

Stochastic Networks: EE 752, Topics in Signal Processing: Spring  
2006

**Summary:** The aim of this course is to introduce the stochastic models that have been found useful in representing complex networks such as occur in computer and communication systems. These stochastic models provide the means for evaluating the performance of the real networks that they represent. Often referred to as queueing networks, the simplest of these models lead to closed form solutions that have a “product form”. A determination of whether or not a practical system will have product form depends on concepts of balance in the system which are to be studied extensively. In many practical applications, however, blocking occurs in the network and disrupts this balance leading most often to non-product form networks that will also be studied. Non-product networks are generally evaluated by either using simulation or with approximate analytical methods. Stochastic Petri nets and semi-Markov networks widen the range of applications by providing less restrictive modelling assumptions and are among the topics that will round out the course.

**Outline of Topics:**

Review of Markov chains in discrete and continuous time  
Single Markovian queueing systems  
Balance, reversibility, and “product form” solutions  
    Open Jackson networks  
    Closed networks  
    BCMP generalizations  
Sojourn Times and Flows in Networks  
Non-product form systems and their solutions  
Networks with Blocking  
    with product form  
    with non-product form  
Numerical and approximate solutions to non-product form networks  
Stochastic Petri nets  
Semi-Markov stochastic networks

**Class Time:** Monday 1:10-2:25 pm Engineering B105  
Wednesday 3:45-5 pm Statistics 006

**Instructor:** Ronald Butler, Professor of Statistics, 212 Statistics Bldg.  
491-5762, walrus@stat.colostate.edu

**Primary Text (optional):**

Van Dijk, N.M. (1993). *Queueing Networks and Product Forms: A Systems Approach*. J. Wiley, NY

**Additional Texts (even less optional):**

Kelly, F.P. (1979). *Reversibility and Stochastic Networks*. J. Wiley, NY  
Available for download from

[http://www.statslab.cam.ac.uk/~frank/BOOKS/kelly\\_book.html](http://www.statslab.cam.ac.uk/~frank/BOOKS/kelly_book.html)

Perros, H.G. (1994) *Queueing Networks with Blocking*. Oxford University Press, New York.

Disney, R.L. and Kiessler, P.C. (1987). *Traffic Processes in Queueing Networks; A Markov Renewal Approach*. The Johns Hopkins University Press, Baltimore.

**Prerequisites:** ST520 or an equivalent course; a basic knowledge of Markov chains and/or ST521 would be useful but is not required

**Course Grading:** 4-5 homework assignments and course projects to be outlined later.