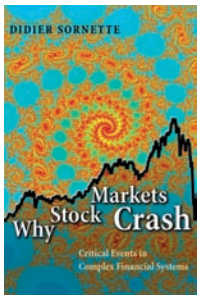
Over the past five decades, DeWitt has worked on the gamut of formal ideas in QFT. *The Global Approach to Quantum Field Theory* crystallizes a pioneer's view of the subject's development during those years. It is in no sense a text, given its dearth of references and elision of many major topics including, for example, any aspect of the standard model. Nevertheless, we in physics would be the poorer without it: Despite the notation, experts will long consult—and beginners will ever marvel at—this tour de force.

Why Stock Markets Crash: Critical Events in Complex Financial Systems

Didier Sornette
Princeton U. Press, Princeton, N.J., 2003. $29.95 (421 pp.). ISBN 0-691-09630-9

In *Why Stock Markets Crash: Critical Events in Complex Financial Systems*, Didier Sornette quotes physicist Eugene Wigner: "The enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious. . . . The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift." This quote appropriately conveys the essence of the book.



Sornette is both a statistical physicist and a member of a new breed of scientist: the econophysicist. Econophysics brings together the worlds of physics, economics, and finance to analyze how, collectively, society behaves. But Sornette's book is not just about finance and economics; it is also a mesmerizing introduction to game theory, fractals, catastrophe theory, critical phenomena, and much more. No prior knowledge of finance or economics is needed to understand the book. And while readers unfamiliar with critical phenomena may become inspired to learn more about that discipline, experts in the field may enjoy seeing critical phenomena applied in an unfamiliar context.

Throughout the book, Sornette makes numerous, vivid comparisons with many other fields in which the various mathematical tools he describes can be applied. Although in some places it seems he is trying to accommodate too wide a readership, for the most part, the book successfully bridges the often wide gaps between fields and skills.

The first three chapters provide a thought-provoking introduction to finance theory, with a clear description of its failure to explain extreme events. These pages require no familiarity with the subject matter because Sornette sticks to the essentials. In doing so, though, he presents finance theory in such an original light that the chapters are enjoyable, even for readers experienced in the field.

Then, in the fourth, fifth, and sixth chapters, Sornette describes extreme events as phase transitions and illustrates how the path to criticality is paved. He leads readers into a fascinating journey through geology, psychology, biology, and paleozoology, all of which he relates to finance and economics through critical phenomena. In many places, a curious reader might wish that a topic were treated in greater depth, but then Sornette never intended to write an encyclopedia. In any case, he provides an abundant

bibliography from standard journals.

Sornette goes on to verify his theory—that stock market crashes are manifestations of a phase transition—against historic financial data. In these three penultimate chapters, which, sadly, are dull in comparison with the earlier six, he has incorporated dreary time-series plots with opaque fits. The text in these chapters is plagued with inconsistent notations and mind-numbing displays of tables filled with irrelevant data, which suggest that the author perhaps rehashed previous papers to meet the publisher's deadline. These three chapters break the spell that Sornette initially had cast upon readers in the first six chapters, which are wonderful to read. Just one chapter instead of three might have better carried the message across to readers.

In his final chapter, Sornette widens the scope of his analysis to include global economic data. By looking at the past 10 or more years, he observes the onset of a phase transition and predicts that around 2050 the world economy is likely to shift into another regime. The evidence he provides may not be convincing to some readers, but his prediction is precise and bold.

Sornette provides many clues as to why stock markets crash. However, the many references to the renormalization group, network theory, and complex fractal dimensions appear as anecdotal analogies. Most physicists are unlikely to be impressed by the quality of the fits to the data. The models seem to contain many parameters, and little is said about the goodness of the fits. Sornette insists on the universality of the values taken by some of the parameters, such as the critical exponent and scaling ratio. However, he offers little evidence for this phenomenon, nor any kind of physical interpretation. In essence, the evidence is intriguing but not yet too convincing.

In the end, readers may be ambivalent about Sornette's book. On one hand, they may feel dissatisfied that this book only summarizes a work still in progress; on the other, they may be gratified by the prospect that there is more to discover. Although Sornette's book contains a couple of weak chapters, it nevertheless provides a captivating account of recent developments in econophysics. I thoroughly enjoyed the book, which substantially widened my horizons. Perhaps *Why Stock Markets Crash* will inspire more physicists to also extend the scope of their investigations to new realms and become, like Sornette, founding members of new branches of physics.

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Essential Mathematical Biology

Nicholas F. Britton
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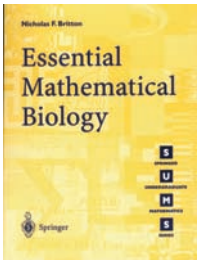

Those of us in mathematical biology like to imagine our field on the verge of achieving critical opalescence, in which the distinct characteristics of mathematicians, biologists, and even physicists are dissolved into a glittering new unity. More precise measurement techniques in molecular biology, evolutionary biology, and ecology are pushing strategic modelers like me