Teaching Statement

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As an academic teacher my educational goal is briefly described as follows: my teaching philosophy places emphasis on good understanding of concepts and fundamentals, as well as their practical meaning. This is of major importance in order my students to be able to understand how they will apply theory into applications. The ultimate objectives of my courses is to assure that students become competent with their problem-solving skills.

To stimulate the students interest and mathematical insight, my approach to giving lectures goes through first explaining the intuitive meaning of the results presented, while elaborating on the logic underlying the arguments in the proof. Coming forth naturally, when I introduce a new task it is important (as an applied mathematician) to devote the first part of a lecture to a good application example to enhance students motivation. Then, the main part of the lecture is devoted to presenting formal mathematical proofs and elucidating subtleties involved in making these arguments rigorous.

1 Indicative Teaching Topics with Bibliography

1. **Introduction to Stochastic Processes (Undergraduate Level)**

   - Durret, R. (2012). Essentials of Stochastic Processes. Springer.
   - Ross, S. (1997). Introduction to Probability Models, Academic Press, New York, .
   - Norris, J. (1998). Markov chains. Cambridge university press.
   - Lawler, G. (2006). Introduction to stochastic processes. CRC Press.
   - Kulkarni, V. G. (2010). Modeling and Analysis of Stochastic Systems, CRC Press, London.
   - Karlin, S. & Taylor, H.M. (1976). A first course in stochastic processes, Academic Press, New York.
   - Grimmett, G., & Stirzaker, D. (2001). Probability and random processes. Oxford UP.

2. **Advanced Stochastic processes (Graduate Level)**

   - Whitt, W. (2002). Stochastic-Process Limits. Springer, New York.

- Bremaud, P. (2013). Markov chains: Gibbs fields, Monte Carlo simulation, and queues. Springer.
- Morters, P., & Peres, Y. (2010). Brownian motion. Cambridge UP.
- Serfozo, R. (2009). Basics of Applied Stochastic Processes. Springer.
- Ross, S. (1996). Stochastic processes. John Wiley & Sons
- Cinlar, E. (1975). Introduction to Stochastic Processes. Prentice-Hall, Englewood Cliffs, N.J.
- Karlin, S., & Taylor, H. (1981). A second course in stochastic processes. Academic Press, New York.

3. **Queueing Systems (Undergraduate Level)**

- Gross, D. & Harris, C. M. (1985) Fundamentals of Queueing Theory, Wiley, New York.
- Kelly, F.P. (1979). Reversibility and Stochastic Networks. Wiley, New York.
- Cohen, J.W. (1982). The Single Server Queue. North-Holland, Amsterdam.
- Kleinrock, L. (1975). Queueing Systems, Vol. I: Theory. Wiley, New York.
- Medhi, J. (2003). Stochastic Models in Queueing Theory, Academic Press.
- Gautam, N. (2012). Analysis of Queues, Methods and Applications. CRC Press.
- Haviv, M. (2013). Queues, A course in Queueing Theory. Springer, New York.

4. **Advanced Queueing Theory (Graduate Level)**

- Networks of queues
  Sample topics: reversibility, output theorem, tandem networks, partial balance, product-form distribution, blocking, insensitivity, BCMP networks, mean-value analysis, Norton's theorem, sojourn times.
- Analytical-numerical techniques
  Sample topics: matrix-analytic methods, compensation method, power-series algorithm, error bound method, approximate decomposition method, boundary value problems.
- Priority and vacation queueing models
- Polling systems
  Sample topics: cycle times, queue lengths, waiting times, conservation laws, service policies, visit orders.
- Asymptotic Methods in Queueing Theory
  Sample topics: Large deviations and tail asymptotics, Heavy-traffic analysis, Perturbation analysis and time scale separation, Fluid and diffusion limits.

Textbooks: Material will draw upon

- Kelly, F.P. (1979). Reversibility and Stochastic Networks, Wiley, 1979.
- Nelson, R. (1995). Probability, Stochastic Processes & Queueing Theory, Springer.
- R.W. Wolff, Stochastic Modeling and the Theory of Queues, Prentice-Hall, 1989.
- Latouche, G., Ramaswami, V. (1999). Introduction to Matrix Analytic Methods in Stochastic Modeling, SIAM, Philadelphia.
- Neuts, M. (1981). Matrix-geometric solutions in stochastic models, An algorithmic approach, Dover, NY.
- P. Whittle, Partial balance and insensitivity, J. Appl. Prob. 22 168-176 (1985)
- van Dijk, N.M. (1998). Bounds and error bounds for queueing networks, Ann. Oper. Res, 79 295-319.
- Adan, I, Wessels, J., Zijm, W. (1990). Analysis of the symmetric shortest queue problem. Stochastic Models, 6 691–713.
- Boxma, O., van Houtum, G. (1993). The compensation approach applied to a 2x2 switch, Prob. Inf Sci 7 471-493.
- Borst, S. (1996). Polling Systems, CWI: Tract.
- Fuhrmann, S.W., Cooper, R. (1985). Stochastic Decomposition in the M/G/1 Queue with Generalized Vacations. Operations Research, 33 1117-1129.
- Resing, J. (1993). Polling systems and multitype branching processes, Queueing Systems 13 409 - 426.
- Shwartz, A., Weiss, A. (1995). Large Deviations for Performance Analysis. Chapman & Hall.
- Takagi, H. (1991). Queueing analysis. Vacation and priority systems, part 1. North-Holland, Amsterdam.
- A. Dembo, O. Zeitouni (1998). Large Deviations Techniques and Applications. Springer, Berlin.
- A. Ganesh, N. OConnell, D. Wischik (2004). Big Queues. Springer, Berlin.

5. **Stochastic Models in Operations Research (Graduate Level)**

- Gross, D. & Harris, C.M. (1985). Fundamentals of Queueing Theory, Wiley, NY.
- Kleinrock, L. (1975). Queueing Systems, Theory, vol. 1, Wiley, New York.
- Medhi, J. (2003). Stochastic Models in Queueing Theory, Academic Press, NY.

- White, D.J. (1993). Markov decision processes, John Wiley & Sons, Chichester, UK.
- Hillier, F., Libermann, G. (2001). Introduction to Operations Research, 7th Edition, McGrawHill.
- Asmussen, S., Albrecher, H. (2010). Ruin probabilities, 2nd edition, World Scientific, Singapore.

6. **Strategic behavior in queues (Short course-Graduate level)**

   Sample topics

   - Introduction in strategic behavior in queues: Unobservable and observable queueing models, strategy profiles, to avoid or to follow the crowd, Nash equilibrium, social optimization, the price of anarchy.
   - Examples: to queue or not to queue, priority purchasing, retrials and abandonment, server selection.
   - Competition between servers: price war, capacity competition, discipline competition.
   - When to arrive to a queue so as to minimize waiting and tardiness costs? Examples: Poisson number of arrivals, fluid approximation.

   Textbooks: Material will draw upon

   - Armony, M., Haviv, M. (2003). Price and delay competition between two service providers, European Journal of Operational Research 147 32-50.
   - Anily, S., Haviv, M. (2010). Cooperation is service systems, Operations Research 58 660-673.
   - Hassin, R., Haviv, M. (2003). To queue or not to queue: Equilibrium behavior in queues. Kluwer Academic Publishers, Boston.

7. **Service Engineering (Graduate Level)**

   Sample Topics:

   - Introduction to service systems and queues (people, telephone calls, forms, projects, etc.)
   - Analytical models, simulation, approximations (fluid and diffusion): How to use them as tools to support strategic, tactical and operational decisions.
   - Measuring methods in face-to-face and computerized systems.
   - Phenomena: Economies-of-scale, PASTA, Biased-sampling, expertise vs. cross-training, etc.
   - Forecasting methods and demand management in service systems. For example: forecasting of number of calls to a call center.

- Stability of service systems.
- Operational quality of service. Planning of service systems. For example: staffing of call centers.
- Multi-disciplinary aspects: Operations research, Industrial Engineering, Statistics, Psychology, Marketing. For example: Analysis of customer patience during waiting for service.
- Design and control of queueing systems.
- Implementation in various systems: emphasis on the interface of the customers to the system in face-to-face services and call centers.

Textbooks: There is No Required Textbook, but we will draw upon:

- Hall, R.W. (1991). Queueing Methods for Services and Manufacturing. Prentice-Hall.
- Fitzsimmons, J.A. (2004). Service Management: Operations, Strategy, and Information Technology, McGraw Hill, 4th Edition.
- Whitt, W. (2002). Stochastic-Process Limits. Springer, New York.
- Gans, N., Koole, G., Mandelbaum, A. (2003). Telephone Call Centers: Tutorial, Review and Research Prospects. Manufacturing and Service Operations Management 5 (2) 79-141.
- Brown, L., Gans, N.,Mandelbaum, A., Sakov, A., Zeltyn, S.,Zhao, L., Haipeng, S.(2005). Statistical Analysis of a Telephone Call Center: A Queueing-Science Perspective. JASA 100 (465) 36-50.
- Newell, G.F. (1982). Applications of Queueing Theory, 2nd edition, Chapman and Hall.
- Whitt, W.(2017). Time-varying queues. Queueing Models and Service Management, forthcoming.
- Whitt, W., Zhang, X. (2017). A data-driven model of an emergency department, Operations Research for Health Care 12 1-15.

8. **Stochastic Decision Theory (Graduate Level)**

   Sample Topics:

   - Markov Decision Processes.
   - Stochastic Programming.
   - Martingales.
   - Multi-Armed Bandits and the Gittins Index.
   - Semi-Markov decision process.

   Textbooks: There is No Required Textbook, but we will draw upon:

- Derman, C. (1970). Finite State Markovian Decision Processes. Academic Press, New York.
- Howard R.A. (1960). Dynamic Programming and Markov Processes. Wiley, New York.
- Putterman, M. (1994). Markov Decision Processes: Discrete Stochastic Dynamic Programming. Wiley, New York.
- Ross, S.M. (1992). Applied Probability Models with Optimization Applications. Dover, Mineola (NY).
- Prekopa, A. (1995). Stochastic Programming, Kluwer, Dordrecht, Boston.
- Gittins, J., Glazebrook, K., Weber, R. (2011) Multi-Armed Bandit Allocation Indices, 2nd Edition, Wiley, NY.