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Erratum

Volume 32, Number 2 (1970), in the Note, "The Optimal Route Problem and the Method of Approximation in Policy Space," by D. Davidson and D. J. White, pp. 435–455:

A "proof" that the policy space method for the standard optimal route problem would terminate in $(N-1)$ steps if there are N states was given. Unfortunately this proof was incomplete.

In the original "proof," it was merely shown that at each stage of the policy space algorithm, $j^m(i)$ could be chosen identical with $j_m(i)$, for $i \in \Omega_m$, and that, as a result of this selection process,

$$f^m(i) = f_m(i) = f(i), \qquad i \in \Omega_m. \tag{19}$$

It can be shown, however, that if $\{F^m(\cdot), J^m(\cdot)\}$ are alternative sequences of cost functions and policies generated by the policy space algorithm, then (19) is still true for $F^m(\cdot)$. Thus, assuming that the result is true for $0 \leqslant t \leqslant m$, and remembering that $\{F^m(\cdot)\}$ is monotonic decreasing in m, we have, for $i \in \Omega_m$, and if $j(\cdot)$ is an optimal policy, such that $i \in \Omega_m \to j(i) \in \Omega_{m-1}$,

$$\begin{aligned} F^m(i) - f(i) &= c_{iJ^m(i)} + F^m(J^m(i)) - c_{ij(i)} - f(j(i)) \\ &= c_{iJ^m(i)} + F^m(J^m(i)) - c_{ij(i)} - F^{m-1}(j(i)) \\ &= c_{iJ^m(i)} + F^{m-1}(J^m(i)) - c_{ij(i)} - F^{m-1}(j(i)) \\ &\leqslant 0. \end{aligned} \tag{20}$$

The last inequality arises because, by virtue of the policy space algorithm, $J^m(i)$ minimizes $c_{ij} + F^{m-1}(j)$.

Since clearly $F^m(i) \geqslant f(i)$, we have $F^m(i) = f(i) = f_m(i)$, $i \in \Omega_m$.

The inductive hypothesis is trivally true with $m = 0$, and hence the original proof is valid with this addition.

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