Wiley StatsRef:
Statistics Reference Online

Charlier, Carl V.L.

By *Peter Guttorp*[1] *and Georg Lindgren*[2]

Keywords: *astronomy, galaxy model, mathematical statistics*

Abstract: Carl Charlier was a Swedish astronomer and statistician. He was influential in making mathematical statistics a university subject in Sweden. His main statistical contribution was the Gram-Charlier expansions of continuous (Type A) and discrete (Type B) distributions. In astronomy he successfully created a hierarchical galaxy cluster model.

C.V.L. Charlier; painting in oil by Henning Malmström, 1922
Born: 1 April 1862 in Östersund, Sweden.
Died: 4 November 1934 in Lund, Sweden.
Contributed to: Stellar statistics, astronomy, mathematical statistics, series expansions.

Carl (Vilhelm Ludvig) Charlier was the son of Inspector Emerich Emanuel Charlier and his wife Aurora Kristina, born Hollstein. He studied astronomy in Uppsala, writing a PhD dissertation on the perturbations caused by Jupiter on the asteroid Thetis, which he successfully defended in 1887. After working at the observatories in Stockholm and Uppsala, he was in 1897 appointed Professor of Astronomy at Lund University, and Director of the University Observatory there. Initially, he worked on celestial mechanics, but in 1906 he published Researches into the Theory of Probability[1] in which he expresses admiration for Karl Pearson and says that he intends to develop his research along the line laid down by Pearson and his school.

Much of statistics originated in astronomy. Measurement error, least squares, and Poisson processes all came out of astronomical applications[2]. **Stellar statistics**, as a subfield of astronomy, deals with the systematic study of planets, stars, galaxies, and other astronomical entities. It originated with Kapteyn's 1906 40-observatory collaborative study of our galaxy[3]. Kapteyn, known as the *astronomer without a telescope*, had immense amounts of data flowing into his institute in Groningen, and said "for statistics we must have great masses of data"[4]. Charlier would work in a very similar vein. He wanted a modern institute

[1]Norsk Regnesentral, Oslo, Norway
[2]Lund university, Lund, Sweden

DOI: 10.1002/9781118445112.stat08144

of scientific computation, analysis, and thought. To avail that he employed, instead of university students or astronomers, a cadre of female computers without formal education, who would do the practical number-crunching, leaving the scientists to do the thinking and draw deductions (Ref. [5], pp. 60–63).

His most important astronomical contribution was probably his development of Fournier d'Albe's hypothesis of a hierarchical structure of the universe into a mathematical description that allows for an infinite hierarchy of clusters with vanishing average density[6]. Thus, a Newtonian universe can be infinite without gravitational collapse. It also solves Olber's paradox: with an infinite number of stars, why is the night sky dark? In Charlier's universe, the integrated contribution of all the stars is negligible. The hierarchical structure is, in fact, one of the earliest examples of a **fractal distribution** in science.

While Charlier was first and foremost an astronomer, he emphasized the role of statistics both in astronomy and in other sciences. He argued strongly for the importance of the university having an instructor in mathematical statistics, in addition to a professor in political science and statistics. His argument prevailed in 1915, and his student Sven Wicksell was appointed to the position.

Charlier's methodological work in statistics dealt mainly with series expansions to approximate distributions (see Ref. [7] for the **continuous case**, and Ref. [8] for the **discrete case**).

Charlier, as many Swedish academics, was often asked to assist the government with policy issues. In 1897, for example, he was called upon as the *secretary* in an official committee to design a new tariff system for person transports on Swedish railways. His scientific approach, supported by empirical data from European railways, was to estimate the change in usage income and maintenance costs that could be expected from a reduction in tariffs. The recommendations in the official report[9] were deemed by the authorities to require too large investments in short haul infrastructure, and the final system favored long-distance transport.

References

[1] Charlier, C.V.L. (1906) *Researches into the theory of probability*, Meddelanden från Lunds Astronomiska Observatorium, vol. II, Olsson, Lund.

[2] Sheynin, O.B. (1984) On the history of the statistical method in astronomy. *Arch. Hist. Exact. Sci.*, **29**, 151–199.

[3] Kapteyn, J.C. (1922) First attempt at a theory of the arrangement and motion of the sidereal system. *Astrophy. J.*, **55**, 302–328.

[4] Paul, E.R. (1985) Kapteyn and statistical astronomy, in *The Milky Way Galaxy*, Vol. 106 of IAU Symposium, (eds H. van Woerden, R.J. Allen, and W.B. Burton), Reidel, Dordrecht, pp. 25–42.

[5] Holmberg, G. (1999) *Reaching for the Stars*, vol. 13 of Ugglan, Lund Studies in the History of Science and Ideas, Lund.

[6] Charlier, C. (1922) How an infinite world may be built up. *Arkiv. Mat. Ast. Fys.*, **16**(22), 1–34.

[7] Charlier, C.V.L. (1905a) Über das Fehlergesetz. *Meddelanden från Lunds Astronomiska Observatorium*, vol. 25, Gleerups, Lund.

[8] Charlier, C.V.L. (1905b) Die zweite Form des Fehlergesetzes. *Meddelanden från Lunds Astronomiska Observatorium*, vol. 26, Gleerups, Lund.

[9] Charlier, C.V.L. (1898) *Förslag till persontariff för Statens Jernvägar*, Berlingska, Lund.

DOI: 10.1002/9781118445112.stat08144