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REPRESENTATION OF NONLINEAR TRANSFORMATIONS ON L^p SPACES

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This note describes integral representations obtained for a class of nonlinear functionals and nonlinear transformations on the spaces $L^p(T)$ $(1 \leqq p \leqq \infty)$ associated with an arbitrary σ-finite measure space (T, Σ, μ). The class of functionals considered here differs from those considered in [1], [3], [7], [8], [9] and its study is mainly motivated by its close connection with nonlinear integral equations [6].

In the study of nonlinear integral equations there is a fundamental class of nonlinear transformations, called Urysohn operators [6], taking measurable functions to measurable functions and having the form

$$(1) \qquad (Ax)(s) = \int_T \phi(s; x(t), t)dt$$

where S, T are Lebesgue measurable subsets of R^n and $\phi: S \times R \times T \to R$ is a real valued function which is measurable on $S \times T$ for each fixed value of its second argument and continuous on R for almost all arguments in $S \times T$. An important subclass of (1) consists of those Urysohn operators whose range is in $C(S)$ where S is compact. This subclass includes the case in which the kernel ϕ is independent of its first argument, so that the operator reduces to a real valued functional:

$$(2) \qquad F(x) = \int_T \phi(x(t), t)dt.$$

Functionals of the form (2) also play an important role in the theory of generalized random processes in probability [5].