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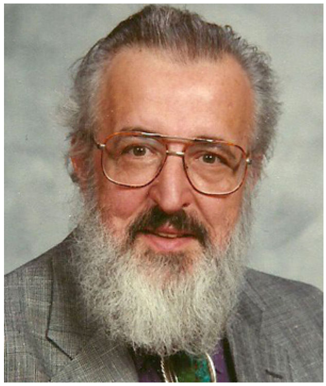
OBITUARY: MARCEL F. NEUTS 1935–2014



Marcel F. Neuts 1935–2014

Marcel Neuts died in his home in Tucson, Arizona, on 9 March 2014. He was born in Belgium on 21 February 1935, and received his school and undergraduate education in Belgium before moving to Stanford University for his Masters (1958–1959) and PhD (1959–1960), supervised by Samuel Karlin. His main academic appointments were at Purdue University (1962–1976), University of Delaware (1976–1985), and The University of Arizona from 1985 until his retirement in 1996.

Marcel Neuts' early papers from the 1960s largely deal with questions from classical applied probability and incorporate topics such as game theory, extreme value theory, and Markov renewal methods. Two keywords for his later work are *structure* and *computability*. His first major contribution in these directions was the formulation of the concept of phase-type (PH) distributions, the pioneering paper being [3]. Here a PH random variable T is defined in terms of a finite continuous-time Markov process $J(t)$ with one absorbing state Δ, with $T = \inf\{t > 0\colon J(t) = \Delta\}$ the time to absorption in Δ. This framework comprises examples such as the mixture or convolutions of p exponentials (of which there is an abundance of examples in earlier literature with $p = 2$) and many more general ones. Two main advantages are denseness (any distribution on $(0, \infty)$ can be approximated arbitrarily well in the weak sense by a PH distribution with sufficiently large p); and computational tractability in applications. Initially, the applications were mainly in queueing, but PH distributions have later appeared in many other areas.

The motivation for this work came to a large extent from Marcel Neuts' interest in queues with semi-Markov services or arrivals. With PH assumptions, these can be viewed as countable state Markov chains/processes $(L(t), J(t))$ with transition matrices/generators of a special block structure of one of the following forms:

$$\underset{\text{GI/M/1 type}}{\begin{pmatrix} \boldsymbol{B}(0) & \boldsymbol{F}(1) & \boldsymbol{0} & \boldsymbol{0} & \cdots \\ \boldsymbol{B}(1) & \boldsymbol{F}(0) & \boldsymbol{F}(1) & \boldsymbol{0} & \cdots \\ \boldsymbol{B}(2) & \boldsymbol{F}(-1) & \boldsymbol{F}(0) & \boldsymbol{F}(1) & \cdots \\ \boldsymbol{B}(3) & \boldsymbol{F}(-2) & \boldsymbol{F}(1) & \boldsymbol{F}(0) & \cdots \\ \vdots & & & & \ddots \end{pmatrix}}, \qquad \underset{\text{M/G/1 type}}{\begin{pmatrix} \boldsymbol{A}(0) & \boldsymbol{A}(1) & \boldsymbol{A}(2) & \boldsymbol{A}(3) & \cdots \\ \boldsymbol{F}(-1) & \boldsymbol{F}(0) & \boldsymbol{F}(1) & \boldsymbol{F}(2) & \cdots \\ \boldsymbol{0} & \boldsymbol{F}(-1) & \boldsymbol{F}(0) & \boldsymbol{F}(1) & \cdots \\ \boldsymbol{0} & \boldsymbol{0} & \boldsymbol{F}(-1) & \boldsymbol{F}(0) & \cdots \\ \vdots & & & & \ddots \end{pmatrix}}.$$