffusion through human networks. The analysis indicates that, as known, nodes with higher rank are the most efficient in creating information percolation. Nevertheless, since these hubs are usually the more expensive to attract, assimilation of new ideas can be reached with a lower cost for by using nodes that are connected to highly-ranked nodes. Initial results from the model point toward a basic structure that is critical for the spreading of ideas in different conditions through social networks. Possible applications can be indicated in viral marketing and financial markets

Kaufman S.*, Rosset S., Perlich C., Stitleman O. Leakage in Data Mining: Formulation, Detection, and Avoidance

Deemed “one of the top ten data mining mistakes”, leakage is the introduction of information about the data mining target that should not be legitimately available to mine from. In addition to our own industry experience with real-life projects, controversies around several major public data mining competitions held recently such as the INFORMS 2010 Data Mining Challenge and the IJCNN 2011 Social Network Challenge are evidence that this issue is as relevant today as it has ever been. While acknowledging the importance and prevalence of leakage in both synthetic competitions and real-life data mining projects, existing literature has largely left this idea unexplored. What little

has been said turns out not to be broad enough to cover more complex cases of leakage, such as those where the classical i.i.d. assumption is violated, that have been recently documented. In our new approach, these cases and others are explained by explicitly defining modeling goals and analyzing the broader framework of the data mining problem. The resulting definition enables us to derive general methodology for dealing with the issue. We show that it is possible to avoid leakage with a simple specific approach to data management followed by what we call a learn-predict separation, and present several ways of detecting leakage when the modeler has no control over how the data have been collected. We also offer an alternative point of view on leakage which is based on causal graph modeling concepts.

Geva T.*, Zahavi J. Integrating Data Mining and Text Mining Methods for Intraday Forecasting of Stock Returns

We address the challenge of constructing a decision support system for intra-day investment recommendations by integrating predictors obtained from both numerical market data and textual news data. In addition to enriching the information available to the forecasting model, this integration can potentially capture patterns that may not otherwise be identified when employing each data source separately. At the core of our research is the empirical evaluation of the joint effect on modeling performance of two influential factors: data representation and forecasting algorithm. For this purpose, we built an end-to-end modeling process, designed to optimize various aspects of the solution so that the results of multiple modeling setups could be impartially compared. We also employ data representation procedures and modeling improvements that have not been previously employed in related studies. Finally, we perform an economic evaluation of the results, using a simulation procedure that inherently accounts for transaction costs and eliminates biases that have potentially affected previous related data-mining studies. The results of our study are promising in that they show that augmenting market data with advanced textual data representation significantly improves stock purchase decisions when the approach is implemented with a non-linear neural network forecasting algorithm.

Water Management (אתרונ)

Cohen A.*, Jan S., Oron G. Restoration of the Dead-Sea: Selecting Optimal Alternative by Implementing the Analytic Hierarchy Process (AHP)

Last years climate changes, over pumpage of water from the Sea of Galilee and decrease in flood inflow caused a real water deficiency in the volume of the Dead-Sea (DS). Water surface decline in the DS is in the range of 1.2 m to 1.5 m/year. The decline in the Dead–Sea water volume is associated with development of the large sinkholes and raises questions related to the sustainable lake existence and its' role in the national economics. Restoration of the DS can be accomplished by soil or water up-filling. Adding sea water might change the DS water quality, creating gypsum and other compounds and might off-set its' health and mineral extraction advantages. Soil up-filling looks non-realistic. Consequently, it is assumed that the DS has to be filled with high quality water, similar to past inflow quality. The purpose is to find optimal solution from a series of alternatives of restoring the DS with high quality waters, maintaining minimal health and environmental damages. Four alternatives were examined. The alternative includes massive desalination of sea water in the coasts area: (i) Red – Dead-Sea carrier, desalination and brine disposal into the DS (RD); (ii) Sea water desalination adjacent to the City of Ashkelon and conveying the permeate to the DS throughout "Maale Yair" along with generating hydro-electricity (AM); (iii) Sea water desalination near the City of Haifa, conveying the permeate via Jezrael Valley and disposing it into the Jordan River adjacent to the City of Bet-Sheaan (MD1), and; (iv) Sea water desalination near the Kishon River, conveying the permeate to the Kinneret and subsequent regulated water release to the Jordan River (KK). Criteria were chosen for comparison between alternatives. The criteria were divided into three groups: (i) costs; (ii) benefits, and (iii) environmental control (maintaining natural equilibrium). Comparison between the alternatives is based on the Analytic Hierarchy Process (AHP) method and the ELLECTRE III threshold method. According to the analytical analysis the KK (Kishon –Kinnert) alternative was preferred. This tendency was supported by an extra complementary AHP analysis which was based on a questionnaire that was responded by 10 water experts in Israel.

Bick A.*, Rockman J., Oron G., Raveh A., Kenig S. Conceptual maps of professional training for the design, operating and managing staff of desalination plants: Core courses and educational programs

It is undisputed among international experts that the importance of water desalination for the fresh water supply will increase as a result of the shortage of renewable water resources in the world. For the expected installation and operation of additional desalination plants, well-trained personnel to actively participate in the industry are of vital importance. This places a burden on the industry to cope with the many drawbacks and inefficiencies of on-the-job training. Concerning knowledge, the human resources on desalination plants can be allocated to six groups: (i) management, (ii) administration, (iii) operation, (iv) maintenance, (v) laboratory, and (vi) reliability & quality control. This work studies the structure of desalination education in 16 schools: academic institutions, training engineering companies and specialized centers for desalination research. The analysis (Figure 1) is based on mapping of core courses and educational programs by multi-dimension scaling (Coplot software).

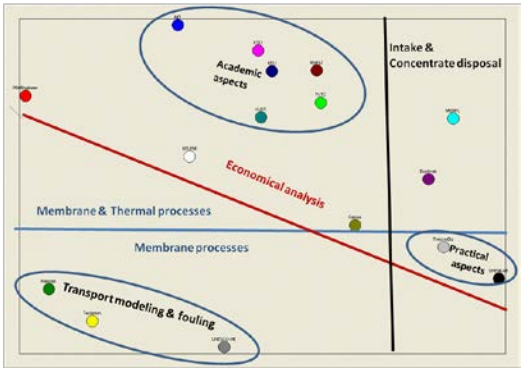
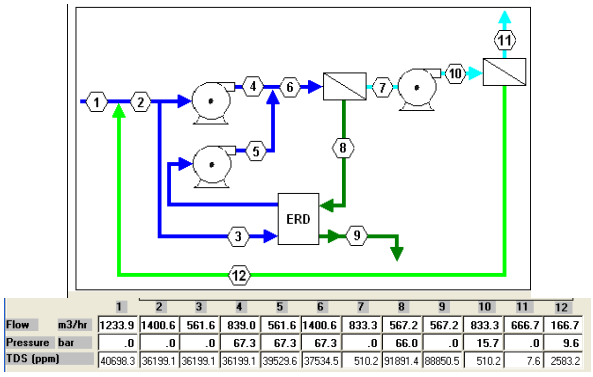


Figure 1. Presentation of desalination education of 16 schools using Coplot analysis

According to Fig 1, it is suggested that (i) training programs have different definitions, (ii) program structure in universities is heavily dependent on the background and interest of the faculty members, and (iii) there is a substantial gap between desalination industry educational needs, universities methodologies, and research centers education.

Kalson P.A., Prigan I., Nissimpor D., Oron G., Bick A.* Sustainable industrial water management through membrane processes- the case of Rutenberg power plant

Technologies developed for power generation plant must be focused on key requirements: (i) reliability based on minimum downtime, proven technology and local maintenance, (ii) efficiency rooted in optimal use of resources, and (iii) sustainability that ensures compliance with environmental legislation, minimum footprints and water conservation. Concerning a coal-fired power plant, major water consumers include: (i) high-purity makeup to the steam generator, (ii) fresh water makeup to the scrubber (FGD), (iii) service water, (iv) FGD wastewater treatment, and (v) cooling tower makeup water. In order to assess the use of water as realistically as possible, technical, economical and ecological information provided by the Israel Electric Design Division and the plant operators of Rotenberg was used. The database helps to analyze several water treatment practical options (figure 1) that were studied using IMSDesign Software. These options allow the quantification and the economical evaluation of water production cost and perform "what if" scenario analysis in order to test technical feasibility and to reach the optimal solution. According to the results, mathematical and simulated models could be powerful and helpful tools to assist decisions concerning design strategies.



		1	2	3	4	5	6	7	8	9	10	11	12
Flow	m3/hr	1233.9	1400.6	561.6	839.0	561.6	1400.6	833.3	567.2	567.2	833.3	666.7	166.7
Pressure	bar	.0	.0	.0	67.3	67.3	67.3	.0	66.0	.0	15.7	.0	9.6
TDS (ppm)		40698.3	36199.1	36199.1	36199.1	39529.6	37534.5	510.2	91891.4	88850.5	510.2	7.6	2583.2

Figure 1. An example of a water treatment flow-sheet for Rutenberg station.

Monday: Session M2

Algorithms 2 (1 שקד)

Vaisbourd Y.*, Beck A. The Chebyshev Center Approach for Image Deblurring Applications

We consider the problem of reconstructing an image from a blurred and noisy representation. We apply the Chebyshev center approach for finding regularized solution to image deblurring problems. This approach aims to minimize the norm of the estimation error rather than the norm of the data error. Clearly, it is not possible to minimize the estimation error directly as the true image is unknown. Instead, the Chebyshev center approach suggests to minimize the maximal estimation error for all the solutions that reside in the so-called feasible parameter set. Usually, an image will be of a very large size, a fact that prevents the possibility of applying a conventional solver to solve the arising optimization problem. We use spectral decomposition methods combined with bisection or ellipsoid method in order to solve the minimization problems proposed for finding the Chebyshev center. We propose to apply a redundant constraint removal technique to reduce the complexity of the optimization problems solved by the ellipsoid algorithm. Finally, we provide numerical comparisons with the Tikhonov regularization solution based on several well-established parameter choice methods such as the discrepancy principal, regularized least squares (RLS), generalized cross validation (GCV) and the l-curve criterion. We show that the proposed approach can significantly improve the reconstruction quality according to the relative error measure.

Sabach S.*, Beck A. An Improved Ellipsoid Method for Convex Differentiable Problems.

We consider the problem of solving convex differentiable problems with simple constraints on which the orthogonal projection operator is easy to compute. We devise an improved ellipsoid method that relies on new and improved deep cuts exploiting the differentiability property as well as the ability to compute an orthogonal projection onto the feasible set. This new version of the ellipsoid method does not require two different oracles as the "standard" ellipsoid method does (i.e., separation and subgradient). An improved linear rate of convergence is proven and several numerical results illustrate the advantage of this approach over the classical ellipsoid method.

Tetruashvili L.*, Censor Y., Gholami M. The Parallel Projections Method for the Cooperative Sensor Network Positioning Problem

Position information is one of essential requirements for a wireless sensor network (WSN) to function as intended. It is assumed that there are a number of fixed sensors called reference or anchor nodes whose positions are initially known using GPS receivers or manual settings. Besides reference nodes, there are a number of other sensor nodes at unknown positions, called targets. The goal of the positioning problem is to find locations of targets. In cooperative networks, measurements between target nodes are used in the positioning process, as well as measurements between target nodes and reference nodes. In non-cooperative networks, only the latter type of measurements is used. We propose a new parallel projections method for the Cooperative Sensor Network Positioning problem and investigate its convergence.

Queuing 4 (שקד 2)

Kerner Y.*, Afeche P., Baron O. Pricing Time-Sensitive Services Based on Realized Performance

Services like Federal Express charge up-front fees but reimburse customers for delivery delays. However, lead time pricing studies ignore price adjustments based on the realized lead time. This paper contributes to filling this gap. It studies revenue-maximizing tariffs that depend on the realized lead time for a provider serving multiple time-sensitive customer types. We relax two important assumptions in the standard model since Naor (1969). First, customers may be risk averse (RA) with respect to payoff uncertainty, where payoff equals valuation, minus delay cost, minus payment; in the standard model, customers are risk neutral (RN). Second, tariffs may be arbitrary functions of realized lead times; the standard model restricts attention to flat rates. Our main findings are: 1. With RN customers, flat rate pricing maximizes revenues but leaves customers exposed to payoff variability. 2. With RA customers, flat rate pricing is suboptimal. If the provider can distinguish types, it is optimal to charge lead time-dependent tariffs that eliminate delay cost risk and yield the same revenue as under optimal flat rates for RN customers. 3. With indistinguishable RA types, the differentiated first-best tariffs may be incentive-compatible even for uniform service, resulting in more revenue than with RN customers.

Haviv M.*, Randhawa R. Pricing in queues without demand information

We consider revenue and social optimization in an M/M/1 queue with price and delay sensitive customers, and study the performance of uninformed pricing that does not require any arrival rate information. We formally characterize the optimal uninformed price and its performance relative to pricing with precise arrival rate knowledge. For uniformly distributed customer valuations, under a large set of parameters, we find that uninformed prices can capture more than 99$\%$ of the optimal revenue and more than 85% of the optimal social welfare. We further prove that the performance of uninformed prices improves as the customers become more delay sensitive and is always better under revenue optimization compared with social optimization.

Haviv M., Shaki Y.* Deterministic retrial rate for a queuing system with retrials

Consider a model with a single server. Customers arrive into a system according to a Poisson process, the service times are independent and exponentially distributed. Balking is not allowed in this model. We relax an assumption in Naor's model (1969) and allow customers to choose retrials times in order to reduce their costs. A customer who arrives when the server is busy, tries again later. We assume that the time lengths between retrials are constants. Since this model is a non-Markov process, we need to show the ergodicity of the system. After that, we assume that each retrial cost is r, and the cost while orbiting is C per unit of time. We consider the optimal retrial time and the equilibrium retrial time.

Financial Engineering 1 (שקד 3)

Gil O.*, Zahavi G. On-line Learning of Market Making Strategy

Many economic markets, including most major stock exchanges, employ market-makers to aid in the transactions and provide a better quality market. This Study is aimed to establish an analytical foundation for electronic market making strategy, by giving a probabilistic interpretation to the Bid-Ask spread. The suggested strategy will be optimized with on-line learning from the high frequency data of the TASE (Tel Aviv Stock Exchange) order book. Based on this foundation, we wish to create an automated securities dealer that will perform the task of providing liquidity to the markets efficiently, and with low downturn risk. We compare the expected performance of the automated dealer with several bench mark measures of Market liquidity such as those presented in Roll (1984) and Glosten & Milgrom (1985).

Rosenstein Y. Zahavi G.* Nonlinear dynamical systems theory in weather derivatives pricing

In recent years we witnessed a rapid growth of weather derivatives market. These derivatives are used to hedge energy contracts and distribute weather risk. While most derivative markets are complete and contingent climes replications are standard procedure, this special market is incomplete, and therefore modeling the weather is a more appropriate approach to pricing. In this work we base our modeling on a widely accepted physical approach. We base our analysis on Navier-Stokes equations applied to a thin atmosphere as presented by Lorentz 1962. This modeling is considered by meteorologists a “very-long-weather” prediction, allows for an accurate and robust temperature forecasting. We show that under this setting we empirically outperform the standard approach to weather derivative pricing.

Kliger D., Gurevich G.*, Haim A. When Chronobiology Met Economics – Seasonal Affective Disorder and the Demand for IPOs

Standard economic theory presumes invariant preferences. We refute this presumption on chronobiological grounds, documenting the effect of Seasonal Affective Disorder (SAD) on investors’ demand for Initial Public Offerings (IPOs). We find that seasonal mood substantially influences short-, mid-, and long-run IPO performance: (i) examining IPO first trading days indicates that in the short run, stocks issued in short, decreasing, photoperiods, i.e., days associated with depressing daylight conditions, earn lower returns than stocks issued in long, increasing, photoperiods, i.e., cheerful days; (ii) by the mid run (up to a quarter of a year), the stocks’ cum-initial-returns are equated, implying that the short-run initial excess returns of the stocks issued in the cheerful periods are fully absorbed by subsequent performance; and (iii) in the long run, the stocks issued in the cheerful periods continue to underperform (till about a year-and-a-half) and subsequently (up to three years) possibly revert to the grand average of IPO underperformance. The average return differential between the IPOs issued in depressing and cheerful days is in the sizable order of between 5% to 10% of the offering,

approaching 15% to 25% for the relatively less publicly exposed firms, as assessed over a database of 1,526 IPOs with average gross proceeds of $15 million.

Military O.R. 5 (אתרוג)

Levav B.* On the Vulnerability of Infantry Soldiers

For several years now the analysts of the Land Warfare Group in the Center for Military Analyses (CEMA) are developing methods to assess the effectiveness of infantry units in combat. Under this framework several studies were conducted, among them: soldiers' performance under fire and battle conditions, the effect of weight load on the soldiers' performance, and the vulnerability of infantry soldiers. Our presentation focuses on assessing the vulnerability of infantry soldiers. The vulnerability assessment to be presented related to two types of common threats in land warfare - direct fire and indirect (statistic) fire.

Boni O.*, Fournier F., Mashkif N., Naveh Y., Sela A., Shani U., Lando Z., Modai A. Utilizing Constraint Programming for Complex Systems Engineering

Along with the increase in the complexity of engineered systems, such as cars and airplanes, there is a pressing need to decrease the system's cost and time to market. Therefore, much effort is put today on the design phase of the system where correcting errors is relatively quick and cheap. To improve both traceability and quality of design, systems engineering methodologies were introduced and adopted by most companies. However, verifying the compliance of a system's design with the chosen methodology is still largely a manual and error-prone process. This is mainly due to the fact that the design of a complex system involves many disciplines, each requiring a separate tool. The relationships between the data residing in the different tools are usually maintained manually. Lately, IBM introduced a platform which holds indexed references to the data in the design tools and maintains the relationships between them. On top of this platform, a constraint programming based application was built. This application receives the methodology guidelines referring to design data relationships formulated as rules. Given the relationships at any stage of the system's design, the application automatically creates sets of variables and constraints reflecting the methodology rules. If there is no solution to the generated constraint problem, the application lists a subset of the relationships and methodology rules that contains violations or contradictions. In case the generated problem is solvable, the application can provide advice to the engineer on how to proceed with the design process. The application was tested using a tutorial example, and proved to be both useful and scalable, at least for small to medium sized systems.

Khoroshevsky S.* Optimal Spare Parts Allocation for Complex Military Systems subject to Performance and Budget Constraints using Monte Carlo Simulation

The increasing use of the Monte Carlo (MC) method in modeling operational and logistic aspects of complex systems has recently created both a problem and an opportunity. While the Monte Carlo method enables realistic and reliable analysis, it may not be sufficient for performing optimization of various aspects of the system, in particular logistic optimization to identify the optimal allocation of spare parts under given performance or budget constraints. This presents a problem since Monte Carlo calculations require a substantial computational effort and a point by point search for an optimum is impractical. It is thus argued that a hybrid approach is required by which an analytic approximation of system performance as a function of spare parts allocation is derived using a small number of MC calculations while the search of the optimum is based on this approximation and controlled by MC verifications. This work presents the new approach which combines "the best of two worlds", namely the use of MC simulation as a performance analysis tool of choice for complex military systems and rapid and reliable spare parts optimization. The approach is validated in case of a complex multi-indenture Air Defense System operating in Multi-Field/Multi-Echelon logistic scenario.

Monday: Session M3

Algorithms 3 (1 שקד)

Hazan E., Koren T.*, Srebro N. Linear Regression with Limited Observation

We consider the most common variants of linear regression, including Ridge, Lasso and Support-vector regression, in a setting where the learner is allowed to observe only a fixed number of attributes of each example at training time. We present simple and efficient algorithms for these problems: for Lasso and Ridge regression they need the same total number of attributes (up to constants) as do full-information algorithms, for reaching a certain accuracy. For Support-vector regression, we require exponentially less attributes compared to the state of the art. By that, we resolve an open problem recently posed by Cesa-Bianchi et al (2010). Experiments show the theoretical bounds to be justified by superior performance compared to the state of the art.

Garber D.* Approximating Semidefinite Programs in Sublinear Time

Semidefinite programming is a convex optimization problem which is wildly used in numerous fields of science and engineering. In combinatorial optimization and machine learning in particular, many algorithms that are based on solving semidefinite programs have been developed in recent years. Although polynomial time algorithms which can solve general semidefinite programs accurately and even faster algorithms that solve such programs only approximately exist, their running may be prohibitive in practice when applied to very large scale problems such as those that are ubiquitous nowadays in machine learning. In this talk I will present an algorithm for solving approximately general semidefinite programs which enjoys a running time that is sublinear in the number of entries in the semidefinite instance. The algorithm also has the benefit of producing low rank solutions which is computationally favorable. Our algorithm is based on solving a Lagrange relaxation of the semidefinite program using the well known Multiplicative Updates Method and applying recent algorithmic machinery from online learning and random

sampling. I will also present lower bounds on the running time of any approximation algorithm for semidefinite programming which demonstrate that our algorithm is close to optimal in certain cases.

Karnin Z.* A poly-log pivot steps simplex algorithm for classification

We present a simplex algorithm for linear programming in a linear classification formulation. The paramount complexity parameter in linear classification problems is called the margin. We prove that for margin values of practical interest our simplex variant performs a polylogarithmic number of pivot steps in the worst case, and its overall running time is near linear. Additionally, our method exploits the classification formulation in order to create an artificial initial point, thus avoiding the phase-1 step.

Queuing 5 (שקד 2)

Raz D.*, Katan S. A Fairness Oriented Fuzzy Logic Queueing Policy

The two issues most often considered in queueing systems are efficiency, which is mostly attributed to the mean waiting time in the system, and fairness. The efficiency aspects of queueing systems have been extensively studied and are well understood. However, although the importance of fairness aspects in queueing systems has been acknowledged in many works, the subject has only started to receive quantitative attention in the recent decade. Measuring the fairness of queueing systems has proven to be a challenge, and there are few works dealing with policies specifically designed to achieve more fairness. A major obstacle is the subjective and approximate nature of fairness. What is considered unfair in one culture may not be so in another. In addition, it is not always clear if a situation is fair or not, and a common claim is that a situation is only "somewhat" unfair. This almost begs the use of fuzzy logic, which is naturally designed to work well with approximate reasoning. Fuzzy logic allows for approximate values and inferences by assigning a "truth value" ranging between 0 and 1. In this work we propose a fairness-oriented queuing policy which is based on fuzzy logic. The policy takes into account three aspects of the queueing system, namely waiting time, service time and overtaking. We show how the policy can be calibrated so it fits a specific situation in a specific society or culture. We use simulation to evaluate both the efficiency (waiting times) and the fairness of the policy, and compare them with those of classic service policies such as First Come First Served and Shortest Job First. We do this in a single queue system under different service time distributions. Not surprisingly, the policy exhibits high fairness values. However, a more surprising result is that the policy also exhibits good efficiency, making it a viable choice for systems where both efficiency and fairness are important.

Haviv M., Ravner L.* Equilibrium and Optimal Arrival to a Loss System

In this paper we examine a system where a single server with no queue buffer (loss system) provides service during some time interval with opening and closing times. The players need to decide when to arrive with the goal of maximizing their probability of obtaining the service. We derive the equilibrium and socially optimal strategies when the number of players is constant. We further show the equilibrium for a random number of players and explain the difficulty in finding the socially optimal strategy in this case.

Ravid R.*, Boxma O., Perry D. Sojourn Times in the Longest Queue System with Exchangeable Items

We consider a repair facility that consists of one server and two arrival streams of failed items. The two arrival streams

are independent Poisson processes with different rates

and , that emerge from two sources; bases 1 and 2. The service times are independent, exponential random variables

with equal rates . The items are exchangeable in the sense that customers who arrive with a broken items can be satisfied by any repaired item. The arriving customers generate two separated lines and each customer is admitted to his own line; namely, the customers are marked according to their sources (bases). As a result, a *backorder* is created in the lines at each arrival. Within the lines the issuing policy is FIFO, but the repaired items are delivered to the longest queue. In case that the lines are of the same length, the item will be delivered to either base 1 or base 2 with probability 0.5. In this talk we will focus on the law of the sojourn time in steady state.

Financial Engineering 2 (שקד 3)

Geidman D., Perry T.*, Zahavi G. Extraction of Economy's Aggregate Expectations, Using a Modified Yield Spread Approach

In this paper we present a unified approach to extracting future expectations, regarding economic activity, from various debt instruments. Our approach is based on former findings about the predictive powers of the yield spread (long-term yields minus short-term yields on government bonds), in some countries like USA and Germany. Because of the incompatibility of the yield spread for forecasting economic activity in other countries, a more robust method, that will fit any economy, is needed. We show a simple optimization procedure for finding an economy specific typical portfolio, which represents the markets aggregate expectations regarding future economic growth. Our optimization method gave an improvement over the classical yield spread, in predicting future economic growth, and was able to predict growth levels even in countries where the yield spread wasn't able to do so with acceptable significance levels.

Galil K., Sher N.* Predicting financial distress more accurately: The choice of the dependent variable

Studies aiming to improve accuracy of default prediction models mainly focused on the choice of statistical methods and sets of explanatory variables. This study alters the focus to the choice of the dependent variable. We examine five definitions of financial distress commonly used in the literature and show that each definition carries considerably different characteristics. In predicting default and in explaining CDS spreads, a default model outperforms any other prediction model despite of being estimated on a substantially smaller sample. A default prediction model

should also take into account a selection bias that exists in default lists provided by rating agencies.

Afik A., Arad O., Galil K.* Using Merton model: an empirical assessment of alternatives

Merton (1974) suggested a structural model for default prediction which allows using timely information from the equity market. The literature describes several specifications to the application of the model, including methods presumably used by practitioners. However, recent studies demonstrate that these methods result in inferior estimates compared to simpler substitutes. We empirically examine various specification alternatives and find that the prediction goodness is only slightly sensitive to different choices of default barrier, whereas the choice of assets expected return and assets volatility is significant. Equity historical return and historical volatility produce underbiased estimates for assets expected return and assets volatility, especially for defaulting firms. Acknowledging these characteristics we suggest specifications that improve the model accuracy.

Combinatorial Optimization 2 (אתרוג)

Ibraheem W.*, Goren L. Automating Chip Assembly using Constraint Programming

In the field of chip design, many efforts are invested in the problem of chip assembly. The problem consists of finding valid placements for the macros on a chip, while taking into consideration various constraints such as: optimizing chip size, wiring length and density, handling heat issues, I/O unit locations, etc. Much of the work in these areas is done manually, and there are many attempts to automate as many components as possible. We describe the problem of optimizing the number of macros that can be placed on a single chip. Designers currently spend up to two weeks solving this problem manually. We developed a constraint programming solution jointly with the Design Automation Group in IBM. This solution is currently being embedded into a new automated assembly process.

Rochman Y.*, Levy H., Brosh E. Max Percentile Replication for Peer-based VoD Systems

Peer-to-peer based (P2P) VoD systems have proven to be an effective solution for scalable video distribution. In P2P VoD, each peer contributes storage to replicate videos and assists video delivery. A fundamental question is how to optimally replicate video content across the peers so as to maximize their upload capacity. We study this question within the context of a large-scale P2P network where peers are grouped into different geographical regions, and downloading a video across regions is more expensive than within a region. Our analysis addresses the combined challenge of (1) optimizing the replica allocation (placement) with respect to an arbitrary (multi-dimensional) stochastic demand distribution, and (2) finding an optimal assignment of video requests to peers. Our main result is that optimal replica placement in single- and multi-region environments is of max percentile nature. We derive optimal algorithms for several variants of the problem and show that they have low complexity and thus very practical. We use numerical analysis and simulation to evaluate the system performance and study its behavior. Our results can be used to provide valuable insights on the design of P2P VoD systems. Aside for VoD systems, the model and the analysis can be applied to formulate and solve problems from the inventory management domain.

Korach E.* 2-Steiner-subgraph Blocking Pair of Clutters with the MAX-FLOW MIN-CUT Property in Series Parallel Graphs

Let G=(V,E) be a 2-connected Series-Parallel graph and let S be a subset of V. A2-Steiner subgraph Of (G,S) is a 2-connected subgraph of G that spans S. Let A be the clutter of all 2-steiner subgraphs of (G,S). and B be its' blocker. We describe B and prove that both (A,B) and (B,A) have the max –flow min-cut property. We show that this is true for every subset S and for every integral weight function w on its edges if and only if G is series Parallel graph. These imply some polyhedral descriptions of the discussed clutters. S a consece of our results we get a simle and optimal algorithm for finding a minimum weight 2-steiner subgraph in a series-parallel graph.

Monday: Session M4

Prize Winners (1 שקד)

Buchbinder N.* A Primal-Dual Approach to Online Optimization Problems

The primal-dual method is one of the fundamental design methodologies in the areas of linear programming, combinatorial optimization, and approximation algorithms. Recently, we have shown the wide applicability of the primal-dual method to the design and analysis of online algorithms. The primal-dual method is useful for making online decisions as well as for performing the competitive analysis. In this talk I will introduce the method and survey recent results obtained for various settings such as ski-rental, set-cover, ad-auctions, routing and load balancing, network optimization problems, paging, k-server, and more.

Avrahami A.* Value of perfect and imperfect information in a multi-location inventory system

The fact that information has value in the management of supply chains is well accepted. Our work is focuses on two aspects of information: quality and quantity. In this presentation we will give a quick overview of our research related to the value of the quality of information. In this part we are concerned with discrepancies known as inventory errors, which are the result of events that can be classified as one of the following: shrinkage, misplacement and wrong scanning. The outcome of these events is discrepancies between IT inventory (inventory as it appears in the computerized system) and inventory available for sale. The literature describes both the extent to which these discrepancies are commonplace and the degree to which they increase lost sales and lower profits. Nevertheless, these discrepancies and their associated negative effects can be eliminated if more accurate information is available. In this presentation we focus on the value of the quantity of information. In particular, we focus on distribution systems that are based on a network of retailers. The goal is to explore the value of additional information in these systems. In particular, we explore the value of the ability to review

the state of the system more frequently. In our study we develop a natural formulation for the problem and later on a working formulation for our model. We prove convexity of our model and find the optimal solution. We developed an algorithm to solve numerically the problem. Later on we performed a large scale field study. We report on the savings that the additional information enabled (i.e. the value of the additional information) and discuss in detail what we learned both about the original system and the information rich system.

Health Care Management (2 שקד)

Prisman E., Prisman E.*, Freeman J. A New Stochastic Approach to the Analysis of the Rapid Intraoperative Parathyroid Hormone

The recent advent of rapid intraoperative Parathyroid assay (PTH) has supported the emergence of a minimally invasive approach whereby a unilateral exploration may suffice. A significant intraoperative decrease in the parathyroid hormone after removal of an abnormal gland supports the notion that the offending parathyroid tissue has been removed. In this paper we suggest and empirically explore a new intuitive stochastic approach to the intraoperative analysis of PTH, which is based on a mean reverting process (MRP). The approach induces a time-dependent confidence interval for the level of the PTH, which indicates a cure and defines a significant decrease in its level. Modeling the evolution of the PTH level is entrenched in the idea that there exists a "normal" equilibrium level of PTH. Once this equilibrium is impaired there are some physiological processes that attempt to bring the PTH level back to normal. The MPR approach is utilized to model the evolution of the term structure of interest rates, as its behavior is very similar. Knowing the limiting distribution of an MRP allows avoiding the common practice of using only 2-3 observations to estimate parameters and test the decision criteria. This is accomplished by borrowing the idea of implied "volatility" from financial Engineering (FE). Goodness of fit tests of the MRP to the PTH dynamic used in VAR studies in FE is extended somewhat to derive this test.

Solnik E.*, Gavious A., Davidovitch N., Pliskin J., Yamin D. Innovative Influenza Vaccination Policy Targeting Last Season's Patients

Vaccination is the most efficient and cost effective method to prevent influenza, reducing morbidity and mortality rates not only for those vaccinated, but also for the entire population by reducing the spread of the virus. In the context of contact network epidemiology, an individual who is located in the center of the network is more likely to become infected. Thus, vaccinating such individuals before others would be more efficient in reducing the influenza burden. However, since the representation of the contact network is not known in real life, one cannot detect the central individuals directly. We offer a practical way to identify the central people by using accessible data; we show that immunizing those who have been infected in the previous season, especially before the peak of the disease, can substantially reduce infection rates for a wide range of influenza viruses. It is achieved by running 2.1 million computerized simulations. Using the Susceptible Infected Recovered (SIR) compartmental model, each simulation reflected two successive influenza seasons over a 1.5 million population contact network based on the Portland population. The second season in each simulation was checked twice: when a Random Vaccination Policy (RVP) was applied and when using a vaccination policy prioritizing first those who were infected in the previous season especially before the peak (PFIP). The number of infected individuals in the two policies (RVP&PFIP) was calculated to determine the conditions where one policy is preferred to another. Results suggest that when no vaccination is offered, individuals who became infected in the previous season have a higher probability of becoming infected in the following season. Accordingly, PFIP can reduce the number of infected by up to 80% compared to RVP. Moreover, even if the cross-antigenisity rate between the viruses of two seasons is as high as 60-80%, a policy prioritizing those who became ill in the previous season is superior. We provide a simple managerial tool describing the conditions when each policy should be used. No CDC recommendations have ever considered the effect of a previous season on an individual in determining a future vaccination policy for him. On a practical basis, applying the PFIP can be achieved easily by sending pamphlets, telephone reminders or even family doctor recommendations to those who were diagnosed by the family doctor as suffering from influenza like illness (ILI) in the previous season.

Financial Engineering 3 (3 שקד)

Kliger D. Kudryavtsev A.* Out of the Blue: Mood Maintenance Hypothesis and Seasonal Effects on Investors' Reaction to News

Contemporary research documents various psychological aspects of economic decision-making. The main goal of our study is to analyze the role of Mood Maintenance Hypothesis (MMH, Isen (1984, 2000)) in financial markets. MMH refers to people's tendency to maintain positive mood states, and implies that positive mood is associated with less critical thinking and reduced information processing, yielding three behavioral effects: (i) out of the blue, resulting in stronger negative reactions to bad news during good mood periods (ii) sunray on a cloudy day, leading to stronger positive reactions to good news during bad mood periods, and (iii) shallow thinking, producing stronger reactions to all kinds of news during good mood periods. Employing daylight duration changes as a proxy for contemporaneous investors' mood, we test the role of mood in investors' reactions to analyst recommendation revisions. We find corroborative results, most notably that negative stock price reactions to recommendation downgrades are significantly stronger during daylight increasing periods. The effect remains significant after controlling for market-, firm-, and event-specific factors, and its magnitude increases in longer event windows.

Gilad D., Kliger D.* Priming the Risk Attitudes of Professionals in Financial Decision Making

This study explores the influence of priming on financial decision making. Priming is a process of activating particular connections or associations in memory prior to carrying out an action or task. The associations, often regarded as unconscious, occur when a certain stimulus or

event increases the availability of specific information categories and, as a result, affect decision making. Our experiments exposed subjects to substance reinforcing risk seeking behavior in uncertain situations and compared their investment decisions to those of subjects in control groups. We focused on investigating decision making by professional investors, namely, investment advisors in large commercial banks and accountants in CPA firms. To do so, we (i) tested the effect of priming on professionals' risk attitude, and (ii) compared it to that on Economics undergraduates'. The results indicate that priming manipulations affect subjects' risk attitudes and, hence, their investment decisions. Captivatingly, the investment decisions of the professionals were affected more significantly by the priming stimuli than the decisions made by the undergraduates, suggesting a more intuitive and less analytic approach used by the professionals in forming their investment decisions. Our work is related to the growing body of literature employing field data to document correlations between stock returns (the results of investors' decisions) and situational factors, such as weather conditions. However, since field data are highly complex, they might exhibit spurious relations. Our approach resolves this problem by suggesting an independent, controlled, test of professional investors' behavior

Yechiam E.*, Zahavi G. Agitated Losses and Relaxed Gains

One of the robust regularities of stock markets is the asymmetric relation between stock returns and their subsequent volatility, commonly referred to as the "leverage effect". In the current paper we present a psychological model linking between gains and losses, choice volatility, and market prices of publicly traded stocks, based on a recent attentional model of losses that accounts for this effect as well as some other regularities of the stock market. The attentional effect of losses implies greater exploratory search behavior and therefore more choice volatility (i.e., incidents of switching between choice options) following monetary losses. Our study begins with an empirical examination using an abstract experiential task. We find increased choice volatility in tasks with losses compared to tasks with no losses, and that this heightened volatility is maintained even in subsequent tasks that do not include losses. Conversely, gains are found to have an opposite "relaxing" effect on choice volatility. Both phenomena are observed even in the absence of loss aversion. We follow with an agent based model of the stock market and demonstrate that embedding a simple increase in choice volatility following losses compared to gains yields increased price volatility subsequent to losses, while also providing sufficient conditions for four other major stock market regularities in a unified framework.

Combinatorial Optimization 3 (אתרוג)

Levin A., Yovel U.* Non-oblivious 2-opt heuristics for the Traveling Salesman Problem

The k-opt heuristics are among the most common techniques for approaching the traveling salesman problem (TSP). They are used either directly or as subroutines in more sophisticated heuristics, such as the celebrated Lin-Kernighan heuristic. The value of k is typically 2 or 3. In this paper, we modify the 2-opt heuristic to be based on a function f of the distances rather than the distances solely. This may be viewed as modifying the local search with the 2-change neighborhood to be non-oblivious. We denote the corresponding heuristic by (2,f)-opt. We provide theoretical performance guarantees for it: both lower and upper bounds based on the ones given by Chandra, Karloff, and Tovey (1999), obtained originally for the standard 2-opt heuristic; the upper bound is improved by a factor of $\sqrt{2}$ with respect to the known upper bound of the standard 2-opt. We then provide experimental evidence based on TSPLIB benchmark problems, showing that (2,f)-opt with $f(x) = xr$ for various values of $r < 1$ significantly outperforms 2-opt. These values of r also depend on the method chosen for constructing the initial tours. Specifically, when the initial tours are random permutations, the improvement over 2-opt is more than 35% for $r = 0.3, 0.4$ when they are generated by the Nearest Neighbor heuristic, it is about 10% for $r = 0.5, 0.6$. We also see that the average length of the tour generated by (2,f)-opt is relatively close to the optimum or the known bound.

Shindin E.*, Weiss G. Full symmetric duality and structure of solution for a continuous linear program with constant coefficients.

We consider continuous linear programs over continuous time finite horizon T, with linear cost coefficient functions and linear right hand side functions and a constant coefficient matrix, where we search for optimal solutions in the space of measures or of functions of bounded variation. These models generalize the separated continuous linear programming models and their various duals, as formulated in the past by Anderson, by Pullan, and by Weiss. We present simple necessary and sufficient conditions for feasibility. We formulate a symmetric dual and show strong duality by considering discrete time approximations. We consider solutions which have impulse controls at the start and end point of the time horizon and have piecewise constant densities inside the interval. We prove a theorem that details the structure of such solutions and show under appropriate non-degeneracy that such solutions are unique. We also discuss solution for small time horizons.

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