

**Vector Calculus.** By *Michael Corral*. [www.mecmath.net](http://www.mecmath.net), 2008. Free electronic download, \$11.00 softcover. vi+213 pp.

*Vector Calculus* is a traditional treatment of the topics covered in a third-semester calculus course, often called “multivariate calculus” or just “Calc III.” While the treatment may be traditional, the distribution and publication terms are a prime example of the newest trends in textbook publication. The author has a standard copyright interest, but has used this government-sanctioned monopoly to grant you additional freedoms in the use of his work through the choice of a GNU Free Documentation License (GFDL). You may download the PDF version from the author’s website at no cost, and you may in turn distribute it from your own site. You may make as many printed copies of the book as you like, and you may do this forever. You may modify the content (via the downloadable source files) for your personal use. The only condition imposed by the author is that if you make modifications and distribute the modified versions, then you must apply the same license. By this arrangement, any improvements are made available for the common good.

You may, of course, carefully scrutinize this text in as much detail as you desire by downloading the PDF version. Suffice it to say the topics chosen are very standard for this course. The first chapter establishes the basics of vector algebra, lines and planes in  $\mathbb{R}^3$ , and basic calculus of vector-valued functions. The second chapter is centered on partial derivatives of functions of two or more variables, culminating with unconstrained and constrained optimization. The next chapter begins with a concise treatment of double and triple integrals, includes a welcome section on numerical techniques for multiple integrals (Java source code for a Monte Carlo method is included) and finishes with applications to center of mass and probability distributions. The final chapter considers line and surface integrals with the usual discussions of Green’s Theorem and Stokes’ Theorem. The only expected topic I found not fully represented is curvature, which appears in the exercises for the first chapter.

The writing style is crisp and concise, while being both informal in tone, but accurate in the technical details. Theorems are stated carefully and set off, often with proofs, subtleties are discussed, pathologies are mentioned but not belabored. In the preface, the author states that on

a 1 to 10 scale, with a 1 being “completely informal” and a 10 being “completely rigorous” he rates it as a 5. When finer points do arise, a footnote will point to one of the more advanced texts described in the excellent annotated bibliography. A refreshing benefit of open-content books is authors striving for the intellectual honesty they feel a topic deserves, without being driven by marketing concerns. This book is a good example of striking the right balance. I would expect a student in a course to find the text very readable in conjunction with lectures, and the independent student should find the explanations sufficient to gain an understanding without assistance.

Many of the crop of new open-content texts are noticeably deficient in exercises, figures and the use of color. This text has 420 exercises, about 15 per section, graded as “Easy,” “Moderate,” and “Challenging.” As an instructor, after I would pick and choose the problems that suit the aims of my course, I think I would find the need to augment the provided exercises with a few of my own, especially to provide some more challenging exercises (there seems to be very good coverage of routine and drill type problems). Of course, with the source files available, it is nearly trivial to incorporate your own additions to the problem sets. For a student’s first exposure to functions of several variables, visualizations of surfaces, tangent planes, vectors, volumes, etc. are crucial, and this text does not disappoint. The excellent graphics are built and rendered with the standard tools: MetaPost, PGF and Gnuplot. Full color is used effectively in the PDF version, while still printing accurately in grayscale, both in the graphics and in highlighting definitions, theorems and corollaries. An appendix includes a careful tutorial for the student on the use of the open-source plotting package Gnuplot. Other open-content authors could learn something by carefully studying Corral’s example.

It is important to note that this text is not an e-book, not an online book and not a distance-learning resource. It is conceived and designed to be a book. But its promotion and distribution are made possible by computer networks, without an investment of capital in a print run. No need to order an evaluation copy, just download the entire text. Only need a single chapter, a single section or a single application? Just print the subset you need (while acknowledging the author and the license terms). Should you desire a printed copy, and for a course I think a student would want a printed copy, it may be ordered via

the print-on-demand service at [lulu.com](http://lulu.com). The cost for a paperback, grayscale version is merely \$11.00 (plus shipping), which represents the entire production cost at Lulu, with no royalties going to the author. The source files for the book (L<sup>A</sup>T<sub>E</sub>X and MetaPost files) may be easily downloaded. It would appear that a couple of additional packages must be added to a standard T<sub>E</sub>X distribution in order to successfully compile the book through the supplied shell script, but this is a small inconvenience to achieve the high-quality output and graphics. The source appears to be written in a style that would make modifications easy for someone reasonably familiar with T<sub>E</sub>X.

It is refreshing to see science and mathematics return to a free exchange of ideas, without proprietary interests impeding a rapid and easy interchange. Corral should be applauded for his excellent and unselfish contribution to this movement. An instructor who builds a course around this text will never need to confront the unfortunate decision to take it out-of-print, or the release of a new edition modified simply to frustrate the used-book market. Based on content alone, this text is worth consideration for a traditional multivariate calculus course, is perfect for a quick refresher, is a good choice as a supplemental text for a more advanced course (such as probability), and is a great choice for the independent student on a budget. Additionally, the price is right and the extra inherent freedoms are a welcome novelty.

ROBERT A. BEEZER  
UNIVERSITY OF PUGET SOUND

An edited version of this review will appear in *SIAM Review* as part of the Book Review section.