



Department of Mathematics, Statistics and Computer Science

Presents

**Aging as a process of deficit accumulation, its assessment in
individuals and populations: mathematical models**

by

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The Gerald Schwartz School of Business

Bergengren Credit Union Lecture Hall (SCHW 290)

I will start from the Gompertz law of mortality (1825) showing exponential increase in death rate (risk of death) with age. Then I discuss heterogeneity of health in people at the same age and how such heterogeneity can be quantified. From our standpoint, to account for such heterogeneity, we have suggested that an individual's health status can be represented by the number of health deficits (broadly defined by biological and clinical characteristics) that they accumulate. This allows health to be expressed in a single number: the frailty index (FI) is the ratio of the deficits present in a person to the total number of deficits considered (e.g. in a given database or experimental procedure). Changes in the FI characterize the rate of individual aging. The behavior of the FI is highly characteristic. I will discuss its major properties and utility in epidemiology, clinical medicine and health economics. I will also address the issue of estimating personal biological age and show some examples of doing so. I will briefly discuss two mathematical models of aging: first one, based on a nonstationary generalization of the Ornstein-Uhlenbeck process and the second one described by the different-differential Kolmogorov equations. The latter model makes it possible to consider organism environment interactions and can be used as a foundation of the deficit accumulation approach developed by our group at Dalhousie University. I will introduce the most recent development of our model based on this approach to link the accumulation of deficits during aging with slowing in the time of recovery. This not only explains why the number of deficits can be used to estimate individual differences in aging rates, but also suggests that targeting the recovery rate (e.g. by preventive or therapeutic interventions) will decrease the number of deficits that individuals accumulate and thereby benefit life expectancy.