The world is most familiar with the concept of yield management as it applies to airlines: Seats are priced according to supply and demand, not to distance. That's why it may cost $199 one-way (round-trip required) to go from New York to California, and $357 one-way from San Francisco to Aspen.

Yield management is the art of dynamically matching supply and demand at a variety of price levels over a variety of time periods. That is, it's market segmentation with a timing component. The goal is to maximize the number of customers who purchase at higher price levels as well as the number who purchase at all, instead of losing customers who find the average price too high and giving money away to customers who would pay more.

Yield management will become increasingly important as we make the shift from a goods-based to a service- and rental-based economy, where holding assets becomes subsidiary to allocating their use over time. Yield management flies in the face of everything we take for granted with cost-based pricing; it's (time-)value-based. Yield management is a way of bargaining statistically -- psyching out the other guy and making him a variety of offers till he bites -- or waiting until he's desperate.

Sophisticated yield management is already standard operating procedure in the airline business. Now other industries, with better data to work from and more competition to work against, are starting to adopt the practice too. Better book that hotel room now!

The recent Yield Management Conference (see box, page 3) was the first mass meeting of a new group of enthusiasts -- the people who will be applying these techniques to pricing of a wide range of goods and services over the next decade. The desire has always been there; now they have the technology in the form of improved data collection, improved data analysis and improved ability to manipulate and control price and availability through automated reservation systems.

Time is money. The pace of economic activity is accelerating as computers give us increasing ability to manage resources and make transactions. An asset

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EDventure Holdings Inc., 375 Park Avenue, New York, NY 10152, (212) 758-3434
idle is an asset wasted, rather than one that can be sold tomorrow. This trend is most visible now in the airline and hotel businesses, but it's cropping up with roads and bridges and workforces. Although these items aren't traditionally considered commodities, market fluidity and automated reservation systems are making them so. Remember that the first use of yield management (and the origin of the term) is the financial industry, which has long been able to price the ultimate commodity, money, at different levels on the basis both of actual and expected interest rates, and of customers' need and creditworthiness. Consider the delicate interplay between credit card interest rates and their availability -- and between their rates and those of home loans.

What is yield management?

"Yield" management is so new that the term hasn't settled down into a single meaning yet. In common usage, yield may mean either occupancy or load factor (the percentage of units used) or average revenue per unit (airline fares on a flight or room rates in a hotel). The real issue is both combined: revenues per unit of capacity -- a proxy for profit in businesses with high fixed costs. Sophisticated yield management systems also deal with variable costs and ancillary revenues, such as food & beverage services in hotels. In the long run, the information generated by yield management systems can guide fixed-asset decisions on planes or cars or the construction of hotels, as well as staffing and fleet scheduling, but yield management itself addresses a world of fixed resources.

Yield management manages pricing and market segments, but its medium is time. That medium operates in two domains: the use of resources over specific periods of time, and patterns of booking and availabilities over time. The latter is where the forecasting comes in. At what point do you determine that your hotel will fill up, and stop offering the low rates because you know you can fill up at higher rates? Adjusting rates as time passes and bookings differ from forecasts is a fine art. As yet, most yield management systems simply call attention to where such action may be needed.

From static to dynamic yield management

The concept of time-based pricing isn't new: Trains have peak and off-peak prices; some highways have rush hours when cars with more than two riders get access to express lanes; restaurants offer pre-theatre dinners; some hairdressers offer Wednesday-night training specials. But yield management is about adjusting pricing and availability dynamically in response to changing conditions of demand and supply:

Those changing conditions show up in advance booking details:

- fares/rates
- times and dates of departure (for airlines); aggregate itineraries

In a goods-short, time-rich society such as the Soviet Union, almost everyone is willing to trade time for goods and spend hours waiting in lines for goods or services of uncertain provenance and character. Over there, people frequently specify desired flights by a range of dates, rather than "from New York to San Francisco around noon next Monday."

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locations, dates and duration (for car rentals and hotels)
• tie-in business (food and beverage in hotels)
• type of business (group, corporate and government business; leisure)
• classes of service (not necessarily connected to price)
• source of business and currency used if relevant

In the context of forecasts based on factors which include:

• historical patterns of all of the above
• predicted no-show and cancellation rates
• estimated "constrained" demand (people who were turned away)
• seasonal, monthly, weekly, daily and hourly patterns
• special events (holidays, trade shows, sports events, royal visits)
• advertising by vendor and competitors (including substitutes)
• weather to the extent that it can be predicted
• pricing (standard fares, special deals, multiple classes)
• competitive offerings and pricing
• impact of time-based offers
• non-revenue use (free tickets, use by employees)

Delicate discrimination

Until recently, mathematical wizards in marketing went into direct mail -- that was where you could work with statistics, quantify results and test hypotheses. (We were surprised to see no direct marketers at the yield management conference.) Yield management is about segmenting your market, developing pricing categories, forecasting demand and supply, and using feedback to validate your efforts. This kind of modeling is what we're talking about (in part) when we talk about computer users modeling their world. A configurable yield management system should contain models for all the objects and attributes listed above, with rules and procedures implementing their behavior and cross-dependencies. All the user would have to do is plug in his own data, rules and forecasts, with his desired amount of "guidance" from the system.

Deriving those rules is difficult, but it will be made easier by better access to data (lots of it), the processing power to use it and the applications to massage it properly. Even tougher, and less susceptible to sheer hard work or computer power, is developing creative marketing programs that will serve to separate the wheat from the chaff -- the price-sensitive from the price-insensitive -- and prevent "arbitrage" between market strata. Arbitrage is when a price-insensitive person buys at the low rate intended for the price-sensitive -- that is, when Juan joins Alice for a luxurious weekend at Ventana but flies to and from Monterey on a Saturday-stay fare.

While it's nice to have advance information and money in the bank, the real purpose of those advance-purchase requirements is to find and serve the most price-sensitive customers without opening the floodgates to those who are less price-sensitive (and who have less certainty of their desired future whereabouts). What are some of the discriminators? Obviously, the Saturday-night stay. (Who was the genius who dreamed up that one?) The advance-reservation, no-refund ticket. The weekend special, $99, two to a room, with a champagne breakfast thrown in. The seven-day rental rate, which guarantees the car will be rented over the slow weekend period (except in resort areas, where the weekly pattern is reversed). Off-peak fares, not-
The yield management community gathers

We recently attended the first multi-industry yield management conference, sponsored by James C. Makens & Associates and Pace Communications, a publisher of airline magazines. Although it followed a conference on yield management for airlines last spring, this was the first devoted to the spread of yield management beyond the airlines (although it's long been practiced under other names). The audience was about one-third airline people and one-third other potential users, including car rental and hotel people and a smattering of interlopers from a blood bank and a resort condo outfit. There were also vendors such as Texas Instruments, Control Data, Unisys and some specialized software companies -- Computerized Lodging Systems, Eloquent Systems, BehavHeuristics and Lodgistics. And there were numerous consultants, most of whom had worked with both vendor and customer companies. It's a small world, even in yield management.

Mostly people were there to learn, but every once in a while we forgot ourselves and thought like consumers, including the fellow who complained about his delayed flight and wondered loudly why a denied-boarding-compensation auction had to take so long. (Sitting in at this conference was a little like attending the enemy's war council.) After lunch, Jim Makens took pains to note that we were discussing pricing strategies, not actual prices.

In fact, yield management offers a competitive advantage that may be worth sharing to some degree.* There are several scenarios. You price rationally and so do they, and the market works: The guy with the best product wins most of the time, and the other guy sells on price. Alternatively, you price rationally, and they don't. If they overprice, you win. If they underprice, everyone loses (even consumers, in the long run). The specter of People Express hung heavy over this meeting.

So did conspiracy theories: Was American's big loss last summer -- when it lost $50 million because of a yield management logic glitch that closed out discount seats and left planes almost empty -- really a mistake? Or was it a pricing experiment that didn't work out, one too radical for American to admit to? (It announced the "mistake" only to reassure travel agents that American will lower prices again and they should come back, the theory goes.) A number of people figure American's data-tracking is too meticulous to miss such a sharp change in load factors for more than a day or two.

Discussion centered not on how to manage yield, but how to make your people carry out the policies you set. Hotel salespeople are often given target room rates that make them turn away a low-rate group that could be profitable by filling a hotel during a slow period. Or they book a group during a busy period to fill a quota, displacing high-yield business. In the end, yield management amounts to measuring profitability -- or total yield -- rather than either occupancy/load factor or average rates; their interaction is complex.

*A possible yield management ad: I use yield management. Don't you wish everybody did?
ably Eastern Airlines' midnight specials, now abandoned, which included a
change of plane in Houston around 2 am. Federal Express' cheap two-day
Standard Air service. Senior citizens' discounts and the Sixties' and
Seventies' youth fares, which introduced a generation of college students to
the pleasures of mobility.2

The mathematics of yield management

Using such discriminators, vendors can reach more of a market with lower
prices and a portion of it with higher prices. Geometrically, it looks like
this (for some very cheap seats and a curiously straight demand curve):

revenues = $4 \times 50 \text{ (A) } = $200

revenues = $6 \times 25 \text{ (A) } + $4 \times 25 \text{ (B) } = $290

$1 \times 40 \text{ (C) }

Rather than sell at a single price where supply (vertical axis) equals
demand (horizontal), you can sell at several prices attuned precisely to the
segments you're addressing. Mathematically, you're approaching the integral
of the space under the curve, rather than simply the area in the block that
fits underneath it. Bargaining is where you attempt to make an individual
transaction occur along the curve. Note that the demand curve also varies
over time. (Numbers approximate!)

Yield management in airlines

In the airline business, the largest, most powerful yield management systems
are proprietary -- notably American's and United's. (Both are beginning to
share their reservation systems but not their yield management techniques
with other airlines. United sold part of its Covia subsidiary to several
other airlines; American is selling half of Sabre to Delta.) As part owners
and operators of the largest, most powerful central reservation systems,
United and American have the best access to data, the best computer systems
in place, and the most incentive to use yield management -- since they com-
pete with almost everyone and suffer from relatively high cost structures.
Yield management enables them to maintain high average fares while competing
with lower-cost carriers. Finally, they have a larger revenue base over
which to spread the fixed cost of developing such a system, and more ab-
solute dollars to gain from a given ratio of revenue enhancement.

While most other airlines optimize point to point, United's and American's
systems can optimize by "O&D," or origin and destination, taking full itin-
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2 The most visible counterexample to yield management is the Eastern shut-
tle -- there's no way to pay up for better service, on-time departures or
anything. The only concession it makes to yield management is lower weekend
rates. We wonder what will happen under the Trump regime....

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eraries into account. (That’s why you may not be able to book a flight from Austin to Dallas although you can book one from Austin to Seattle through Dallas.) And progress continues: United’s Covia hopes to move its yield management from last-night information to a real-time process-control mode starting in mid-1990. That way a yield management system can monitor current bookings of close-in (soon-to-depart) flights instead of relying on data from the night before. (Commercial systems are described on page 8.)

**Yield management in hotels**

In hotels, yield managers must segment the market not just by price but by behavior. The length of a guest’s stay (analogous to a flyer’s itinerary) is one issue; another is predicting his use of high-profit ancillary services, mostly food and drink. Transient business must be balanced against groups, who provide business guaranteed in advance and may fill the hotel during soft periods, but who also get lower rates and fill the hotel during strong days (usually Tuesdays and Wednesdays). Certain groups (such as the PC Forum) may add to a property’s cachet. From a chain’s perspective, should a high-class hotel turn away price-conscious business in favor of a lower-class property of the same owner nearby?

The hotel business is especially problematical for yield management because most hotels are managed locally, as properties; it’s as if the crew of each plane took reservations for that plane. That’s not easily changed, especially in franchise operations. On the other hand, it’s something even the property managers would like to change, while maintaining some local control: Most reservations are made direct, especially in smaller operations, and easily cost $10 or more apiece considering phone time and overhead. Mid-sized hotel companies are eager to join multi-vendor central reservation systems to benefit from economies of scale and easy access to travel agents, while larger operations are hesitant about ceding control. (Small operations face a difficult future in this automated market.)

The hotel business will change substantially over the next few years as a few early players such as Marriott, Hilton and Stouffer and vendors such as Confirm and Covia lead their peers in attention to these issues. (See page 10.) One of the first things to go will be the general corporate rate -- which amounts to giving a discount to the least price-sensitive customers. (This is different from negotiated rates, where an individual corporation commits to a specified level of business with a chain in return for a guaranteed rate.) Corporate rates tend to depress pricing when demand is strong without raising it when demand is weak.

**Yield management in car rentals**

Car rental agencies have some of the same problems as hotels: They can’t predict the length of their relationships. But they have different ones too: Their assets don’t stay put. Because cars can be moved around, you have to figure out whether they should be. That involves a whole new set of costs and trade-offs. There’s also the problem of a much broader variety of inventory -- not just first, business and coach, but different makes and models of cars. (Now you know why you can’t ask for a red Camaro.) The tendency in the car-rental business, says Bill Carroll of Hertz, is to buy more cars when demand makes things tight -- but he’s working on better yield management instead.
Yield management in other industries

Yield management presents different problems in each particular market where it may be applied. Beyond hotels, there's temporary help and also permanent workers (night-shift differentials and overtime), restaurants, health clubs (early-bird specials), computer rentals, computer support, health care (scheduling and charging for liposuctions or, as noted in a recent Wall Street Journal article, night-time clinics for non-emergencies such as flus and colicky babies), cargo, telecommunications, etc.

The big issues are the quantity and quality of information. Specifically, does the product get reserved in advance? How much information do those reservations provide? How long will the guy making a reservation for a mid-size car in Bedford use it, and where does he plan to drop it off? Does the traveler who wants a seat from Austin to Dallas plan to connect to a cross-Atlantic flight to London, or is he going only as far as the Loews Anatole? How good is the loop between actual behavior and forecasts? How predictable is individual behavior?

Conversely, how good is consumers' information? For the moment, for example, it's much easier to shop around among airlines than among hotels. A hotel offers rooms at certain rates, but can't yet specify in most automated reservation systems that the room would be available at a lower rate to someone willing to stay a week or more.

Fare classes and booking classes

In the airline business, a few dozen price analysts at each of the top airlines price approximately 10 million available flight segments at almost 6 million possible fares. That's all available flights 180 days into the future, each priced in up to about 40 fare classes in four to seven booking classes, or "buckets." Fare classes carry restrictions and prices, and are assigned to particular booking classes; booking classes are inventories of seats at a variety of prices that are offered or withheld from sale ("protected") as a group.

A large number of booking classes gives you more control over seat inventory and pricing -- and more complex yield management calculations. Y, B, M and Q are typical booking classes each comprising a variety of fare classes; F, or first class, has less variation in fares, although that is changing because of the large proportion of frequent-flyer upgrades. While standard Y full-coach fares generally stay fixed over long periods, special fares expressed as discounts from them change all the time according to a variety of conditions. A flight segment may be priced differently according to the total itinerary that contains it. Be kind to your travel agent!

Software for yield management

So where do computers come in? They do a lot of the legwork that makes yield management possible. First of all, they keep data so that you can forecast demand. The sheer volumes of data are enormous, comprising histor-
ical data, current bookings and potential bookings. Speaking broadly, software for yield management does a variety of things: It (1) collects and manages historical data, bookings and actuals, from which it (2) generates forecasts, so that it can (3) monitor exceptions and possibly (4) suggest changes in strategy. As a system matures, it should (5) establish a firm loop among its various parts so that it can (6) assess the impact of various pricing strategies and changes to them. Long-run, with improved technology and more confidence on the part of users, yield management software will actually (7) implement the strategies it derives by controlling the reservation systems in real-time.

Yield management generally takes prices as given and manages them as aggregates. It adjusts prices by changing availability of a particular booking class (which includes many fare classes) rather than by changing the price of any particular flight or room or car, which would tax even today’s computer systems. People may be sold up to a higher price class but the prices themselves don’t change. It results in the same thing mathematically, but with less fine-tuning. (It’s all statistics and probabilities anyway.)

Yield management has a little flavor of AI to it -- simply by virtue of its being something humans normally do to the extent that it’s done at all. In fact, the gating elements have more to do with systems integration and making the software usable by ordinary folks than with anything terribly high-tech. Another issue is control -- getting the pricing analysts and reservations clerks to follow the systems’ recommendations and observe their restrictions in booking reservations.

YIELD MANAGEMENT IN ACTION: VENDORS AND USERS

Yield management embodies enticing buzzwords: It’s a mission-critical, revenue-generating solution. Accordingly, people who built their own are starting to share (for a fee) with others. People with computers to sell have added value to those computers with yield management software, but many of these look a little old by now. Finally, software vendors are entering the market with yield management tools targeted at pcs and other standard hardware. And everywhere there are consultants, advising both vendors and users. Herewith a sampling...

Control Data

Control Data is probably the oldest player in the business with Optix, a mainframe-based system which it has sold to about 10 airlines since 1983. The most prestigious of these customers, Delta, took it in-house and has modified it substantially. Other customers are mostly smaller or foreign. Last summer, the company came out with a pc version, Micro-Optix, and has already signed up five customers. Micro-Optix is targeted at regional air-

3Computers can also track different kinds of customers -- something the airlines started doing seriously with the frequent-flyer programs. All the while that they were giving us free tickets, a discriminatory price break tied to customer loyalty, we were giving them valuable insights into our travel behavior. However, this information isn’t yet used much in yield management systems.
lines -- which makes sense, since the larger carriers tend to use in-house systems. Presidential, for example, uses it with data downloaded nightly from the Apollo reservation system, and runs it on a single Compaq 386. The package costs about $150,000, plus $50,000 for installation and consulting.

Control Data used the same underlying technology to enter the hotel business in 1986. It has garnered installations managing a total of 450 properties at five of the top six U.S. hotel firms, including Holiday Inns as well as Hilton and Marriott, who are partners in Confirm (below). It costs about $500,000 and requires a mainframe. CDC is studying a down-sized version that would reside at individual hotels.

Unisys

Unisys offers a mainframe-based system called ARE, for Airline Revenue Enhancement. Unisys' dozen-plus customers for ARE include Lufthansa, Air France, Cathay Pacific, Iberia and Finnair. Currently, it is mostly a forecasting and monitoring system that doesn't make recommendations, but that will change in a new release due later this year. Unisys is working on it with aviation consultant Simat, Helliesen & Eichner in a pilot installation for Air France that will suggest strategies and collect feedback on their impact. Some years ago, incidentally, Unisys (then Sperry) applied AI to this problem, but, says one observer, "It only suggested the easy stuff they could do themselves, and didn't do any of the hard [statistical] things that were really needed."

Unisys is now entering the hotel market with a UNIX-based system called Hotel Revenue Enhancement, in beta test at Disney. Although it can be used centrally, HRE can also operate on-site in configurations costing $15,000 to $50,000. (Yes, the open systems are coming!!)

Pros3 from Seabrook Marketing

While Control Data and Unisys have each sold serious numbers of mainframe-based yield management systems, they face competition from Pros3, a new-generation pc-based system that we saw in action at Alaska Airlines' Seattle reservation center last week. Pros3 was developed by independent consultant Jerry Jung and is marketed by consulting firm Seabrook Marketing. Pros3 comes on a LAN, typically with a file server and a number of pcs adjustable to match the size of the operation it handles. Priced between $250,000 and $1 million, the software works in batch mode overnight to produce forecasts and exception reports. These exceptions are generally bookings out of the predicted range: A particular flight may be booking heavily in a particular booking class, which may mean that it will sell out totally, and low-price fares should no longer be offered.

The pcs are available for interaction with pricing analysts during the day. An analyst can pick any flight to look at, or work off the exception list. Although it uses day-old data like its competition, Pros3 is more interactive in its ability to let the user try out his own models against the system's recommendations or modify a forecast because of special factors (a local event or new competition from another carrier).

Virtually everything is modifiable: overbooking limits, data "collection points" (specified sampling days before departure; until the final few days,
not every flight is examined every night), number of booking classes (Alaska uses five), variance thresholds that will trigger exception reports. In its basic form, the system displays a flight's vital statistics -- bookings vs. forecast and protected seats for each booking class, expected revenues, expected shrinkage (no-shows and cancellations) -- and suggests new availabilities to adjust for low or high demand. There's enough data on screen to be meaningful, but not enough to be confusing. Booking history and projections can be displayed as bar charts, with each booking class displayed in a different color. Flights have their own patterns: Generally, business flights book slowly, with a lot of last-week business in the Y bucket; weekend flights book earlier but tend to be more variable. (We have included a couple of screen shots on page 35; unfortunately we received them too late to put them here where they belong. Oh for a desktop publishing system and the time to use it!)

Alaska Airlines acquired its system in 1986, and runs it on seven pcs. During the day, they are used by four pricing analysts who follow flights in four geographic markets, about 70 routes to a person. That leaves two for development and data collection, and one for director of yield management Jim Quentin. Quentin estimates that in 1987 Pros3 helped Alaska do a significantly better job of managing overbooking: The average actual load factor on booked-full flights (which didn't actually all fill up) increased by 1 point to 97 percent, while the rate of denied boardings dropped from 18 to 12 per 10,000. Quentin is reluctant to give a dollar figure for yield improvement per se because there are so many other factors involved, but his enthusiasm for the system is clear. He's now looking forward to expanding its use by feeding data and models to marketing, pricing, capacity planning and other strategic areas of the company.

Confirm

Confirm is a hotel and car rental reservation system partnership sponsored by American Airlines sibling AMR Information Services. Hilton and Marriott own 32.5 percent each, AMR has 20 percent and Budget 15 percent, according to the Dallas Times-Herald. AMR is managing development and operations for Confirm, announced last spring. It will not use the system itself, since Confirm handles everything except airlines -- first hotels and rental cars, and later on cruises, condos and anything anyone wants to sell through Confirm. It may also extend into on-site property management systems for individual hotel use. The customer partners already have their own central reservation systems and do some yield management in-house, but are looking to Confirm to lower their costs, improve their access and information bandwidth to customers and agents, and ultimately do more powerful yield management. The start-up investment is more than $60 million, and the partners will reinvest as time passes. Certainly they hope that this system will be as profitable for them as Sabre has been for AMR/American Airlines, generating returns well beyond the business it brings in.

The impetus behind Confirm is not yield management so much as a general need for better reservation and information systems for hotels, which until now have sold direct or through central 800 numbers or tagged along on airline systems which aren't equipped to provide the kind of information customers and vendors want to share -- including property and car specifics, agent commissions and better access to resources by agents. "There has been a thin pipeline [through the airline reservation systems] between us and the..."
travel agents," says Bob Daley, vp of rooms operations for Marriott Hotels and Resorts at Confirm partner Marriott. "There's a lot of information about our rooms that we'd like to give to the agents." Agency users of Confirm will not have their own crts, but will reach it through terminals installed by Sabre (of course), Apollo, PARS and other airline systems.

In the meantime, AMR is operating Confirm-800, a telephone system operated by AMR employees. They work off a UNIX-based system from Action Software running on a Sequent and showing availabilities (yes or no) and, more recently, inventories (how many). The Confirm-800 reservation database supports five hotel customers -- Registry, York Hanover, Wyndham, Aircoa and Fairmont. They and the three partners will switch to Confirm in 1991, says Dave Harms, vp of information systems development for AMR Travel Services.

The full Confirm system will run on IBM mainframes or compatibles with sophisticated software for making and tracking transactions. Harms stresses that Confirm will operate separately from Sabre, although it will use much the same mainframe-based architecture and systems software such as TPF and LU 6.2 (for cooperative processing with pc-based front-ends). However, Confirm will be built using CASE and information engineering tools and will be designed from the start to support a DB2-based decision-support database, something that has only recently been added to Sabre's IMS/TPF system.

Harms has been working on the system's design since September 1987; the Confirm partners joined last May, although the final deal was signed only last September. They have worked up the features they want in a yield management system, but Harms hasn't yet committed to have it when the system goes on line in 1991. Marriott and Hilton are both using Control Data's yield management system currently. The assumption is that Confirm's yield management system will be built by American Airlines Decisions Technology, which did Sabre's, but that's not certain. In addition, consultant Aeronomics may help work up the specific (as opposed to conceptual) design.

Confirm will give hotel chain managements better control over how their services are offered and priced. In the end, Confirm (along with a similar system from Covia) stands to change the landscape of the hotel business during the early Nineties, by transforming yield management from a local exercise into a centralized process. At the same time, it will ultimately give consumers a way to fight back, by creating a more fluid market for rooms and increasing consumers' and travel agents' ability to shop around for rates and such. From under half today (including airline systems), the proportion of hotel reservations handled centrally will grow dramatically, although it will never reach the airline's 90-plus percent since you can call a hotel directly. Hotels on the central systems will enjoy a competitive advantage.

More controversial is the possibility of cross-selling. It's a given that each vendor will attempt to manage bookings across their own properties; more problematical is the notion of allowing the system to refer potential customers of one chain to properties of another. The fees for each booking won't make up for the loss of a customer; on the other hand, you could just as easily gain a customer. Whatever hotels' discomfort with the notion now, it's inevitable. Travel agents want that flexibility, and if Confirm doesn't offer it, someone else will...

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Covia

For example, Covia could offer it. Covia has plans to announce shortly a similar cross-industry, cross-company enhanced central reservation service for hotels and car rental agencies. Unlike Confirm, however, Covia's offering will be tied into its Apollo airline reservation network, which itself is owned by several airlines -- Covia's original parent United and Swissair, British Airways, KLM, Alitalia and USAir.

Covia is already in the hotel reservation system business with Westron, a system it built for Westin back when Westin was owned by United Airlines, and which Covia still operates. Covia hopes to install the system for a second multi-line hotel chain this summer.

Marriott

Marriott is already one of the leaders in hotel reservation administration. It operates its own version of Covia's Westron for reservations and uses the CDC system for yield management. Marriott's Daley is nonetheless glad of the chance to start fresh through its partnership in Confirm and share the costs with some other folks. ("We felt we could work with Hilton without shattering our culture," he says.) Daley is a big fan of yield management and its positive revenue impact, although he's loath to give specific numbers. In addition, he notes that rather than fine-tune rates constantly, the CDC system actually helps Marriott hotels behave more consistently. Rather than switch availabilities every time someone feels that bookings are fast or slow, a skittish manager can set availabilities and wait for the system to point out a genuine trend one way or the other. "We feel more confident about leaving things alone," says Daley.

Computerized Lodging Systems

CLS's Artificial Intelligence Yield Management system product was co-developed with Eloquent Systems and launched last fall. It has been installed to rave reviews at the Royal Sonesta in Cambridge (you've probably stayed there on a visit to Lotus). But the AI pitch hasn't gone over too well, and the system is costly at $133,000 to $200,000 (by number of rooms) including a TI Explorer. So, says president Dave Berkus, CLS has built internally a non-AI software-only system that will sell for $10,000 to $33,000, starting this month with an installation at the Palm Springs Resort (not the Wyndham!). It is similar to the AI system and offers yield management strategies, but no learning capability or automatic feedback. Both products add on to CLS's Property Management System, $30,000 to $600,000.

Although CLS has sold only one other AI system and a few more of the low-end yield management system, says Berkus, CLS's mere promotion of yield management "has given us the biggest boost we've ever had in 15 years in the business" -- with 1000 PMS installations including L'Ermitage in Los Angeles, Boston Harbor Hotel at Rowe's Wharf, several Sheratons and all the Guest Quarters and Courtyard by Marriott properties. Now he's selling PMS as a hotel-management system that will ultimately provide the appropriate hooks when users want to expand into yield management.

The AI system has Mac front-ends and is extremely easy to use. It comes with 300 strategies that users can modify or extend by pointing and click-
ing. But it ends up automating more of the decisions than most users feel comfortable with -- a frequent complaint with all these systems. Most managers ended up using combinations of incentives; in the end, it's a matter of training and motivating people to engage in profitable behavior.

(AI for yield management tends to be fairly simple (other than BehavHeuristics' neural net-based system; Release 1.0, 87-7), along the lines of "If sales are low, then lower the prices," or "If bookings look good, consider closing out the budget category." The rules are easy to express, but what are the precise numerical parameters they should use? -- a question best answered with linear programming and the like. Beyond that, the trick lies in knowledge of the market -- What factors are influencing bookings? -- and in coming up with creative responses outside the purview of today's yield management systems, such as clever marketing programs or discriminatory pricing schemes that work.)

YIELD MANAGEMENT IN THE NINETIES

Yield management is a paradigm for the Nineties -- just-in-time availability instead of just-in-time manufacturing. Yield management will make the economy more efficient, because it takes the notion of resource allocation one step further, allocating resources not just among customers but over time. It's the antidote to our increasing inability to price goods individually -- it's information making the market more fluid again.

Software per se isn't strategic; only the use of it, with luck, is strategic. Automation is just part of the game in yield management. The challenge is not in using sophisticated forecasting techniques to predict bookings or set prices, nor in any kind of complex AI to determine when reality fails to match predictions, but in setting up a consistent, coherent system that does all of these in a way intelligible to the average analyst.

For sure, consumer groups are likely to find fault with the concept -- witness the recent outcries over AT&T's would-be rate drops, which will give a larger percentage drop to business traffic during the week than to consumer traffic at off-hours. Witness the commotion over Logan Airport's exemplary attempts to price small aircraft off its airfield during busy hours in favor of larger aircraft carrying many more passengers. (In fact, airport access is one of the scarcest resources of all.) But the truth is that yield management gives breaks to those who need them most (as shown by their price-sensitive behavior) and ultimately will allocate resources more efficiently so that there will be more for all. But never underestimate the negative image of anything that looks like market manipulation -- or the ingenuity and pride of the consumer who's figured it out and knows how to beat the rules by buying two 40 percent roundtrip tickets for a 20 percent discount, or by interleaving two trips to create spurious Saturday night stays. Ain't the game fun!
VISUAL THINKING

The lure of visual "programming" is great, but it generally resolves into a hybrid of approaches -- flow charts and entity-relationship diagrams, icons and structures -- visual tools that help the user think. The display is the computer's job, but the interpretation remains the person's job. One stunning new (to us) technique for displaying complex data in easy-to-interpret form is a statistical tool that maps correlations within data sets (correspondence analysis), ideal for seeing how brands stack up against each other, or concepts relate, or faults cluster in certain parts of a piece of equipment. The goal is not mathematical exactitude but the selection or presentation of meaning that is useful rather than exact.

Two very different tools (their common use of perceptual maps is virtually their only similarity, as the tools themselves would show) are Neuron Data's Nextra, sold as a knowledge acquisition tool, and MapWise, a market-research analysis tool. Both work around the principle of perceptual mapping, positioning items and categories by their similarities (correspondences) based on multivariate data. In the case of Neuron Data, a user describes a set of concepts or things; in MapWise, the system uses quantitative data to generate a perceptual map. Other products include CORRESP from SAS Institute, and several specialty tools.

Anyone can draw a two-dimensional perceptual map, classifying things according to two criteria -- intelligence and beauty, say. There are four basic quadrants: smart and ugly, smart and good-looking, dumb and ugly, and dumb and good-looking -- which are easy to display on a map. Life gets more interesting when you want to add a third criterion -- wealth, say. The simple answer is to add another dimension and draw a crude 3D representation, but that approach breaks down when you get to a fourth criterion -- kindness.

Both these products use traditional mathematical techniques to determine correlations and present the results in a way meaningful and marketable to non-statisticians. The trick is to take a multi-dimensional set of data and display it on a 2D perceptual map. Each number in a table indicates the relationship between a column and a row category: A high number indicates a positive relationship; a low number, a negative relationship; a number in line with expectations a weak relationship.

The distances of the items from each other on the resulting map are proportional to the strength of their correlation. (See illustrations on the following pages.) The math is complex and each vendor uses different algorithms, but the results provide a clear display as similar items cluster together. Objects and qualities sit on the same perceptual map, since correlations are indifferent to what they're correlating. Items near the center of the map don't have much character: These attributes don't discriminate, or distinguish one item from another.

These maps guide the user rather than give him data for further calculation (although they can do so). In the case of MapWise, they can tell you a lot about your data. In the case of Neuron Data's Nextra, they can tell you if you're thinking straight about concepts before it takes them and puts them into a knowledge base. With the perceptual map, you can see correlations or work interactively to differentiate items that the system places uncomfortably close. Or you can change factors for a what-if analysis. If we moved
our Mac product to the PC, what other PC products would it compete with?
What about porting it to UNIX? What's the impact of price on positioning?
If we change our candidate's position on abortion, what groups will he appeal to? Neuron Data's system is in fact being used in political positioning for a candidate in an unnamed country. Philips Consumer Electronics uses MapWise to select optimum competitive strategies.

More than you need to know about correspondence analysis

There are three major kinds of numerical data: time series, which are easily expressed and interpreted with graphs; other numerical data about, say, markets or relative sizes, which can be visualized with pie charts, maps, bar charts and the like.4

Finally, there's multivariate data (the stuff of multiple cross-tabs), where you measure the frequency of joint occurrence of things: sales of goods by product and market, ratings of a variety of items by a variety of criteria, et cetera. These data generally come as tables with two sets of "axes" that aren't axes as mathematicians think of them. That is, they're nominal rather than ordinal; each row and each column is discrete with no particular relationship to the ones next to it. The goal is to find out what relationships do in fact exist among the various rows and columns. Perceptual mapping is an attempt to cluster and group items and categories and show their correlations. In a two-value world it would be easy, but you're generally dealing with multiple values, or dimensions. What you end up with is a two-dimensional projection of a multi-dimensional map, with each axis/dimension representing one category. It's the software's job to figure out the best way to represent this on a screen or print-out.

Correspondence analysis was established in the early Seventies by professor Jean-Paul Benzecri in Paris to display correspondences among elements in the Chinese language. It was rapidly adopted in France and taught to children in lycees, but mostly ignored over here. From our perspective, it is most analogous to similarity measures in text, with the addition of the visual element.5 The perceptual map shows the similarities among a larger number of items without making the math or the rankings visible, as illustrated on the following pages.

4Our favorite is the map that shows geographical areas relative to their ranking on some scale other than area, so that in a population map, say, Japan and especially China are huge, while Australia shrinks away. The U.S. is large, but Canada almost disappears.

5In the text systems we have described (see Release 1.0, 88-1), you're simply trying to rate the closeness of pieces of text to a single target rather than represent them all on a map -- although you could certainly do this. In this case, the rows might be individual pieces of text, while the columns would be individual words. The values in each cell would be the frequency of occurrence of each word (weighted as appropriate) in each text. The similarity of two pieces of text is a sum (the exact algorithms vary) of the cross-products of the words they have in common, weighted for comparative frequency and other measures.
A perceptual map of this table, with no correlations at all...

A perceptual map of this table, with one-to-one correlations....

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

A perceptual map of this table, with arbitrary correlations...

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

As the correlations get less regular and the numbers of rows and columns increase, the maps get harder to draw -- which is where the calculations and the software come in. In essence, the math involves dividing each column by a divisor so that the column sums are equal, and each row by a divisor so that the row sums are equal and computing multi-dimensional distances of each item from each other by creating vectors in multi-dimensional space. For example, if you had a set of numbers indicating sales by brand (A, B, C) and by state, you'd want to normalize for the impact of New York's greater population, looking at the correlation of brands to customer category independent of total purchases by each category. Yet you'd also like to look at the strength of sales by region independent of brand strength. And you might want to correlate all that with a third set of categories, showing advertising expenditures (passive variables).

You end up with numbers (not shown) indicating how each correlation -- market/brand -- deviates from the norm, or the expected distribution if there were no correlations: i.e. if sales varied only by state, or only by brand, and were apportioned equally across the other axis. These numbers produce the charts on page 17. The third table shows media spending superimposed on the active-variable table.
MapWise: Making meaning from numbers

The charts above were created with MapWise by president Betsy Goodnow. MapWise works in batch mode with existing data sets imported in ASCII. It works automatically until the user wants to change data to compare different scenarios and play around with the data. Suppose, for example, we were able to associate our new toothpaste with luxury, or with wholesomeness...

MapWise was developed by Betsy Goodnow, a former marketing professor, who founded Market Action Research Software to sell the product to market researchers in agencies and corporations. It costs $495 and works on a 256K PC or clone. The value of this program is that one can see the correlations without doing (or even understanding) the math. MapWise lacks the richness and speed of Nextra, but it's a handy tool in its own right.
"In terms of information, the transfer of knowledge into any given formalism is an irreversible task: there is a loss of information due to the limits of artificial representation... However, there may also be the emergence of information of a new kind, the derivation of higher-level structures corresponding to the development of upper levels of the inductive modeling hierarchy."

-- Brian Gaines, University of Calgary and Neuron Data

Neuron Data's Nexpert Object is one of the more popular expert system development tools on the market, with versions for the Mac (the original; Release 1.0, 85-6), Sun, Apollo, the PC with Windows, the VAX and others. From a simple if powerful rule-based system on the Mac it has grown into a full-featured development and execution tool, with an object-oriented knowledge base, graphical browsers (another example of visual display providing clarity) and other features that offer power, flexibility and intelligibility.

However, the problem with expert systems remains knowledge acquisition and the people who do it. To build an expert system, you have to understand your domain -- a task that's difficult to automate. Neuron Data's Nextra goes partway, as far as one can at present, to solving this problem by helping the user to think. It uses perceptual maps, as described above, but only as part of a process designed to foster the necessary perceptions. While MapWise works mostly with imported data sets, Nextra leads the user through an interactive process designed to make him think and elicit perceptions he hasn't previously articulated. (MapWise uses principal-components analysis and multi-dimensional scaling (don't ask!) as well as correspondence analysis.)

Nextra is a work in progress

Nextra should be available this spring for $4000. It will appear first on the Mac, with versions for other front-end systems such as OS/2 and UNIX workstations on the way. Unlike expert systems, which are embeddable, Nextra is inherently a front-end tool that exists almost entirely for user interaction. (However, it can work on large imported data sets in the manner of MapWise.) It follows the new paradigm of applying huge horsepower to make things easy and clear for users, and is the kind of system that workstations must dream of in their idle moments.

For what it's worth, we saw two demos and then Neuron Data's Alain Rappaport sent us a disk of version 0.952, which we used to create the screens on the following pages. We assume there will be some documentation, and we may have missed some finer points, but we got tremendous value out of the product without it.

Nextra on a work in progress

Since Nextra is interactive, the best way to describe it is to show it. The next few pages are a record of part of a session with Nextra. The data is drawn from some work in progress, and is used for illustration only. In fact, what you'll see on the next few pages is how we're using Nextra to clarify our own thinking: What distinctions are we failing to make that could easily distinguish among the tools we're classifying? As you can see, this exercise is not finished. Nextra has prompted us to think harder, and more clearly, than we would have otherwise. When we get around to writing the article, we will use Nextra output as illustration.
To start with, Nextra prods you to describe your domain ("tool styles") and its relevant entities and qualities ("tools" and "styles;" we forgot to define styles so it keeps on saying "qualities" in this demo) so that it can refer to them in a familiar way. It asks you to list a set of entities. The system lists the entities at random, and asks you to define qualities that describe and distinguish them, below. It directs you to place the entities on that scale by dragging them over to it. (Overall, Nextra observes the first rule of ergonomics: Never make anyone type a piece of data twice. The prompting can be very helpful to start; later, you can turn it off.)

This display shows a new quality which needs to be specified and used for rating the tools.  
Type each pole name followed by the RETURN key or clicking "Done". 
You will not be able to exit except by clicking "Cancel" until the names are entered. 
You can click on the any of the tools and drag them to the rating bar to change their ratings. 
You can click on the quality names to select them for editing. 
Click in this box to remove this advice.

HyperCard  
C compiler  
Metaphor  
Lotus 1-2-3 (with macros)  
Lotus 1-2-3 (spreadsheet only)  
Index's Excelerator  
A text expert system shell  
Smalltalk  
C++  
Saber-c  

At any point, you can ask Nextra to show you the two most similar entities or qualities, across.

Nextra will also find them for you itself, on top of the facing page, where it complains that "1-2-3 (with macros)" and "1-2-3 (spreadsheet only)," and "visual-textual" and "displays structure not visible" are too similar (hardly surprising!) and asks us to refine our thinking.

Release 1.0  
27 February 1989
In your context of "tool styles" you have entered 10 tools and the 5 qualities shown below. Click on the qualities to select them for editing, deleting, and showing matches. Click in this box to remove the advice. Click on "Advice" to get it back.

textual - visual
not object-oriented - object-oriented
data-/object-driven - procedural
structure not visible - displays structure
icons - text-only

The "Triple" button helps you add another quality by thinking about the similarities and differences between three tools. NEXTRA normally choses the three tools at random. However, you can select one or more tools to be part of the triple by selecting them above. Click in this box to add another quality in this way.

The two tools, "Lotus 1-2-3 (w macros)" and "Lotus 1-2-3 (ss only)", are very similar. You can add another quality to reduce the match. Click in this box to show the matching tools.

The two qualities, "visual - textual" and "displays structure - structure not visible", are very similar. You can add another tool to reduce the match. Click in this box to show the matching qualities.

Click in this box to add a new tool.

Click in this box to add a new quality.

We can refine our thinking as requested by editing our data, below, or across, on top of the facing page. (The qualities edited don't correspond to the request, because this screen came later in the session.)

This display compares the ratings of all the tools on two qualities. You can click on the any of the tools, on either side, and drag them to the rating bar to change their ratings. You can click on the quality names to select them for editing. Click on "Yes" if you wish to add a new tool to reduce the match. Click in this box to remove this advice.

Icons visual
HyperCard - Smalltalk
Metaphor
Index's ExceLerator
Smalltalk

Lotus 1-2-3 (w macros)
Lotus 1-2-3 (ss only)
A text expert system shell
C compiler
C++
Lotus 1-2-3 (ss only)
C compiler
C++
A text expert system shell
text-only textual

Release 1.0

27 February 1989
This display compares two tools rated on each of the qualities.

You can click on the upper vertical markers and drag them to change the ratings on the upper tool.
You can click on the lower vertical markers and drag them to change the ratings on the lower tool.

You can click on the tool or quality names to select them for editing.
Click on "Yes" if you wish to add a new quality to reduce the match.
Click in this box to remove this advice.

Lotus 1-2-3 (ss only)  
visual •  
not object-oriented •  
data/object-driven •  
structure not visible •  
icons •  
no rules •  

Lotus 1-2-3 (w macros)  

Alternatively, we can define a new quality, below, that will distinguish "1-2-3 (with macros)" from "1-2-3 (spreadsheet only)."

This display shows a new quality which needs to be specified and used for rating the tools.
Type each pole name followed by the RETURN key or clicking "Done".
You will not be able to exit except by clicking "Cancel" until the names are entered.
You can click on the any of the tools and drag them to the rating bar to change their ratings.
You can click on the quality names to select them for editing.
Click in this box to remove this advice.

quality of this tool  

Lotus 1-2-3 (w macros)  

HyperCard  
C compiler  
Metaphor  
Index's Excelerator  
A text expert system shell  
Smalltalk  
C++  
Saber-c

Neither  

opposite for this tool  

Lotus 1-2-3 (ss only)  

Release 1.0  

27 February 1989
When you think you're ready, you can ask Nextra to draw a cluster, below, or a map, across. Our cluster shows the cross-tab of the numerical values we implicitly assigned to each tool/style pairing as we dragged the tools to the appropriate place on each style scale. Beyond that, it illustrates their correlations with color coding (the shaded areas in the illustration) and creates taxonomies of both entities and qualities. Entities and qualities positioned close together on the trees on the right are close together in character. (If they’re not, you need to revise your data!)

Cluster: Tool styles
Entities: 10, Attributes: 6, Range: 1 to 9, Context: tool styles

Our map, across, is a different way of showing the same data. There are no horizontal/vertical axes per se; instead, each quality pair shows up as an axis. Axes that are close together such as "visual/textual" and "icons/text-only," may be redundant, or some data distinguishing them is missing. For example, in our next iteration we may include a "shows data structure/shows sequence" dichotomy to resolve things. (Other functions include compare, to compare two different maps of the same items -- two experts', or the same person's responses at different times.)

Frequently, the process of building an expert system can be as valuable as the resulting system, because it clarifies and articulates the rules and assumptions governing the situation the expert system addresses. The builder may learn so much he no longer needs the system (but someone else does). Nextra simply enriches and assists that process even further and makes it more enlightening, even if you never build an expert system with it.
Output as Input

Although we see Nextra's major benefit as its interactivity, it can generate ("induct" and "entail") rule modules and object hierarchies from its data to populate Nexpert Object. The joint system can transfer data between the knowledge acquisition world (or from standard databases) and the production-rules/object-oriented world easily, so that knowledge can easily be validated or updated.

Nextra's "topological induction" won't generate all kinds of rules automatically and it doesn't create complete expert systems, but it's a tremendously useful tool for classification or diagnosis modules within one, as well as for describing taxonomies of objects that expert systems can reason about.
MOONRISE ECLIPSES SUN: THE OPEN BINARY FOUNDATION

Sun has long been fond of pointing out the importance of a binary standard for UNIX; indeed, it likes the idea so much that it has proposed three: the 68000 family, the 386 family and, with special fondness, its own SPARC. But before Sun can fully launch its low-end strategy, some of the visible leadership for that position is being assumed by a group of clone-makers who want to make sure no leader emerges; call them the EISA of the system world, or the Open Binary Foundation. But note that this is not so much a group as a bunch of vendors who are licensing components of an integrated UNIX environment to Santa Cruz Operation (who will pay royalties) to resell with their own systems.

Employing a much more effective tactic than the Open Software Foundation, these companies want to head Sun off at the pass before it can effectively set the standard. Rather than rhetoric, this group's weapon is a product priced for a mass market -- a pieced-together version of UNIX V.3.2 from Santa Cruz Operation for $995 at retail. For that price, Open Desktop includes the OSF Motif user and programmer interface (see Release 1.0, 89-1) and Ingres from Relational Technology. It also includes a DOS integration system, Merge 386, from Locus Computing, including its XSight window manager/interface and a Locus version of IXI's X.desktop UNIX shell called Xhibit (sort of an add-on to Motif; see Release 1.0, 88-11). For the embarrassing moment, demos of the system will use DEC's DECwindows interface, since OSF Motif isn't yet ready. The plan is that by the time it ships it will have the full OSF Motif. (DEC itself will also move to OSF Motif overall, DEC says.) This operating environment will be sold with 386 machines from DEC, Compaq and Tandy and will support the same shrink-wrapped software on any of them, thus fulfilling Sun's vision but neatly leaving Sun out of the game.

Sun so far has picked up only a couple of clones with limited U.S. presence and little installed base. Open Desktop, by contrast, can claim an installed base of a million 386 machines which could run the Open Desktop software tomorrow if it were available. Unfortunately, developers will get their copies this spring and users won't get theirs until next fall.

Overall, this announcement is yet another win for UNIX and separately for Presentation Manager.

MIPS offers a distant star

Meanwhile, MIPS has rounded up a high-class bunch of second sources who will give its RISC chip credibility and drive prices down as they compete with each other. Into the bargain, NEC and Siemens have vowed that they will build or support no other RISC architectures, and MIPS will get a steady, guaranteed-price supply of DRAMS -- perhaps the most valuable asset in its attempts to make its system a standard.

Lacking as yet, however, is any attempt at setting a binary standard. MIPS may get the scientific applications and make large customers and ISVs comfortable that there are second sources, but it still won't assure smaller customers that they can mix and match machines. We assume the arrival of Chuck Boesenberg, from Data General via Apple, may have something to do with a possible future expansion by MIPS into retail markets with a machine it would open to binary-compatible clones. Stay tuned!

Release 1.0 28 February 1989
"CD-ROM is only a medium. It doesn’t make any difference to what the user requires of an application." That’s true up to a point, but the sheer quantity of data on a CD-ROM is so great that traditional software may not handle it effectively without some substantial strengthening of the plumbing.

Rather than employ one super-awesome single indexing scheme, Dataware of Cambridge, MA, takes the sensible approach of offering eight different indexing techniques optimized for different types of data and searches. The CD-ROM creator has to know a fair amount about his data -- as you’d expect him to -- but the end-user simply fills in forms, specifies values, keywords or ranges and sees nothing more than a familiar interface.

Dataware is typical of the hybrid approach (cf. Interbase, Release 1.0, 88-12) people will be taking to data, which after all comes in many forms as well as many sizes. Dataware too has a target style of data, but it’s fairly flexible -- semi-structured records that combine typical database-style fields with full text or images. If it were all text, you wouldn’t need Dataware’s database capabilities, and if it were all structured data you wouldn’t need the text-search capabilities.

As you load in the data, you tell the system how to recognize the records and fields, and you describe the database, just as you would with any other system. But you also determine the kind of index -- one or several -- that you want to use in each field. The eight choices are: (1) regular inverted-file word index; (2) truncated word index; (3) phonetic word index; (4) line (or phrase) index, using lines or phrases specified by the database builder; (5) binary; (6) integer; (7) decimal; and (8) date. In addition, you can specify any of three different search techniques: unique term, keyword or large range (many occurrences of a small number of things, such as 50 states or 12 months or 15 job classifications (in a 20-person company, of course!).

Each of these is most effective for a particular kind of data. Users search by field, without even knowing which search/indexing technique is being used. A particular field can also be indexed in more than one way.

Dataware was founded by Kurt Mueller, who ran Lotus Germany until 1985 when he left to become a consultant. Among his clients was Computer 2000, the leading German distributor of pcs and related software. Despite his background at Lotus, it was at the first Microsoft CD-ROM conference that he discovered CD-ROM and persuaded Software 2000 to fund a start-up in the area after he found existing products lacking -- too slow, text-only and tailored to service bureaus, says vp marketing David Wilcox. Last month, Dataware raised $3 million from U.S. venture capitalists Oxford Partners and Morgan Holland and bought out its parent, which continues as its German distributor. In the U.S. it sells direct to publishers, corporations (internal publishers) and government agencies, and through CD-ROM hardware vendor Meridian Data.

FREE ADVICE ON OS/2

We see that IBM may be offering rebates on OS/2. We think the real way to get people to buy and use the system to offer free installation with any full-price copy. Inertia’s a more powerful deterrent than parsimony.
1989 PERSONAL COMPUTING FORUM: GET SET FOR THE NINETIES

The 1989 Personal Computing Forum will take place from March 19 to 22 in Palm Springs. We are now sold out -- sorry! We look forward to seeing those of you already registered in Palm Springs! Your families are also welcome for all the social events.

Daphne Kis, associate publisher

Our roster of speakers is:

Tania Amochaev  Natural Language Incorporated
Ed Anderson       ComputerLand
Gordon Bell       Ardent
John Seely Brown  Xerox PARC
Jim Cannavino     IBM Entry Systems
Vittorio Cassoni   Olivetti
John Dvorak       Himself (EDwards MC)
Bob Epstein       Sybase
Ed Esber          Ashton-Tate
Gordon Eubanks    Symantec
Bill Gates         Microsoft
Adele Goldberg    ParcPlace Systems
Bill Joy          Sun Microsystems
Philippe Kahn     Borland International
Mitchell Kapor    ON Technology
Bob Kavner        AT&T
Frank King        Lotus
Chip Lacy         Ingram/Micro D
John Roach        Tandy
Mort Rosenthal    Corporate Software
John Sculley      Apple
Enzo Torresi      NetFrame
John Warnock      Adobe

We are also arranging company/product/concept presentations by certain attendees. They include Action Technologies, Adobe, AICorp, Aion, Aldus, Avalanche, Brightbill-Roberts, Channel, Claris, Clear Software, Coordination Technology, DB/Access, Folio, Fox, Geovision, Hewlett-Packard (NewWave), IBM (MCA), Interbase, MacroMind, MapInfo, Microrim, NetFrame, Neuron Data, NeXT, Novell, Persoft, Phoenix, Premise, Saber Software, Saros, SoftQuad, Softsel (UNIX division), Software Publishing, Stepstone (Objective-C/NextStep), Sun Microsystems, Sybase, Tandy (DeskMate/Open Desktop), Traveling Software (ViewLink), Verity, Wang (Freestyle), WordTech.

Desert EDventure!  Stanford PhD in geophysics Colleen Barton (Larry Tesler's wife) will lead a day-long field trip exploring natural sites and a geodetic station (where they measure fault activity) on Tuesday for companions, "children" over 12 (with a parent) and miscreant attendees. (Palm Springs sits near the San Andreas fault.)

Release 1.0        27 February 1989
RESOURCES & PHONE NUMBERS

Jim Quentin, Alaska Airlines, (206) 433-3382
Dave Hrms, AMR Travel Services/Confirm, (214) 788-8608
Ken Stephens, BehavHeuristics, (301) 454-0311
Dave Berkus, Computerized Lodging Systems, (213) 421-2191
Gary Campbell, Control Data Yield Management Services, (404) 399-2141
Mark Teflian, Covia, (312) 518-4501
Kurt Mueller, Dataware, (617) 621-0820
Bill Hunscher, Eloquent Systems, (603) 627-9494
Denny Goetz, Fert Travel, (212) 269-1085
Bill Carroll, Hertz, (201) 307-2000
Ray Anderson, IXI, (011) 44-223 462-131
Jerry Popek, Locus Computing, (213) 337-5202
Jim Makens, James C. Makens & Associates, (919) 761-0738
Elizabeth Goodnow, MARS/MapWise, (309) 677-3299
Bob Daley, Marriott, (301) 380-7655
Chuck Boesenberg, MIPS, (408) 728-1700
Alain Rappaport, Patrick Perez, Neuron Data, (415) 321-4488
Allen Ginsburg, Santa Cruz Operation, (408) 425-7222
Robert Salter, Seabrook Marketing, (713) 523-5151
Sam Fuchs, Simat, Helliesen & Eichner (SH&E), (617) 894-6214
Howard Elias, Tandy, (817) 390-3999
Randy Beck, Texas Instruments, (512) 250-6747 or 250-6596
Terry Elliott, Unisys/ARE, (612) 687-2647
Pat Barfield, Unisys/HRE, (215) 278-5571

COMING SOON...

- Microsoft’s strategy for objects and operating systems.
- A composition engine.
- Fiber can be fun.
- Active and passive objects.
- And much more... (If you know of any good examples of the categories listed above, please let us know.)

Also, we will be traveling to the Soviet Union in April. Please let us know of any contacts over there whom we should visit.
<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 6-8</td>
<td>The software re-engineering symposium - Oakland, CA. Sponsored by Digital Consulting Inc. With Rich Currier, Panoramic; Charles Bachman, Eric Bush, Nick Zvegintzov, others. Contact: Dan Horgan, (508) 475-6990 or (508) 470-3880.</td>
</tr>
<tr>
<td>March 6-10</td>
<td>*Fifth IEEE conference on artificial intelligence applications - Miami. Keynote by Ray Kurzweil, plus Mark Fox, Ron Kaplan, Sanjay Mittal, Beau Shell, Mike Stonebraker, Len Tedesco (Ford), Esther Dyson, John Clippinger. Call IEEE, (202) 371-1013, or Mark Fox, (412) 268-3832.</td>
</tr>
<tr>
<td>March 9-10</td>
<td>COMPUTER ACCESS AND USE FOR DISABLED PERSONS - Decatur, GA (near Atlanta). A topic of increasing social and business impact. Sponsored by Trace R&amp;D Center (see Release 1.0, 87-6). Contact: Gregg Vanderheiden, (608) 262-6966.</td>
</tr>
<tr>
<td>March 13-16</td>
<td>West Coast Computer Faire - San Francisco. The traditional event. Contact: Cheryl Delgreco, (617) 449-6600.</td>
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<tr>
<td>March 13-17</td>
<td>Seybold Seminars '89 - San Francisco. Wish we could be there...with Jean-Louis Gassee, Dave Liddle, Bill Joy, John Warnock, Alvy Ray Smith, Yuri Rubinsky, John Meyer, Dave Boucher, Steve Ballmer, Paul Brainerd, Dan Cheifetz, Mike Bosworth, et al. Call Kevin Howard, (213) 457-5850.</td>
</tr>
<tr>
<td>March 15</td>
<td>EIA Government/Industry Dinner - Washington, DC. With (quite a coup. though he doesn’t have to walk for) Gerorge Bush as keynote. Part of EIA’s Spring Conference. Contact: Mark Rosenker, (202) 457-4980.</td>
</tr>
<tr>
<td>March 21</td>
<td>Effective marketing for a small computer and software services company - Santa Clara. Sponsored by Adapso. Speakers from Landmark, Lawson Associates and Tower Systems (if you haven’t heard of them, now you know this is really for small companies!) Call Phyllis Cockerham, (703) 522-5055.</td>
</tr>
<tr>
<td>March 22-23</td>
<td>Neural networks in the real world - San Jose. Keynote by DARPA program manager Barbara Yoon. Organized by Tom</td>
</tr>
</tbody>
</table>
March 22-23
International Phoenix conference on computers and communications - Phoenix. Keynote by TRW's Barry Boehm. Spon-
sored by IEEE et al. Call Kathleen Mutch, (602) 891-6080.

March 23

March 28-30

March 28

March 28-30
AAAI's Spring Symposium on innovative applications of AI - Stanford, CA. AI in many guises: manufacturing, language, software engineering, knowledge systems, planning, search. Sponsored by AAAI. Call Rick Skalsky, (415) 328-3123.

March 29-31
Visions '89 - San Diego, CA. Sponsored by ABCD, the micro-computer industry association (mostly dealers). With H-P's John Young. Contact: Deborah Keating, (312) 240-1818.

March 30-31

April 3-5
*Patricia Seybold's third annual Technology Forum - Cambridge, MA. Sponsored by Patricia Seybold's Office Computing Group. With a focus on object-oriented computing. Contact: Connie Sagona, (617) 742-1028.

April 10-13
*Spring Comdex - Chicago. Keynote panel: John Doerr, Kleiner Perkins; Ray Noorda, Novell; Heidi Roizen, T/Maker. Also including MACdex, with a keynote by Claris' Bill Camp-
bell. Contact: Jane Wemyss at (617) 449-6600.

April 10-13
Electronic Imaging West - Pasadena. Sponsored by the Institute for Graphic Communications. Call Richard Murray, (617) 891-1550.

April 12-14
International markup conference - Gmunden, Austria. Spon-
sored by Graphic Communications Association. Contact: Marion Elledge at (703) 841-8160.

April 12-14
Facsimile and image communications conference - Orlando, FL. Sponsored by CAP International. Call Kristin Fischer at (617) 982-9500.

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| April 18-20 | Connect '89 - Boston. Sponsored by Cahners Exposition Group with Larry DeBoover and Dale Kutnick. For MIS managers mostly. Contact: Dave Sell at (203) 964-0000. |
| April 30-May 4 | CHI '89: Conference on human factors in computing systems - Austin. Sponsored by ACM/SIGCHI and a host of other groups. Contact: Claudia Raun, MCC, (512) 338-3798. |
| May 7-10 | *IBM computer services and consultants executive conference - Phoenix. Contact Charlotte Scott at (212) 745-3500. |
| May 9-11 | Second international conference on computer-assisted learning - Dallas. Sponsored by U of Texas' Computer Learning Research Center. Contact: Janet Harris, (214) 690-2204. |
| May 11 | Massachusetts Software Council spring membership meeting - Newton, MA. Contact: Joyce Plotkin at (617) 437-0600. |

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<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Details</th>
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<tbody>
<tr>
<td>May 14-17</td>
<td>*ADAPSO Management Conference/IIA Spring Conference - San Diego. Mingle with your peers (and the zoo's nearby just in case). A joint session sponsored by ADAPSO and the Information Industry Association, with the usual round of business-focused sessions, networking and speeches by luminaries, including AT&amp;T's Robert Allen and Sun's Scott McNealy. Contact: Sheila Wakefield, (703) 522-5055.</td>
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<td>May 21</td>
<td>Warning! Annual Bay to Breakers Race - San Francisco. Sponsored by the San Francisco Examiner.</td>
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<td>May 21-24</td>
<td>Expert systems and the leading edge in productions and operations management - Hilton Head Island, SC. Sponsored by AAAI, the Operations Management Association, others. Contact: Libby Shropshier, (803) 777-2231.</td>
<td></td>
</tr>
<tr>
<td>May 31-June 2</td>
<td>*SIGMOD - Portland, OR. User interfaces to dbms systems and some more esoteric management of data topics. Sponsored by ACM/SIGMOD. Keynote: Esther Dyson! Contact John Bruno, (503) 629-8383.</td>
<td></td>
</tr>
<tr>
<td>June 5</td>
<td>Toshiba Micro Industry Golf &amp; Tennis Celebrity Tournament - Industry Hills/Los Angeles. With Tom Selleck, others; funds raised go to the Starlight Foundation for terminally ill children. Contact: Dave Freeman, (714) 558-8813.</td>
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</tr>
<tr>
<td>June 5-8</td>
<td>*AIIM show &amp; conference - San Francisco. &quot;Discover the power of imaging.&quot; Keynote: astronaut Wally Schirra.</td>
<td></td>
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</tbody>
</table>
Sponsored by the Association for Information and Image Management. Contact: James Breuer, (301) 587-8202.

June 6–8  
International expert systems conference and exhibition - London. Sponsored by Learned Information. Contact: Jean Mulligan, (011) 44 865 730275; fax, 865 736354.

June 11–14  
*Expert Communication '89 - San Francisco. Sponsored by Graphic Communications Association and chaired by Mills Davis. Contact: Norman Scharpf, (703) 841-8160.

June 12–14  

June 12–16  
Summer USENIX technical conference - Baltimore. Tutorials on networking, environments, development tools, window systems, etc. Contact USENIX at (213) 592-1381 or 592-3243, or John Donnelly, (303) 499-2600 (exhibits) or Neil Ground Water (703) 883-1221 (papers).

June 13  
Effective marketing for a small computer and software services company - Chicago. Sponsored by Adapso. See March 19. Contact: Kelly Bailey, (703) 522-5055.

June 20–22  
*PC Expo & National CASEcon - New York. Sponsored by PC Expo. Call Steven Faher, (800) 444-EXPO or (201) 569-8542.

June 21–23  
*Programming language design and implementation - Portland, OR. Sponsored by ACM SIGPLAN. Contact: Bruce Knobe, (508) 879-2960 x3376 or Knobe@S56.Prime.com.

June 25–28  
Twelfth international conference on R&D in information retrieval - Cambridge, MA. Sponsored by ACM SIGIR and other groups. Contact: Bruce Croft, (413) 545-0463.

June 25–28  
*Twenty-sixth Design Automation Conference - Las Vegas. The big event for designers and vendors to designers. Sponsored by ACM. Contact: Pat Pistilli, (303) 530-4333.

July 10–14  

July 17–21  
*CASE 89 - London. Sponsored by Index Technology and a host of academic groups, including London's Imperial College. Contact: Elliot Chikofsky, (617) 494-8200, x 1989.

July 31–August 4  
*SIGGRAPH '89 - Boston. Sponsored by the Association For Computing Machinery. The annual festival for visual, graphical thinkers. Contact Cindy Stark, (312) 644-6610.

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August 1-3  Comdex Asia/Pacific - Sydney, Australia. Sponsored by Interface Group. Contact: Cheryl Delgreco, (617) 449-6600.

August 6-9  DB2 Users Group annual meeting - Chicago. Sponsored by International DB2 Users Group. Contact: Samantha Sipowicz, (312) 644-6610.

August 9-10 *Macworld Expo - Boston. Contact: Peggy Kilburn, (617) 326-9955.

August 9-11 *Conference on object-oriented dbms applications - Santa Clara, CA. Sponsored by Santa Clara University. Contact: Mohammed Ketabchi, (408) 554-2731 or mketabchi@scu.bitnet.


August 22-26 *IJCAI-89 - Detroit. The international version of AAAI. Sponsored by the American Association for Artificial Intelligence. Contact: Claudia Mazzetti, (415) 328-3123.

August 23-25 TechDoc '89 - San Jose. "Publishing in the '90s...the art of publishing and the science of information management." Technical documentation and all its ramifications, including hypertext. Sponsored by Graphic Communications Association. Contact: Patti Hill, (703) 841-8160.

August 24-September 1 *Eleventh World Computer Congress - San Francisco. With a focus on tools and application software this year; in the U.S. for the first time in 24 years. Sponsored by 46 IFIP member societies. Call Nancy Dana, (303) 696-6100.

September 6-9 Breakaway '89 - Orlando. Sponsored by ABCD, the microcomputer industry association (mostly dealers). Contact: Deborah Keating, (312) 240-1818.

September 7-10 Comtec '89 - Singapore. Regional micro exhibition. Sponsored Microcomputer Trade Association of Singapore. Contact: Yong Mee Hiong, Singapore 2913238; fax 2965384.

September 12-14 NetWorld - Dallas. Managed by H.A. Bruno. Contact: Adam Torres at (201) 569-8542 or (800) 444-EXPO.

September 18-20 DataStorage - San Jose. Sponsored by DISK/TREND and Freeman Associates. Call Darlene Plamondon, (408) 554-6644.


September 20-23 *Seybold computer publishing conference - San Francisco. Sponsored by Seybold Publications. The usual extravaganza, expanded from desktop publishing to include all electronic publishing. Contact: Kevin Howard, (213) 457-5850.

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September 24-26  *Agenda 90 - La Costa, CA. Sponsored by P.C. Letter/PCW Communications; staged by Stewart Alsop. Contact: Tracy Beiers, (415) 592-8880. (Please note the date carefully; it has changed from the previous listing.)


October 1-4  *ADAPSO Management Conference - Orlando. Mingle with your peers (and Disneyworld's nearby just in case). Contact: Sheila Wakefield, (703) 522-5055.

October 2-6  *OOPSLA - New Orleans. Sponsored by ACM/SIGPLAN. Come meet your fellow objects and share procedures. Send a message to Carole Mann, (407) 628-3602.

October 2-6  CD-ROM Expo - Washington, DC. Sponsored by IDG Conference Group. Contact: Mitch Hall, (617) 329-8090.

October 3-5  PC Expo - Chicago. Sponsored by PC Expo. Contact: Steven Faher, (800) 444-EXPO or (201) 569-8542.


October 11-14  *Software Publishers Association annual conference - Montreal. Sponsored by SPA. Call Jayne White, (202) 452-1600.


November 13-17  *Comdex - Las Vegas. Also including MACdex. Contact: Jane Wemyss at (617) 449-6600 or (800) 325-3330.

*The asterisks indicate events we plan to attend, not merit. Please let Denise DuBois know about any other events we should include.

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### FARE MIX DECISION SUPPORT

**SM 0200 - Leg: CCC-BBB - Friday - 10/28/88 - Cmprt: Coach**

Total Booked: 79  
Adjusted Total Booked: 71  
Total Demand: 114.1

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--- Revenue (Base: 10,095) ---

|       | Current: 15,155 | Proposed: 16,299 | Model: 16,299 | New: 15,155 |

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**ADVANCE BOOKING SEQUENCE: REVENUE ($100s)**

Days Prior to Departure:
**SM 0200 - Leg: CCC-BBB - Departure: Friday, 28 October 1988**

Compart: Coach, Capacity: 120  
Estimated revenue: $15,500 +/- 2,261

(F1) Class/Compartment  
(F2) Date  
(F3) Passengers  
(F4) Line graph  
(F5) Numeric  
(F6) Print  
(F7) Capture  
(F8) Return  
(F9) Technical

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Daphne Kis
Associate Publisher