Index

Approximation: degree of, for Kakutani fixed point, 89–93; for general equilibrium model with production, 107–08
Arrow, K. J., 6, 12, 204
Association: rule of, for fixed point of Kakutani mapping, 86; for general equilibrium model with production, 103–04; for nonlinear programming problem, 131; for computation of invariant optimal capital stock, 140
Aumann, R. J., 206

Barone, E., 2, 9
Barycentric subdivision of the simplex, 195–99
Block, H. D., 12
Bondareva, O., 209
Brouwer, L. E. J., 5, 12, 28
Brouwer's theorem, 13, 23, 28–31, 67, 74, 170; description of, 5–6; and existence of an equilibrium for an exchange economy, 12; demonstration of, using algorithm, 51–53
Burger, E., 12

Capital stock: optimal invariant, 136–43
Coalitions: in game theory, 201–06; balanced collections of, 209–10
Cohen, D. I. A., 191
Competitive equilibrium: proof of existence using alternative to Kakutani's theorem, 119–23
Computational experience: of fixed point algorithms, 16–17, 60–61, 163, 168–69; relationship between dimensionality and computation time, 238–40
Computer, electronic: importance of, for computational techniques, 10
Convexity: the importance of techniques of, 3
Convex programming, 69–71
Core of an n-person game: relationship to competitive equilibria, 14–15, 207–08; nonemptiness of, 14–15, 211, 214–19, 221–27; notion of blocking, 206; definition of, 207
Cottle, R. W., 14
Cycling: argument excluding, 45–48

Dantzig, G. B., 7, 14
Debreu, G., 6, 14, 119
Decomposition method of computing equilibrium, 162–69
Degeneracy: procedures for resolving, 61–62, 144–69

Eaves, B. C., 15, 50, 119, 121, 130, 188, 191
Edgeworth, F. Y., 206
Endowment: of resources, 98–99

Freidenfelds, J., 188

Gale, D., 6
Game theory: n-person, 200–31; normal form of, 200; characteristic form of, 201–06; balanced, 211; nonemptiness of core of n-person balanced game, 211, 214–19; game derived from n-person exchange economy, 213–14; examples of balanced games, 219–32
General equilibrium (neoclassical) model, 1–2; existence of an equilibrium, 2–6,

General equilibrium (*cont.*)
119–23; pure-trade model, 4–5, 17–23; with production, 98–107, 124–29
Gradient (tâtonnement) method of solution, 11–12

Habetler, G. J., 121
Hansen, T., 15, 61, 113, 130, 136–38, 143, 148, 157, 237
Hayek, F. A., 9, 10
Howson, J. T., 13–14, 45
Hurwicz, L., 12

Increasing returns to scale, 227–32
Intersection theorem, 67–71; generalized, 97

Kakutani, S., 13
Kakutani's theorem, 13, 75, 121–23, 137–38; demonstration of, using algorithm, 82–89; statement of, 85
Kannai, Y., 97
Kantorovitch, L. V., 7
Karamardian, S., 121
Karlin, S., 23
Knaster-Kuratowski-Mazurkiewicz lemma, 68, 192
Koopmans, T. C., 136–38, 143
Kuhn, H. W., 6, 13, 15, 50, 148, 173, 185, 188
Kuhn-Tucker theorem, 3, 138

Labelling, 45–46, 75
Lange, O., 8–10
Lemke, C. E., 13–14, 45, 47, 48
Lexicographic tie-breaking rule, 144–47
Linear programming: development of, and importance, 7; simplex method and applications, 7–8; fundamental concepts, 77–79; pivot steps and relationship to replacement operation, 79

Mangasarian, O. L., 13
Mantel, R. R., 14–15
Mappings: continuous, 24–31; point-to-set, 75
McKenzie, L. W., 6
Merrill, O. H., 130, 188
Miller, M., 17
Minimax theorem: for two-person zero-sum games, 31
Mises, L. von, 8
Morgenstern, O., 200, 203, 205, 206

Nash, J. F., 6, 13
Nash equilibrium point: two-person non-zero-sum games, 13, 31; existence for n-person game, 74
Neoclassical model. *See* General equilibrium model
Newton's method, 52, 72, 112, 135
Nikaido, H., 6
Nondegeneracy assumption, 32–33
Nonlinear programming: application of Brouwer fixed point algorithm, 69–71; numerical example, 71–73; application of Kakutani fixed point algorithm, 129–34; numerical example, 134–36
Numerical examples of algorithms: pure exchange model, 65–67; nonlinear programming problems, 71–73, 134–36; Kakutani fixed point, 93–96; general equilibrium with production, 109–19, 128–29

Price, A. L., 121
Primitive sets, 14; definition of, 34, 37; examples of, 35–36; theorem for existence of with distinct labels, 45; number with distinct labels, 49–50; generalization of, 53–56; relationship to dual feasible basis, 56–59; existence of whose corresponding columns form a feasible basis, 76–81; characterization with lexicographic tie breaking, 147–49; properties with lexicographic tie breaking, 150–56; interpretation as an undominated utility vector, 215–16
Production: organization in a socialist economy, 8–10
Production technology, 98–99

Quadratic programming problems, 31

Replacement operation, for primitive sets: geometrical interpretation, 38–40; numerical examples, 40–42; summarized, 42;

Replacement operation (*cont.*)
uniqueness of, 43–44; with lexicographic tie breaking, 157–62; FORTRAN program for, 233–37
Robbins, L. C., 9, 10
Robinson, S. M., 112

Scarf, H., 12, 14, 15, 34, 45, 97, 103, 157, 200, 221
Shapley, L. S., 188, 195, 209
Shoven, J. B., 17
Simplex: *n*-dimensional unit, 26
Simplicial subdivisions: relationship to primitive sets, 15–16, 170–88, 193–95; algorithm based on, 188–93; restricted, 189–93; barycentric, 195–99
Sonnenschein, H., 12
Spencer, J., 17
Sperner's lemma, 13, 170; demonstration of, 191–93
Subsimplex: definition of, 32
Sutherland, W. R. S., 136–38

Transferable utility, 203–06, 219–21

Upper semicontinuity, 83–85
Uzawa, H., 12

Von Neumann, J., 6, 13, 200, 203, 205, 206
Von Neumann model of proportional capital growth, 136

Wagner, M. H., 69, 188
Wald, A., 3, 12
Wallman, H., 68
Walras, L., 1, 2
Walrasian model. *See* General equilibrium model
Walras law, 4, 20, 21, 23, 28, 30, 65, 99, 107
Whalley, J., 17
Wolfe, P., 14