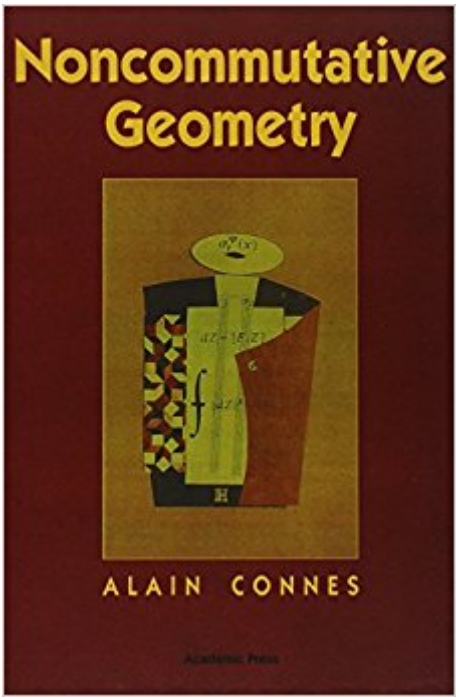
Noncommutative Geometry



Synopsis

This English version of the path-breaking French book on this subject gives the definitive treatment of the revolutionary approach to measure theory, geometry, and mathematical physics developed by Alain Connes. Profusely illustrated and invitingly written, this book is ideal for anyone who wants to know what noncommutative geometry is, what it can do, or how it can be used in various areas of mathematics, quantization, and elementary particles and fields.First full treatment of the subject and its applicationsWritten by the pioneer of this fieldBroad applications in mathematicsOf interest across most fieldsIdeal as an introduction and surveyExamples treated include: the space of Penrose tilingsthe space of leaves of a foliationthe space of irreducible unitary representations of a discrete groupthe phase space in quantum mechanicsthe Brillouin zone in the quantum Hall effectA model of space time

Book Information

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Customer Reviews

"...A milestone for mathematics. Connes has created a theory that embraces most aspects of ’classical’ mathematics and sets us out on a long and exciting voyage into the world of noncommutative mathematics. "The book contains a colourful account of the meaning of the term ’non-commutative space,’ based on an extraordinary wealth of examples, including the set of all Penrose tilings, the space of leaves of a foliation, the quantum Hall effect and an intriguing non-commutative model of four-dimensional space-time that reproduces the standard model of elementary particles from quite general considerations... "The reader of the book should not expect

proofs of theorems. This is much more a tapestry of beautiful mathematics and physics which contains material to intrigue readers with any mathematical background. At the same time there is a comprehensive bibliography that will lead the reader straight to the sources and proofs of the results." --VAUGHAN F.R. JONES, University of California, Berkeley "This beautiful, ambitious, and erudite book explains, through many examples, the phenomena, tools, and some of the applications of noncommutative geometry...The book is written in a way that anyone can get some of the feeling and ideas of the subject...Connes has accomplished the wonderful feat of explaining in a simple and coherent way 20 years (or so) of his impressive work. I recommend this book most highly." --Jonathan Block, THE MATHEMATICAL INTELLIGENCER, Vol. 20, No. 1, 1998

Text: English (translation) Original Language: French

An excellent introduction to NCG

Not so simple to read, but it contain a lot of very interesting arguments

Foundational book on Noncommutative Geometry. A must read for anyone working in NCG. There is a long motivational introduction and the book is split into clear sections.

Even though detailed proofs are omitted for most of the major results, the book is an excellent overview of a beautiful subject that the author has made substantial contributions to. The subject of noncommutative geometry has recently made its way into theoretical physics, and so a perusal of this book would be of interest to individuals working in string theory or quantum field theory. The main idea of this book is to generalize measure and operator theory to non-commutative situations. In the usual operator theory, von Neumann algebras serve as a generalization of "classical" measure theory. Commutative von Neumann algebras, or W*-algebras as they are sometimes called, are essentially bounded meausurable functions, and have measure spaces as their dual. These facts and a fine movtivation for the subject appear in the introduction to the book. The author shows with great clarity what is involved in extending measure theory to the non-commutative case. What is most interesting about the extensions is that they involve ideas from quantum physics. In addition, readers familiar with K-theory will see some brilliant uses of it in the book, particularly in the extension of BDF-theory to noncommutative situations, namely the KK-theory of Kasparov. The author also gives a taste of physics applications in the very last section of the book. He shows,

interestingly, that when space-time is replaced by a product with a certain finite space, the Lagrangian of quantum electrodynamics becomes that of the Standard Model. Although such "add-ons" to space-time are not uncommon in physics (Kaluza-Klein theories being one example), the author's strategy is unique in its use of bimodules, and gives the three lepton generations. There are also many other interesting topics as well in the book, such as how to deal with non-Hausdorff quotient spaces using noncommutative C*-algebras, deformation theory and the Kasparov group, the notion of Morita equivalence, leaf spaces of foliations, the E-theory of morphisms of separable C*-algebras, the extension of de Rham cohomology to a noncommutative framework (cyclic cohomology) and its relation to K-theory, the noncommutative torus and the quantum Hall effect. The book is an excellent source of information on noncommutative geoemtry and with the many references given one can find more detailed proofs. It is a subject that will no doubt continue to make its presence known in mathematics (and physics) in years to come.

This book is a source of inspiration. Alain Connes' breathtaking idea of taking Heisenberg's matrix mechanics to the last consequences - substituting algebras of vector spaces by algebras of operators in all branches of mathematics in which this concept arises - gave rise to a new world of concepts that permits to treat deep and esoteric topics in many branches of mathematics and physics. It provides so a deep and shocking insight into geometric topics as did quantum mechanics with the microscopic physics. However, his book has its problems: beyond the lack of a pedagogical introduction to noncommutative geometry, which is a inexistent thing in the realm of mathematical texts, it asks too many prerequisites: operator algebras, differential geometry, abstract algebra, measure theory, topology... It collects much more results than basic principles (as seen by the enormous quantity of papers in the bibliography). Nevertheless, these provisos don't obscure the captivating power of this work, and although I couldn't manage to understand many of the topics treated, it moved me so much that I became really interested in doing research on this field. Even if you don't have all the needed knowledge, but have interests in math and physics (particularly in "quantizing" things), give a try to this book (no wonder Connes is a Fields Medalist).

I must depart a bit from the previous breathless outpourings about this book. The fact is, it is a whirlwind TOUR (or travellog) of noncommutative geometry, not anything like a handbook of it, or even an atlas of detailed maps of it. I say this because theorems are asserted but almost never proved, no 'problems' are worked, and it is my experience and universally that of all mathematicians/physicists I know, no matter how gifted, that one cannot really understand the

subject matter without doing problems! The previous reviewer does hint: "even if you do not know the subject matter" - aye, there's the rub! I appreciate the author's gifts, and I can compass his vision of how useful his approach might be, but between rather trivial points in quantum mechanics to very abstruse theorems in abstract harmonic analysis there is no bridge provided, and the original literature, either by Connes or his predecessor Dixmier, is practically all in French. If you already know this stuff, it might be useful to have all the relevant topics gathered together in one place, but if you don't already know it, you are going to be disappointed. Customers should be aware of this fact before they shell out the bucks. A much better book covering similar ground, but at a more directly physical and more elementary level, is Souriau's: "Structure of Dynamical Systems. A Symplectic View of Physics" Although that work again doesn't have worked exercises. I wonder, is it just the STYLE in French literature nowadays to DISCOURSE about mathematics, instead of DEMONSTRATING it? Rather like a self-fulfillment of the Derrida-Lacan-Latour-deconstructionist position about scientific communities and their provenance, I'd say.

This is *the book* on noncommutative geometry. Alain Connes created the main parts of the theory, and paved the way forits many exciting applications. As most would expect, the bookcovers operator algebras, quantum theory, and other areas of mathematical physics; --but, in addition, there is a lovely treatment of tiling theory[Penrose tilings, cartwheel tilings and the like], of the Dixmier trace, of groupoids, and of foliations.-- All new subjects: intriguing and penetrating!

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