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Awi Federgruen
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Graduate School of Business
Columbia University
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Academic Degrees

December 1972 B.Sc. in Econometrics and Operations Research at the
Institute for Actuarial and Econometric Sciences,
University of Amsterdam (cum laude)

November 1974 Doctoral examen" (equivalent to M.Sc.) in Operations Research at the Institute for
Actuarial and Econometric Sciences, University of Amsterdam (cum laude)

May 1978: Doctoral degree in Operations Research from the
Mathematics Department of the University of Amsterdam

Interest/ Expertise

1. Production/distribution planning problems, centralized and decentralized supply chain management; operation/marketing interface
2. Modeling and evaluation of complex deterministic or stochastic systems
3. Marketing Mix models.
4. Design and modelling of financial instruments.
- 4 Modeling of service systems.
5. Application of quantitative methods, and construction of efficient computational procedures for optimization or control of large scale systems.
6. Markov decision processes, other applied probabilistic models and game theoretical models.
7. Econometric and mathematical economics models.

Employment Summary

July 2018- Chairman of Decision Risk and Operations Division

July 2004- June 2010: Chairman Decision, Risk and Operations Division

July 1997- June 2002 **Senior Vice Dean of the Graduate School of Business; responsible for all faculty and curricular affairs**

October 2000 -April 2001: **Acting Dean of the Graduate School of Business**

July 1989-July 1997: Chairman Management Science and Operations Management Division

October 1992-: Charles E. Exley Professor of Management

July 1986 -: Professor of Management Science and Operations Management, at the Graduate School of Business, Columbia University

October 1987 - Lady Davis Foundation Visiting Professor at Graduate
February 1988: School of Business, Hebrew University, Jerusalem.

February Visiting Professor, Dept. of Statistics, Tel-Aviv
- June 1988: University, Tel-Aviv.

July 1981 - Associate Professor in Management Science and Operations
July 1986: Management at the Graduate School of Business, Columbia University

1979 - Assistant Professor in Management Science and Operations
July 1981: Management, Columbia University

1978 -1979: Assistant Professor in Operations Management and Operations Research at the Graduate School of Management, University of Rochester, N.Y. (on leave of absence from the Mathematical Centre, Amsterdam, Netherlands)

1975 -1978: Research Fellow, Mathematical Centre, Operations Research Department; research in applied probabilistic modelling; various consulting tasks for private industry and government institutions, the most important of which are listed below.

15 April - Visiting Research Fellow in the Department of Industrial
15 May 1977: Engineering and Operations Research, University of California, Berkeley

February - Visitor to I.B.M. Watson Research Center, Yorktown
March 1976: Heights, N.Y.

Fall 1974: Research Fellow and Instructor at the University of Amsterdam

1973 - Teaching and Research Assistant of Prof. Dr. G. De Leve,
Fall 1974: Operations Research Department, University of Amsterdam

Courses TaughtAt the University of Rochester

ORM 447: Dynamic Programming Course for Ph.D. students

ORM 402: Introduction to Management Science Models 1;
Introductory first year MBA course

ORM 436: Planning and Design of Production Capacity; Elective second year course for MBA's

OMG 478: Seminar in Operations Management; Project course involving the application of operations
analogous to actual company or institutional problems

GBA 591: Ph.D. seminar in Distribution Modelling

At Columbia University

B8108 Supply Chain Management

B9120 Dynamic Programming

B6015: Decision Models

B7015: Operations Research (Masters Degree Program for Executives)

B9801 (1): Sequential Decision Making under uncertainty

B9801 (2): Distribution Planning

B9801 (3): Modelling of Supply Chain Competition

E8602: Markov Decision Processes

B8815: Inventory Management and Scheduling

B8834: Operations Research--Management Science

B9821: Probability Theory Mgmt Sci/OR

6410W: Logistics and Distribution Management

6406W: Inventory Theory

Major School- and University-wide Committees

1. Chair of the Management Science and Operations Division, 1989-1997;2004-2010, 2018-
2. Member of the Executive Committee, highest School-wide Committee, 1989-1997; 2004-2010, 2018-.
3. Member of the Promotions and Tenure Committee
4. Member of the Faculty Governance Committee
5. Member of the EMBA Advisory Committee
6. Member of the Admissions Committee
7. Member of the Career Services Committee
8. Member of the Core Curriculum Review Committee
9. Member of the Housing Priorities Committee
10. Member of the Housing Strategy Committee
11. Member of the Executive Committee overseeing the Management Science and Engineering Masters' Degree Program; co-designer of this Masters' degree program enrolling approximately 80 students per year; 2010-
12. Member of the Executive Committee overseeing the Masters in Business Administration Degree Program; co-designer of this Masters' degree program enrolling approximately 130 students per year; 2018-

Awards and Grants

INFORMS Fellow

Sackler Fellow, Institute of Advanced Studies, Tel Aviv University, November/December 2007

2004 Distinguished Fellowship Award for Outstanding Research and Scholarship in Operations Management by the Manufacturing Service and Operations Management Society

Participant Annual Supply Chain Management Thought Leaders Roundtable(from its inception 1998-2007)

Finalist in Worldwide Business Research Logi –Pharma Award Competition, Best Supplier Competition, 2017

Finalist in Worldwide Business Research Logi –Pharma Award Competition, Distinction in End to End Supply Chain Planning, 2017

Finalist in Worldwide Business Research Logi –Pharma Award Competition, Most Innovative Supply Chain Planning, 2017

National Science Foundation Grant no. ECS - 8604409 (with P. Zipkin)

Grant from the Lady Davis Foundation (academic year 1987-1988)

National Science Foundation Grant no. DDM-8920660 (with P. Zipkin)
(Inventory and Production Control)

Consultant to ARPA grants no, BAA 94-31-19 (with Philips Laboratories)
(Decision Support Systems for the Management of Agile Supply Chains)

Consulting Experience

Consulting Engagements include, among others:

- 1) project evaluating and designing the entire production and distribution system for **AGA Gas**, one of the largest producers of industrial gases in Europe
- 2) personal consultations to the C.E.O. of **AGA Gas**, on quantitative aspects of administrative, organizational and marketing problems
- 3) design of computerized models to assess tradeoffs between capital outlays and inventories in multi-stage batch production facilities for **Pfizer, Inc.**
- 4) analysis of international co-marketing arrangements for a pharmaceutical company
- 5) development of a computerized foreign exchange arbitrage system
- 6) development of the Adjustable Rate Mortgage Indemnification program. This program introduces a new mortgage instrument, based on a swap transaction between an adjustable and a fixed rate mortgage, backed up by specific hedging strategies in the financial futures' markets. This project undertaken for **Donaldson, Lufkin and Jenrette, Inc.**, included the development of a detailed business plan as well as a large scale feasibility study based on a computerized simulation model.
- 7) development of computerized planning models of the replenishment and distribution of all

consumable items' inventories at the **Israel Air Force**

- 8) principal consultant to the **Israel Air Force** Logistics Command with respect to its strategic inventory management problems
- 9) development of computerized planning models for asset/liability matching problems for a major U.S. insurance company
- 10) supervision of the development of a computerized system planning the integrated check collection and processing activities of **Chemical Bank**
- 11) development of a computerized bus routing system for the **Fresh Air Fund**
- 12) studies of the logistics of sales force sizing and operations for **Pfizer, Inc.**, a major pharmaceutical company
- 13) a study determining optimal locations and throughput capacities for the distribution network of one of **General Electric's** divisions
- 14) design of multi-echelon inventory planning systems for **Nabisco Brands** (multiple studies over a sequence of years)
- 15) consultant for **Philips Laboratories**; development of computerized planning models for integrated forecasting, production/inventory planning and direct replenishment strategies for Philips Consumer Electronics
- 16) consultant to **North American Philips** to investigate synergies in distribution activities between different NAPC subsidiaries
- 17) statistical analysis of French War-Time Banking System and their restitution policies to Holocaust victims, on behalf of **Goodkind, Lubaton, Ridoff & Sucharow LLP**
- 18) design of matching models for chemical suppliers
- 19) consultant for **NY Times** inventory allocation and pricing strategies
- 20) consultant to **United Bank of Switzerland (UBS)**, verifying statistical analyses underlying Initial Public Offering of new biotechnology company
- 21) consultant to **Seligman Financial Services**, developing estimations and confidence intervals for various return measures
- 22) development of computerized planning systems for **Oil and Gas Executive**, an investment firm specializing in oil and gas leases
- 23) assistance in econometric model building for a study of the cost structure of the Dutch hospitals, undertaken at the request of the **Dutch Secretary of Public Health**

- 24) econometric study of the monetary demand in the Dutch economy, for the **Dutch Central Bank**, in combination with the Economics Department of the Free University of Amsterdam
- 25) assistance in the design of a forecasting model for prices of raw materials, for the **Nederlandse Middenstandsbank**, one of the top five commercial banks in the Netherlands
- 26) statistical assessment of market timing opportunities in global mutual fund investments for **Seligman Financial Services**
- 27) design and control of **ELAL's** North American call center
- 28) Inventory planning models for **Arrow Electronics**
- 29) Simulation studies of variable annuities with lifetime withdrawal guarantees, for **Jackson National Life Insurance**
- 30) Development of large scale aggregate marketing mix optimization models, solution methods and user interfaces, for **Novartis**, 2007-2014.
- 31) Design of decision support tool for auditing strategies to support employee compensation plans, for **Capital IG**.
- 32) Development of planning model for inventories of pharmaceutical samples, for **Pfizer**
- 33) Design of supply chain network design models for **Agro-Farma**, its **Chobani** division.
- 34) Review of statistical analyses to evaluate the effectiveness of a compliance program for pharmaceutical prescriptions, developed by **LDM**, a marketing analytics firm.
- 35) Design of sales force compensation plans for **Orthocon**, a medical therapeutics provider.
- 36) Design of supply chain network design models for **Chobani**, a yoghurt manufacturer/distributor
- 37) Design of supply chain network design models for **Skyrco**, a yoghurt manufacturer/distributor
- 38) Design and evaluation of long-term purchasing agreements in global vaccine supply chains, for **Sanofi Pasteur**.
- 39) Design of procurement policies for Mexican solar panel distributor.
- 40) Design of Production/Distribution System for Icelandic Provisions

Legal Consulting Experience

- 41) Statistical analyses and multiple affidavits submitted as expert witness in class action suit

Bodner et al. vs .Banque Paribas et al , on behalf of **Goodkind, Lubaton, Rudoff & Sucharow LLP.**

- 42) Written testimony to the Committee on Banking and Financial Services of the US House of Representatives, on behalf of **Goodkind, Lubaton, Rudoff & Sucharow LLP.**
- 43) Oral testimony to the Committee on Banking and Financial Services of the US House of Representatives, on behalf of **Goodkind, Lubaton, Rudoff & Sucharow LLP.**
- 44) Statistical analyses and multiple affidavits in support of Plaintiffs in Central Rabbinical Congress Of America and Canada Vs. The New York City Department of Health and Mental Hygiene, District Court of the Southern District of New York; on behalf of **Jones Day, 2013-2015.**
- 45) Consultant to Jones Day in the writing of various briefs submitted on behalf of Plaintiffs in Central Rabbinical Congress Of America and Canada Vs. The New York City Department of Health and Mental Hygiene, Federal Appellate Court , Second Circuit; on behalf of **Jones Day, 2014-2015.**
- 45) Consultant to Mc Kool Smith & Hennigan re GAF/Paramount litigation, 2015.
- 46) Expert witness in The Estate of Arya Singh v. Amazon, Inc. et al.; consultant to Conrad O'Brien, 2016.
- 47) Expert witness in Stiner v. Amazon, Inc. , consultant to Perkins & Coie. 2017
- 48) Expert witness in Bigel vs. Ludwin, Israel
- 49) Expert witness in Young Advocates for Fair Education vs. Andrew Cuomo, Betty Rosa and M.Elia, New York State
- 50) Expert witness in PEARLS et al. vs Betty Rosa and M.Elia, New York State

Editorial Activities

Editor-in-Chief of Naval Research Logistics, 2008- 2018 .

Departmental Editor for Management Science "Manufacturing, Distributions Service Operations" area (1989-2001)

Associate Editor for Operations Research

Senior Editor for MSOM journal "Manufacturing and Service Operations Management" from its inception- 2006.

Professional

Reviewer for Operations Research, Mathematics of Operations Research
 Management Science, Journal of Applied Probability, Advances in Applied
 Probability, SIAM Journal on Control and Optimization, Stochastic
 Processes and its Applications, Networks, Queuing Systems, European Journal of Operations
 Research, Journal of Optimization Theory and its Applications,
 Mathematical Programming, Naval Research Logistics, Manufacturing and Service Operations
 Management

Member of INFORMS

Member of ORSA Lanchester Prize Committee

Publications in Popular Press

Various oped /invited articles in:

Financial Times
 Wall Street Journal;
 Real Clear markets
 Jerusalem Post;
 The Jewish Press;
 The Forward.
 Mishpacha

Publications in Refereed Journals or Proceedings

Dynamic Programming/Markov Decision Processes (D)

- 1) A general Markov decision method I: model and method, Adv. Appl. Prob. 9, 296-316 (1977)
 (with De Leve, G. and H.C. Tijms).
- 2) A general Markov decision method II: applications, Adv. Appl. Prob. 9, 316-336 (1977) (with
 De Leve, G. and H.C. Tijms).
- 3) The rate of convergence for backward products of a convergent sequence of finite Markov
 matrices, Stoch. Proc. and its Appl. 11, 187-192 (1981).
- 4) Discounted and undiscounted value-iteration in Markov decision processes: a survey, in
 "Dynamic Programming and its Applications," (ed. by M. Puterman), Academic Press, New
 York, 23-53 (refereed proceedings) (1978) (with P.J. Schweitzer).
- 5) Nonstationary Markov decision problems with converging parameters, Journal of Optimization
 Theory and its Applications 34, 207-241(1980) (with P.J. Schweitzer).
- 6) A survey of asymptotic value-iteration in undiscounted Markov decision problems, in "Recent
 Developments in Markov Decision Processes," (ed. by R. Hartley, L.C. Thomas and D.J. White),
 Academic Press, London, 73-109 (refereed proceeding) (1980) (with P.J. Schweitzer).

- 7) Successive approximation methods for solving nested functional equations in Markov decision theory, Mathematics of Operations Research 9, 319-345 (1984) (with P.J. Schweitzer).
- 8) A fixed point approach to undiscounted Markov renewal programs, SIAM Journal on Algebraic and Discrete Methods, 5, 539-551 (1984) (with P.J. Schweitzer).
- 9) The optimality equation in average cost denumerable state semi- Markov decision problems, recurrency conditions and algorithms, J. Appl. Prob. 15, 356-374 (1978) (with H.C. Tijms).
- 10) A new specification of the multi-chain Policy Iteration Algorithm in undiscounted Markov renewal programs, Management Science 26, 1211-1217 (1980) (with D. Spreen).
- 11) Recurrence conditions in denumerable state Markov decision processes, in "Dynamic Programming and its Applications," (edited by M. Puterman), Academic Press, New York, 3-23 (referred proceedings) (1979) (with A. Hordijk and H.C. Tijms).
- 12) A note of simultaneous recurrence conditions on a set of denumerable stochastic matrices, J. Appl. Prob. 15, 842-847 (1978) with A. Hordijk and H.C. Tijms).
- 13) Denumerable state semi-Markov decision processes with unbounded costs, average cost criterion, Stochastic Processes and their Applications 9, 223-235 (1979) (with A. Hordijk and H.C. Tijms).
- 14) Contraction mappings, underlying undiscounted Markov decision problems, Journ. Math. Anal. Appl. 65, 711-730 (1978) (with P.J. Schweitzer and H.C. Tijms).
- 15) Denumerable undiscounted semi-Markov decision processes with unbounded rewards, Mathematics of Operations Research 8, 298-314 (1983) (with P.J. Schweitzer and H.C. Tijms).
- 16) Functional equations of undiscounted Markov renewal programming, Math.of O.R. 3, 308-322 (1978) (with P.J. Schweitzer).
- 17) The asymptotic behavior of undiscounted value-iteration in Markov decision problems, Math. of Op. Res. 2, 360-382 (1976) (with P.J. Schweitzer).
- 18) Geometric convergence of value-iteration in multichain Markov decision problems, Adv. Appl. Prob. 11, 188-217 (1979) (with P.J. Schweitzer).
- 19) Foolproof convergence in multichain policy iteration, Journ. Math. Anal. Appl. 64, 360-368 (1978) (with P.J. Schweitzer).
- 20) Variational Characterizations in Markov decision problems, J. Math Anal. Appl. 117, 326-357 (1986) (with P.J. Schweitzer).
- 21) Ergodicity in parametric non-stationary Markov chains; an applica- tion to simulated annealing methods, Operations Research 35 867-874 (1987) (with S. Anily)

- 22) Fast solution and detection of minimal forecast horizons in dynamic programs with a single indicator of the future: applications to dynamic lotsizing models (with M. Tzur) (1995), Management Science **41**, 874-894.
- 23) Detection of minimal forecast horizons in dynamic programs with multiple indicators of the future (with M. Tzur) (1996), Naval Research Logistics **43**, 169-191.
- 24) The value-iteration method for countable state Markov Decision Processes (with Y. Aviv) Operations Research Letters **24** (1999), 223-234.
- 25) Time Partitioning Heuristics: Application to One Warehouse, Multi-Item, Multi-Retailer Lot Sizing Problems, Naval Research Logistics **46**, 463-486 (with M. Tzur).

Game Theory and Oligopoly Models (G)

- 26) On N-person stochastic games with denumerable state space, Adv. In Appl. Prob. **10**, 452-572 (1978).
- 27) On the functional equations in undiscounted and sensitive discounted stochastic games, Zschr. f. Operations Research **24**, 243-262 (1980).
- 28) Successive approximation methods in undiscounted stochastic games, Operations Research **28**, 794-810 (1980).
- 29) Comparative Statics, Strategic Complements and Substitutes in Oligopolies (with F. Bernstein) to appear in Journal of Mathematical Economics.

Queueing Models (Q)

- 30) AN M/G/c queue in which the number of servers required is random, J. Appl. Prob., **21**, 583-602 (1984) (with L. Green).
- 31) The computation of the stationary distribution of the queue size in an M/G/1 queueing system with variable service rate, J. Appl. Prob. **17**, 515-523 (1980) (with H.C. Tijms).
- 32) Approximations for the steady-state probabilities in the multi-server M/G/C queue, Adv. Appl. Prob. **13**, 186-206 (1981) (with H.C. Tijms and M. van Hoorn).
- 33) Queueing systems with service interruptions (with L. Green) Operations Research **34**, 752-769 (1986).
- 34) On the impact of the composition of the customer base in general queueing systems J. Appl. Prob. **24**, 709-724 (1987) (with H. Groenevelt).
- 35) Characterization and Control of Achievable Performance in General Queueing Systems, Operations Research **36**, 733-741 (1988) (with H. Groenevelt).

- 36) M/G/c queueing systems with multiple customer classes: characterization and control of achievable performance, Management Science **34** (1988) with H. Groenevelt).
- 37) Optimal time to repair a broken server (with K. So) (1989) Advances of Applied Probability **21**, 376-397.
- 38) Queueing systems with service interruptions II, Naval Research Logistics **35**, 345-358 (1988) (with L. Green).
- 39) Optimal maintenance policies for single server queueing systems subject to breakdown (1990) (with K. So), Operations Research, **38**, 330-344.
- 40) Optimality of threshold policies in single server queueing systems with server vacations (1991) (with K. So) Adv. Appl. Prob., **23**, 388-405.
- 41) Approximating Queue Size and Workload Distributions in General Polling Systems. (1994) (with Z. Katalan). Queueing Systems, **48**, 353-386.
- 42) The impact of set-up times on the performance of multi-class service and production systems (1996) (with Z. Katalan) Operations Research **44**, 989-1001.
- 43) Mass Vaccination: Can It be Done in Time? Completion Times in Queueing Systems (with M. Kress) (cond. accepted by Operations Research).

Inventory Models (I)

- 45) Solution techniques for some allocation problems, Columbia University Graduate School of Business, Mathematical Programming **25**, 13-24 (1983) (with P. Zipkin).
- 46) Approximation of dynamic, multi-location production and inventory problems, Management Science **30**, 69-84 (1984) (with P. Zipkin).
- 47) Computational issues in an infinite-horizon, multi-echelon inventory model, Operations Research **32**, 818-836 (1984) (with P. Zipkin).
- 48) An efficient algorithm for computing optimal (s,S) policies, Operations Research, **32**, 1268-1286 (1984) (with P. Zipkin).
- 49) Allocation policies and cost approximation for multilocation inventory systems, Naval Research Logistics Quarterly **31**, 97-131 (1984) (with P. Zipkin).
- 50) Coordinated replenishments in a multi-item inventory system with compound Poisson demands and constant lead times, Management Science **30**, 344-357 (1984) (with H. Groenevelt and H.C.Tijms)
- 51) Cost formulae for continuous review inventory models with fixed delivery lags, Operations Research **31**, 957-965 (1983) (with Z. Schechner).

- 52) Computing optimal (s,S) policies in inventory models with continuous demands, (with P. Zipkin) (1985) Advances of Applied Prob. 17, 424-443.
- 53) An inventory model with limited production capacity and uncertain demands I: the average cost criterion, (1986) (with P. Zipkin) Math. of Oper. Research 11, 193-207.
- 54) An inventory model with limited production capacity and uncertain demands II: the discounted cost criterion, (1986) (with P. Zipkin) Math. of Oper. Research 11, 208-215.
- 55) Methodologies for evaluation and control of large scale production/ distribution systems under uncertainty, in "Shell Conference on Logistics: Where ends have to meet," Pergamon Press, (1989).
- 56) The joint replenishment problem with general joint cost structures: general solution methods and performance bounds (with Y.S. Zheng) Operations Research 40, 348-404.
- 57) Finding optimal (s,S) policies is about as simple as evaluating a single policy (with Y.S. Zheng) Operations Research 39, 654-666 (1991).
- 58) Capacitated two-stage multi-item production/inventory model with joint setup costs (1991) (with S. Anily) Operations Research 39, 443-456.
- 59) Simple power of two policies are close to optimal in a general class of production/distribution networks with general joint setup costs (with M. Queyranne and Y. S. Zheng) (Math. Operations Research).
- 60) The dynamic lot size model with quantity discount (1990) (with C. Lee), Naval Res. Logistics, 37, 707-713.
- 61) Centralized planning models for multi-echelon inventory systems under uncertainty (to appear as Chapter 4 in Handbook in Operations Research and Management Science, Vol. 4: Logistics of Production and Inventory, to be published by North Holland, eds., S. Graves, A. Rinnooy Kan and P. Zipkin) (1993).
- 62) A simple and efficient algorithm for computing optimal (r,Q) policies in continuous-review stochastic inventory systems (with Y.S. Zheng) Operations Research 40, 808-813.
- 63) A simple forward algorithm to solve general dynamic lot sizing models with n periods in $O(n \log n)$ or $O(n)$ time (with M. Tzur) Management Science 37, 909-925 (1991).
- 64) The dynamic lot sizing model with backlogging: a simple $O(n \log n)$ algorithm and minimal forecast horizon procedure (with M. Tzur) Naval Research Logistics, 40 (1993), pp. 459-479.
- 65) Minimal forecast horizons and a new planning procedure for the general dynamic lotsizing model: nervousness revisited (with M. Tzur) (1994) Operations Research. 42, 456-469.
- 66) Optimal power-of-two replenishment strategies in capacitated general production/distribution networks (with Y.S. Zheng). Management Science. (1993). 39, pp. 710-728.

- 67) Characterization and efficient computation of optimal policies for general inventory systems endogenously supplied by a single server production facility (with Y. Zheng). (1993). Probability in the Engineering and Informational Sciences, 7, pp. 257-272.
- 68) The Joint Replenishment Problem with time-varying parameters: efficient, asymptotic and ϵ -optimal solutions (with M. Tzur) (1994). Operations Research. 42, 1067-1087.
- 69) Multilocation Inventory Systems with Transshipments in Response to Stockouts (with R. Klein) (conditionally accepted for Management Science).
- 70) Efficient algorithms for finding optimal power-of-two policies for production/distribution systems with general joint setup costs (with Y.S. Zheng), 1995. Operations Research 43, 458-470.
- 71) The stochastic economic lot scheduling problem cyclical base-stock policies with Idle Times (1996) (with Z. Katalan) Management Science 42, 783-796.
- 72) Customer waiting time distributions under base-stock policies in single facility multi-item production systems (with Ziv Katalan) (1996), Naval Research Logistics 43, 533-549.
- 73) Stochastic Inventory Models with Limited Production Capacity and Periodically Varying Parameters (with Y. Aviv) (1996) Probability in the Engineering and Information Sciences 11,107-135.
- 74) Determining Production Schedules under Base-Stock Policies in Single Facility Multi-Item Production Systems (with Ziv Katalan) Operations Research 46 (1998), 883-898.
- 75) Capacitated Multi-Item Inventory Systems with Random and Fluctuating Demands: Implications for Postponement Strategies, Management Science 47, (2001), 512-531 (with Y. Aviv).
- 76) The Impact of Adding a Make-to-Order Product Line to a Make-to- Stock Productive System, Management Science 45 (1999), 980-994 (with Z. Katalan).
- 77) Progressive Interval Heuristics for the Multi-Item Capacitated Lot Sizing Problem (with J. Meissner and M. Tzur) (2007), Operations Research 55, pp. 490-502
- 78) Selecting a Portfolio of Suppliers under Demand and Supply Risks(with N. Yang) (2007), Operations Research
- 79) Optimal Supply Diversification under General Supply Risks (with N.Yang) (2009), Operations Research 57, pp.1461-1468.
- 80) Procurement Strategies with Unreliable Suppliers (with N.Yang) (2009), Operations Research 59, pp.1033-1039
- 81) Infinite Horizon Strategies for Replenishment Systems with a general Pool of Suppliers, (with N.Yang), Operations Research.
- 82) Monotonicity properties of stochastic inventory systems, (with M.Wang), Annals of Operations Research.

- 83) Supply Chain Management under Simultaneous Supply and Demand Risks (with N.Yang), in Supply Chain Disruptions; Theory and Practice of Managing Risk (2011), Springer Verlag, London.
- 84) Inventory Models with Shelf Age and Delay Dependent Inventory Costs, (with M.Wang) Operations Research.
- 85) A continuous review Model with General Shelf Age and delay Dependent Inventory Costs, (with M.Wang) Probability in the Engineering and Informational Sciences.
- 86) Two-Echelon Distribution Systems with Random Demands and Storage Constraints (with D. Guetta and G. Iyengar), to appear in Naval Research Logistics.
- 87) A Synthesis and Generalization of Structural Results in Inventory Management (with Z. Liu and L. Lu), to appear in Mathematics of Operations Research.

Supply Chain Design (SD)

- 88) The Benefits of Design for Postponement in "Qualitative Models for Supply Chain Management" (eds. S. Tayur, R. Goneshan and M. Magazine) (1999), 553-585 (with Y. Aviv).
- 89) Design for Postponement: A comprehensive Characterization of its Benefits under Unknown Demand Distributions (2001), Operations Research 49, 578-598 (with Y. Aviv).
- 90) Delayed Product Differentiation via Optimal Process Sequencing (under second review for Manufacturing and Science Operations Management).
- 91) Supply Chain Analysis of Contract Farming (with U. Lall and S. Simsek), to appear in M&SOM.

Combined Vehicle Routing/Inventory Control Models (RI)

- 92) A combined vehicle routing and inventory allocation problem, Operations Research, 32, 1019-1038 (1984) (with P. Zipkin).
- 93) An allocation and distribution model for perishable products, (1986) (with G. Prastacos and P. Zipkin), Operations Research 34, 75-83.
- 94) A class of Euclidean routing problems with general route cost functions (1990) (with S. Anily), Mathematics of Operations Research, 15, 268-285.
- 95) One warehouse multiple retailer systems with vehicle routing costs, (1990) (with S. Anily) Management Science, 36, 92-115.
- 96) Rejoinder to "Comments on 'One warehouse multiple retailer systems with vehicle routing costs'" (1991) (with S. Anily), Management Science, 37, 1497-1499.
- 97) Two-echelon Distribution Systems with Vehicle routing Costs and Central Inventories (with S. Anily). Operations Research, 41, pp. 37-48.

- 98) Analytical analysis of vehicle routing and inventory routing problems (with D. Simchi-Levi), Chapter 4 in "Handbooks in Operations Research and Management Science," Vol. 8: Network Routing (eds. M. Ball, T. Magnanti, C. Monma and G. Nemhauser), North Holland, Amsterdam (1995).
- 99) Probabilistic analysis of a generalized bin packing problem and applications to the capacitated vehicle routing problem with time windows (with G. van Ryzin) Operations Research.
- 100) Probabilistic Analysis and Practical Algorithms for inventory routing problems (with A. Chan and Simchi-Levi) Operations Research.
- 101) Probabilistic Analysis of a Combined Partitioning and Math Programming Heuristic for a General Class of Vehicle Routing and Scheduling Problems (with Garrett Van Ryzin, Management Science).

Resource Allocation Models (RA)

- 102) The Greedy Procedure of Resource Allocation Problems: Necessary and Sufficient Conditions for Optimality, (with H. Groenevelt) Operations Research, 34, 909-919 (1986).
- 103) Optimal flows in networks with multiple sources and sinks; applications to oil and gas lease investment programs (1986) (with H. Groenevelt) Operations Research, 34, 218-226.
- 104) Polymatroidal flow network models with multiple sinks (with H. Groenevelt) Networks, 18, 285-302 (1988).

Production Scheduling (PS)

- 105) Preemptive scheduling of uniform machines with release times and due dates, (1986) (with H. Groenevelt) Management Science, 32, 341-349.
- 106) Simultaneous Optimization of Efficiency and Performance Balance Measures in Single Machine Scheduling Problems. (1993). (with G. Mosheiov), Naval Research Logistics, 40, pp. 951-971.
- 107) Greedy heuristics for single machine scheduling problems with general earliness and tardiness costs. (1994). (with G. Mosheiov), Operations Research Letters 16, 199-209.
- 108) Scheduling problems with general breakdowns, earliness and tardiness costs (1996) (with G. Mosheiov), Operations Research 45, 66-71.
- 109) Multi-machine scheduling problems with earliness and tardiness cost structures (1996) (with G. Mosheiov), Management Science 42, 1544-1555.
- 110) Heuristics for Multi-Machine Minmax Scheduling Problems With General Earliness and Tardiness Costs (with Gur Mosheiov) (1996) Naval Research Logistics 44, 287-299.

Operations/Marketing Interfaces (OM)

- 111) Combined Pricing and Inventory Control under Uncertainty (with A. Heching) Operations Research 47, pp. 454-475.
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- S2 A Matching Problem in the Talmud (single authored).
- S3 The Price and Variety Effects of Vertical Mergers (with M. Hu).
- S4 Log-Concave Leadtime Demand Distributions: General Conditions and Implications for Optimizing Procurement Strategies (with F. Badia and C. Sanguesa).
- S5 Multi-tem Two Echelon Distribution System with Random Demands: Bounds and Effective Strategies (with D. Guetta and G. Iyengar).
- S6 Price Competition Based on Relative Prices (with L. Lu).
- S7 Inventory Subsidy versus Supplier Trade Credit in Decentralized Supply Chains (with M. Wang).
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- Book: "Modeling Competition and Coordination in Supply Chains and Service Networks" (to be

published by Princeton University Press)

- (Q) Design and Control of an Airline's Call Center (with G. Allon)
- (OM) The dynamics of market equilibria under combined price-and-service competition.
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- (RI) Hierarchical Distribution Modeling with Routing Costs (with B.J. Lageweg).
- (I) Integrating Inventory Control and Production Scheduling (with H. Groenevelt).
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- (C) On interrupted Markov processes (with H. Groenevelt).
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- (1) H. Groenevelt (1984), "Resource Allocation Problems with Decreasing Marginal Returns to Scale," currently at the Graduate School of Management, University of Rochester, Rochester, N.Y.
- (2) S. Anily (1986), "Infinite Horizon Combined Routing and Inventory Replenishment Strategies," currently at Recanati Business School, Tel-Aviv University, Israel.
- (3) S. Zheng (1987), "Replenishment strategies for production/distribution networks with general joint setup costs," currently at Wharton School, University of Pennsylvania, Philadelphia, PA.
- (4) R. Klein (1990), "Dynamic multilocation inventory problems with transshipments," currently at AT&T Bell Laboratories, Holmdel, NJ.
- (5) G. Mosheiov (1990), "Balancing earliness and tardiness cost structures in production scheduling: a Just-in-Time Approach," currently at Hebrew University, Jerusalem.
- (6) M. Tzur (1992), "A new planning approach for single- and multi-item dynamic lotsizing models," currently at Tel-Aviv University, Tel-Aviv, Israel.
- (7) I. Kamara, (1983) "Dynamic Routing and Replenishment Strategies under Demand Uncertainties".
- (8) Z. Katalan, (1995) "Production and Service Management under Setup Times and Uncertainties", currently at Wharton School, University of Pennsylvania.
- (9) R. Marerro (1997), "An Integrated Model for Check Collection and Check Processing: Theory and Implementations".
- (10) Y. Aviv (1997), Capacitated Stochastic Inventory Systems: Implications for Product Design,

currently at Washington University at St. Louis, Olin School.

- (11) A. Heching (1999), Combined Pricing and Inventory Central Under Demand Uncertainty, currently at IBM Thomas J. Watson Research Center.
- (12) F. Bernstein (2001) Coordination Mechanisms and Equilibrium Performance in Supply Chains with Retailer Competition, currently at Fuqua School of Duke University.
- (13) J. Meissner (2004) Multi-Item Supply Chain and Revenue Management Problems, currently at Lancaster University, England.
- (14) G. Allon (2005) Competition in Service Industries, currently at the Kellogg School of Management, Northwestern University.
- (15) N. Yang (2006) Supply Risks in Supply Chain Management , currently at the Olin School, Washington University at St Louis.
- (16) M.Hu (2008), currently at the Rotman School, University of Toronto.
- (17) M.Wang (2012), currently at The Lebow College of Business, Drexel University.
- (18) M.Pierson, currently at the Tuck School of Business, Dartmouth College.
- (19) L. Lu 2015, Goldman Sachs
- (20) D., Guetta 2016, Paentir, now on the faculty of Columbia Business School,
- (21) Z. Liu 2018. Imperial College, England.

Recent Presentations/Seminars (with coauthors)

INFORMS Conferences,
Key Note Speaker at POMS Hong Kong Conference,

Columbia University
MIT
Stanford University
Wharton School
Duke University
University of British Columbia
INSEAD
London School of Economics
Cornell University
Washington University at St. Louis
Northwestern University
University of Michigan
Dartmouth
Tel-Aviv University
Hebrew University
U. North Carolina
Universidad Di Tella
Technion
IMS Institute
IBM Thomas J. Watson Research Center
Supply Chain Thought Leaders Roundtable
Revenue Management Conference