Largeness of the Set of Finite Products in a Semigroup

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We investigate when the set of finite products of distinct terms of a sequence $\langle x_n \rangle_{n=1}^{\infty}$ in a semigroup $(S, \cdot)$ is large in any of several standard notions of largeness. These include *piecewise syndetic*, *central*, *syndetic*, *central**, and *IP**. In the case of a "nice" sequence in $(S, \cdot) = (\mathbb{N}, +)$ one has that $FS(\langle x_n \rangle_{n=1}^{\infty})$ has any or all of the first three properties if and only if $\{x_{n+1} - \sum_{t=1}^{n} x_t : n \in \mathbb{N}\}$ is bounded from above.