

# DISSERTATION DEFENSE

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## **Applications of Stochastic and Queueing Models to Operational Decision Making**

An operations manager makes operational decisions in the face of a, by definition, uncertain future. In this thesis we develop tools that can improve the quality of operational decision making by modeling the stochastic environment and analyzing the trade-offs that the operations manager faces within this environment.

The question of how to best leverage technology is fundamental to almost any industry. Natural resources producers have the option to pause production. Using real data from EQT Corp. we analyze the interaction between the real options to scale technology and the extraction rate. We find that the values of these options are highly interdependent and their optimal use is rather complex. We bring to light data-driven managerial principles guiding the use of these options.

Prioritizing demand streams is common in inventory management. In many settings (e.g. a central warehouse), some demands can be backordered while others are lost when not immediately satisfied. A critical level (CL) policy reserves some inventory for future high priority demand by backordering current, lower priority, demands. We develop an efficient algorithm to find the optimal CL policy and compare the performance to the globally optimal policy. We find that although the CL policy performs (slightly) worse, it is almost insensitive to variations in the lead time distribution.

Emergency Department (ED) demand for care is by its very nature hard to predict accurately. As ED capacity is regularly outstripped by demand, EDs attempt to decrease the inflow of patients during such periods of "crowding". We use real data to model the Pittsburgh (PA) EMS system and evaluate the impact of several coordination mechanisms on the timeliness of care and hospital revenues. We find that coordination mechanisms in which hospitals share certain indicators with EMS crews can significantly outperform the coordination mechanisms currently used in practice in term of quality of care, without being detrimental to hospital revenues.