$p_r g_r$ *pre,* then it must be true that $pa \cdot qa = p^{a.}\, q^{b}, p^{b} g^{b}{}_{p} b_{e} c_{,p} r q,$ _ *pre.* He then shows that cyclical consistency is necessary and sufficient for the finite set of points to be consistent with the existence of a continuous, non-satiated, concave and monotonic utility function. Afriat also provides a constructive method of evaluating such a utility function. Varian (1982) shows that cyclical consistency is equivalent to a "generalized axiom of revealed preference" (GARP) that is formulated as follows. Varian defines q^i *as strictly directly revealed preferred to q,* written $q'P^{\circ}q$ if *pill> p'q,* i.e. *q'* was bought at *p'* even though *q* cost less. Secondly *q'* is *revealed preferred* to *q,* written *q'Rq,* if *p'q'* $p\ ^{l}q> > piqk\ ,\ ,\ pmel\ pmq,$ for some sequence of observations *(q', q', , gm), i.e.* q^i is indirectly or directly (weakly) revealed preferred to *q.* GARP then states **that** $q^i Rql$ implies not *felN',* and all the nice consequences follow. Varian has also supplied an efficient and easily used algorithm for checking GARP, and his methods have been widely applied. Perhaps not surprisingly, the results show few conflicts with the theory, since on aggregate time series data, most quantities consumed increase over time so that contradictions with revealed preference theory are not possible; each new bundle was unobtainable at the prices and incomes of all previous periods.

Since these methods actually allow the construction of a well-behaved utility function that accounts exactly for most aggregate time-series data, the rejections of the theory based on parametric models (and on semi-parametric models like Gallant's Fourier system) must result from rejection of functional form and not from rejection of the theory per se. **Of** course, one could regard the non-parametric utility function as being a very profligately parametrized parametric utility function, so that if the object of research is to find a reasonably parsimonious theory-consistent formulation, the non-parametric results are not very helpful.

Afriat's and Varian's work, in particular see Afriat (1981) and Varian (1983), also allows testing of restricted forms of preferences corresponding to the various kinds of separability discussed in Section **4.** Varian has also shown how to handle goods that are rationed or not freely chosen, as in Section 6 below. Perhaps most interesting are the tests for homotheticity, a condition that requires the utility function to be a monotone increasing transform of a linearly homogeneous function and which implies that all total expenditure elasticities are unity. Afriat (1977) showed that for two periods, 0 and 1, the necessary and sufficient condition for consistency with a homothetic utility function is that the Laspeyres price index be no less than the Paasche price index, i.e. that

$$\frac{P_1 q_1}{P_0 q_1} \geq \frac{P_1 q_0}{P_0 q_0} \quad (74)$$

For many periods simultaneously, Afriat (1981) shows that the Laspeyres index between any two periods *i* and *j,* say, should be no less than the chain-linked Paasche index obtained by moving from *i* to *j* in any number of steps. Given that