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Suppose $\mathfrak{B}_1$ and $\mathfrak{B}_2$ are Banach spaces, $\{P_\tau\}$ and $\{Q_\tau\}$ are families of projection operators on $\mathfrak{B}_1$ and $\mathfrak{B}_2$ respectively which converge strongly as $\tau\to\infty$ to the respective identity operators, and A is a bounded linear transformation from $\mathfrak{B}_1$ to $\mathfrak{B}_2$. One says that the projection method (P_τ, Q_τ) is applicable to A if, roughly speaking, $(Q_\tau AP_\tau)^{-1}$ converges strongly to A^{-1} as $\tau\to\infty$. More precisely what is required is that $Q_\tau AP_\tau$, as an operator from $P_\tau\mathfrak{B}_1$ to $Q_\tau\mathfrak{B}_2$, be invertible for sufficiently large τ and that $(Q_\tau AP_\tau)^{-1}Q_\tau$ converge strongly as $\tau\to\infty$. (Then A is necessarily invertible and the strong limit is A^{-1}.)

To give an example, the prototype of those considered in this book, let a be a bounded function defined on the unit circle having Fourier coefficients a_k ($k=0, \pm 1, \cdots$), and consider the operator A on l_2 of the positive integers defined by

$$A\{\xi_j\} = \left\{\sum_{k=1}^{\infty} a_{j-k}\xi_k\right\}_{j=1}^{\infty}.$$

This is the (semi-infinite) Toeplitz operator associated with a. The projections are the simplest ones: $P_n=Q_n=$projection on the subspace of sequences $\{\xi_j\}$ satisfying $\xi_j=0$ for $j>n$. The operator P_nAP_n may then be represented by the finite Toeplitz matrix

$$A_n = (a_{j-k})_{j,k=1}^{n}$$

and the question is whether these matrices are invertible from some n onward and, if so, whether the inverses of these matrices converge strongly