The Poincaré-Bertrand Theorem
An Introduction with Applications to the Physical Sciences

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The Poincaré-Bertrand Theorem describes a very simple mathematical operation: the rearrangement of the order of integration of improper, Cauchy principle valued integrals. Whereas, for proper integrals, one can simply use Fubini’s Theorem to rearrange the order of integration, improper integrals of the Cauchy value type are not so simple. In this talk, I will derive the Poincaré-Bertrand Theorem (which formulates a rule for integration order rearrangement) after a brief introduction to Cauchy-type integrals. I will then proceed to more complex examples, including triple improper integrals and finally a general formula for $N$-order integrals. I will conclude with a discussion of physical applications of the Poincaré-Bertrand Theorem to the physical sciences.

Keywords: Cauchy integrals, complex analysis, integration order rearrangement, transport theory