

Some multi-stream problems in the theory of dams

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This thesis, in the main, is concerned with continuing the development of the probabilistic study of dams. Specifically, emphasis is placed on some multi-stream and multi-dam problems both categories of which have only received fleeting attention previously. An effort has been made to keep practical considerations to the fore whilst studying various flow dependent models. Additional effort has been made to present material and arguments in such a way as to make the content available to a more general as well as to a mathematical readership.

Chapter I is an effort to highlight some of the major steps in the development of dam theory and to place the contributions of this thesis into the subject as a whole as well as to make some suggestions for further research.

Chapter II is concerned with obtaining the stationary dam content for a discrete input dam with release regulated by a stream that has flows cross-correlated with the dam inputs. Three models of cross-dependence are introduced.

Chapter III focuses in on the use of Wald's Identity to solve certain dam problems. After reviewing the development and application of the Identity, use is made of it to obtain expressions for the probability of emptiness and the generating function of the time to first emptiness of a dam subject to a release regulated in a similar fashion to that in Chapter II. Here, however, the dam inputs and stream flows, rather than being cross dependent, form independent Markov-chains of a particular type.

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Chapter IV extends a technique used by Weesakul, Ali Khan and Gani to obtain expressions for the generating function of the times to first emptiness of dams with discrete, dependent inputs and dependent release.

Chapter V presents a generalisation of a well known duality relation of random walk and in Chapter VI use is made of it to obtain the joint stationary distribution of dam content of jointly operating dams with discrete, dependent inputs.

Chapter VII gives a generalisation of a generating function relation first presented in univariate form by Feller and used in bivariate form in Chapter II.

Chapter VIII introduces the concept of dam release regulated by demand and restriction.

Chapter IX presents material which is out of the general context of the thesis, on cyclic queues. Some approximate results are given in what is an exploratory section on adapting existing techniques to cases of modified service and general independent inputs.