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A Stone's Representation Theorem and Some Applications

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Abstract: In this paper, we prove the following form of Stone's representation theorem: Let \sum be a σ-algebra of subsets of a set X. Then there exists a totally disconnected compact Hausdorff space {\cal K} for which (\sum, \cup, \cap) and ({\cal C}({\cal K}), \cup ,\cap), where {\cal C}({\cal K}) denotes the set of all clopen subsets of {\cal K}, are isomorphic as Boolean algebras. Furthermore, by defining appropriate joins and meets of countable families in {\cal C}({\cal K}), we show that such an isomorphism preserves σ-completeness. Then, as a consequence of this result, we obtain the result that if ba(X,\sum) (respectively, ca(X,\sum)) denotes the Banach space (under the variation norm) of all bounded, finitely additive (respectively, all countably additive) complex-valued set functions on (X, \sum), then ca(X, \sum) =ba(X, \sum) if and only if (1) {\cal C}({\cal K}) is σ-complete; and if and only if (2) \sum is finite. We also give another application of these results.

Key Words: Boolean ring, Boolean space, Stone space, Stone representation, bounded finitely additive set function, countably additive set function, convergence of sequences of measures, weak topology.

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