APPENDIX A Core Business Reference Sources, Printed and Electronic[1]

101 Business Ratios: A Manager's Handbook of Definitions, Equations, and Computer Algorithms. How to Select, Compute, Present, and Understand Measures of Sales, Profit, Debt, Capital, Efficiency, Marketing, and Investment. (C. Sheldon Gates) McLane, 1993.

411 Stocks—http://www.411stocks.com/

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ABI World—http://www.abiworld.org/

Accountants' Handbook. (Carmichael, D.R., Steven B. Lilien, and Martin Mellman, eds.) 6th ed. Wiley, 1996. 2v.

Accounting and Tax Index. UMI, quarterly and annual.

Accounting Desk Book: The Accountant's Everyday Instant Answer Book. (Tom Plank) 11th ed. Prentice-Hall, 2000.

Accounting Handbook. (Joel G. Siegel and Jai K. Shim, eds.) 3rd ed. Barron's, 2000.

Accounting Literature Index. (Jean Louise Heck et al., eds.) 4th ed. McGraw-Hill, 1996.

Accounting Research Directory: The Database of Accounting Literature. 3rd ed. Wiener, 1994.

Accounting websites (compiled by the American Accounting Association)—http://accounting.rutgers.edu/raw/aaa/links/accsites.htm

Ad*Access—http://scriptorium.lib.duke.edu/adaccess/

Advertising Age—http://www.adage.com/

Advertising Research Foundation—http://www.arfsite.org/

Advertising World (University of Texas)—http://advertising.utexas.edu/world/

AFL-CIO—http://www.aflcio.org/

AICPA Audit and Accounting Manual as of June 1, 1998. AICPA, annual.

AICPA Professional Standards as of June 1, 1997. 2v. AICPA, annual.

AICPA Technical Practice Aids as of June 1, 1996. AICPA, annual.

Almanac of Business and Industrial Ratios. Prentice-Hall, annual.

American Academy of Advertising—http://advertising.utexas.edu/aaa/

American Advertising Federation—http://www.aaf.org/

American Almanac of Jobs and Salaries. (John W. Wright) 2000–2001 ed. Avon Books, 2000.

American Arbitration Association—http://www.adr.org/

[1]Compiled by Judith L. Violette, MLS, Director of Library Services, Walter E. Helmke Library, Indiana University–Purdue University, Fort Wayne, IN.

American Association for Public Opinion Research—http://www.aapor.org/main.html

American Association of Individual Investors—http://www.aaii.com/

American Banker's Association—http://www.aba.com/default.htm

American Banker's Banking Factbook. American Banker, annual.

American Demographics—http://www.inside.com/default.asp?entity=AmericanDemo

American Enterprise Institute for Public Policy Research—http://www.aei.org/

American Finance Association —http://www.afajof.org/

American Institute of Certified Public Accountants—http://www.aicpa.org/

American League for Financial Institutions—http://www.alfi.org/

American Management Association—http://www.amanet.org/

American Marketing Association—http://www.MarketingPower.com/

American Public Health Association—http://www.apha.org/

American Salaries and Wages Survey: Statistical Data from More Than 300 Government Business News Sources. Gale, annual.

American Society for Public Administration—http://www.aspanet.org/

American Society for Training and Development—http://www.astd.org/

American Statistics Index. Congressional Information Service, monthly and annual.

American Stock Exchange—http://www.amex.com/

American Taxation Association—http://www.atasection.org/

Americans for Tax Reform—http://www.atr.org/

Americans with Disabilities Act Handbook. (Henry H. Perritt, Jr.) 3rd ed. Wiley, 1997.

AMEX Fact Book. American Stock Exchange, annual.

AMEX Glossary—http://www.amex.com/reference/glossary.stm

Annual Report Gallery, A–Z link—http://www.reportgallery.com/

Annual Reports Online—http://www.zpub.com/sf/arl/arl_www.html

Association of Consumer Research—http://www.acr_news.org/

AuditNet.org—http://www.auditnet.org/karlhome.htm

Ayer Glossary of Advertising and Related Terms. 2nd ed. Ayer, 1977.

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Background Notes on Countries of the World—http://www.state.gov/www/background_notes/

Bank Administration Institute—http://www.bai.org/

Bank Marketing Association—http://www.aba.com/MarketingNetwork/default.htm

Barkley's Comprehensive Financial Glossary—http://www.oasismanagement.com/glossary/index.html

Barron's Finance and Investment Handbook. (John Downes and Jordan Elliot Goodman, eds.) 5th ed. Barrons, 1998.

Basic Business Library: Core Resources. (Bernard S. Schlessinger) 3rd ed. Oryx, 1995.

Basic Guide to Exporting. 1998 ed. U.S. Department of Commerce, 1998.

Biographical Dictionary of American Business Leaders. (John N. Ingham) Greenwood, 1983. 4v.

Biographical Dictionary of Management. (Morgan Nitzel, ed.) University of Chicago Press, 2001. 2v.

Blackwell Encyclopedia of Management. (Gary L. Cooper and Chris Argyris, eds.) Blackwell Business, 1997. 11v.

Bloomberg.com—http://www.bloomberg.com/

BNA's Human Resources Library. Bureau of National Affairs, update varies with format.

Book of the States. Council of State Governments, annual.

Brands and Their Companies. Gale, annual. 2v.

Business Advisor—http://www.business.gov/busadv/index.cfm

Business and Company Resource Center. Gale Group, updated daily.

Business Buzzwords: The Tough New Jargon of Modern Business. (Michael Johnson) Blackwell, 1990.

Business Information: How to Find It, How to Use It. (Michael R. Lavin) 3rd ed. Oryx, 2001.

Business Periodicals Database. H. W. Wilson, updating varies with version.

Business Plans Handbook: A Compilation of Actual Business Plans Developed by Small Businesses Throughout North America. (Erin Hoss, ed.) Gale, annual.

Business Source. EBSCOHost, updated daily.

Business Statistics of the United States. 7th ed. Bernan, 2002.

C

Cabell's Directory of Publishing Opportunities in Accounting, Economics, and Finance. 7th ed. Cabell, 1997. 2v.

CCH Internet Tax Research Network—*http://tax.cch.com/ipnetwork*

CDA/Wiesenberger Mutual Funds Update. CDA Investment Technologies, monthly.

Certified Financial Planner Board of Standards—http://www.cfp_board.org/

Chicago Mercantile Exchange—http://www.cme.com/

CIFAR's Global Company Handbook. Center for International Financial Analysis & Research, annual.

Citizens for a Sound Economy—http://www.cse.org/n_index.php

CNNfn—the financial network—http://www.cnnfn.com/

Codification of Statements on Auditing Standards, Numbers 1 to 87. AICPA, 1999.

Collective Bargaining Negotiations and Contracts. Bureau of National Affairs, looseleaf.

Commercial Atlas and Marketing Guide. Rand McNally, annual.

Companies and Their Brand Names. Gale, annual. 2v.

CompaniesOnline—http://www.companiesonline.com/

Complete Guide to Human Resources and the Law. (Dana Shilling) Prentice-Hall, 1998.

Conference Board—http://www.conference_board.org/

Consumer Connection—http://www.aba.com/consumer+connection/default.htm

Consumer Expenditure Survey. U.S. Bureau of Labor Statistics, annual. http://www.bls.gov/cex/

Corporate Information—http://www.corporateinformation.com/

Council of State Governments—http://www.statesnews.org/

Country Commercial Guides—http://www.state.gov/www/about_state/business/

CRB Commodity Year Book. Commodity Research Bureau, annual.

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D&B Million Dollar Directory: America's Leading Public & Private Companies. Dun & Bradstreet, annual. 5v.

Daily Stock Price Record: American Stock Exchange. Standard & Poor's, quarterly.

Daily Stock Price Record: NASDAQ. Standard & Poor's, quarterly.

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Dictionary of Marketing and Advertising. (Jerry M. Rosenberg) Wiley, 1995.

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Direct Marketing Association—http://www.the_dma.org/

Direction of Trade Statistics Yearbook. International Monetary Fund, annual.

Directory of American Firms Operating in Foreign Countries. Uniworld Business Publications, annual. 3v.

Directory of Corporate Affiliations. National Register, annual. 5v.

Directory of Foreign Firms Operating in the United States. 9th ed. Uniworld Business Publications, 1998.

Directory of Marketing Information Companies Featuring the Best 100. American Demographics, annual.

Directory of Mutual Funds, Closed-End Funds, Unit Investment Trust Sponsors. Investment Company Institute, annual.

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Dun & Bradstreet's Guide to Doing Business Around the World. (Terri Morrison et al.) Prentice-Hall, 2001.

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Ecommerce-guide.com—http://ecommerce.internet.com

Economic Indicators Handbook. 6th ed. Gale, 2002.

Economic Report of the President. Office of the President of the U.S., annual.

EDGAR Database of Corporate Information—http://www.sec.gov/edgarhp.htm

EEOC Compliance Manual. Bureau of National Affairs, looseleaf.

Elsevier's Dictionary of Financial Terms in English, German, Spanish, French, Italian, and Dutch. (Diana Phillips and Marie-Claude Bignaud, comp.) 2nd ed., rev. and enlarged Elsevier, 1997.

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Employee Benefit Plans: A Glossary of Terms. (Mary Jo Brzezinski, ed.) 8th ed. International Foundation of Employee Benefit Plans, 1993.

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Encyclopedia of American Industries. (Scott Heil and Terrance W. Peck, eds.) 3rd. ed. Gale, 2001. 2v.

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Encyclopedia of Consumer Brands. (Janice Jorgensen, ed.) St. James Press, 1994. 3v.

Encyclopedia of Emerging Industries. 4th ed. Gale, 2001.

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Encyclopedia of Taxation and Tax Policy. (Joseph J. Cordes, Robert D. Ebel, and Jane G. Gravelles, eds.) Urban Institute Press, 1999.

Entreworld: Resources for Entrepreneurs—http://www.entreworld.org/

Eurojargon: A Dictionary of European Union Acronyms, Abbreviations, and Sobriquets. (Anne Ramsay, ed.) 6th ed. Dearborn, 2000.

Europa World Year Book. Europa Publications, annual.

Exporters' Encyclopedia. Dun & Bradstreet, annual.

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Financial Planning Association—http://www.fpanet.org/

FINWeb—http://www.finweb.com/

FISonline. Mergent FIS, updated weekly.

Forbes 200 Best Small Companies in America—http://www.forbes.com/200best/

Fortune 500—http://www.pathfinder.com/fortune/fortune500/

Free Management Library—http://www.mapnp.org/library

G

Geographic Reference Report. ERI Economic Research Institute, annual.

Global Edge (MSU-CIBER International Business Resources on the WWW)—http://globaledge.msu.edu/ibrd/ibrd.asp

Glossaries of Financial Terms (from the Federal Reserve Bank of Chicago)—http://www.chicagofed.org/publications/glossary/index.cfm

Government Accounting Standards Board—http://raw.rutgers.edu/raw/gasb/welcome.htm

GPO Access—http://www.access.gpo.gov/su_docs/

Green Box Resources—http://www.indiana.edu/~libgpd/guides/green/home.html

Guide to Country Information in International Governmental Organization Publications. American Library Association, Government Documents Round Table, 1996.

Guide to Labor-Oriented Internet Resources—http://www.lib.berkeley.edu/IIRL/iirlnet.html

Guide to Reference Books. (Robert Balay, ed.) 11th ed. American Library Assn., 1996.

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Hoover's Online—http://www.hoovers.com/

Household Spending: Who Spends How Much on What. 4th ed. New Strategist Publications, 1997.

I

Inc. 500 Fastest Growing Companies in America—http://www.inc.com/500/home.html

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Index to Current Urban Documents. Greenwood Press, monthly.

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Internal Revenue Code (Title 26 of U.S. Code)—http://www.access.gpo.gov/congress/cong013.html

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International Economics—http://www.mnsfld.edu/depts/lib/globecon.html

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International Guide to Accounting Journals. (J. David Spiceland and Surendra P. Agrawal, eds.) 2nd ed. Wiener, 1993.

International Labour Organization—http://www.ilo.org/

International Marketing Data and Statistics. Euromonitor, 2001.

International Monetary Fund—http://www.imf.org/

International Trade Statistics Yearbook. United Nations, annual. 2v.

Internet Public Library Business Associations—http://www.ipl.org/cgi_bin/ref/aon.out.pl?id=bus0000

Internet Resources for International Economics & Business—http://www.ship.edu/~business/

Investment Company Institute ("the mutual fund connection")—http://www.ici.org/

IRS Bulletin—http://www.irs.ustreas.gov/prod/bus_info/bullet.html

IRS Tax Terms—http://www.irs.ustreas.gov/prod/taxi/taxterms.html

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Kipplinger's Global Investor—http://www.global_investor.com/

Knowledge@Wharton—http://knowledge.wharton.upenn.edu/

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Mergent Bond Record. Financial Information Services, monthly and annual.

Mergent Dividend Record. Mergent FIS, weekly and annual.

Mergent Unit Investment Trusts. Mergent FIS, annual.

Miller GAAP Guide: Restatement and Analysis of Current FASB Standards. (Jan R. Williams). CCH, annual.

Money—Past, Present & Future—http://www.ex.ac.uk/~RDavies/arian/money.html

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Mortgage Bankers Association of America—http://www.mbaa.org/

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Multilingual Dictionary of Local Government and Business. (Clive Leo McNeir) Cassell, 1993. See also multilingual and bilingual dictionaries listed in the library's online catalog.

Municipal Year Book. International City/County Management Association, annual.

Mutual Fund Encyclopedia. (Gerald W. Perritt) 1993–1994 ed. Dearborn Financial Publishing, 1993.

Mutual Fund Fact Book—http://www.ici.org/facts_figures/factbook_toc.html

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Nasdaq Stock Exchange—http://www.nasdaq.com

National Assembly of State Arts Agencies—http://www.nasaa_arts.org/

National Association of Counties—http://www.naco.org/

National Association of Credit Management—http://www.nacm.org/

National Association of Purchasing Management—http://www.icma.org/

National Association of Securities Dealers—http://www.nasd.com/

National Association of State Information Resource Executives—http://www.nasire.org/

National Association of Tax Practitioners—http://www.natptax.com/

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National Conference of State Legislatures—http://www.ncsl.org/

National Governors' Association—http://www.nga.org/

National Labor Relations Board Decisions and Orders. NLRB, irregular.

National League of Cities—http://www.nlc.org/

National Tax Association—http://ntanet.org

National Taxpayers Union—http://www.ntu.org/

Nelson's Directory of Investment Research: The Financial Professional's Guide to the Research Marketplace. Nelson Publications, annual.

New Palgrave Dictionary of Economics and the Law. (Peter Newman, ed.) Macmillan, 1998. 3v.

New Palgrave Dictionary of Money & Finance. (Peter Newman, Murray Milgate, and John Eatwell, eds.) Stockton, 1992. 3v.

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New York Stock Exchange Fact Book. New York Stock Exchange, annual.

New York Stock Exchange Glossary of Financial Terms—http://www.nyse.com/

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NTC's Dictionary of Advertising. (Jack G. Wiechmann, ed.) 2nd ed. National Textbook Co., 1992.

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Occupational Employment Statistics. U.S. Bureau of Labor Statistics website—http://stats.bls.gov/oes/

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OTC Bulletin Board—http://www.otcbb.com/dynamic/

Other Markets Online (from NASDAQ)—*http://dynamic.international.nasdaq.com/asp/globalmarkets.asp?lang-eng*

Overseas Private Investment Corp.—http://www.opic.gov/

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Pacific Exchange—http://www.pacificex.com/

Portable MBA Desk Reference: An Essential Business Companion. (Paul A. Argenti) Wiley, 1994.

Principal International Businesses: The World Marketing Directory. Dun & Bradstreet. annual.

Public Relations Society of America—http://www.prsa.org/

Q

Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations. U.S. Department of Commerce, quarterly.

R

Rand McNally Commercial Atlas and Marketing Guide. Rand McNally, annual.

Reference Book of Corporate Managements. Dun & Bradstreet, annual.

RIA OnPoint Federal Tax Service (available through Lexis-Nexis).

RMA Annual Statement Studies, Including Comparative Historical Data and Other Sources of Composite Financial Data. Robert Morris Associates, annual.

Robert Morris Associates, the Association of Lending and Credit Risk Professionals—http://www.rmahq.org/

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S&P Advantage. Standard & Poor's, updated daily.

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Tax Executives Institute—http://www.tei.org/

Tax Foundation—http://www.taxfoundation.org/

Taxpayer Information Publications—http://www.irs.ustreas.gov/prod/forms_pubs/pubs/index.htm

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U.S. Chamber of Commerce—http://www.uschamber.org/

U.S. Conference of Mayors—http://www.usmayors.org/uscm/

U.S. Congress House Banking and Financial Services Committee—http://www.house.gov/banking/

U.S. Congress Joint Committee on Taxation—http://www.house.gov/jct/

U.S. Congress Senate Banking, Housing, and Urban Affairs Committee—http://www.senate.gov/~banking/

U.S. Customs Service—http://www.customs.ustreas.gov/

U.S. Department of Commerce—http://www.doc.gov/

U.S. Department of Commerce. Office of Trade & Economic Analysis—http://www.ita.doc.gov/tradestats/

U.S. Department of Labor—http://www.dol.gov/

U.S. Department of State, Bureau of Consular Affairs—http://travel.state.gov/

U.S. Department of the Treasury (includes the U.S. Comptroller of the Currency)—http://www.ustreas.gov/

U.S. Employment and Training Administration—http://www.doleta.gov/

U.S. Equal Employment Opportunity Commission—http://www.eeoc.gov/

U.S. Federal Deposit Insurance Corp.—http://www.fdic.gov/

U.S. Federal Reserve System—http://www.federalreserve.gov/

U.S. Internal Revenue Service—http://www.irs.gov/; http://www.irs.ustreas.gov/

U.S. International Information Program—http://usinfo.state.gov/homepage.htm

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U.S. Justice Department, Tax Division—http://www.usdoj.gov/tax/

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U.S. National Labor Relations Board—http://www.nlrb.gov/

U.S. Securities and Exchange Commission—http://www.sec.gov/

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V

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APPENDIX

B

Decision Theory Problem

The value of research information can be assessed by several means, one of which is decision theory. The example considered here concerns the case of a manager who is deciding on a change in production equipment. Research information will play a major role in this decision. The new equipment can be leased for five years and will replace several old machines that require constant attention to operate. The problem facing the manager is, "Shall I lease the new machines with the attendant efficiencies, reduced labor, and higher lease charges, or shall I continue to use the old equipment?"

The decision situation has been prompted by news that the firm might secure several large orders from companies that have not been previous customers. With added volume, departmental profit contributions will increase substantially with the new equipment. For this decision, the manager adopts the decision variable "average annual departmental profit contribution."[1] The decision rule is, "Choose that course of action that will provide the highest average annual contribution to departmental profits."

Exhibit B–1 indicates the results of the evaluation of the two available actions. Under the conditions cited, it is obvious that course A_1 is preferred.

Conditions of Certainty

Exhibit B–1 presents the case with the assumption that the anticipated new business will materialize. It therefore represents, in decision theory terminology, *decision making under conditions of certainty.* It is assumed the payoffs are certain to occur if the particular action is chosen and the probability of the additional business being secured is 1.0.[2] The decision to choose action A_1 is obvious under these conditions with the given payoff data and decision rule.

Conditions of Uncertainty

In a more realistic situation, the outcome is less than certain. The new business may not materialize, and then the department might be left with costly excess capacity. The union may resist introduction of the new equipment because it replaces workers. The new equipment may not perform as anticipated. For these or other reasons, the decision maker may be uncertain about the consequences (for instance, that course A_1 will result in a $20,000 contribution).

Suppose the manager considers these other possible outcomes and concludes the one serious uncertainty is that the new business may not be forthcoming. For purposes of simplicity, one of two conditions will exist in the future—either the new business will be secured as expected (O_1), or the new business will not materialize (O_2). In the first case, the expected payoffs would be the same as in Exhibit B–1; but if the new business is not secured, then the addition of the new equipment would give the department costly excess capacity, with fixed lease charges. The payoff table may now be revised as Exhibit B–2.

Under these conditions, the original decision rule does not apply. That rule said, "Choose that course of action that will provide the highest average annual contribution to departmental profits." Under the conditions in Exhibit B–2, action A_1 would be better if the new business were secured, but A_2 would be the better choice if the new business were not secured. If the decision

EXHIBIT B–1 Payoff Under Conditions of Certainty

Course of Action	Average Annual Departmental Profit Contribution
A_1—Lease new equipment	$20,000
A_2—Retain old equipment	12,000

EXHIBIT B–2 Payoff Under Conditions of Uncertainty

	Average Annual Departmental Profit Contribution		
Course of Action	New Business (O_1)	No New Business (O_2)	Expected Monetary Value
A_1—Lease new equipment	$20,000	$5,000	$14,000
A_2—Retain old equipment	12,000	9,000	10,800

can be delayed until the new order question is resolved, the dilemma is escapable. However, because of lead times, the equipment decision may need to be made first.

When faced with two or more possible outcomes for each alternative, the manager can adopt one of two approaches. First, the likelihood that the company will receive the new business cannot be judged. Even so, a rational decision can be made by adopting an appropriate decision rule. For example, "Choose that course of action for which the minimum payoff is the highest." This is known as the *maximum criterion* because it calls for maximizing the minimum payoff. In Exhibit B–2, the minimum payoff for alternative A_1 is shown as $5,000, and the minimum payoff for A_2 is $9,000. According to the *maximum rule,* the choice would be A_2 because it is the best of the worst outcomes. This decision is a "cut your losses" strategy.

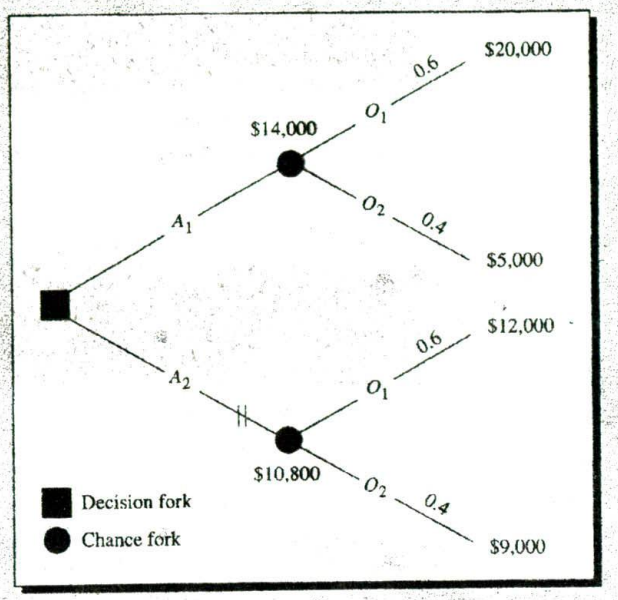
The second approach is to use subjective judgment to estimate the probability that either O_1 or O_2 will occur.[3] When the assumption was decision under certainty, only one event was possible (had a probability of 1.0). Now, however, with experience and information from other sources, there is a less-than-certain chance of the new business materializing, and this doubt should be part of the decision.

One might estimate that there is a 0.6 chance the new business will be secured and a 0.4 chance it will not. With this or any other set of similar probabilities, an overall evaluation of the two courses of action is possible. One approach is to calculate an *expected monetary value (EMV)* for each alternative.[4]

The Decision Flow Diagram

The decision problem already has been summarized in a payoff table, but further illustration in the form of a decision flow diagram (or decision tree) may be helpful. The decision tree for the equipment problem is shown in Exhibit B–3. The diagram may be seen as a sequential decision flow. At the square node on the left, the manager must choose between A_1 and A_2. After one of these actions, a chance event will occur—either the new business will be received by the company (O_1), or it will not be received (O_2). At the right extremity of the branches are listed the conditional payoffs that will occur for each combination of decision and chance event. On each chance branch is placed the expected probability of that chance event occurring. Keep in mind that these are subjective probability estimates by the manager that express a degree of belief that such a chance event will occur.

EXHIBIT B–3 Decision Tree for the Equipment Problem



Having set up this series of relationships, one calculates back from right to left on the diagram by an *averaging out and folding back* process. At each decision juncture, the path that yields the best alternative for the decision rule is selected. Here the EMV for A_1 averages out to $14,000, while the EMV for A_2 is $10,800. The double slash line on the A_2 branch indicates it is the inferior alternative and should be dropped in favor of A_1.

The Contribution of Research

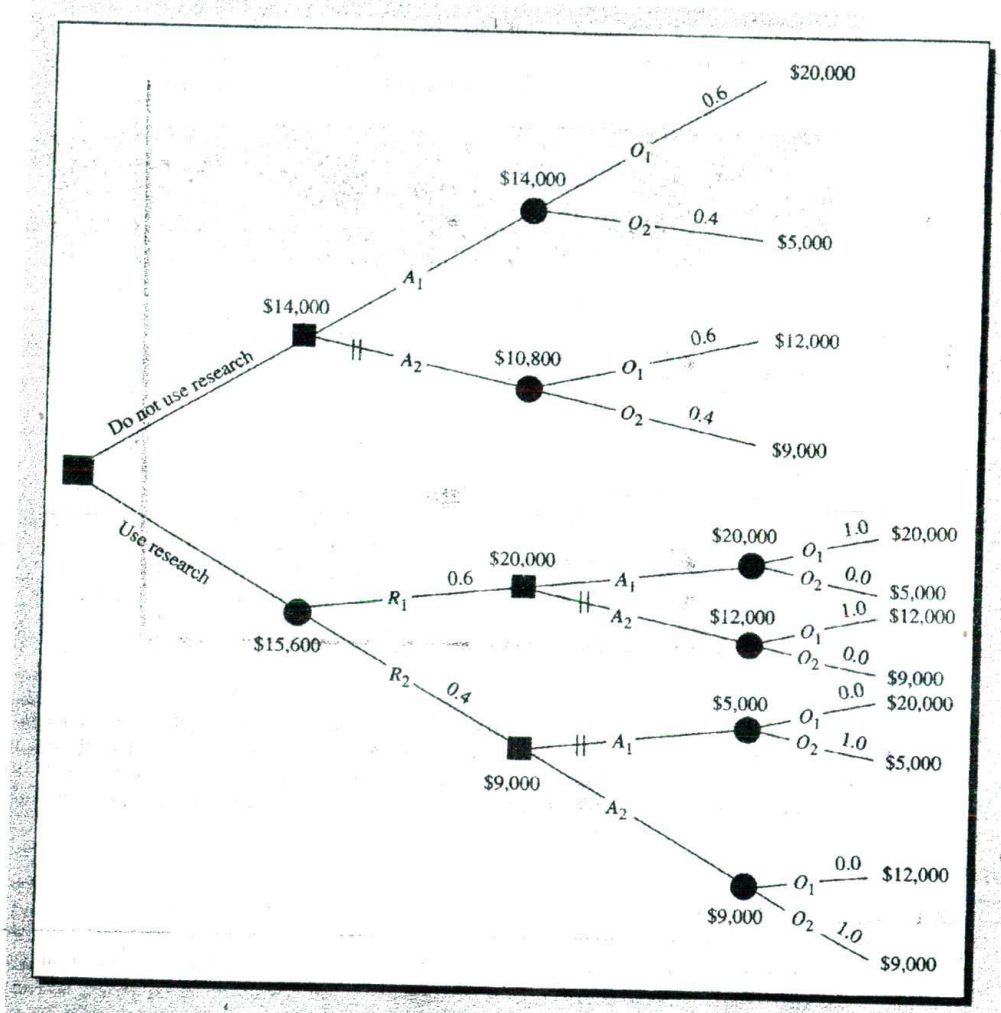
Now the contribution of research can be assessed. Recall that the value of research may be judged as "the difference between the results of decisions made with the information and the results of decisions that would be made without it." In this example, the research need is to decide whether the new business will be secured. This is the uncertainty that, if known, would make a perfect forecast possible. Just how much is a perfect forecast worth in this case?

Consider Exhibit B–3 once again. What would happen if the manager had information to accurately predict whether the new business orders would be secured? The choice would be A_1 if the research indicated the orders would be received, and A_2 if the research indicated the orders would not be received. However, at the decision point (before the research is undertaken), the best estimate is that there is a 0.6 chance that the research will indicate the O_1 condition and a 0.4 chance that the condition will be O_2. The decision flow implications of the use of research are illustrated in Exhibit B–4.

The decision sequence begins with the decision fork at the left. If the manager chooses to do research (R), the first chance fork is reached where one of two things will occur. Research indicates either that the orders will be received (R_1) or the orders will not be received (R_2). Before doing the research, the best estimate of the probability of R_1 taking place is the same as the estimate that O_1 will occur (0.6). Similarly, the best estimate that R_2 will occur is 0.4.

After the manager learns R_1 or R_2, there is a second decision fork: A_1 or A_2. After the A_1-A_2 decision, there is a second chance fork (O_1 or O_2) that indicates whether the orders were received.

EXHIBIT B–4 The Value of Perfect Information



Note that the probabilities at O_1 and O_2 have now changed from 0.6 and 0.4, respectively, to 1.0 and 0.0, or to 0.0 and 1.0, depending on what was learned from the research. This change occurs because we have evaluated the effect of the research information on our original O_1 and O_2 probability estimates by calculating *posterior probabilities*. These are revisions of our prior probabilities that result from the assumed research findings. The posterior probabilities (for example, $P(O_1|R_i)$ and $P(O_2|R_i)$ are calculated by using Bayes's theorem.[5]

The manager is now ready to average out and fold back the analysis from right to left to evaluate the research alternative. Clearly, if R_1 is found, A_1 will be chosen with its EMV of $20,000 over the A_2 alternative of $12,000. If R_2 is reported, then A_2 is more attractive. However, before the research, the probabilities of R_1 and R_2 being secured must be incorporated by a second averaging out. The result is an EMV of $15,600 for the research alternative versus an EMV of $14,000 for the no-research path. The conclusion then is this: Research that would enable the manager to make a perfect forecast regarding the potential new orders would be worth up to

$1,600. If the research costs more than $1,600, decline to buy it because the net EMV of the research alternative would be less than the EMV of $14,000 of the no-research alternative.

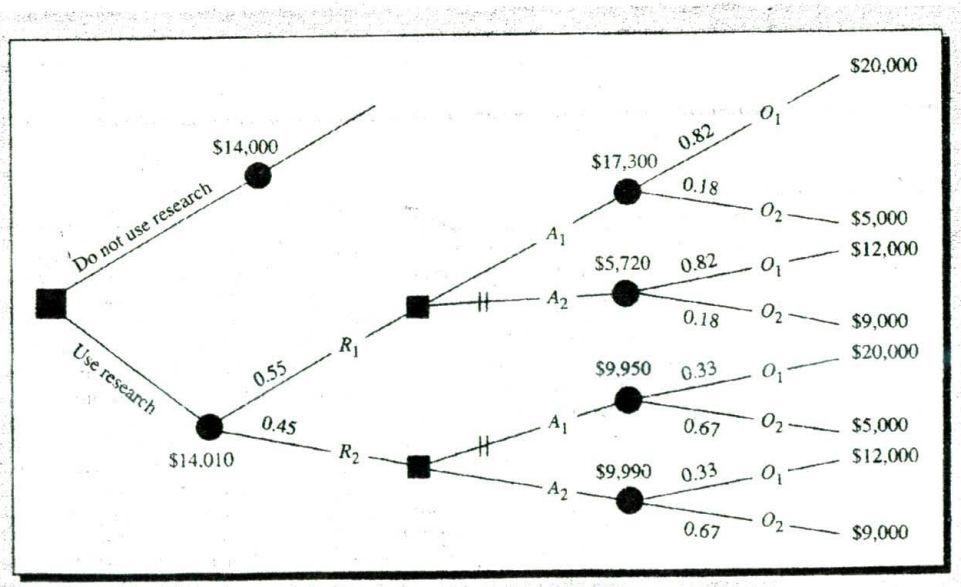
	States of Nature			Posterior Probabilities	
Research Outcomes	O_1	O_2	Marginal Probabilities	$P(O_1\|R_i)$	$P(O_2\|R_i)$
R_1	0.6	0.0	0.6	1.0	0.0
R_2	0.0	0.4	0.4	0.0	1.0
Marginal probabilities	0.6	0.4			

Imperfect Information

The analysis up to this point assumes that research on decision options will give a perfect prediction of the future states of nature, O_1 and O_2. Perfect prediction seldom occurs in practice. Sometimes research reveals one condition when later evidence shows something else to be true. Thus, we need to consider that the research in the machinery decision will provide less-than-perfect information and is, therefore, worth less than the $1,600 calculated in Exhibit B–4.

Suppose the research in that example involves interviews with the customers' key personnel and some customers' executives. They might all answer our questions to the best of their ability but still predict imperfectly what will happen. Consequently, we might judge that the chances of their predictions being correct are no better than 3 to 1, or 0.75. If we accept that our research results may provide imperfect information in this manner, we need to factor this into our evaluation decision. We do this by averaging out and folding back again. The results are shown in Exhibit B–5. The revised EMV, given research judged to be 75 percent reliable, is $14,010. This

EXHIBIT B–5 The Value of Imperfect Information



revised EMV is only $10 higher than the $14,000 EMV using no research and would seem to be hardly worth consideration.

Pragmatic Complications

This discussion, while simplified, contains the basic concepts for finding the value of research. Practical difficulties complicate the use of these concepts. First, the situation with two events and two alternatives is artificial. Problems with more choices and events are common, and the chief complication is the increased number of calculations.

	States of Nature			*Posterior Probabilities*	
Research Outcomes	O_1	O_2	Marginal Probabilities	$P(O_1\|R_i)$	$P(O_2\|R_i)$
R_1	0.45	0.10	0.55	0.82	0.18
R_2	0.15	0.30	0.45	0.33	0.67
Marginal probabilities	0.60	0.40			

A more serious problem is posed by the measurement of outcomes. We have assumed we could assess the various actions in terms of an unambiguous dollar value, but often we cannot. It is difficult to place a dollar value on outcomes related to morale or public image, for example.

An allied problem lies in the exclusive use of EMV as the criterion for decision making. This is correct in an actuarial sense and implies that each decision maker has a linear system of evaluation. In truth, we often use another evaluation system. The person who accepts EMV as a criterion sees that an even bet of $20 between two people on the toss of a fair coin is a fair bet. Many people, however, may not be willing to make such a bet because they fear the loss of $20 more than they value the gain of $20. They may need to be offered a chance, say, to win $20 but to lose only $10 before they would be willing to bet. These persons have a nonlinear decision scale. The "utility" concept is more relevant here.

The development of more precise methods of evaluating the contribution of research continues. In the meantime, continued emphasis on the improvement of our understanding of the researcher's task and the research process will make research more valuable when it is conducted.

Reference Notes

1. Recall that the decision variable is the unit of measurement used in the analysis. At this point, we need not be concerned with how this measure is calculated or whether it is the appropriate decision variable. Assume for purposes of this illustration that it is appropriate.
2. A probability is a measure between 1.0 and 0.0 that expresses the likelihood of an event occurring. For example, the probability of a "head" on a toss of a coin is 0.5. Under conditions of certainty, the forecasted outcome is assumed to have a probability of 1.0 even though we might agree that we normally cannot know the future with certainty. In most forecasting where a specific amount is named, there is an implicit assumption of certainty.
3. Concepts of probability enter into three types of situations. In the classical situation, each possible outcome has a known chance of occurrence. For example, a coin tossed in the air has a 0.5 chance of landing heads up; a spade card has a 0.25 chance of being drawn from a well-mixed deck.

   In the same type of situation, probabilities are thought of as "relative frequencies." Even if the probability is not known from the structure of the problem (as it is in the classical case), it can still be estimated if there is a body of empirical evidence. For example, experience may show that about 1 in 50

products produced is defective. From this statistic, one can estimate there is a 0.02 chance that any given product will be defective.

If there is no direct empirical evidence, one can still assess probability on the basis of opinion, intuition, and/or general experience. In such cases, uncertainty is expressed as a subjectively felt "degree of confidence" or "degree of belief" that a given event will occur. The discussions in this appendix are cases in point. For more information on probability concepts, see any modern statistics text.

4. One calculates an EMV for an alternative by weighting each conditional value (for example, \$20,000 and \$5,000 for A_1) by the estimated probability of the occurrence of the associated event (0.6 probability of the \$20,000 being made).

$$\begin{aligned} EMV &= P_1(\$20{,}000) + P_2(\$5{,}000) \\ &= 0.6(\$20{,}000) + 0.4(\$5{,}000) \\ &= \$14{,}000 \end{aligned}$$

5. Bayes's theorem with two states of nature is

$$\begin{aligned} P(O_1|R_1) &= \frac{P(R_1|O_1) \times P(O_1)}{P(R_1|O_1) + P(O_1) \times P(R_1|O_2) \times P(O_2)} \\ &= \frac{1.0 \times 0.6}{(1.0 \times 0.6) + (0.0 \times 0.4)} \\ &= 1.0 \end{aligned}$$

APPENDIX

C Request for Proposal (RFP): Assessment and Contents

Chapter 4 identified the request for proposal (RFP) as a means to formalize the process of documenting, justifying, and authorizing a procurement of research. RFPs provide the opportunity to evaluate different solutions and offer a mechanism to establish, monitor, and control the performance of the winning supplier of research services.

Summary of RFP Effectiveness

In the literature (the *ABI/Inform* database), over 100 journal articles discuss the role of RFPs, ranging from the reasons to use them to specific industry applications. The emerging consensus is that, except for government contracts and highly specialized industrial applications (e.g., engineering, manufacturing, construction, hospital systems), *traditional RFPs are not time and cost effective*. Commonly, the cost of preparing the RFP exceeds 15 percent of the final bid, the preparation can take as long as two years, and the document may run between several hundred and a thousand pages. An article in the *Journal of Business Communication* said this device has become virtually worthless for the procurement of services.

Several modifications or alternatives to RFPs are currently being considered:

- Send shorter RFPs by investing time up-front to decide specific, desirable outcomes.
- Use site visits and demonstrations to be certain the suppliers' designs or systems can meet their claims.
- Automate the process to reduce time and cost of preparation (Strategic Systems Solutions International offers software called Product Analyzer to simplify objective supplier evaluation through various scoring algorithms).
- Replace the RFP with a request for application (RFA). The RFA would consist of the following:
  - An overview of the requesting firm's organizational structure.
  - Business objectives.
  - Basic operational procedures.
  - Problems that the supplier's bid should address.
- Replace the RFP with a request for recommendation (RFR). The RFR would contain a clear statement of the problem and be sent to a small number of credible suppliers. The suppliers' responses would
  - Be limited to a 10-page reply.
  - Contain ballpark prices for the information to be provided.
  - Include supplier recommendations with brief descriptions of solutions and support that can be offered.
  - Be due in three to four weeks (saving the cost of a consultant to prepare an RFP and leaving the firm with the flexibility to maintain control of the project's ultimate direction). Suppliers (usually no more than six) would be invited to visit the firm and make a two-

hour presentation. The firm's statement of work would then be refined and the supplier list narrowed.

- Similar to RFAs and RFRs, the request for information (RFI) is often the first step in overall RFP development. The RFI lets a supplier know you are gathering information but are not prepared to purchase a good or service. It provides the company with an opportunity to more carefully define its requirements and alerts suppliers to the opportunity to respond to its requirements. There are several advantages to RFIs. An RFI
  - Is an accepted method for determining if the techniques and methods are available, if cost estimates are reasonable, and if solutions exist.
  - Requires in-house people to agree on the requirements and set minimal expectations.
  - Eliminates supplier surprise, thereby helping suppliers to build a better response.
  - Requires a formal written response that may later be incorporated into the contract.
  - Provides a qualified list of suppliers and eliminates those who could not have responded to the RFP.

The Organization and Content of an RFP

The RFP process, properly modified, allows an organization to analyze its current operations, problems, and future challenges. Communications with potential suppliers can be clear and based on a mutual understanding of the problems being addressed and the proposed solutions. Proper planning and management commitment to the project are essential.

The first step in developing an RFP is to fully understand and define the problem being addressed. In a formal RFP process, an internal set of experts defines the problem. (One can hire an expert or a group of experts who specialize in the problem area to help in defining the problem and writing the RFP.) Once the problem is defined, the technical section of the RFP can be written.

Besides defining the technical requirements, critical components of the RFP include project management, pricing, and contract administration. These sections allow the supplier to understand and meet expectations of the management team for carrying out the contracted services. Also, a section on the proposal administration, including important dates, is included.

The components of an RFP are

- Proposal administration information.
- Summary statement of the problem.
- Technical section.
- Management section.
- Pricing section.
- Contracts and license section.

Proposal Administration

This section is an overview with important information on the administration of the proposal itself. It establishes the dates of the RFP process—when the RFP is released, the time when the RFP team is available for questions, the date the proposals are expected, and the dates of the evaluation and supplier selections. It includes all requirements for preparing the proposal and describes how the proposals will be evaluated. Contact names, addresses, and relevant telephone and fax information are listed.

Summary Statement of the Problem

This section can be an abstract of the technical section, or it can be included as the first page of the technical section.

Technical Section

Technical information needed for the supplier to create the proposal is presented in this section. It begins by describing the problems to be addressed and the technical detail of each requirement. It loosely describes the services to be performed and the equipment, software, and documentation required. This section should be neither too specific nor too general to allow the suppliers flexibility in design creativity but should restrict them to meeting the needs of the corporation. Typically, the following would be included:

- Problem statement.
- Description of functional requirements.
- Identification of constraints.

Management Section

Each project requires some level of management. The extent to which the corporation expects schedules, plans, and reports is included in this section. The management section should include requirements for implementation schedules, training and reporting schedules, and other documentation. If specific supplier qualifications are needed, they should be shown here. References from the supplier's customers should also be requested.

Pricing Section

To cost the proposal, all information needed by the supplier is contained in this section. By using a rigid format, proposals with different approaches can be compared on costs. The following list shows examples of items that should be included:

- Services.
- Data collection.
- Data analysis.
- Meetings with client.
- Travel.
- Respondent survey incentives.
- Mail and telephone costs.
- Design meetings.
- Facilities and equipment.
- Extensions to work agreements.
- Pilot tests.
- Report preparations.
- Computer models.
- Project management.
- Deliverables:
  - Training
  - Brochures/literature
  - Videotapes
  - Reports
- Questionnaire and reproduction costs.
- Manpower costs.

Contracts and License Section

This section includes the types of contracts the supplier is expected to sign and any nondisclosure agreements. The safeguarding of intellectual property and the use of copyright are discussed. Terms of payment and required benchmarks are set forth. Typically a sample purchase contract would be included.

Conclusion

A well-written RFP allows an organization to request state-of-the-art proposals for dealing with complex problems. When not done properly, the process will take longer, cost more, and not provide a complete long-term solution. Therefore, when an organization decides to put a project to bid using an RFP-type mechanism, it is essential that time and effort be invested at the beginning of the process. Modifications to traditional RFP methods would also be beneficial. Clear communications with suppliers through a coherent RFP will result in a well-managed project with long-term benefits.

APPENDIX D

Sample External Proposal: Seagate Technology

Contract research requires a more formal proposal, such as this one prepared by Cooper Research Group for Seagate Technology.

Visit our website to see the actual proposal: www.mhhe.com/business/cooper8.

Customer Satisfaction Measurement for Seagate Technology

Cooper Research Group

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- Background
- Objectives and Scope
- Design
- Timeline
- Team and Professional Fees

Cooper Research Group

Seagate seeks to develop and implement . . .

a successful improvement strategy obtained by a systematic understanding of their customers' satisfaction with their products and (sales & marketing) services

Through:

- an identification of aggregate and subgroup customer responses.
- an understanding of the elements necessary to create and execute a plan for enhanced customer perceptions.
- a program to achieve and sustain competitive advantage through successive identification and correction of customer issues.

Cooper Research Group

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Cooper Research Group

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Cooper Research Group

Our approach includes thorough and collaborative planning, design, pilot testing and fieldwork, data analysis, and recommendations

Approach Summary

Step 1	Step 2	Step 3	Step 4	Step 5
[illegible]	Study Design	Fieldwork	Data Analysis	Recommend
• Identify team members • Announce project • Develop work plan • Create team understanding of the priorities • Understand linkages and logistics for Seagate and the vendor • Formulate action plans to address study objectives	• Conduct focus groups • Design sample from existing databases and supplemental sources • Collaboratively prepare interview schedule/ questionnaire • Design pretest • Prepare data analysis plan including database structure	• Develop questionnaire with Seagate • Create and reproduce questionnaire • Pretest the questionnaire • Conduct telephone interviews	• Assess instrument reliability and validity • Assess sample adequacy, error rates, outlier detection • Profile segments and key demographic variables • Evaluate statistical differences, attribute strengths & weaknesses • Identify key drivers of customer satisfaction	• Provide guidelines for Seagate's marketing strategy and resource allocation • Develop a results-oriented program leading to increased customer satisfaction • Present findings for implementation • Reassess implementation success

Communication with client, partner, vendors

Cooper Research Group

Sample Design

- design the sampling frame based on Seagate requirements; use the sampling frame for selection of focus group members and survey participants
- identify subpopulations and subsets (resellers, distributors/desktop HD, server systems/managers, directors) in the proportions specified by project director and the RFP)
- acquire sample from Seagate databases and from other agreed upon sources
- select focus group participants using quota-based techniques
- secure (probability-based) representative samples controlling for segment, geography, enterprise size, etc. (A conventional stratified probability sample may used.)
- draw the probability sample

Cooper Research Group

Focus Group Design

- Two sessions of focus groups:
  - Round 1, **Problem Definition:** Identify the attributes, factors, and characteristics that are important to various customers, the way these factors interact and how they relate to satisfaction and loyalty. Include utility of key processes (how much and at what cost). Use neural network analysis if possible. We recommend at least two groups for this round.
  - Round 2, **Test Improvement Plans:** A focus group to test solutions to issues arising from surveys. Taking key improvements to be planned: define packages; create trade-off analyses. We recommend three focus groups for this round, the last of which is for the Seagate (implementation) team.
- Round 3: We would recommend a follow-on survey rather than a third focus group given the importance of corrective action to Seagate's decision making. This survey would contact approximately 150 individuals and would include questions common to the first survey (for pre-post comparisons) and trade-off analyses. Advantages would include wider representation and much greater statistical rigor.

Cooper Research Group

Fieldwork Highlights

- develop questionnaire between Cooper Research and XLM based upon focus group results and Seagate knowledge
- create questionnaire and program in CATI
- pretest the questionnaire for appropriateness
- revise CATI programming as necessary
- brief interviewers
- execute survey
- provide action cards as required
- weekly updates from the field
- code open ends on an ongoing basis
- data compilation
- generate electronic data files
- tabulate data

Cooper Research Group

Data Collection

- data gathering (based in Canada for cost effectiveness)
- develop initial coding scheme; code open ends
- CATI programmed
- pretest
- revise questionnaire as needed
- interviewing through June and early July
- provide action cards as situation warrants
- coding and error checking
- high-level data to Seagate
- data cleaned and initial tables developed
- data file delivered
- data tables and final data sets delivered

Cooper Research Group

Data Analysis

- perform outlier detection (multivariate statistics are sensitive to the presence of outliers)
- split data and cross-replicate to assess the stability of solutions (a missing data contingency)
- evaluate results by segments and key demographics
- seek additional input from Seagate team members to gain insight into statistical results
- profile segments in terms of characteristics of interest to Seagate
- develop a profile of key drivers of customer satisfaction: describe strengths and weakness
- prepare report on implementation targets based on study findings
- begin transition to implementation-solution testing
- repeat analysis process for mini survey (assessment of the success of implemented solutions)
- revise data strategies for continuation of a results-oriented program leading to increased customer satisfaction.

Cooper Research Group

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Cooper Research Group

Preliminary Project Schedule

Tasks	1	3	5	7	9	11	13	15	17	19	21	23
Project kickoff with complete team												
Focus groups: first round												
Questionnaire design and programming												
Sample design including acquisition from Seagate where appropriate												
Pretest, briefing and survey data collection												
Data tabulation and electronic files												
Data analysis												
Reporting												
Focus groups: second round												

Week 1, March 6
Week 5, April 2
Week 9, April 30
Week 15, June 4
Week 19, July 2
Week 23, July 30

Cooper Research Group

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Cooper Research Group

The teams will have specific responsibilities to successfully complete the project

Team Representations

Client Team Members

- demonstrate leadership and support for project objectives
- provide knowledge of Seagate organization
- schedule participants for workshops and interviews
- collaborate on questionnaire design and segment profiling decisions
- provide adequate on-site facilities for focus group sessions

Consulting Team Members

- apply research methodology experience
- execute the activities outlined in the approach
- develop actionable recommendations
- communicate regularly with sponsors
- transfer knowledge of research concepts and techniques to client team

Cooper Research Group

Cooper Research Group: Overview

Cooper Research Group, Inc., is a customer satisfaction and market research consultancy based in Boca Raton, Florida. We help companies understand their customers' satisfaction with products and services, their marketplace, and their competitors. With a concentration on high tech, our services speed critical information for decisions made in dynamic and changing environments.

CRG specializes in quick turnaround, thoughtful client education, and leading-edge measurement and statistical analysis. With a small staff of highly trained experts, we are many times more responsive than full-service houses. By selecting our projects carefully, we can dedicate considerable energy to early completion. The reduced lag between data collection and reporting accelerates early warning of opportunities and obstacles

Services

Our services include research design, data analysis and reporting, expert consultancy, vendor evaluation, and education. Advanced statistical techniques such as Conjoint Analysis, Factor Analysis, Discriminant Analysis, Cluster Analysis, Multiple Regression, and Structural Equation Modeling are regularly employed for our clients with complex marketplace questions.

We design questionnaires and sampling frames to best meet your needs and budget. Reliability and validity studies, both as an integral part of our own designs and as specialized studies, are typically conducted. We use exploratory data analysis to give you the big picture and confirmatory analysis to zero-in on your strategic options.

Projects

During the last ten years, CRG has completed projects several hundred satisfaction, loyalty, and competitive brand analysis projects for major I/T providers, working in Europe, Latin America, and the U.S. markets. Among these was the development of IBM's customer satisfaction program for European Community countries. The scope of this program required coordination with many vendors throughout the continent.

We are currently involved in research on service satisfaction with the repair of mobile computers. Our closed-loop feedback system provides weekly reports to managers alerting them to actual problems while anticipating trends. We have also provided sophisticated customer satisfaction market modeling (LISREL) for all Latin American country/regional operations of a major I/T provider in a multi-year project. Other programs provide monthly measurements of satisfaction and repurchase intention. Our ongoing brand satisfaction research monitors progress in the market indexed to the Best of Class and targeted competitors.

Cooper Research Group

Strategic Partner: Overview

XLM Marketing Group (disguised for this example) is leading the way in developing successful, integrated Relationship Marketing applications that offer a unique breadth of abilities across an array of industries and disciplines.

Our professionals are strategic marketing experts backed by extensive marketing services, utilizing the latest technological advances in marketing. They can act locally or globally by tapping into a worldwide network to deliver a single service or to integrate a wide spectrum of marketing services for any business. At XLM, we use the strength of our experience, technology, research, and assessment tools to evaluate and design the right solutions to help you stay ahead of your competition.

Running ongoing relationship marketing programs for employees or channels takes a huge investment of time, capital, and technology. XLM offers solutions that simplify your research tasks, with a variety of cost-effective efficiencies built in.

XLM is wired for results today, with clients worldwide:

- Operating more than 180 support programs for Fortune 1000 clients.
- Employing full-time administrative pros worldwide.
- Developing customized solutions with minimal lead times.

We have the technology, systems, and resources to set up and manage the business processes that support your sales and marketing programs.

- Designing, testing and implementing customized research solutions.
- Providing complete coordination of survey data and processing support.
- Communicating program-specific feedback to clients.
- Converting survey data into meaningful marketing information.

Our leading-edge technology solutions can be matched to your individual requirements, with a process that's been fine-tuned and proven successful:

- Client-focused teams continuously manage, monitor, and measure results.
- Periodic benchmark measurements ensure the program is meeting your goals.
- XLM makes program adjustments as needed.
- Enhanced reporting helps you understand data that impacts your decisions.

Cooper Research Group

Relevant Industry Experience: XLM Marketing Group

The following is a list of studies XLM has conducted in the industry. Although the list is not exhaustive, it is provided as an example of the broad spectrum of studies conducted in this area.

Technology Industry:
Studies within the North American and European markets to measure customer satisfaction and corporate identity. Entailed a variety of methodological approaches including focus groups, depth interviews, and business to business interviews.

Pharmaceutical Industry:
A series of surveys have been conducted to determine competitive strengths, customer satisfaction, and segment awareness. Decisions concerning corporate direction are made based on the information gathered.

Telecommunications Industry:
Multiple surveys were conducted to understand both business-to-business customers and consumer customers. Linkages were created to a parallel employee survey to determine value chain impacts.

Retail Industry:
Store specific customer satisfaction linked to employee satisfaction and mystery shopping assessments to optimize service though optimal staffing and training.

Distribution of Consumer Products:
Value chain analysis of distribution, retail and consumer satisfaction of fast moving consumer goods. Information used to modify merchandising contracts, displays and value added information in the distribution chain.

Auto Parts Distribution Customer Satisfaction:
Customers satisfaction survey among customers for a major automotive parts organization.

Cooper Research Group

Project Costs

The cost for conducting the U.S. research is $142,500. Reimbursable expenses for travel and living away from home will be billed at cost. Project contingencies typically will not exceed 10% of proposed fees.

Estimates for your anticipated international projects are based on 150 completed surveys in Europe and 150 in Asia-Pacific. The estimate does not include focus groups or other exploratory analysis. The range for Europe: $35,000–$45,000. Asia-Pacific: $40,000–$55,000.

Our standard payment terms are 1/3 at the commencement of work, 1/3 at midpoint, and 1/3 upon project completion, subject to negotiation.

CRG and XLM will devote their best efforts to the work performed on this engagement. The findings, recommendations, and written materials we provide will represent our best professional judgment based on the information made available to us.

We require a one-week period from signature of the Document of Understanding to appropriately staff the engagement before beginning work. During this time we will be available to meet with you. Our timeline schedule and subsequent project execution is based on early notification by Seagate.

Notes

1. It is the policy of Cooper Research Group to present proposals with the understanding that their contents are copyrighted and that the ideas, conceptual approaches, and techniques expressed in them are the intellectual property of the Cooper Research Group, Inc. Nothing contained in this document may be divulged to any third party without the prior written permission of Cooper Research Group, Inc.

2. The concept specifications and costs will remain valid for a two-month period from the date of this proposal.

3. Pricing does not include travel and accommodation costs related to client meetings or focus groups. The cost for facilities and other focus group-related costs (other than professional fees) are also not included in the project costs.

APPENDIX

E Sample Student Term Project

Four members of a graduate research methods course formed a team to investigate career prospects in product management. Their stated research objectives were (1) to provide an inventory of major U.S. manufacturers that use the product management system, (2) to gather descriptive data on the nature and degree of product management, and (3) to collect information on how product managers are recruited, selected, and prepared for their responsibilities.

The research question was: "What is the role and scope of product management in U.S. manufacturing companies?" Since financial support from the student research fund was limited to *Fortune*'s top 1,000 manufacturing companies, the students further defined manufacturers according to this criterion. Their investigative questions were:

1. What is the incidence of use of the product manager system?
   a. To what degree is it presently in use?
   b. Has it been used in the past and discontinued?
   c. Was it considered and not adopted?
   d. What are future expectations regarding its use?
2. How are product managers recruited and selected?
3. What are the qualifications for employment as a product manager?
4. How does the product manager function in the company?
5. How can we classify the characteristics of individuals and companies to discern trends and differences?

The students selected a mail survey as their data collection method. Their initial plan was to use a screening or qualifying question to establish which companies use product management.

The team members developed the following procedure for constructing their questionnaire. Having agreed on the investigative questions, each member attempted to write measurement questions aimed at tapping the essence of each investigative question. Each measurement question was written on a 5-by-8-inch card to facilitate comparisons, revisions, additions, and deletions. At a meeting of the team, all questions were reviewed, duplicates were eliminated, and a general winnowing occurred. The remaining 31 questions were included in questionnaire draft 1, shown in Exhibit E–1. In this first draft, there was no effort to place questions in sequence or to present them graphically as they would eventually be seen by respondents.

After discussion, the team members concluded the questionnaire would probably need to be three pages long. In addition, the cover letter would require a page. They decided to use a printed cover letter and to incorporate it as the first page of the questionnaire. The combination would be printed on both sides of an 11-by-17-inch sheet of paper, folded in booklet form to 8 1/2-by-11 inches.

Each team member was assigned the task of translating draft 1 into draft 2. In the new draft, the questions were in planned sequence, had response formats chosen, and had graphic arrangements selected. Individual drafts were submitted to a subcommittee of the team who used them as the basis for developing questionnaire draft 2. This is shown in Exhibit E–2.

Draft 2 was reproduced and submitted to other members of the research class for critique. Comments and challenges were sought on (1) sources of confusion and vagueness; (2) question value (What useful information does the question provide? Not provide?); (3) appropriateness of the proposed response formats and suggestions for improvement; and (4) gaps in question coverage.

EXHIBIT E–1 Preliminary Questionnaire, Product Manager Study—Draft 1

1. What is your position in the company?
2. Is your company engaged primarily in industrial products, consumer products, or both?
3. Does your company use product managers?
4. How many product managers does the company have?
5. How many products are assigned to one PM?
6. Would you please give or include a job description of your company's PM position?
7. How many brands does your company have?
8. Approximately what percentage of your company's brands have product managers?
9. What percentage of sales volume do the brands in question 8 account for as a whole?
10. How long have product managers been used in your company?
11. Has a PM system been used and dropped in your company? If yes, why was it dropped?
12. Has a PM system ever been considered but never adopted in your company? If yes, why was it not adopted?
13. Are there any plans for the adoption of a PM system in the future?
14. What percentage of your product managers come *directly* from each of the following sources? Campuses, within the company, other companies, other (list).
15. If PMs come from within the company, what department or departments do they come from? Sales, marketing, production, advertising, other (list).
16. If PMs come from outside the company (other than campuses), what department or departments do they come from? Product manager, sales, marketing, production, advertising, other (list).
17. If PMs are recruited directly from campuses, what, if any, are typical degrees required?
18. Rank on a scale from 1 to 5 the relative importance of each of the following qualifications for a PM (1 denotes the greatest importance): Education, age, work experience, personality, creativity.
19. If PMs are recruited from within the company, what is the average age, length of work experience (with the company), and educational background?
20. If PMs are recruited from outside the company (not including campuses), what is the average age, length of work experience, and educational background?
21. What functions (advertising, pricing, etc.) does the PM actually perform in day-to-day activities, and what percentage of time is spent on each?
22. Of those functions listed in question 21, which, if any, does the PM have *final* authority over?
23. To whom does the PM report?
24. Does your company have a structured training program for product management? If yes, please explain.
25. On the basis of which of the following is the PM evaluated? Market share, ROI, sales volume, profits, other (list).
26. What were the objectives of the company in instituting the PM concept?
27. How successful has the PM concept been in fulfilling the objectives set for it?
28. What were the characteristics of the PM concept that contributed to the fulfillment of these objectives?
29. What elements, if any, of the PM system did not adequately contribute to the fulfillment of the objectives?
30. What specific actions, if any, have been taken to deal with the inadequacies listed in question 29?
31. If your company is currently planning any broad revisions in the present PM program, please describe.

EXHIBIT E–2 Product Manager Questionnaire—Draft 2

1. Does your company now use product managers? yes _____ no _____ (If no, please go to question 17).
2. Would you please send a copy of your job description?
3. How many product managers does your company have? _____
4. What percentage of your total sales is accounted for by product managers? _____ %
5. How long have product managers been used by your company? _____ years
6. What percentage of your personnel enters the product management program from the following sources?

   Campuses _____ %

   Within the company _____ %

   From elsewhere _____ %
7. If product managers come from within the company or elsewhere, what department(s) do they come from?

   Sales _____ %

   Marketing _____ %

   Production _____ %

   Advertising _____ %

   Other product management programs _____ %

   Advertising agencies _____ %

   Elsewhere _____ %
8. If product managers are recruited directly from campuses, please rank the following degrees from 1 to 6, with 1 being the most desirable, 2 the next most desirable, and so forth.

   BS _____ areas _____

   AB _____ areas _____

   BSBA (BBA) _____ areas _____

   MA _____ areas _____

   MBA _____ areas _____

   PhD _____ areas _____
9. Briefly state what you consider to be an appropriate profile of a product manager recruited directly from the campus.

   Age:

   Work experience (length and type):

   Personal traits (personality, creativity, aggressiveness, etc.):

   Education:

EXHIBIT E–2 (Continued)

10. What do you consider to be an appropriate profile for a product manager recruited from within or from another company?

    Age:

    Work experience (length and type):

    Personal traits (personality, creativity, aggressiveness, etc.):

    Education:

11. To whom does the product manager report? _____
12. What percentage of his or her time does the product manager spend in various functionary areas, such as production, advertising, pricing, etc.? Please list.
13. Please rank on a scale of 1 to 5 (1 is most important) the following criteria used in evaluating a product manager.

    _____ Market share

    _____ Return on investment

    _____ Sales volume

    _____ Profits

    _____ Other (please explain) _____

14. Does the company have a structured training program?

    yes _____ no _____ If yes, please describe. _____

15. What prompted your firm to initiate the product manager system?
16. Is your company currently planning any future revisions in the product manager system?

    yes _____ no _____ If yes, please explain. _____

17. Is your company primarily engaged in

    Industrial goods _____ %

    Food products _____ %

    Consumer package goods _____ %

    Consumer durable goods _____ %

    Automotive products _____ %

    Other (list)

    _____ _____ %

    _____ _____ %

18. What is your company's total sales volume? $ _____

    If you answered question 1 yes, you have completed the questionnaire. If your answer was no, please answer question 19. Thank you for your cooperation.

19. Please check which of the following best describes your company's use of product managers.

    _____ Have never considered product managers.

    _____ Have considered, but never adopted product management.

    _____ Have used previously and discontinued.

    _____ Presently considering adoption of the system in the future.

EXHIBIT E–3 (continued)

(please check)

2. Will you be answering the following for: _____ your company
   _____ your division
3. How many product managers (include all levels such as group PM, PM, assoc. PM, and assistant PM) does your company/division employ? _____
4. How long have product managers been used by your company/division? _____ years
5. What percentage of your company/division total sales are accounted for by products controlled by product managers? _____ %
6. From the following, please indicate whether the position exists in your company/division. Then indicate the source from which the personnel at the various levels were obtained to fill that position. If you have a similar position but with a different name, please indicate that position in the blank.

	Do You Have?		*(please check) Major Sources Within Company*			
	Yes	**No**	**Campuses**	**Other PM Jobs**	**Other Jobs**	**Other Companies**
Group PMs	___	___	___	___	___	___
PMs	___	___	___	___	___	___
Assoc. PMs	___	___	___	___	___	___
Asst. PMs	___	___	___	___	___	___
Other (specify)	___	___	___	___	___	___

7. What is the typical age of your
   Group product managers _____ years
   Product managers _____ years
   Associate PMs _____ years
   Assistant PMs _____ years
8. Of the following personal traits, please indicate their degree of importance in the evaluation of a candidate for a product management position.

	(please check)			
	Not Important	**Desirable**	**Very Desirable**	**Essential**
Leadership	___	___	___	___
Creativity	___	___	___	___
Aggressiveness	___	___	___	___
Analytical ability	___	___	___	___
Communications skill	___	___	___	___
Ability to work with others	___	___	___	___
Other _____	___	___	___	___

EXHIBIT E–3 (continued)

9. If you recruit directly from campus, please indicate the importance of the following traits of a product manager candidate.

	(please check)			
	Not Important	**Desirable**	**Very Desirable**	**Essential**
Business experience	___	___	___	___
High grade-point avg.	___	___	___	___
Extracurricular activities	___	___	___	___
MBA	___	___	___	___
Master's, technical	___	___	___	___
Bachelor's, business	___	___	___	___
Other (specify) _____	___	___	___	___

10. If you recruit into your PM group from other jobs (either from within your company or from other companies), please indicate the importance of the following experiences.

	(please check)			
Experience	**Not Important**	**Desirable**	**Very Desirable**	**Essential**
Sales	___	___	___	___
Other product manager programs	___	___	___	___
Other marketing positions	___	___	___	___
Production	___	___	___	___
Ad agencies	___	___	___	___
Undergraduate degree	___	___	___	___
Graduate degree	___	___	___	___
Other (specify) _____	___	___	___	___

11. Please indicate the percentage of time a typical product manager spends in the following activities:

Advertising	_____ %
Pricing	_____
Distribution	_____
Packaging	_____
Product development	_____
Marketing research	_____
Production liaison	_____
Finance and budgeting	_____
Other (specify) _____	_____
Other (specify) _____	_____
Total	100%

EXHIBIT E–3 (continued)

12. Please indicate which of the following criteria are used in evaluating product managers in your company/division.
    a. _____ Market share
    _____ Return on investment
    _____ Sales volume
    _____ Dollar profits
    _____ Other (please specify)
    b. Which one is most important? _____
13. Does your company/division have a structured training program for product managers?
    yes _____ no _____ (If yes, please describe.)
    _____
14. Is your company/division currently planning any revision in its product manager system?
    yes _____ no _____ (If yes, please describe.)
    _____
15. Judging from your company's experience, what do you feel is the major problem facing the product management system?
    _____
16. It would be most valuable to our studies if you could supply a sample job description of your product manager positions.
    Are such available?
    ____ Yes, examples enclosed
    ____ Yes, examples sent under separate cover
    ____ Not available
    Thank you for your assistance.
17. If you would like a summary of the results of this survey, please check here. ____

Thank you for your assistance.

APPENDIX

F Nonparametric Significance Tests

This appendix contains additional nonparametric tests of hypotheses to augment those described in Chapter 17 (see Exhibit 17–7).

One-Sample Case

Kolmogorov-Smirnov Test

This test is appropriate when the data are at least ordinal and the research situation calls for a comparison of an observed sample distribution with a theoretical distribution. Under these conditions, the Kolmogorov-Smirnov (KS) one-sample test is more powerful than the χ^2 test and can be used for small samples when the χ^2 test cannot. The KS is a test of goodness of fit in which we specify the *cumulative* frequency distribution that would occur under the theoretical distribution and compare that with the observed cumulative frequency distribution. The theoretical distribution represents our expectations under H_0. We determine the point of greatest divergence between the observed and theoretical distributions and identify this value as D (maximum deviation). From a table of critical values for D, we determine whether such a large divergence is likely on the basis of random sampling variations from the theoretical distribution. The value for D is calculated as follows:

$$D = \text{Maximum } |F_0(X) - F_T(X)|$$

in which

$F_0(X)$ = The observed cumulative frequency distribution of a random sample of n observations. Where X is any possible score, $F_0(X) = k/n$, where k = the number of observations equal to or less than X.

$F_T(X)$ = The theoretical frequency distribution under H_0.

We illustrate the KS test, with an analysis of the results of the dining club study, in terms of various class levels. Take an equal number of interviews from each class, but secure unequal numbers of people interested in joining. Assume class levels are ordinal measurements. The testing process is as follows (see accompanying table):

1. **Null hypothesis.** H_0: There is no difference among student classes as to their intention of joining the dining club.
   H_A: There is a difference among students in various classes as to their intention of joining the dining club.
2. **Statistical test.** Choose the KS one-sample test because the data are ordinal measures and we are interested in comparing an observed distribution with a theoretical one.
3. **Significance level.** $\alpha = .05$, $n = 60$.
4. **Calculated value.** D = Maximum $|F_0(X) - F_T(X)|$.
5. **Critical test value.** We enter the table of critical values of D in the KS one-sample test (see Appendix Exhibit G–5) and learn that with $\alpha = .05$ the critical value for D is

	Freshman	Sophomore	Junior	Senior	Graduate
Number in each class	5	9	11	16	19
$F_0(X)$	5/60	14/60	25/60	41/60	60/60
$F_T(X)$	12/60	24/60	36/60	48/60	60/60
$\lvert F_0(X) - F_T(X)\rvert$	7/60	10/60	11/60	7/60	0
$D = 11/60 = .183;$					
$n = 60$					

$$D = \frac{1.36}{\sqrt{60}} = .175$$

6. Interpret. The calculated value is greater than the critical value, indicating we should reject the null hypothesis.

Two-Samples Case

Sign Test

The sign test is used with matched pairs when the only information is the identification of the pair member that is larger or smaller or has more or less of some characteristic. Under H_0, one would expect the number of cases in which $X_A > X_B$ to equal the number of pairs in which $X_B > X_A$. All ties are dropped from the analysis, and n is adjusted to allow for these eliminated pairs. This test is based on the binomial expansion and has a good power efficiency for small samples.

Wilcoxon Matched-Pairs Test

When you can determine both *direction* and *magnitude* of difference between carefully matched pairs, use the Wilcoxon matched-pairs test. This test has excellent efficiency and can be more powerful than the t-test in cases where the latter is not particularly appropriate. The mechanics of calculation are also quite simple. Find the difference score (d_i) between each pair of values, and rank-order the differences from smallest to largest without regard to sign. The actual signs of each difference are then added to the rank values, and the test statistic T is calculated. T is the sum of the ranks with the less frequent sign. Typical of such research situations might be a study where husband and wife are matched, where twins are used, where a given subject is used in a before-after study, or where the outputs of two similar machines are compared.

Two types of ties may occur with this test. When two observations are equal, the d score becomes zero, and we drop this pair of observations from the calculation. When two or more pairs have the same d value, we average their rank positions. For example, if two pairs have a rank score of 1, we assign the rank of 1.5 to each and rank the next largest difference as third. When $n < 25$, use the table of critical values (see Appendix Exhibit G–4). When $n > 25$, the sampling distribution of T is approximately normal with

$$\text{Mean} = \mu_T = \frac{n(n+1)}{4}$$

$$\text{Standard deviation} = \sigma_T \sqrt{\frac{n(n+1)(2n+1)}{24}}$$

The formula for the test is

$$z = \frac{T - \mu_T}{\sigma_T}$$

Suppose you conduct an experiment on the effect of brand name on quality perception. Ten subjects are recruited and asked to taste and compare two samples of a product, one identified as a well-known drink and the other as a new product being tested. In truth, however, the samples are identical. The subjects are then asked to rate the two samples on a set of scale items judged to be ordinal. Test these results for significance by the usual procedure.

1. **Null hypothesis.** H_0: There is no difference between the perceived qualities of the two samples.
   H_A: There is a difference in the perceived quality of the two samples.
2. **Statistical test.** The Wilcoxon matched-pairs test is used because the study is of related samples in which the differences can be ranked in magnitude.
3. **Significance level.** $\alpha = .05$, with $n = 10$ pairs of comparisons minus any pairs with a d of zero.
4. **Calculated value.** T equals the sum of the ranks with the less frequent sign. Assume we secure the following results:

Pair	Branded	Unbranded	d_i	Rank of d_i	Rank with Less Frequent Sign
1	52	48	4	4	
2	37	32	5	5.5*	
3	50	52	–2	–2	2
4	45	32	13	9	
5	56	59	–3	–3	3
6	51	50	1	1	
7	40	29	11	8	
8	59	54	5	5.5*	
9	38	38	0	*	
10	40	32	8	7	$T = 5$

*There are two types of tie situations. We drop out the pair with the type of tie shown by pair 9. Pairs 2 and 8 have a tie in rank of difference. In this case, we average the ranks and assign the average value to each.

5. **Critical test value.** Enter the table of critical values of T with $n = 9$ (see Appendix Exhibit G–4) and find that the critical value with $\alpha = .05$ is 6. Note that with this test, the calculated value must be smaller than the critical value to reject the null hypothesis.
6. **Interpret.** Since the calculated value is less than the critical value, reject the null hypothesis.

Kolmogorov-Smirnov Two-Samples Test

When a researcher has two independent samples of ordinal data, the Kolmogorov-Smirnov (KS) two-samples test is useful. Like the one-sample test, this two-samples test is concerned with the agreement between two cumulative distributions, but both represent sample values. If the two samples have been drawn from the same population, the cumulative distributions of the samples should be fairly close to each other, showing only random deviations from the population distribution. If the cumulative distributions show a large enough maximum deviation D, it is evidence for rejecting the H_0. To secure the maximum deviation, one should use as many intervals as are available so as not to obscure the maximum cumulative difference.

The two-samples KS formula is

$$D = \text{Maximum } |F_{N1}(X) - F_{N2}(X)| \quad \text{(two-tailed test)}$$

$$D = \text{Maximum } |F_{N1}(X) - F_{N2}(X)| \quad \text{(one-tailed test)}$$

D is calculated in the same manner as before, but the table for critical values for the numerator of D, K_D (two-samples case) is presented in Appendix Exhibit G–6 when $n_1 = n_2$ and is less than 40 observations. When n_1 and/or n_2 are larger than 40, D from Appendix Exhibit G–7 should be used. With this larger sample, it is not necessary that $n_1 = n_2$.

Here we use a different sample from the smoking-accident study. (To make $n_1 = n_2$, we increased the sample size of no accidents to 34. Nonsmokers with no accidents is 24.) Suppose the smoking classifications represent an ordinal scale, and you test these data with the KS two-samples test. Proceed as follows:

1. **Null hypothesis.** H_0: There is no difference in on-the-job accident occurrences between smokers and nonsmokers.
   H_A: The more a person smokes, the more likely that person is to have an on-the-job accident.
2. **Statistical test.** The KS two-samples test is used because it is assumed the data are ordinal.
3. **Significance level.** $\alpha = .05$. $n_1 = n_2 = 34$.
4. **Calculated value.** See the one-sample calculation (KS test) and compare with table below.
5. **Critical test value.** We enter Appendix Exhibit G–6 with $n = 34$ to find that $K_D = 11$ when $p = \leq .05$ for a one-tailed distribution.

	Heavy Smoker	Moderate Smoker	Nonsmoker
$F_{n1}(X)$	12/34	21/34	34/34
$F_{n2}(X)$	4/34	10/34	34/34
$d_i = K_{D/n}$	8/34	11/34	0

6. **Interpret.** Since the critical value equals the largest calculated value, we reject the null hypothesis.

Mann-Whitney *U* Test

This test is also used with two independent samples if the data are at least ordinal; it is an alternative to the *t*-test without the latter's limiting assumptions. When the larger of the two samples is 20 or less, there are special tables for interpreting U; when the larger sample exceeds 20, a normal curve approximation is used.

In calculating the U test, treat all observations in a combined fashion and rank them, algebraically, from smallest to largest. The largest negative score receives the lowest rank. In case of ties, assign the average rank as in other tests. With this test, you can also test samples that are unequal. After the ranking, the rank values for each sample are totaled. Compute the U statistic as follows:

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

or

$$U = n_1 n_2 + \frac{n_2(n_2 - 1)}{2} - R_2$$

in which

n_1 = Number in sample 1

n_2 = Number in sample 2

R_1 = Sum of ranks in sample 1

With this equation, you can secure two U values, one using R_1 and the second using R_2. For testing purposes, use the smaller U.

An example may help to clarify the U statistic calculation procedure. Let's consider the sales training example with the t distribution discussion. Recall that salespeople with training method A averaged higher sales than salespeople with training method B. While these data are ratio measures, one still might not want to accept the other assumptions that underlie the t-test. What kind of a result could be secured with the U test? While the U test is designed for ordinal data, it can be used with interval and ratio measurements.

1. **Null hypothesis.** H_0: There is no difference in sales results produced by the two training methods.
   H_A: Training method A produces sales results superior to the results of method B.
2. **Statistical test.** The Mann-Whitney U test is chosen because the measurement is at least ordinal, and the assumptions under the parametric t-test are rejected.
3. **Significance level.** $\alpha = .05$ (one-tailed test).
4. **Calculated value.**

Sales Per Week per Salesperson			
Training Method A	Rank	Training Method B	Rank
1,500	15	1,300	10
1,540	16	1,300	8.5
1,860	22	1,620	18
1,230	6	1,070	3
1,370	12	1,210	5
1,550	17	1,170	4
1,840	21	1,770	20
1,250	7	950	1
1,300	8.5	1,380	13
1,350	11	1,460	14
1,710	19	1,030	2
	$R_1 = 154.5$		$R_2 = 98.5$

$$U = (11)(11) + \frac{11(11+1)}{2} - 154.5 = 32.5 \qquad U = (11)(11) + \frac{11(11+1)}{2} - 98.5 = 88.5$$

5. **Critical test value.** Enter Appendix Exhibit G–8 with $n_1 = n_2 = 11$, and find a critical value of 34 for $\alpha = 0.5$, one-tailed test. Note that with this test, the calculated value must be smaller than the critical value to reject the null hypothesis.

6. Interpret. Since the calculated value is smaller than the critical value (34 > 32.5), reject the null hypothesis and conclude that training method A is probably superior.

Thus, one would reject the null hypothesis at $\alpha = .05$ in a one-tailed test using either the t- or the U test. In this example, the U test has approximately the same power as the parametric test.

When $n > 20$ in one of the samples, the sampling distribution of U approaches the normal distribution with

$$\text{Mean} = \mu_U = \frac{n_1 n_2}{2}$$

$$\text{Standard deviation } \sigma_U = \sqrt{\frac{(n_1)(n_2)(n_1 + n_2 + 1)}{12}}$$

and

$$z = \frac{U - \mu_U}{\sigma_U}$$

Other Nonparametric Tests

Other tests are appropriate under certain conditions when testing two independent samples. When the measurement is only nominal, the Fisher exact probability test may be used. When the data are at least ordinal, use the median and Wald-Wolfowitz runs tests.

k-Samples Case

You can use tests more powerful than χ^2 with data that are at least ordinal in nature. One such test is an extension of the median test mentioned earlier. We illustrate here the application of a second ordinal measurement test known as the Kruskal-Wallis one-way analysis of variance.

Kruskal-Wallis Test

This is a generalized version of the Mann-Whitney test. With it we rank all scores in the entire pool of observations from smallest to largest. The rank sum of each sample is then calculated, with ties being distributed as in other examples. We then compute the value of H as follows:

$$H = \frac{12}{N(N+1)} \sum_{j=1}^{k} \frac{T_j^2}{n_j} - 3(N+1)$$

where

T_j = Sum of ranks in column j

n_j = Number of cases in jth sample

$N = \sum w_j$ = Total number of cases

k = Number of samples

When there are a number of ties, it is recommended that a correct factor (C) be calculated and used to correct the H value as follows:

$$C = 1 - \left\{ \frac{\sum_{i}^{G} (t_i^3 - t_i)}{N^3 - N} \right\}$$

where

G = Number of sets of tied observations

t_i = Number tied in any set i

$H' = H/C$

To secure the critical value for H', use the table for the distribution of χ^2 (see Appendix Exhibit G–3), and enter it with the value of H' and d.f. $= k - 1$.

To illustrate the application of this test, use the price discount experiment problem. The data and calculations are shown in Exhibit F–1 and indicate that, by the Kruskal-Wallis test, one again barely fails to reject the null hypothesis with $\alpha = .05$.

EXHIBIT F–1 Kruskal-Wallis One-Way Analysis of Variance (price differentials)

One Cent		Three Cents		Five Cents	
X_A	Rank	X_B	Rank	X_C	Rank
6	1	8	5	9	8.5
7	2.5	9	8.5	9	8.5
8	5	8	5	11	14
7	2.5	10	11.5	10	11.5
9	8.5	11	14	14	18
11	14	13	16.5	13	16.5
	$T_j = 33.5$		60.5		77.0

$$T = 33.5 + 60.5 + 77$$
$$= 171$$

$$H = \frac{12}{18(18+1)}\left[\frac{33.5^2 + 60.5^2 + 77^2}{6}\right] - 3(18+1)$$

$$= \frac{12}{342}\left[\frac{1{,}122.25 + 3{,}660.25 + 5{,}929}{6}\right] - 57$$

$$= 0.0351\left[\frac{10{,}711.5}{6}\right] - 57$$

$$H = 5.66$$

$$C = 1 - \left(\frac{3[(2)^3 - 2] + 2[(3)^3 - 3] + 4[(4)^3 - 4]}{18^3 - 18}\right)$$

$$= 1 - \frac{18 + 48 + 60}{5814}$$

$$= .978$$

$$H' = \frac{H}{C} = \frac{5.66}{.978} = 5.79$$

$$d.f. = k - 1 = 2$$

$$p > .05$$

APPENDIX

G Selected Statistical Tables

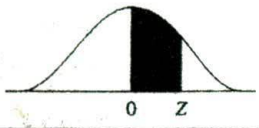


EXHIBIT G–1 Areas of the Standard Normal Distribution

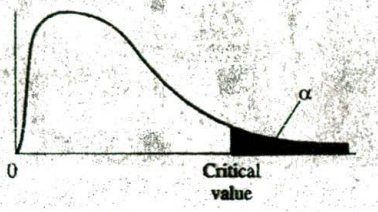
	Second Decimal Place in z									
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998									
4.0	0.49997									
4.5	0.499997									
5.0	0.4999997									
6.0	0.499999999									

EXHIBIT G–2 Critical Values of t for Given Probability Levels

	Level of Significance for One-Tailed Test					
	.10	.05	.025	.01	.005	.0005
	Level of Significance for Two-Tailed Test					
d.f.	.20	.10	.05	.02	.01	.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.598
3	1.638	2.353	3.182	4.541	5.841	12.941
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.859
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.767
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
40	1.303	1.684	2.021	2.423	2.704	3.551
60	1.296	1.671	2.000	2.390	2.660	3.460
120	1.289	1.658	1.980	2.358	2.617	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.291

SOURCE: Abridged from Table III of Fisher and Yates, *Statistical Tables for Biological, Agricultural, and Medical Research*, 6th ed., published by Oliver and Boyd Ltd., Edinburgh, 1963. By permission of the publishers.

EXHIBIT G–3 Critical Values of the Chi-Square Distribution



	Probability Under H_0 that $\chi^2 \geq$ Chi Square				
d.f.	.10	.05	.02	.01	.001
1	2.71	3.84	5.41	6.64	10.83
2	4.60	5.99	7.82	9.21	13.82
3	6.25	7.82	9.84	11.34	16.27
4	7.78	9.49	11.67	13.28	18.46
5	9.24	11.07	13.39	15.09	20.52
6	10.64	12.59	15.03	16.81	22.46
7	12.02	14.07	16.62	18.48	24.32
8	13.36	15.51	18.17	20.09	26.12
9	14.68	16.92	19.68	21.67	27.88
10	15.99	18.31	21.16	23.21	29.59
11	17.28	19.68	22.62	24.72	31.26
12	18.55	21.03	24.05	26.22	32.91
13	19.81	22.36	25.47	27.69	34.53
14	21.06	23.68	26.87	29.14	36.12
15	22.31	25.00	28.26	30.58	37.70
16	23.54	26.30	29.63	32.00	39.29
17	24.77	27.59	31.00	33.41	40.75
18	25.99	28.87	32.35	34.80	42.31
19	27.20	30.14	33.69	36.19	43.82
20	28.41	31.41	35.02	37.57	45.32
21	29.62	32.67	36.34	38.93	46.80
22	30.81	33.92	37.66	40.29	48.27
23	32.01	35.17	38.97	41.64	49.73
24	33.20	36.42	40.27	42.98	51.18
25	34.38	37.65	41.57	44.31	52.62
26	35.56	38.88	42.86	45.64	54.05
27	36.74	40.11	44.14	46.96	55.48
28	37.92	41.34	45.42	48.28	56.89
29	39.09	42.56	46.69	49.59	58.30
30	40.26	43.77	47.96	50.89	59.70

SOURCE: Abridged from Table IV of Fisher and Yates, *Statistical Tables for Biological, Agricultural, and Medical Research*, 6th ed., published by Oliver and Boyd Ltd., Edinburgh, 1963. By permission of the publishers.

EXHIBIT G–4 **Critical Values of T in the Wilcoxon Matched-Pairs Test**

n	*Level of Significance for One-Tailed Test*		
	.025	.01	.005
	Level of Significance for Two-Tailed Test		
	.05	.02	.01
6	0	—	—
7	2	0	—
8	4	2	0
9	6	3	2
10	8	5	3
11	11	7	5
12	14	10	7
13	17	13	10
14	21	16	13
15	25	20	16
16	30	24	20
17	35	28	23
18	40	33	28
19	46	38	32
20	52	43	38
21	59	49	43
22	66	56	49
23	73	62	55
24	81	69	61
25	89	77	68

SOURCE: Adapted from Table 1 of F. Wilcoxon, *Some Rapid Approximate Statistical Procedures* (New York: American Cyanamid Company, 1949), p. 13, with the kind permission of the publisher.

EXHIBIT G–5 Critical Values of D in the Kolmogorov-Smirnov One-Sample Test

Sample Size n	Level of Significance for D = Maximum $\lvert F_0(X) - S_N(X)\rvert$				
	.20	.15	.10	.05	.01
1	.900	.925	.950	.975	.995
2	.684	.726	.776	.842	.929
3	.565	.597	.642	.708	.828
4	.494	.525	.564	.624	.733
5	.446	.474	.510	.565	.669
6	.410	.436	.470	.521	.618
7	.381	.405	.438	.486	.577
8	.358	.381	.411	.457	.543
9	.339	.360	.388	.432	.514
10	.322	.342	.368	.410	.490
11	.307	.326	.352	.391	.468
12	.295	.313	.338	.375	.450
13	.284	.302	.325	.361	.433
14	.274	.292	.314	.349	.418
15	.266	.283	.304	.338	.404
16	.258	.274	.295	.328	.392
17	.250	.266	.286	.318	.381
18	.244	.259	.278	.309	.371
19	.237	.252	.272	.301	.363
20	.231	.246	.264	.294	.356
25	.21	.22	.24	.27	.32
30	.19	.20	.22	.24	.29
35	.18	.19	.21	.23	.27
Over 35	$\frac{1.07}{\sqrt{N}}$	$\frac{1.14}{\sqrt{N}}$	$\frac{1.22}{\sqrt{N}}$	$\frac{1.36}{\sqrt{N}}$	$\frac{1.63}{\sqrt{N}}$

SOURCE: F. J. Massey, Jr., "The Kolmogorov-Smirnov Test for Goodness of Fit," *Journal of the American Statistical Association* 46, p. 70. Adapted with the kind permission of the publisher.

EXHIBIT G–6 Critical Values of K_D in the Kolmogorov-Smirnov Two-Samples Test (small samples)

	One-Tailed Test*		Two-Tailed Test†	
n	$\alpha = .05$	$\alpha = .01$	$\alpha = .05$	$\alpha = .01$
3	3	–	–	–
4	4	–	4	–
5	4	5	5	5
6	5	6	5	6
7	5	6	6	6
8	5	6	6	7
9	6	7	6	7
10	6	7	7	8
11	6	8	7	8
12	6	8	7	8
13	7	8	7	9
14	7	8	8	9
15	7	9	8	9
16	7	9	8	10
17	8	9	8	10
18	8	10	9	10
19	8	10	9	10
20	8	10	9	11
21	8	10	9	11
22	9	11	9	11
23	9	11	10	11
24	9	11	10	12
25	9	11	10	12
26	9	11	10	12
27	9	12	10	12
28	10	12	11	13
29	10	12	11	13
30	10	12	11	13
35	11	13	12	
40	11	14	13	

*SOURCE: Abridged from I. A. Goodman, "Kolmogorov-Smirnov Tests for Psychological Research," *Psychological Bulletin* 51 (1951), p. 167, copyright (1951) by the American Psychological Association. Reprinted by permission.

†SOURCE: Derived from Table 1 of F. J. Massey, Jr., "The Distribution of the Maximum Deviation Between Two Sample Cumulative Step Functions," *Annals of Mathematical Statistics* 23 (1951), pp. 126–27, with the kind permission of the publisher.

EXHIBIT G–7 Critical Values of D in the Kolmogorov-Smirnov Two-Samples Test for Large Samples (two-tailed)

Level of Significance	Value of D So Large as to Call for Rejection of H_0 at the Indicated Level of Significance, Where D = Maximum $\lvert S_{n_1}(X) - S_2(X)\rvert$
.10	$1.22\sqrt{\frac{n_1+n_2}{n_1n_2}}$
.05	$1.36\sqrt{\frac{n_1+n_2}{n_1n_2}}$
.025	$1.48\sqrt{\frac{n_1+n_2}{n_1n_2}}$
.01	$1.63\sqrt{\frac{n_1+n_2}{n_1n_2}}$
.005	$1.73\sqrt{\frac{n_1+n_2}{n_1n_2}}$
.001	$1.95\sqrt{\frac{n_1+n_2}{n_1n_2}}$

SOURCE: Adapted from N. Smirnov, "Table for Estimating the Goodness of Fit of Empirical Distribution," *Annals of Mathematical Statistics* 18 (1948), pp. 280–81, with the kind permission of the publisher.

EXHIBIT G–8 Partial Table of Critical Values of U in the Mann-Whitney Test

	Critical Values for One-Tailed Test at $\alpha = .025$ or a Two-Tailed Test at $\alpha = .05$											
$n_1 \backslash n_2$	9	10	11	12	13	14	15	16	17	18	19	20
1												
2	0	0	0	1	1	1	1	1	2	2	2	2
3	2	3	3	4	4	5	5	6	6	7	7	8
4	4	5	6	7	8	9	10	11	11	12	13	13
5	7	8	9	11	12	13	14	15	17	18	19	20
6	10	11	13	14	16	17	19	21	22	24	25	27
7	12	14	16	18	20	22	24	26	28	30	32	34
8	15	17	19	22	24	26	29	31	34	36	38	41
9	17	20	23	26	28	31	34	37	39	42	45	48
10	20	23	26	29	33	36	39	42	45	48	52	55
11	23	26	30	33	37	40	44	47	51	55	58	62
12	26	29	33	37	41	45	49	53	57	61	66	69
13	28	33	37	41	45	50	54	59	63	67	72	76
14	31	36	40	45	50	55	59	64	67	74	78	83
15	34	39	44	49	54	59	64	70	75	80	85	90
16	37	42	47	53	59	64	70	75	81	86	92	98
17	39	45	51	57	63	67	75	81	87	93	99	105
18	42	48	55	61	67	74	80	86	93	99	106	112
19	45	52	58	65	72	78	85	92	99	106	113	119
20	48	55	62	69	76	83	90	98	105	112	119	127

EXHIBIT G–8 Continued

Critical Values for One-Tailed Test at $\alpha = .05$ or a Two-Tailed Test at $\alpha = .10$												
$n_1 \backslash n_2$	9	10	11	12	13	14	15	16	17	18	19	20
1											0	0
2	1	1	1	2	2	2	3	3	3	4	4	4
3	3	4	5	5	6	7	7	8	9	9	10	11
4	6	7	8	9	10	11	12	14	15	16	17	18
5	9	11	12	13	15	16	18	19	20	22	23	25
6	12	14	16	17	19	21	23	25	26	28	30	32
7	15	17	19	21	24	26	28	30	33	35	37	39
8	18	20	23	26	28	31	33	36	39	41	44	47
9	21	24	27	30	33	36	39	42	45	48	51	54
10	24	27	31	34	37	41	44	48	51	55	58	62
11	27	31	34	38	42	46	50	54	57	61	65	69
12	30	34	38	42	47	51	55	60	64	68	72	77
13	33	37	42	47	51	56	61	65	70	75	80	84
14	36	41	46	51	56	61	66	71	77	82	87	92
15	39	44	50	55	61	66	72	77	83	88	94	100
16	42	48	54	60	65	71	77	83	89	95	101	107
17	45	51	57	64	70	77	83	89	96	102	109	115
18	48	55	61	68	75	82	88	95	102	109	116	123
19	51	58	65	72	80	87	94	101	109	116	123	130
20	54	62	69	77	84	92	100	107	115	123	130	138

SOURCE: Abridged from D. Auble, "Extended Tables from the Mann-Whitney Statistic," *Bulletin of the Institute of Educational Research at Indiana University* 1, no. 2, reprinted with permission. For tables for other size samples consult this source.

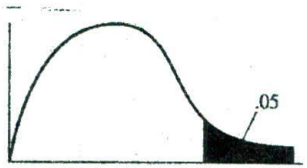


EXHIBIT G–9 Critical Values of the F Distribution for $\alpha = .05$

Degrees of Freedom for Numerator (n_1) \ Degrees of Freedom for Denominator	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	243.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

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EXHIBIT G–10 Random Numbers

97446	30328	05262	77371	13523	62057	44349	85884	94555	23288
15453	75591	60540	77137	09485	27632	05477	99154	78720	10323
69995	77086	55217	53721	85713	27854	41981	88981	90041	20878
69726	58696	27272	38148	52521	73807	29685	49152	20309	58734
23604	31948	16926	26360	76957	99925	86045	11617	32777	38670
13640	17233	58650	47819	24935	28670	33415	77202	92492	40290
90779	09199	51169	94892	34271	22068	13923	53535	56358	50258
71068	19459	32339	10124	13012	79706	07611	52600	83088	26829
55019	79001	34442	16335	06428	52873	65316	01480	72204	39494
20879	50235	17389	25260	34039	99967	48044	05067	69284	53867
00380	11595	49372	95214	98529	46593	77046	27176	39668	20566
68142	40800	20527	79212	14166	84948	11748	69540	84288	37211
42667	89566	20440	57230	35356	01884	79921	94772	29882	24695
07756	78430	45576	86596	56720	65529	44211	18447	53921	92722
45221	31130	44312	63534	47741	02465	50629	94983	05984	88375
20140	77481	61686	82836	41058	41331	04290	61212	60294	95954
54922	25436	33804	51907	73223	66423	68706	36589	45267	35327
48340	30832	72209	07644	52747	40751	06808	85349	18005	52323
23603	84387	20416	88084	33103	41511	59391	71600	35091	52722
12548	01033	22974	59596	92087	02116	63524	00627	41778	24392
15251	87584	12942	03771	91413	75652	19468	83889	98531	91529
65548	59670	57355	18874	63601	55111	07278	32560	40028	36079
48488	76170	46282	76427	41693	04506	80979	26654	62159	83017
02862	15665	62159	15159	69576	20328	68873	28152	66087	39405
67929	06754	45842	66365	80848	15262	55144	37816	08421	30071
73237	07607	31615	04892	50989	87347	14393	21165	68169	70788
13788	20327	07960	95917	75112	01398	26381	41377	33549	19754
43877	66485	40825	45923	74410	69693	76959	70973	26343	63781
14047	08369	56414	78533	76378	44204	71493	68861	31042	81873
88383	46755	51342	13505	55324	52950	22244	28028	73486	98797
29567	16379	41994	65947	58926	50953	09388	00405	29874	44954
20508	60995	41539	26396	99825	25652	28089	57224	35222	58922
64178	76768	75747	32854	32893	61152	58565	33128	33354	16056
26373	51147	90362	93309	13175	66385	57822	31138	12893	68607
10083	47656	59241	73630	99200	94672	59785	95449	99279	25488
11683	14347	04369	98719	75005	43633	24125	30532	54830	95387
56548	76293	50904	88579	24621	94291	56881	35062	48765	22078
35292	47291	82610	27777	43965	31802	98444	88929	54383	93141
51329	87645	51623	08971	50704	82395	33916	95859	99788	97885
51860	19180	39324	68483	78650	74750	64893	58042	82878	20619
23886	01257	07945	71175	31243	87167	42829	44601	08769	26417
80028	82310	43989	09242	15056	48250	04529	96941	48190	69644
83946	46858	09164	18858	12672	55190	02820	45861	29104	75386
00000	41586	25972	25356	54260	95691	99431	89903	22306	43863
90615	12848	23376	29458	48239	37628	59265	50152	30340	40713
42003	10738	55835	48218	23204	19188	13556	06610	77667	88068
86135	26174	07834	17007	97938	96728	15689	77544	89186	41252
54436	10828	41212	19836	89476	53685	28085	22878	71868	35048
14545	72034	32131	38783	58588	47499	50945	97045	42357	53536
43925	49879	13339	78773	95626	67119	93023	96832	09757	98545

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Examples Index

Company	Scenario	CH
ABC News	Commissioned TNS Intersearch to conduct numerous opinion polls following the September 11, 2001, attacks on the World Trade Center and the Pentagon.	7
Abiomed	Medical trial for the AbioCor implantable replacement heart system.	2
ACNielsen	Ad recall survey and purchasing behavior data drawn from its Household Scanner Panel™ served as the test and control groups for the Magazine Publishers of America study on ad effectiveness.	14
Advertising World (University of Texas)	Developing a portal to advertising websites of interest to students and practitioners.	10
Airsole*	Constructing agreement items for a scale.	9
Albany Outpatient Laser Clinic Inc.*	A preprocedure self-administered study of patients awaiting eye surgery on patient issues and attitudes.	11, 12
American Demographics	Used TNS Intersearch to measure attitudes toward copyright infringement for a special issue on privacy.	8, 12
American legal system	Correct and incorrect decisions about hypothesis testing are compared to the U.S. legal system's presumption of innocence until guilt is proven.	17
Army Reserve	Testing weaponry and ammunition.	2
ArtDecoAppliances*	A company choosing a location for a new manufacturing plant.	3
Association of American Publishers	A trade association that conducted research to develop an ad campaign that would encourage the reading of books.	3
Audience Selection, Ltd.	Conducted the second round of phone interviews in the Global Entrepreneurship Monitor (GEM) study.	6
AutoCorp*	An automotive manufacturer, about to do research on competitive issues, that finds a competitor's intelligence report.	5
Avionics Inc.*	An aviation firm conducting an employee survey.	5
Bank of America	Using data-mining software to pinpoint marketing programs that attract high-margin, low-risk customers.	10
BankChoice*	A bank experiencing eroding profits and lackluster growth using a descriptive study of account owners' activity to develop new strategies for targeting large, active accounts.	3, 6
Bayer Consumer Care	Used personal interviews, phone interviews, and syndicated data to reposition Aleve; resulting ad campaign increased market share by 1 percent, a major feat in the highly competitive analgesic category.	11
Bissell, Inc.	Small-budget ethnography study to guide the development of the Steam 'n Clean marketing plan.	4

*Due to the confidential and proprietary nature of most research, the names of some companies have been changed.