

Auerbach, Lotka, and Zipf: pioneers of power-law city-size distributions [1] – Tab. I

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Author	Year	Ref.	Trans.	Type	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	Comment
Pareto	1896	[2]		book	o											French
Auerbach	1913	[3]	[13]	paper		o										German, no reference at all
Lotka	1925	[4]	-	book	.	x	o									
Goodrich	1926	[5]	-	paper					o							no references at all
Saibante	1928	[6]		paper	x	x	x		o							Italian, first connection to Pareto 1896 [2]
Gibrat	1931	[7]		book	.				a	o						French, finds log-normal distribution
Christaller	1933	[8]	[14]	book	x						o					German
Singer	1936	[9]	-	paper	x				b	x		o				
Lösch	1940	[10]	[15]	book	x					x	x	x	o			c German, mentions “Singer’s discovery”
Stewart	1947	[11]	-	paper	.	x	x				.			o		c
Zipf	1949	[12]	-	book	.	x	x	x		x	.			.	o	mentions “Pareto school”

Table I: Citation matrix. x, ‘proper’ referencing; ., either mentioning or citing in a different context; o, diagonal elements; ^a,

Saibante 1926 [16]. ^b, Goodrich 1928 [17]. ^c, Zipf 1941 [18]. Lösch’s book first appeared in 1940 but we consider the translation which is based on the 1944 2nd edition. We would like to note that we compiled this table with the best of our knowledge but cannot exclude that we miss a citation. “Ref.” stands for reference and “Trans.” for translation to English.

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- [1] D. Rybski and A. Ciccone, Auerbach, Lotka, Zipf – pioneers of power-law city-size distributions, *Arch. Hist. Exact Sci.* 10.1007/s00407-023-00314-0 (2023).
- [2] V. Pareto, *Cours d'économie politique: professé à l'Université de Lausanne* (F. Rouge, Librairie de l'Université, Lausanne, Paris, Leipzig, 1896, 1897) two volumes.
- [3] F. Auerbach, Das Gesetz der Bevölkerungskonzentration, *Petermanns Geogr. Mitteilungen* **59**, 74 (1913).
- [4] A. J. Lotka, *Elements of Physical Biology* (Williams & Wilkins Company, Baltimore, 1925).
- [5] E. P. Goodrich, The statistical relationship between population and the city plan, in *The Urban Community – Selected Papers from The Proceedings of the American Sociological Society 1925*, edited by E. W. Burgess (The University of Chicago Press, Chicago, IL, 1926) pp. 144–150.
- [6] M. Saibante, La concentrazione della popolazione, *Metron – Rivista Internazionale di Statistica* **7**, 53 (1928).
- [7] R. Gibrat, *Les Inégalités Économiques* (Recueil Sirey, Paris, 1931).
- [8] W. Christaller, *Die zentralen Orte in Süddeutschland* (Gustav Fischer, Jena, 1933).
- [9] H. W. Singer, The “courbe des populations” A parallel to Pareto’s Law, *Econ. J.* **46**, 254 (1936).
- [10] A. Lösch, *Die räumliche Ordnung der Wirtschaft* (Gustav Fischer, Jena, 1940) 2nd edition.
- [11] J. Q. Stewart, Empirical mathematical rules concerning the distribution and equilibrium of population, *Geogr. Rev.* **37**, 461 (1947).
- [12] G. K. Zipf, *Human Behavior and the Principle of Least Effort: An Introduction to Human Ecology* (Martino Publishing, Manfield Centre, CT, 2012) (Reprint of 1949 Edition).
- [13] F. Auerbach, Das Gesetz der Bevölkerungskonzentration (1913) – The Law of Population Concentration (translation by A. Ciccone), (2023).
- [14] W. Christaller, *Central Places in Southern Germany* (Prentice-Hall International, Inc., London, 1966) (Translated from “Die zentralen Orte in Süddeutschland” by C. W. Baskin).
- [15] A. Lösch, *The Economics of Location* (Yale University Press, New Haven, 1954) (Translated from “Die räumliche Ordnung der Wirtschaft” [2nd edition, 1944; 1st edition, 1940] by W. H. Woglom [with the assistance of W. F. Stolper]).
- [16] M. Saibante, I profitti delle società per azioni e la concentrazione dei capitali industriali, *Metron – Rivista Internazionale di Statistica* **6**, 165 (1926).
- [17] E. P. Goodrich, Mass and density of buildings in relation to open spaces and traffic facilities in the united states of america, in *International Housing and Town Planning Congress – Paris 1928* (Imprimerie Chaix, Paris, 1928) Chap. Part I – Papers, pp. 387–400.
- [18] G. K. Zipf, *National unity and disunity. The nation as a bio-social organism* (Principia Press, Bloomington, Indiana, 1941).