

# Current Comments®

## The 100 Most-Cited Books in the *CompuMath Citation Index, 1976-1980*

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We recently identified 100 articles that were most cited in the 1976-1980 *CompuMath Citation Index*® (*CMCI*®) cumulation.<sup>1</sup> We have now identified the 100 books most cited during the same five-year period. Although most of these books are on pure and applied mathematics, many come from disciplines such as computer science, mathematical physics, econometrics, and statistics. Available since 1982,<sup>2</sup> *CMCI* covers the literature of these fields as well as systems analysis, biometrics, psychometrics, and numerous medical fields that heavily depend on computers. For example, the index to *Research Fronts in ISI/CompuMath*®<sup>3</sup> includes emerging disciplines such as "Computer-Aided Diagnosis and Clinical Judgement" and "Knowledge Engineering and Computer-Aided Medical Decision Making." In short, *CMCI* accesses the literature of interest to researchers who rely heavily on computational theory and methods. More than 280,000 articles and books from 1976 to date, and the 3,000,000 references they cited, are included in the *CompuMath* data base.

Table 1 lists the 100 most-cited *CMCI* books, in alphabetic order by first author. The number of citations each received in *CMCI* is shown, followed by full bibliographic information. Forty-five of these books were previously identified in a study of the most-cited math publications from 1961 to 1972.<sup>4</sup> Six were discussed in *Citation Classic*™<sup>5</sup> commentaries. The issue, year, and edi-

tion of *Current Contents*® (*CC*®) in which these commentaries were published is also provided.

We have unified the varied types of citations to the works in this study. Some authors make only a general reference to a key book, while others clearly cite a particular page or chapter. Also, books may appear in several editions, including translations in different languages. We have combined all citations to these different editions and listed them in Table 1 with the bibliographic information for the earliest edition we could identify. It should be noted that our definition of a book is somewhat restricted. It does not include symposia proceedings or edited monographs in which each chapter is by an author different from the editors. While such publications are indexed in *Current Book Contents*® (*CBC*®)<sup>6</sup> and *Index to Scientific & Technical Proceedings*® (*ISTP*®),<sup>7</sup> citations to them can be found in *Science Citation Index*® (*SCI*®) and *CMCI*. They will be discussed in a separate essay.

The citation frequencies of the books in Table 1 ranged from 1,522 to 181. The average book was cited 382 times. In comparison, the 100 articles we identified<sup>1</sup> averaged 116 cites. Thus, high impact *CompuMath* books were cited three times more often than high impact articles. We found a similar ratio in a study based on *Social Sciences Citation Index*® (*SSCI*®) from 1969 to 1977.<sup>8</sup> However, the opposite situation was reported for the most-cited *SCI* works

**Table 1:** The 100 books most cited in 1976-1980 *CMCI*<sup>®</sup>, in alphabetic order by first author. A number symbol (#) indicates that the book also was one of the most-cited math publications in 1961-1972. An asterisk (\*) indicates that the book was the subject of a *Citation Classic*<sup>™</sup> commentary. A = total *CMCI* citations, 1976-1980. B = bibliographic data.

A	B
513	<b>Aho A V, Hopcroft J E &amp; Ullman J D.</b> <i>The design and analysis of computer algorithms.</i> Reading, MA: Addison-Wesley, 1974. 470 p.
297	<b>Aho A V &amp; Ullman J D.</b> <i>The theory of parsing, translation, and compiling.</i> Englewood Cliffs, NJ: Prentice-Hall, 1972-73. 2 vols.
391	<b>#*Anderson T W.</b> <i>An introduction to multivariate statistical analysis.</i> New York: Wiley, 1958. 374 p. 10/79/PC&ES
197	<b>Barlow R E &amp; Proschan F.</b> <i>Mathematical theory of reliability.</i> New York: Wiley, 1965. 256 p.
244	<b>Bass H.</b> <i>Algebraic K-theory.</i> New York: W.A. Benjamin, 1968. 762 p.
208	<b>Bellman R.</b> <i>Dynamic programming of continuous processes.</i> Santa Monica, CA: RAND Corp., 1954. 141 p.
325	<b>Berge C.</b> <i>Graphes et hypergraphes.</i> (Graphs and hypergraphs.) Paris: Dunod, 1970. 502 p.
519	<b>#Billingsley P.</b> <i>Convergence of probability measures.</i> New York: Wiley, 1968. 253 p.
319	<b>Birkhoff G.</b> <i>Lattice theory.</i> New York: American Mathematical Society, 1940. 155 p.
312	<b>Bourbaki N.</b> <i>Groupes et algèbres de Lie.</i> (Lie algebra groups.) Paris: Hermann, 1960. 288 p.
608	<b>Box G E P &amp; Jenkins G M.</b> <i>Time series analysis. Forecasting and control.</i> San Francisco, CA: Holden-Day, 1970. 553 p.
204	<b>Brelman L.</b> <i>Probability.</i> Reading, MA: Addison-Wesley, 1968. 421 p.
322	<b>#Cartan H P &amp; Eilenberg S.</b> <i>Homological algebra.</i> Princeton, NJ: Princeton University Press, 1956. 390 p.
466	<b>#Clifford A H &amp; Preston G B.</b> <i>The algebraic theory of semigroups.</i> Providence, RI: American Mathematical Society, 1961. 216 p.
408	<b>#Coddington E A &amp; Levinson N.</b> <i>Theory of ordinary differential equations.</i> New York: McGraw-Hill, 1955. 429 p.
718	<b>#Courant R &amp; Hilbert D.</b> <i>Methoden der mathematischen physik.</i> (Methods of mathematical physics.) Berlin: J. Springer, 1924. 2 vols.
340	<b>#*Cramer H.</b> <i>Mathematical methods of statistics.</i> Uppsala, Sweden: Almqvist & Wiksells, 1945. 575 p. 28/83/PC&ES
297	<b>Curtis C W &amp; Reiner I.</b> <i>Representation theory of finite groups and associative algebras.</i> New York: Interscience, 1962. 685 p.
292	<b>Dantzig G B.</b> <i>Linear programming and extensions.</i> Princeton, NJ: Princeton University Press, 1963. 627 p.
312	<b>#Dixmier J.</b> <i>Les algèbres d'opérateurs dans l'espace Hilbertien, algèbres de Von Neumann.</i> (Operator algebras in Hilbert space, Von Neumann algebras.) Paris: Gauthier-Villars, 1957. 368 p.
494	<b>#Doob J L.</b> <i>Stochastic processes.</i> New York: Wiley, 1953. 654 p.
269	<b>#*Draper N R &amp; Smith H.</b> <i>Applied regression analysis.</i> New York: Wiley, 1966. 407 p. 1/81/S&BS
258	<b>Duda R O &amp; Hart P E.</b> <i>Pattern classification and scene analysis.</i> New York: Wiley, 1973. 482 p.
258	<b>#Dugundji J.</b> <i>Topology.</i> Boston: Allyn and Bacon, 1966. 447 p.
1412	<b>#Dunford N &amp; Schwartz J T.</b> <i>Linear operators.</i> New York: Interscience, 1958. 3 pts.
206	<b>Federer H.</b> <i>Geometric measure theory.</i> Berlin: Springer-Verlag, 1969. 679 p.
1522	<b>#Feller W.</b> <i>An introduction to probability theory and its applications.</i> New York: Wiley, 1950-66. 2 vols.
208	<b>Flacco A V &amp; McCormick G P.</b> <i>Nonlinear programming: sequential unconstrained minimization techniques.</i> New York: Wiley, 1968. 210 p.
231	<b>Ford L R &amp; Fulkerson D R.</b> <i>Flows in networks.</i> Princeton, NJ: Princeton University Press, 1962. 194 p.
395	<b>#Friedman A.</b> <i>Partial differential equations of parabolic type.</i> Englewood Cliffs, NJ: Prentice-Hall, 1964. 347 p.
333	<b>Fuchs L.</b> <i>Infinite Abelian groups.</i> New York: Academic Press, 1970. 2 vols.
181	<b>Gamelin T W.</b> <i>Uniform algebras.</i> Englewood Cliffs, NJ: Prentice-Hall, 1969. 257 p.
607	<b>Gantmacher F R.</b> <i>Teoriya matrits.</i> (The theory of matrices.) Moscow: Gos. Izd. Tekhniko-Teoreticheskoi Literatury, 1954. 491 p.
206	<b>Gear C W.</b> <i>Numerical initial value problems in ordinary differential equations.</i> Englewood Cliffs, NJ: Prentice-Hall, 1971. 253 p.
509	<b>#Gelfand I M &amp; Shilov G E.</b> <i>Obobshchennye funktsii.</i> (Generalized functions.) Moscow: Fizmatgiz, 1958. 5 vols.
312	<b>#Gillman L &amp; Jerison M.</b> <i>Rings of continuous functions.</i> Princeton, NJ: D. Van Nostrand, 1960. 300 p.

## A

- 406 #Gorenstein D. *Finite groups*. New York: Harper & Row, 1967. 527 p.
- 597 #Gradshcheyn I S & Ryzhik I M. *Tablitsy integralov, summ, ryadov i proizvedenii*. (Table of integrals, series, and products.) Moscow: Fizmatgiz, 1963. 1100 p.
- 231 #Hall M. *The theory of groups*. New York: Macmillan, 1959. 434 p.
- 239 #Halmos P R. *A Hilbert space problem book*. New York: American Book, 1967. 365 p.
- 309 #Halmos P R. *Measure theory*. New York: Springer-Verlag, 1950. 304 p.
- 634 #Harary F. *Graph theory*. Reading, MA: Addison-Wesley, 1969. 274 p.
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- 392 #Helgason S. *Differential geometry and symmetric spaces*. New York: Academic Press, 1962. 486 p.
- 426 #Hewitt E & Ross K A. *Abstract harmonic analysis*. New York: Springer-Verlag, 1963. 2 vols.
- 274 Hille E & Phillips R S. *Functional analysis and semi-groups*. Providence, RI: American Mathematical Society, 1957. 808 p.
- 203 #Hoffman K M. *Banach spaces of analytic functions*. Englewood Cliffs, NJ: Prentice-Hall, 1962. 217 p.
- 285 Hopcroft J E & Ullman J D. *Formal languages and their relation to automata*. Reading, MA: Addison-Wesley, 1969. 242 p.
- 228 Hormander L. *An introduction to complex analysis in several variables*. Princeton, NJ: D. Van Nostrand, 1966. 208 p.
- 473 #Huppert B. *Endliche Gruppen*. (Finite groups.) Berlin: Springer-Verlag, 1967. 796 p.
- 294 \*Johnston J. *Econometric methods*. New York: McGraw-Hill, 1963. 300 p. 16/79/S&BS
- 227 Kaplansky I. *Commutative rings*. London: Dillon's Q.M.C. Bookshop, 1968. 129 p.
- 885 #Kato T. *Perturbation theory for linear operators*. Berlin: Springer-Verlag, 1966. 592 p.
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- 678 #Kendall M G & Stuart A. *The advanced theory of statistics*. New York: Hafner, 1958-66. 3 vols.
- 222 Kleinrock L & Martin D F. *Queueing systems*. New York: Wiley, 1975-76. 2 vols.
- 1291 Knuth D E. *The art of computer programming*. Reading, MA: Addison-Wesley, 1968. 3 vols.
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- 191 Lakshmikantham V & Leela S. *Differential and integral inequalities*. New York: Academic Press, 1969. 2 vols.
- 279 #Lehmann E L. *Testing statistical hypotheses*. New York: Wiley, 1959. 369 p.
- 331 Lions J L. *Quelques methodes de resolution des problemes aux limites non lineaires*. (Some methods for the resolution of problems with nonlinear limits.) Paris: Dunod, 1969. 554 p.
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- 433 #Loeve M. *Probability theory*. New York: D. Van Nostrand, 1954. 515 p.
- 239 Mac Lane S. *Categories for the working mathematician*. New York: Springer-Verlag, 1971. 262 p.
- 226 Mac Lane S. *Homology*. Berlin: Springer-Verlag, 1963. 422 p.
- 292 Meyer P A. *Probability and potentials*. Waltham, MA: Blaisdell, 1966. 266 p.
- 384 Morse P M & Feshbach H. *Methods of theoretical physics*. Cambridge, MA: Technology Press, MIT, 1946. 497 p.
- 383 Ortega J M & Rheinboldt W C. *Iterative solution of nonlinear equations in several variables*. New York: Academic Press, 1970. 572 p.
- 225 #\*Papoulis A. *Probability, random variables, and stochastic processes*. New York: McGraw-Hill, 1965. 583 p. 19/80/ET&AS
- 238 Protter M H & Weinberger H F. *Maximum principles in differential equations*. Englewood Cliffs, NJ: Prentice-Hall, 1967. 261 p.
- 555 #\*Rao C R. *Linear statistical inference and its applications*. New York: Wiley, 1965. 625 p. 12/80/S&BS
- 417 Reed M & Simon B. *Methods of modern mathematical physics*. New York: Academic Press, 1972. 4 vols.

## A

- 321 #Richtmyer R D & Morton K W. *Difference methods for initial-value problems*. New York: Interscience, 1957. 405 p.
- 302 #Riesz F & Szokafalvi-Nagy B. *Lecons d'analyse fonctionnelle*. (Functional analysis.) Budapest: Akademiai Kiado, 1955. 468 p.
- 474 Rockafellar R T. *Convex analysis*. Princeton, NJ: Princeton University Press, 1970. 451 p.
- 232 Rogers H. *Theory of recursive functions and effective computability*. New York: McGraw-Hill, 1967. 482 p.
- 215 Rosenbrock H H. *State-space and multivariable theory*. London: Nelson, 1970. 257 p.
- 273 Rudin W. *Real and complex analysis*. New York: McGraw-Hill, 1966. 412 p.
- 243 Ruelle D. *Statistical mechanics*. New York: W.A. Benjamin, 1969. 219 p.
- 206 Salomaa A. *Formal languages*. New York: Academic Press, 1973. 322 p.
- 280 #Schaefer H. *Topological vector spaces*. New York: Macmillan, 1966. 294 p.
- 209 #Scheffe H. *The analysis of variance*. New York: Wiley, 1959. 477 p.
- 332 Schwartz L. *Theorie des distributions*. (Theory of distributions.) Paris: Hermann, 1950-51. 2 vols.
- 375 #Spanier E H. *Algebraic topology*. New York: McGraw-Hill, 1966. 528 p.
- 382 Stein E M. *Singular integrals and differentiability properties of functions*. Princeton, NJ: Princeton University Press, 1970. 287 p.
- 326 Strang W G & Fix G J. *An analysis of the finite element method*. Englewood Cliffs, NJ: Prentice-Hall, 1973. 306 p.
- 281 Theil H. *Principles of econometrics*. New York: Wiley, 1971. 736 p.
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- 331 #Varga R S. *Matrix iterative analysis*. Englewood Cliffs, NJ: Prentice-Hall, 1962. 322 p.
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## B

from 1961 to 1972—articles were cited four times as often as books.<sup>9,10</sup>

The 100 books in this study were published by 33 publishing houses. Table 2 lists these publishers and the nations where they are located. Five publishers produced 45 books which received more than 16,000 citations, or 42 percent of the 38,000 total. As expected, the majority of high impact publications are concentrated in a small number of publishing houses.

Nineteen US publishers are listed in Table 2. The UK accounts for four publishers; France and the USSR for three each; and the Federal Republic of Germany, Hungary, Poland, and Sweden have one each.

Eighty-four books were originally published in English, nine in French, five in Russian, and two in German. Many of these books were subsequently translated into other languages not discussed here. Clearly, mathematical computation is a system of universally grasped signs and symbols. As in synthetic chemistry, language may not present as much of a barrier to communication in mathematics as it does in medicine or social science. However, the data indicate that

English is the *lingua franca* of computer science as well as mathematics. The existence of many translations of these works indicates that they are used heavily outside of research.

The 130 authors in Table 1 are from 12 nations. It is significant that Russian authors account for five books in this study. Russian authors also contributed five of the most-cited *CMCI* articles.<sup>1</sup> These data for mathematics from the USSR stand in sharp contrast to the impact of Soviet science in other fields. While Soviet representation among the most-cited life scientists is quite small,<sup>11</sup> there were seven Russians among the 200 most-cited mathematicians in 1978 and 1979.<sup>12</sup>

Although ten French authors are indicated in Table 3, one of them is actually a collective pseudonym for a group of mostly French mathematicians—Nicolas Bourbaki. The Bourbaki "membership" has varied over the years from ten to 20 mathematicians, and they have been affiliated with universities in France and the US.<sup>13</sup> Technically speaking, the Bourbaki book should not have been included in this study, as it can be considered one of a series of multiauthored books. An-

**Table 2:** Publishers (first edition) of the 100 most-cited books, 1976-1980 *CMCF*<sup>8</sup>. A=publisher. B=number of books.

A	B
Wiley (US)	14
Springer-Verlag (FRG)	9
McGraw-Hill (US)	8
Prentice-Hall (US)	8
Academic Press (US)	6
Addison-Wesley (US)	5
Princeton University Press (US)	5
D. Van Nostrand (US)	5
Interscience (US)	4
American Mathematical Society (US)	3
W.A. Benjamin (US)	3
Dunod (France)	3
Clarendon Press (UK)	2
Fizmatgiz (State Publishing House for Physical and Mathematical Literature) (USSR)	2
Funduszu Kultury Narodowej (Fund for National Culture) (Poland)	2
Gosudarstvennoe Izdatel'stvo Tekhniko-Teoreticheskoi Literatury (State Publishing House for Technical and Theoretical Literature) (USSR)	2
Hermann (France)	2
Macmillan (US)	2
Akademiai Kiado (Publishing House of the Hungarian Academy of Sciences) (Hungary)	1
Allyn and Bacon (US)	1
Almqvist & Wiksells (Sweden)	1
American Book (US)	1
Blaisdell (US)	1
Cambridge University Press (UK)	1
Dillon's Q.M.C. Bookshop (UK)	1
Gauthier-Villars (France)	1
Hafner (US)	1
Harper & Row (US)	1
Holden-Day (US)	1
Technology Press, MIT	1
Nauka (USSR)	1
Nelson (UK)	1
RAND Corp. (US)	1

**Table 3:** Current national affiliations of the authors of the 100 books most cited, 1976-1980 *CMCF*<sup>8</sup>, in order of the total number of authors from each nation. A=country. B=total number of authors from that country.

A	B
US	91
France	10
UK	10
USSR	8
FRG	2
Hungary	2
Sweden	2
Australia	1
Finland	1
India	1
Italy	1
Poland	1
<b>Total</b>	<b>130</b>

other work by the Bourbaki group was among the most-cited math publications for 1961-1972.<sup>4</sup>

Including Bourbaki, 55 authors in Table 1 also appeared in a study of the most-cited mathematicians in 1978-1979.<sup>12</sup> In addition, three Fields Medal winners are included in this study—L. Hormander, L. Schwartz, and R. Thom. Thom's book, *Structural Stability and Morphogenesis*, described the principles of his catastrophe theory.<sup>14</sup> It was cited 233 times. The Fields Medal is widely considered to be the equivalent of the Nobel prize in mathematics. It is awarded every four years by the International Mathematical Union to researchers under age 40.<sup>15</sup>

Table 4 shows the publication year distribution for the 100 most-cited *CompuMath* books. Thirty-one of the books were published before 1960, as compared to only 12 for the 100 most-cited *CompuMath* articles.

About 60 of the books are in pure and applied mathematics. Among the many topics they discuss are algebraic functions and equations, graph theory, topology, linear operators, etc. About 15 books are on statistics and probability theory. The most-cited is a two-volume work by W. Feller published in 1950, *An Introduction to Probability Theory and Its Applications*. It was cited in more than 1,500 publications from 1976 to 1980. As an indication of the multidisciplinary impact of statistics and probability theory, five of the most-cited statistics books in this study were also among the 100 books most cited by social scientists from 1969 to 1977.<sup>8</sup>

Several authors have commented on the growth of statistics and its extensive application in the social and natural sciences. Most attribute the increased use of statistical methods to the development of high-speed computers. For example, Theodore W. Anderson, Stanford University, California, made the following observations in a *Citation Classic* commentary on his 1958 book, *An Introduction to Multivariate Statistical Analysis*: "There has been an even greater growth in the use of...statistical methods in the analysis of data in all fields of study due to an increase in mathematical sophistication among social scientists, more comprehensive training of investigators in statistics, and collection of more data. Perhaps the most important factor is the availability of high-speed computers with packages of programs that permit calculation of procedures with hardly more than the effort of entering the data."<sup>16</sup>

Computer science is also well represented in this study, accounting for ten books which

**Table 4:** Publication year distribution (based on the first year of publication) for the 100 most-cited books, 1976-1980 *CMCI*<sup>®</sup>.

Year	Books
1920s	1
1930s	4
1940s	3
1950s	23
1960s	49
1970s	20
<b>Total</b>	<b>100</b>

deal with programming, languages, networks, etc. D.E. Knuth's *The Art of Computer Programming*, published in 1968, was cited about 1,300 times from 1976 to 1980. The book, also available in a 1981 edition, continues to be well cited.

Three books on mathematical physics are listed in Table 1. These include the oldest book in this study, published in German in 1924—R. Courant and D. Hilbert's *Methods of Mathematical Physics*. It is still quoted quite often—more than 150 times in 1983

alone. In addition, two books discuss the principles and methods of econometrics, another field that has grown partly as a result of the increasing availability of powerful computers.

Our analysis of *CompuMath* books and articles has been limited to the period 1976-1980. We'll update these studies upon completion of the five-year cumulation for 1981-1985. In the meantime, we intend to solicit commentaries from authors whose works qualify as *Citation Classics*. For a variety of reasons, math and computer science publications have been underrepresented in our *Citation Classics* series. This is not due to any failing in our journal coverage, but rather to our initial heavy reliance on absolute instead of normalized citation counts.

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