Practical License Revenue Forecasting

By Tim Gossett, Don Ladwig, and Greg Speno

Introduction

Like many managers with profit and loss responsibilities, licensing professionals are often responsible for making forecasts concerning the financial performance of active license agreements within their portfolio. However, unlike managers of existing products or services that enjoy historic sales and marketing data, the licensing professional typically has no such data, especially for new licenses. Statistical tools normally available for financial forecasting such as multivariate time series analysis or econometric methods are impractical to apply under these circumstances [1]. In addition, the very nature of intellectual property licensing implies new business partners, new products and new markets; consequently making any attempt to model the complex and interrelated underpinning factors useless [2]. If traditional quantitative methods have been judged inadequate at the commencement of the forecasting activity, the most often used alternate is a class of forecasting methods involving a judgmental approach [1]. This paper will present a hybrid forecasting method based on the synthesis of a time-honored judgmental forecasting technique for structured group analysis with the use of fuzzy numbers as its modeling construct. Finally, the practical application of the method in license revenue forecasting will be explored and a particular implementation of the method will be presented.

Assumptions & Objectives

To delineate the scope of developing a new forecasting method the following assumptions, based on empirical data and experience, were used. In turn, evaluation of these assumptions yielded the objectives of the forecasting method. Foremost is the assumption that the canny atmosphere that may have existed between all parties during the negotiation of the license has subsided and both the licensor and the licensee are engaged in a good faith relationship in order to make the financial outcome of the license a success. In reality, both parties have an interest in the financial success of the license and a desire to have an accurate financial forecast for the license.

The second assumption is that the stakeholders of both parties will most likely be burdened in simply the governance and execution of the license once performance under the license begins. In addition, in the early stages, the long-term financial success of a license is far from apparent. Therefore any additional burden on the resources used to administer a license in the beginning should be kept to a minimum, as well as any additional costs, thereby requiring any forecasting method be easy to deploy and simple to use.

The third assumption is that no single license stakeholder possesses all of the knowledge needed to produce a quality judgmental financial forecast. Most licenses will involve many participants from both the licensee and licensor. Although this assumption is generally true for all types of intellectual property licenses, it is especially true in technology licenses where a license is the instrument governing the commercialization of technology and where there may exists a high degree of communication on many levels or functions between the licensee and licensor. All license stakeholders possess a unique view, and interpretation as to how the underlying financial events that are associated with the license may unfold. Therefore, an effective judgmental forecast will include many individual judgments about the potential financial performance of the license [2].

The fourth assumption is that all revenue flow stemming from a license will only occur in conjunction with events that have been defined within the license. Consequently, events such as the payment of fees or royalties will be well defined as to the condition that generates them with only the amount and timing of the revenue left to conjecture.

As a corollary, the fifth assumption is that an efficient judgmental forecasting method will require participants to make subjective decisions about the amount and timing of the financial events associated with the license. In collecting only the necessary quantitative speculative data, it obligates the forecasters to decompose, translate, and encapsulate their perceptions into a useable quantitative format. This in turn relieves the licensing professional from performing what usually turns into a time consuming ad hoc process to arrive at information that is less structured and accurate. Furthermore, concentrating solely on the outcome of financial events, and not their root causes, tends to reduce any emotive thinking that influences the forecaster to forecast within a framework of a common ideology or a preconceived model that happens often in ad hoc methods [4].

The overall objective of a useful judgmental forecasting method is to provide its users with a communication tool that quantifies the collective presumptions of the license stakeholders by imparting to them a medium to express their presumptions tempered with intuitive uncertainty.

The Delphi Method

Under a United States Air Force directive in the early 1950's, Rand Corporation set out to develop a forecasting process for use in making informed decisions when developing budgets for technology research and development programs [5]. During these studies it quickly became apparent that individual expert opinion could not produce sustained accurate forecasts. However, it was discovered that if a panel of experts was assembled with a broad range of experience and skills, the precision of the panel's forecast tended to improve in repeatability [6]. Over a number of years Rand Corporation refined and formalized the process of developing a group's collective intelligence into what became known as the Delphi process [2].

In its most general form, a Delphi process begins when a moderator develops a questionnaire that is meant to query individuals about their presumptions concerning future events of interests [5]. When applied to license revenue forecasting, the licensing professional acts as a Delphi process moderator by analyzing a license and identifying all revenue producing events that will affect the financial performance of the license. Once identified, the licensing professional develops a questionnaire consisting of pointed questions meant to extract presumptive information about the amount and timing of all financial events associated with the license, but in a way such that the presumptions can be quantified.

In the next step of a standard Delphi process, the moderator identifies experts who can contribute unique and useful insight into the particular subject matter of interest and obtains their support to participate as part of a forecasting team [2]. In a standard Delphi process this group is usually a dispersed and disparate team known as the Delphi panel. [2]. Applied to licensing, the Delphi panel may consist of many people with varied responsibilities related to the successful outcome of a license including: business managers, subject matter experts, contract professionals, marketing managers, etc. In the case of licenses in which there is a significant level of ongoing interaction between the licensor and licensee regarding the transfer of technology and/or interchange of marketing data, the more important it is to have both licensee and licensor representation on the Delphi panel. The Delphi panel should at a minimum contain members of the licensee's business development organization and any other unit within the licensee's organization that will contribute to the overall success of the license.

Following the dispersion of the Delphi questionnaires to the Delphi panel, each panel member analyzes the Delphi questionnaire and provides their individual responses based on their experience and unique knowledge base. Applied to license revenue forecasting, the Delphi panel members will translate their overall opinions and feelings into quantified presumptions about the amount and timing for the financial events surrounding a license.

In the final step of the Delphi process, the Delphi moderator collects and analyzes the information from the questionnaires and then amalgamates the results for redistribution to each member of the Delphi panel. These results serve as a feedback mechanism to the panel and are the baseline by which the Delphi panel makes future forecast. Applied to licensing, the licensing professional would collect all presumptive data concerning financial events from the Delphi panel and formulate to form a single output representing the collective judgment of future performance for each particular financial event within the license and the overall financial performance of the license. After several iterations of this process, the results of a successful Delphi process will start to converge on particular profiles for the amount and timing of all financial events [2] (see Figure 1).

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Many studies have been performed on the robustness of the Delphi process and its benefit in the process of forecasting [5]. A valuable trait often attributed to a Delphi-styled forecasting process is that the information that can be assimilated and processed by a Delphi panel is greater than any one member of the Delphi panel [2]. In addition, the number of scenarios and events that the panel can consider is only limited by the number of people that are included in the panel [2]. In addition, the Delphi process can be conducted with anonymous or semi-anonymous participation allowing experts to communicate without counterproductive social interaction which often hampers a quality response by committees [5].

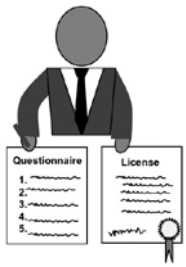
Quantifying Presumptions With Fuzzy Numbers

One of the most difficult activities in constructing an effective judgmental forecast framework is designing a questionnaire in such a way that it allows the forecasters to easily quantify their presumptions. This stems from the fact that aggregating arithmetic with qualitative reasoning is one of the most complex analytical tasks a forecaster can undertake [4]. One approach that has been successful in allowing forecasters to translate empirical observations into the quantitative realm has been to allow them to express their forecast models in terms of fuzzy numbers [11]. The use of fuzzy numbers is often advantageous when a forecaster is trying to describe presumptions linguistically using uncertain or approximate reasoning in addition to incomplete information [10].

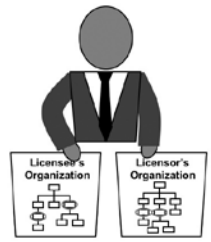
Fuzzy numbers are actually an extension of the set of real numbers but can be structured to represent situations in which the quantities involved are not well defined [7]. If viewed as a bar graph, the graph is fuzzy in those areas in which the fuzzy number less aptly represents a targeted set. The same fuzzy number can be represented as a membership mapping function in which the domain, or set of real world quantities of interest, is mapped into a range that represents the forecaster's presumption about their relative strength of membership to a particular set [8].

Figure 1. The Delphi Process For License Revenue Forecasting

① **Licensing professional acts as a Delphi coordinator by first analyzing the active license for key financial events and creating a questionnaire meant to draw out presumptions from the Delphi panel.**

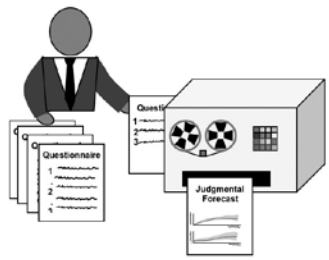


② **Licensing professional identifies the Delphi panel by selecting stakeholders from within the licensee's and licensor's organization and distributes the questionnaire to the panel.**



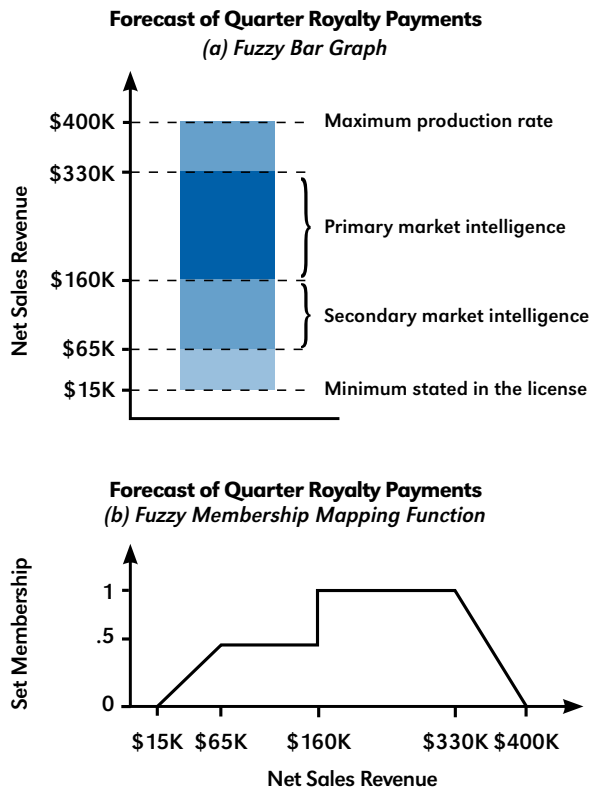
③ **Each member of the Delphi panel reflects on the key license revenue producing events and quantifies their presumptions based on their own experience and knowledge.**

④ **Finally, the licensing professional processes all questionnaires and formulates a numeric forecast based on the Delphi panel's collective presumptive input.**



For example, consider a licensing professional who is monitoring the financial performance of a new license with a pharmaceutical company. As part of this task, she desires to formulate a forecast for the probable amount of royalties that will be paid each quarter. The licensing professional could start with extreme ranges in which she is fairly confident. For example, if the license contains a provision that quarterly minimum royalty payments will be $15,000, it is a fair assessment to presume that $15,000 will be the minimum value of the fuzzy number representing quarterly royalties. Furthermore, based on her intuition about the licensee and her overall knowledge about the market, she feels that the licensee will produce much more than the minimum royalty payments. Therefore her expectations that royalty revenue would be close to the minimum is extremely low. At the other extreme, the licensing professional might contact the product manager within the licensee's organization and learn that the maximum quarterly sales revenue would be limited to selling one hundred percent of the licensed product produced at the maximum production rate for a quarter which in turn would generate a royalty revenue of $400,000. If the opinion of the licensee's product manager is that this has an extremely slim chance of occurring, the licensing professional would have the maximum fuzzy number value representing quarterly royalty payments with the expectation of this occurrence being low. To develop the most likely values of the fuzzy number representation of the quarterly royalty revenue the licensing professional might refer back to the business case that was developed while the license was being negotiated. If a best guess at quarterly outlook for royalties of the licensed product was predicted at that time, for whatever reason, to be between $160,000 and $330,000 then the values of the fuzzy number that correspond to the greatest strength of set membership for the expected monthly royalties would be between $160,000 and $330,000. Furthermore, as additional information is discovered it may be superimposed on the baseline information. For instance, the licensing professional may consult a source which makes her feel that the largest value associated with the range corresponding to the greatest strength of set membership should be lowered by fifty percent and the smallest value associated with the range corresponding to the greatest strength of set membership should be lower by sixty percent. This additional information can be represented by creating an additional range within the fuzzy number with a corresponding range representing set strength membership. If the secondary source of market information was deemed to be less reliable (say by greater than one half) than the primary source of market intelligence, then this information could be superimposed with the primary source of market intelligence resulting in a fuzzy number that reflects all of the presumptions the licensing professional has intuitively developed about quarterly royalty payments (see Figure 2).[1]

Figure 2. Two Fuzzy Number Representations of Possible Quarter Royalty Payments



Although the use of fuzzy numbers has many benefits, one of the drawbacks is that fuzzy numbers in general require their own unique and often complex mathematical operators [7]. For the fuzzy number representing a presumptive quarterly revenue forecast described in Figure 2, even the most fundamental arithmetic operations would require robust algorithms to process this fuzzy number with other fuzzy numbers or real world data. Also, as seen in the example, developing a

1. A fuzzy number membership function is not a probability distribution function because the fuzzy membership function does not have to adhere to the second probability axiom in which the probability that all events within the sample set will occur is defined to be one [9].

fuzzy number representation often requires the forecaster to make several decisions about relative strength of set membership that may start with arbitrary set membership values. Fortunately, by limiting the type of fuzzy numbers used to a special case called a *triangular fuzzy number* (TFN) the basic mathematical operators become trivial while at the same time making the linguistic description of the fuzzy number easier to express [8]. A TFN is defined by two endpoints that denote the least and greatest value of the fuzzy number and correspond to lowest confidence presumption (defined to be zero) in set membership. The most likely value of the fuzzy number corresponds to the highest confidence presumption in terms of set membership (defined to be one) and it will lie somewhere in between the least and greatest values of the fuzzy number [7].

This profile allows forecasters to easily describe their presumptions based on the intuition they have developed from experience and does not require the forecaster to guess at arbitrary values representing the strength of set membership. For example, those with experience within a particular industry can usually give a qualitative description of their feelings concerning potential future events by using phrases like: "I think we will sell about X licensed products in the first quarter"; "It is highly unlikely the number of licensed products sold in the first quarter will surpass X"; "I am positive that we will sell at least X licensed products in the first quarter"—even though they would have difficulty translating these vague presumptions into a completely deterministic quantitative model [7]. A TFN representation of the presumed potential quarterly revenue for the pharmaceutical license could then be made by using the two extreme points for the endpoints and including the average of the primary market information (see Figure 3).

Table 1 shows the approximate mathematical operators for TFNs as well as a defuzzification operation (defuzzification is the act of converting the fuzzy set confidence ranges back into real numbers).

Delphi Implementation

A practical implementation of the Delphi process in terms of license revenue forecasting involves first identifying all the events surrounding the license that may affect its financial outcome. Usually the revenue stemming from a license arises from the fees and royalties defined within the license. License fees are usually triggered by one time events and may

Figure 3. Two Triangular Fuzzy Number Representations of Possible Quarter Royalty Payments

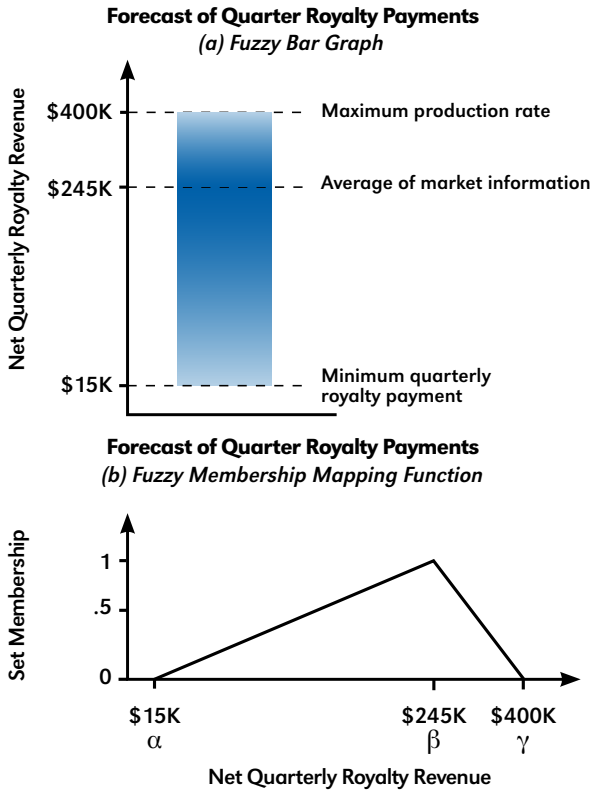


Table 1. Triangular Fuzzy Number Approximate Mathematical Operators[2]

Addition	$\bar{A}$ (+) $\bar{B}$ = ((A_α+B_α), (A_β+ B_β), (A_γ+ B_γ))
Subtraction	$\bar{A}$ (-) $\bar{B}$ = ((A_α-B_α), (A_β-B_β), (A_γ-B_γ))
Multiplication	$\bar{A}$ (*) $\bar{B}$ = ((A_α*B_α), (A_β*B_β), (A_γ*B_γ))
Division	$\bar{A}$ (÷) $\bar{B}$ = ((A_α÷B_α), (A_β÷B_β), (A_γ÷B_γ))
Defuzzification	$A = (A_\alpha+A_\beta+A_\gamma)/3$ $B = (B_\alpha+B_\beta+B_\gamma)/3$

Where: $\bar{A} = (A_\alpha, A_\beta, A_\gamma)$ *where* $A_\alpha \le A_\beta \le A_\gamma$

$\bar{B} = (B_\alpha, B_\beta, B_\gamma)$ *where* $B_\alpha \le B_\beta \le B_\gamma$

2. Using the approximate mathematical operators for fuzzy numbers will result in the loss of some fidelity within the range of the membership function; however, the interval math contained within the domain of the membership function will remain precise.

Table 2. Technology License Financial Terms

Technology License—Financial Events	
Financial Term 1:	Progress payments fee: (a) $250,000 is due after the 5,000th unit is sold (b) $250,000 is due after the 10,000th unit is sold
Financial Term 2:	7% royalty paid on the net sale price of each licensed product

manifest as license issuance fees, down payment fees, progress payments, termination fees, etc. License royalties are usually obtained from applying a royalty rate to a royalty base. The royalty rate may change over time via royalty kickers, royalty scaling on sales, minimum royalties, etc. [12]. The royalty base is usually a measurable parameter associated with the licensed product that may change over time during the lifetime of the license in a dynamic manner that may be affected by things such as product development risks and market forces. These underlying dynamic events are what the Delphi panel ultimately must forecast.

Table 3. Delphi Panel Presumptions

				Year 1				Year 2			
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Delphi Panel	Member 1	Sales of Licensed Product (Units/Quarter)	Low α	800	800	900	900	1,000	1,000	1,100	1,100
			Nominal β	2,300	2,300	2,300	2,800	3,400	3,600	3,800	4,000
			High γ	5,000	5,000	5,000	5,000	8,000	8,000	8,000	8,000
		Net Sale Price of Licensed Product(s)	Low α	$800	$800	$800	$800	$800	$800	$800	$800
			Nominal β	$1,500	$1,500	$1,500	$1,500	$1,100	$1,100	$1,100	$1,100
			High γ	$1,600	$1,600	$1,600	$1,600	$1,400	$1,400	$1,400	$1,400
	Member 2	Sales of Licensed Product (Units/Quarter)	Low α	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
			Nominal β	8,000	8,160	8,323	8,490	8,659	8,833	9,009	9,189
			High γ	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
		Net Sale Price of Licensed Product(s)	Low α	$1,700	$1,700	$1,700	$1,700	$1,900	$1,900	$1,900	$1,900
			Nominal β	$2,550	$2,550	$2,550	$2,550	$2,350	$2,350	$2,350	$2,350
			High γ	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000	$3,000
	Member 3	Sales of Licensed Product (Units/Quarter)	Low α	1,200	1,250	1,300	1,350	1,400	1,450	1,500	1,500
			Nominal β	2,500	2,600	2,700	2,800	2,900	3,000	3,100	3,100
			High γ	3,000	3,050	3,100	3,200	3,300	3,400	3,500	3,500
		Net Sale Price of Licensed Product(s)	Low α	$1,500	$1,500	$1,500	$1,500	$3,000	$3,000	$3,000	$3,000
			Nominal β	$6,500	$6,500	$6,500	$6,500	$4,500	$4,500	$4,500	$4,500
			High γ	$12,000	$12,000	$12,000	$12,000	$8,000	$8,000	$8,000	$8,000
	Member 4	Sales of Licensed Product (Units/Quarter)	Low α	2,000	2,000	2,000	2,000	3,000	3,000	3,000	3,000
			Nominal β	3,500	3,500	3,500	3,500	4,000	4,000	4,000	4,000
			High γ	4,000	4,000	4,000	4,000	5,000	5,000	5,000	5,000
		Net Sale Price of Licensed Product(s)	Low α	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700
			Nominal β	$2,200	$2,200	$2,200	$2,200	$2,200	$2,200	$2,200	$2,200
			High γ	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800
	Member 5	Sales of Licensed Product (Units/Quarter)	Low α	1,500	1,800	2,100	2,400	2,700	3,000	3,300	3,600
			Nominal β	2,500	2,800	3,100	3,400	3,600	3,800	4,000	4,300
			High γ	3,000	3,300	3,600	3,900	4,200	4,500	4,800	5,100
		Net Sale Price of Licensed Product(s)	Low α	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
			Nominal β	$5,500	$5,500	$5,500	$5,500	$4,000	$4,000	$4,000	$4,000
			High γ	$8,000	$8,000	$8,000	$8,000	$6,000	$6,000	$6,000	$6,000

In a properly drafted license the financial events will be well defined with only the timing and amounts of some of the license's revenue left to conjecture. When developing a Delphi questionnaire, each financial event should be disintegrated into its requisite parts. In general, financial events should be broken down so they contain no other compound events [2]. When dealing with ambiguous situations people tend to forecast more accurately when the associated events are decomposed into independent elements [4].

For example, if forecasting license revenue over the life of a license, instead of asking the Delphi panel members to directly forecast the total net revenue, one could ask the Delphi members to forecast the number of units of licensed product sold over time and the net sale price of the licensed product as it changes over time. The number of units licensed and the net sale price of each licensed product are independent of each other and would provide the necessary information to develop an overall forecast for the total net revenue produced by the license. Once all the financial events have been identified they should be formulated into a questionnaire which will allow the members of the panel to express their presumptions on the amounts and timing of each event for every period those events could possibly occur. The panel members would be constrained to conveying their presumptions as triangular fuzzy numbers.

As an example, consider a simple technology license in which the licensor is allowing the licensee to develop a new product that will involve the use of the licensor's intellectual property. The financial

Table 4. Fuzzy Number Calculations

Net Revenue from the Sales of Licensed Product	Sales of Licensed Product x Sale Price of Licensed Product
Net Revenue from the Sales of Licensed Product	7% x Sales of Licensed Product x Sale Price of Licensed Products
Progress Payment Fee (Two payments of $250,000)	Payments based on Sales of Licensed Product reaching 5,000 units and 10,000 units respectively

Table 5. Processed Forecast Data

		Year 1				Year 2			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Cumulative Average Sales of License Product (Units/Quarter)	Low α	$1,300	$2,670	$4,130	$5,660	$7,480	$9,370	$11,350	$11,350
	Nominal β	$3,760	$7,632	$11,617	$15,815	$20,326	$24,973	$29,755	$34,673
	High γ	$6,000	$12,070	$18,210	$24,430	$31,530	$38,710	$45,970	$53,290
Average Net Sale Price of Licensed Product ($)	Low α	$1,540	$1,540	$1,540	$1,540	$1,880	$1,680	$1,880	$1,880
	Nominal β	$3,650	$3,650	$3,650	$3,650	$2,830	$2,830	$2,830	$2,830
	High γ	$5,480	$5,480	$5,480	$5,480	$4,240	$4,240	$4,240	$4,240
Average Licensor's Net Revenue from Sales of Licensed Product ($)	Low α	$2,108,000	$2,243,000	$2,394,000,	$2,529,000	$3,480,000	$3,630,000	$3,796,000	$3,916,000
	Nominal β	$12,310,000	$12,851,600	$13,394,832	$14,089,729	$3,480,000	$12,443,344	$12,820,371	$13,189,058
	High γ	$24,840,000	$25,440,000	$26,040,000	$26,760,000	$24,360,000	$24,880,000	$25,400,000	$25,760,000
Royalty Revenue from Sales of License Product @7% Royalty ($)	Low α	$147,560	$157,010	$167,580	$177,030	$243,600	$254,100	$265,720	$274,120
	Nominal β	$861,700	$899,612	$937,638	$986,281	$844,756	$871,034	$897,426	$923,234
	High γ	$1,738,800	$1,780,800	$1,822,800	$1,873,200	$1,705,200	$1,741,600	$1,788,000	$1,803,200
Progress Payment Fee ($)	Conservative Case				$250,000			$250,000	
	Nominal Case		$250,000	$250,000					
	Aggressive Case	$250,000	$250,000						

terms of the license are listed in Table 2.

The licensee has good knowledge of their market and customers, but at the onset of the license, is not very knowledgeable about how to apply the licensor's intellectual property to their product line. The licensor is familiar with applying their intellectual property to different product lines but is not familiar with the licensee's market sector. Neither has a strong basis for what the final *Net Sale Price* of the product may be or the *Sales of Licensed Product* for each reporting period.

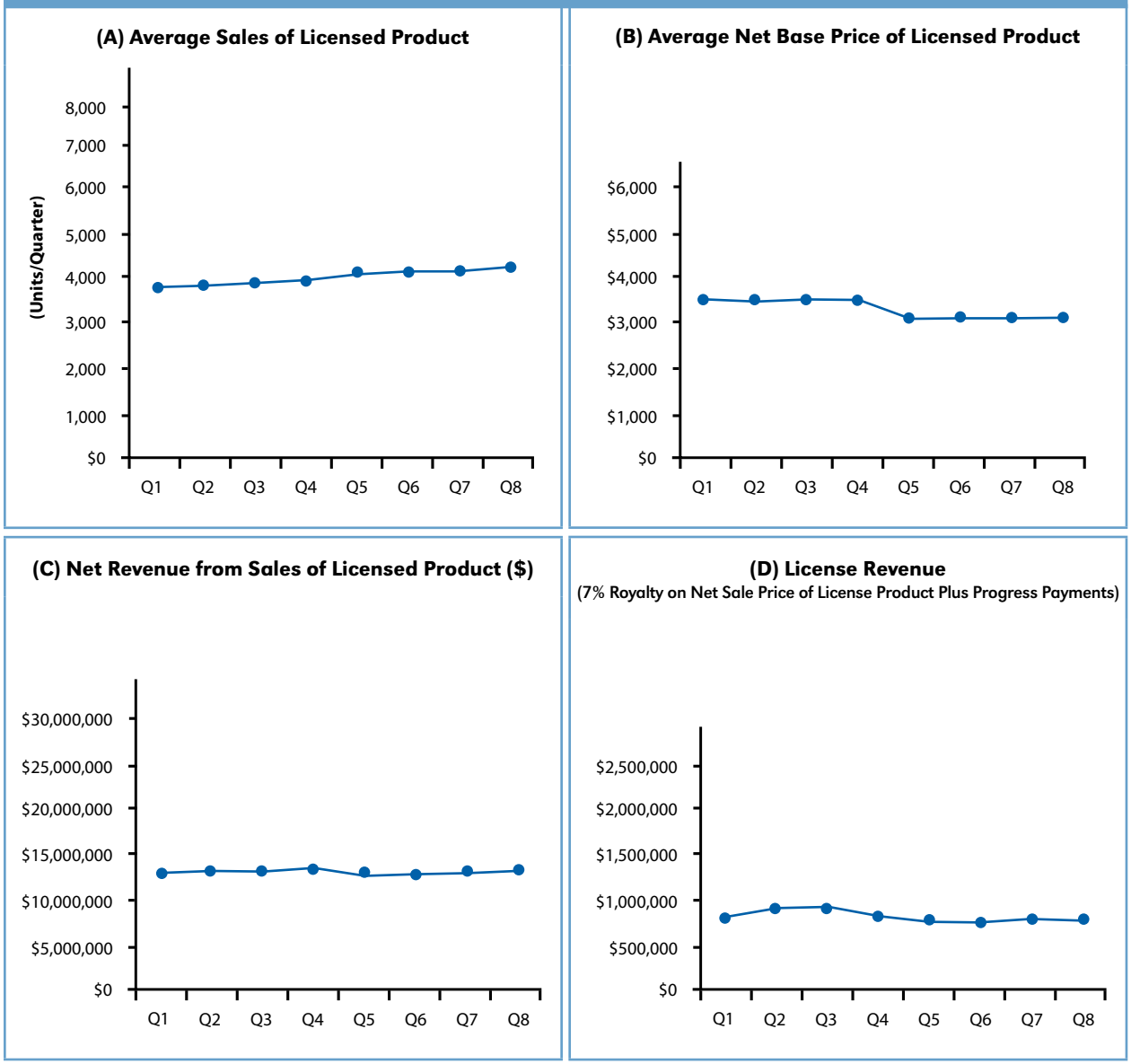
To forecast the financial performance of the license a Delphi panel was formed by members from both the licensee and licensor. The panel was asked to make forecasts concerning the *Sales of Licensed Product* and *Net Sale Price of Licensed Product* per quarter. The output of the panel is shown in Table 3.

Using fuzzy arithmetic on the fuzzy numbers supplied by the Delphi panel, the *Net Revenue from the Sales of Licensed Product* and *Royalty Revenue from Sales of Licensed Product* was obtained as well.

These values are shown in Table 5 along with the Delphi panel member averages for *Sales of Licensed Product* and *Sale Price of Licensed Products*.

In addition, the fuzzy number data was plotted to offer a visual interpretation of the data (see Figure 4).

Figure 4. Processed Forecast Data Graphs



The fuzzy bands surrounding the nominal values offer a quantitative interpretation as to the qualitative feel for the strength of the Delphi panel's average presumptions. A visual interpretation of the data can also be used as feedback to the Delphi panel as a baseline reference for any additional forecast they may make in the future.

Ideally the most efficient way to perform a Delphi forecast would be through the use of a software application. A software tool built around a Delphi process would allow each member of the Delphi panel to anonymously make forecasts for each active license for which they were a panel member. Within the application each license would be represented by the financial events defined within the license. The required financial forecasting events would be represented by separate line items that spanned all reporting periods for the license (see Figure 5). In addition, triangular fuzzy number input could be simplified by allow panel members to simply enter the number boundaries via a visual input (see Figure 6).

Conclusion

A successful revenue forecasting process based on a modified Delphi process is meant to convey the collective presumptions of a group of experts over an extended period of time. A successful process based on this method is actually a communication tool. The accuracy of the forecast it develops depends on the relative intuitiveness of the panel members about the products and markets in which they are engaged in. The modified Delphi process would be used when there is little or no historical revenue data available or the underlying financial events cannot be modeled sufficiently using inferential statistics. ■

References

[1] Armstrong J.S., ed. *Principles of Forecasting: A Handbook for Researchers and Practitioners*. Boston, Massachusetts: Kluwer Academic Publishers; 2001.

[2] Martino J P. , *Technological Forecasting for Decision Making*. New York, New York: Elsevier Science Publishing Company; 1983.

[3] Ayers, R., *Technological Forecasting and Long-range Planning*. New York: McGraw-Hill Book Company; 1969.

[4] Aisbett J., Gibbon G., Davis C., van Gelder T., Wales R., eds., "Reasoning with Numbers," *Cognitive Science in Australia*. Adelaide, Australia: Causal Productions (electronic); 2000.

[5] Linstone H., ed., Turoff M. ed., *The Delphi Method Techniques and Applications*. Newark, New Jersey: College of Computing Sciences, New Jersey Institute of Technology; 2002.

[6] Bright J., *A Brief Introduction to Technology Forecasting*. Austin, Texas: The Pemaquid Press; 1972.

[7] Kaufmann A., Gupta MM., *Fuzzy Mathematical Models in Engineering and Management Science*. Amsterdam: Elsevier Science Publishers B.V.; 1988.

[8] Buckley J., Eslami E., Feuring T., *Fuzzy Mathematics in Economics and Engineering*. Heidelberg: Physica-Verlag; 2002.

[9] Kruse A., Gebhardt J., Klawonn F., *Foundations of Fuzzy Systems*. New York: Van Nostrand Reinhold Company; 1985.

[10] Zadeh L., *Knowledge Representation in Fuzzy Logic*. Boston, Massachusetts: Kluwer Academic Publisher; 1992.

[11] McKee T., "A New Approach to Uncertainty in Business Valuations," *The CPA Journal*, 2004 April; v.74, no. 4, (April 2004): p. 46.

[12] Razgaitis R., *Technology-Based Intellectual Property*. Hoboken, New Jersey: John Wiley & Sons; 2003.

Figure 5. Forecast Application

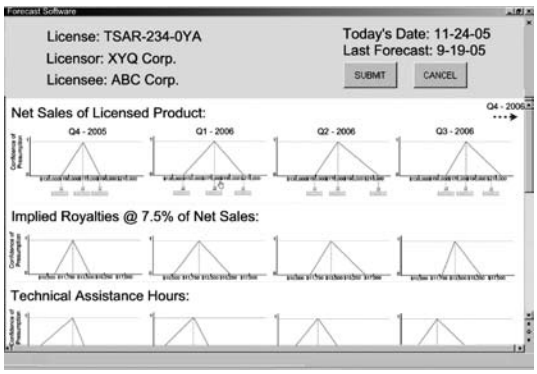


Figure 6. Triangular Fuzzy Number Input