In This Issue

The Mathematics of Time

Can you imagine a world without time? In such a place, everything would happen at once. There certainly would be no futures industry, because futures are all about time. Since time is with us, it stands to reason that mathematical methods addressing the effects of time should be included in futures trading systems. A major goal of this News Journal is to help our readers understand the many complexities of the futures markets and to help you benefit from this knowledge. To further that goal, this month we'll discuss the mathematics of time.
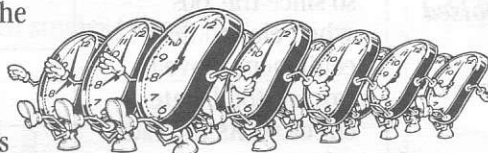
Would it be helpful to the market analyst to know when to expect the next high price or next low price? Would you like to be able to forecast the event of the next moving average crossover? Since I spent a decade in the military reliability business, it has been a fascination of mine to apply the mathematics of time and reliability to the futures industry. I believe that with further study, such predictions could be made accurately and reliably.

Perhaps I can offer some insights which will help you incorporate time analysis, a la reliability theory, into your next system trading tool. This article is intended as background information for further study on your own. It is my hope to give you ideas from which you might develop your own unique strategies.

Like the futures industry, the field of reliability engineering is heavily time oriented. The focus of reliability engineering is to determine how long an electronic component or system will survive. You might call the field of reliability engineering an event-oriented science. The event considered by the reliability engineer is system failure: the failure of a space shuttle or a radar detection network, etc.

Fortunately for the market analyst, other events can be considered with the same failure analysis methods used by the reliability engineer. In applying this science to trading, failure can be defined as a trading loss, failure to complete a predicted price pattern or failure to meet other predicted criteria. If it suits your purpose, success could be substituted for failure without invalidating the analysis. The mathematics work best when the event to be analyzed is rare. Certainly, very large profits fall into this category for many system applications.

In reliability theory, the reliability of a product is expressed as a function of time and either its rate of failure or the mean time between failures. Reliability is a probability measure that expresses your chance of performing a mission without failure.

Failure analysis can be handled in many ways. Just how one mathematically addresses the problem depends on how failures are distributed over time. For example, the life insurance actuary is concerned with failure of the human body. "The force to mortality" is a statistical measure for the human body that generally increases over time. The older one gets, the more

The Mathematics of Time
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Robert C. Pelletier

"The intent of the exercise is to understand the dynamics of any event-producing process so that you can be poised to profit from it."

likely is the time-conditioned probability of death. The force to mortality briefly decreases as an infant gets older, and then flattens out. As we reach our teenage years, our human failure rate begins an endless climb.

Electronic equipment has been shown to exhibit a constant conditional rate of failure. This means that no matter how long a piece of electronic equipment has been in service, the probability of failure remains the same. This has been so since the '60s when electronic equipment moved toward solid state circuitry. As the radio tube gave way to solid state transistors and other miniature components, electronic circuitry was observed to exhibit a constant failure rate. These new electronic components produced significant reliability advances.
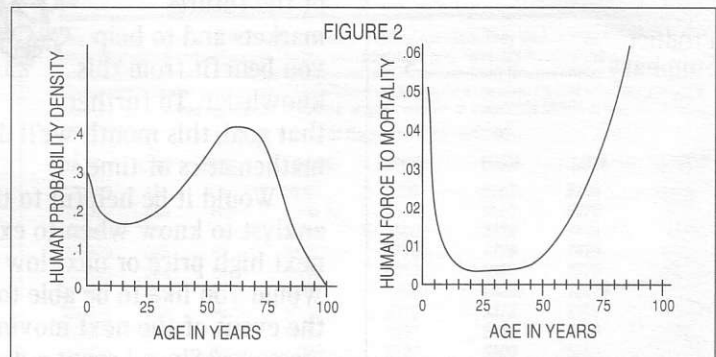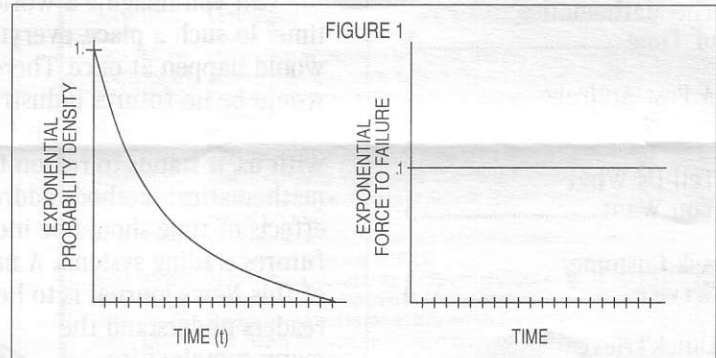
Whether your application involves either a constant failure rate or the wear-out condition, the distribution of failures over time can be shown to exhibit a characteristic distributional form. With a chance or constant failure rate, reliability, R, is expressed mathematically as:

$$R = e^{-t/T}$$

where T is the reciprocal of the rate of failure per unit time, t is the operating time and e is the natural log base, 2.7182818285...

In this example, as the operating time goes up, the reliability slowly drops, but the rate of failure or the mean time between failures stays the same regardless of time.

When the distribution is more normally distributed, the rate of failure depends on how long a component has been in operation. The force to failure for a device likely to wear out will actually increase over time. As you can see by the charts below, the

FIGURE 1
(EXPONENTIAL PROBABILITY DENSITY vs TIME (t); EXPONENTIAL FORCE TO FAILURE vs TIME)

FIGURE 2
(HUMAN PROBABILITY DENSITY vs AGE IN YEARS; HUMAN FORCE TO MORTALITY vs AGE IN YEARS)

nature of any analysis depends heavily on the distributional form of the event under study.

Figure 1, which shows the exponential density and force to mortality and figure 2, which shows the human force to mortality and density, illustrate these points.

The proper way to apply reliability theory to market analysis depends on the needs of the trader. A starting point for all traders is to first define the event you plan to study. This can be any specific type of failure or success, depending on your perspective. Then empirically observe the frequency of the event to form your T estimate. From there, you would apply

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A Post-Andrew Report

The September News Journal had already gone to press when Hurricane Andrew visited South Florida, so we felt an epilogue, albeit tardy, was in order. We are pleased to report that CSI survived intact, less a few trees and full electric power. As Andrew roared through the pre-dawn and morning hours of August 24, our automatic diesel generator kicked in as planned, keeping the CSI host computer humming throughout the day. Phone service was intermittent, but persistent callers did manage to get through.

We in Boca Raton were fortunate that we did not receive the full brunt of the storm that devastated many of our neighbors to the south. Although Boca was a virtual ghost town the morning after, CSI's motivated staff showed up or called in. Data was delivered on time in a business-as-usual fashion.

Andrew called into motion CSI's emergency service plan which includes the use of our generator and uninterruptable power supplies. The major weakness we found was in telephone network access. Both Telenet and Tymnet were down for a time. This reminds us to alert our users that direct-dial phone lines should be tried whenever network access repeatedly fails.

All CSI personnel join me in thanking the many thoughtful users who called to express concern that we were O.K. Hurricane Andrew left a path of devastation that words cannot describe. Your kind thoughts and words enhance our dedication to provide the best possible service under the most trying circumstances. ✦

Many Thanks

Tell Us What You Want:

We are continually looking for new ways to serve our users. Below are a few software possibilities that have been suggested. Please rate the following trading aids in terms of whether they would be of interest to you.

Tool Kit Additions

Unattended analysis	Yes	Maybe	No
User Defined-studies and system simulator	Yes	Maybe	No

New canned analysis

1) Bolinger bands	Yes	Maybe	No
2) Retracement	Yes	Maybe	No
3) Point and figure	Yes	Maybe	No

Suggested studies (please list)

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File Management Utilities

1) combine discrete data into continuous files	Yes	Maybe	No
2) prepare Perpetual Contract® data	Yes	Maybe	No

Stand Alone Analysis

Portfolio optimization and weighting	Yes	Maybe	No
ARIMA	Yes	Maybe	No
Multiple correlation	Yes	Maybe	No
Trading system evaluation	Yes	Maybe	No
User defined system analysis	Yes	Maybe	No
Spread trading	Yes	Maybe	No
Intermarket analysis	Yes	Maybe	No

Other: (please list)

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Please clip and return with your invoice. Thank you! ✦

Ask Customer Service

Q. *If I access daily updates once a week, making just one call for five days of data, does this count as one or five updates?*

A. The CSI host computer counts each day of data you access as one update. Picking up five days in a single call counts as five updates. Users sometimes make the mistake of selecting the "full week" collection feature to pick up five days when only one or two days are needed. Repeatedly accessing redundant days in this manner can result in additional access charges. The rates shown on our price schedules assume no more than 26 updates per billing period.

Users of QuickTrieve® version 4.03 or higher have a "Multiple Days" option for data retrieval. This feature lets you retrieve all uncollected days for your portfolio since your last access without redundancy, thus avoiding additional charges.

Q. *How long does it take for a portfolio change to be effective after I place my order?*

A. If you order via QuickTrieve's Order Subsystem or Trade Data Manager's Portfolio Change feature, your changes will be posted to your private portfolio on CSI's host computer almost immediately. Under normal circumstances, you can expect to retrieve your new portfolio within five minutes or so. If you order by calling one of our service representatives, we'll make your changes on a first-come, first serve basis. This process may take as long as an hour or two, depending on the backlog of orders.

Q. *How long does it take to process a historical data order?*

A. Historical data orders for phone retrieval typically take from one to three hours to process. Data provided on diskettes is normally shipped from one to three days after receipt, with very large orders taking longer. Please allow extra time for shipping and specify courier service if desired.

Q. *How do I know which is more economical - direct dial or network access at a higher rate?*

A. Network service is probably the most economical if you use it to your best advantage. For example, accessing our Error Correction File is a toll-free benefit, but will result in extra phone charges if you dial direct. Often customer service calls can be avoided through QuickTrieve and Trade Data Manager's electronic message subsystems. Many simple questions can be asked and answered in this way at no extra charge to you. You can use the subsystem whether or not you use network service, but network users pay no extra phone bills for these transmissions. Any time you have to call a second time to retrieve data (for whatever reason) network users incur no extra expense, whereas direct-dial callers will pay the phone company for the extra calls.

Q. *And finally, a question that is rarely asked that we'd like to answer anyway... I want to make my calls to Customer Service as brief as possible. What steps should I take to assure fast service?*

A. We can help you most efficiently if you have all the necessary information on hand when you call us. Anything that might be relevant to your problem should be available. Your User I.D., for example, is almost always needed. If you're having a software problem, make sure your program is up and running when you call. Also, be sure to write down and mention any error message you may have received. In general, the more information you can give us, the faster we can solve the problem. To reach Customer Service, please call (407) 392-8663. ✦

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