habit, the coincidence has also raised excitement in the gravitational community. Hawking's article in this volume, however, contains a strong critique of the D-brane computation of the entropy. Hawking finds that correctly including curvature effects changes the boundary behavior of the D-brane, so there is no real conservation of information from early to late times. (The bounding hypersurfaces become null, that is, light-like.) Generic information from the past bounding surface cannot be measured across the future one, and so, Hawking argues, the D-brane entropy calculation fails.

Wald (the volume's editor) provides an elegant introduction to black hole thermodynamics and entropy from the 4D point of view. From this perspective, it is extremely difficult to see any connection with mode counting. Information that falls into the black hole appears to be lost, because what emerges from an evaporating black hole is thermal radiation (by definition, uncorrelated). We cannot recover this information because there are modes inside the horizon that are inaccessible to the outside observer. Hawking's thermal radiation computation is on very solid footing for black holes above the Planck mass, $\sim 10^{-5}$ gram (*2*). Thus it is unlikely that the information is emitted prior to this "Planck era." Then, if the black hole finally evaporates under Hawking radiation, there is a presumably momentary singularity (a "thunderbolt"), which must be given a quantum gravity description. More importantly, most of the information that fell into the hole appears to have been lost, unless it can escape during the quantum era. It seems impossible that it could escape then, because the Hawking temperature of a 10^{-5}-gram black hole corresponds to a single thermal photon having enough energy to carry away all the remaining 10^{-5} gram mass of the black hole, and one photon cannot carry out all the classical information that fell into the black hole. Hence, either the information disappears (there is a "thunderbolt"), or the evaporation stops roughly at the Planck scale and one can view the information as being stored forever in surviving 10^{-5}-gram "nuggets." These seem to be the only possibilities.

Hartle proposes that we ought to be satisfied with a 4D view of the situation (in which we do not demand that a particular time contains all the information), but that our exterior knowledge must be enhanced by using knowledge from within the black hole (before it evaporated). Sorkin suggests ways in which the information in the black hole can in principle be stored, and discusses why the entropy is proportional to the black hole's surface area rather than to its volume.

The contributors have produced a surprisingly readable and topical volume; still, there is definitely room for a broader survey of work inspired by Chandrasekhar. Wali mentions Chandra's works on Newton's *Principia* and on aesthetics in science, but these are not discussed. Chandra made extensive contributions to stellar astronomy and was for many years the editor of the *Astrophysical Journal*. (Legend has it that he read every submission; from personal experience, I believe this is true.) The position reflected his expertise in all aspects of "classical" astronomy, as well as in the more exotic astrophysics that are the focus of the current volume. So we can hope to see other tributes to Chandra, concentrating on substantially different areas of discourse. If they match the standards of *Black Holes and Relativistic Stars*, they too will be very valuable contributions to the current research literature.

References and Notes

1. J. Glanz, *Science* **275**, 476 (1997).

2. For the Planck mass, the Compton wavelength and horizon radius are equal. The Compton wavelength (referring to quantum-mechanical properties) gets larger as the mass gets smaller, while the horizon radius is proportional to the mass. For black holes smaller than the Planck mass, quantum effects are at least as important as gravitational effects and a correct description requires a still unspecified quantum gravity.

NEW MEDIA: SOFTWARE

Statistics, Fast and Easy

John Wass

The large number of statistics software products on the market is a mixed blessing. Although the variety of options is welcomed by statisticians, identifying an easy-to-use package for the average laboratory can be a problem. In contrast to sophisticated software like STATISTICA, InStat takes a kinder, gentler approach. Its stated aim is to "help the experimental or clinical scientist analyze small amounts of data." In spite of its limitations—a lack of data manipulation capabilities and an inability to manage large databases with many variables—what InStat does, it does extremely well.

> **InStat 3.0**
> *GraphPad Software, Inc.*
> San Diego, CA. $119, $149 (bundle), $179 (bundle with book). (619) 457-3909
> www.graphpad.com

InStat works optimally on single queries with small data sets. All prompts to the user are in plain English and simple to follow. The program guides the user through a four-step process: defining the data type, entering data, choosing a statistical test, and presenting the results. First, the user defines a goal and describes its data type, which means letting the program know, for example, whether to compare means or medians (with raw or averaged data), do a regression or correlation (with *x*/*y* type data), or build a contingency table. The test menu is short but contains important, basic functions such as paired *t* test, ANOVA, and Bonferroni test.

The program offers several options for regression-correlation analysis, including multiple regression and Pearson correlation. Regression lines with 95% confidence intervals are easily generated. Tests providing analysis of contingency tables include Fisher's exact test, chi-square test, relative risk, odds ratio, and the difference of two proportions—all with 95% confidence intervals.

The data screen, or worksheet, is also simple. Data are easily cut and pasted from common spreadsheets, or can be imported. Columns or rows may be tagged for numerical format change, mathematical transformation, or a combination. Buttons provide instant advice and descriptions for importing and arranging data, moving quickly through the analysis, and viewing and editing notes.

The user navigates easily through these step, to a lucid and complete output format. The output sheet for an unpaired *t* test provides sections for the 95% confidence interval, the assumptions underlying use of the test, and a data summary. The analysis checklists are a masterstroke, explaining how tests are made and suggesting methods to test the assumptions or treat the data for specific needs.

The "small, yet powerful" philosophy of the package extends to the documentation. Subtitled *The InStat Guide to Choosing and Interpreting Statistical Tests*, this 153-page tome explains in simple terms some of the elementary concepts underlying statistical analysis, as well as the mechanics of doing a test, pitfalls and common errors, and interpretations of the results. The bundled package includes the GraphPad StatMate guide (an even simpler helpmate) and the deluxe option adds Harvey Motulsky's delightful book entitled *Intuitive Biostatistics*.

This small, but effective package is highly recommended to users with modest needs and limited skills in advanced statistics. Although technically a beginner's package, the range of tests and the excellent texts expand the set of InStat users from undergraduates wishing to learn the basics quickly to research scientists with a variety of analytic needs.

The author is in the Immunochemistry R&D Group at Abbott Laboratories, Abbott Park, IL 60064, USA. E-mail: John.Wass@add.ssw.abbott.com