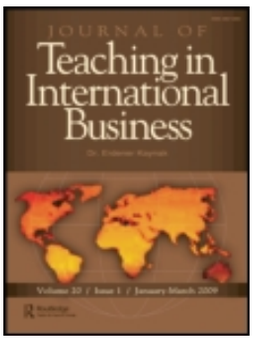

Routledge
Taylor & Francis Group

Journal of Teaching in International Business

ISSN: 0897-5930 (Print) 1528-6991 (Online) Journal homepage: http://www.tandfonline.com/loi/wtib20

Teaching the Concept of Risk: Blended Learning Using a Custom-Built Prediction Market

John Garvey & Patrick Buckley

To cite this article: John Garvey & Patrick Buckley (2010) Teaching the Concept of Risk: Blended Learning Using a Custom-Built Prediction Market, Journal of Teaching in International Business, 21:4, 346-357, DOI: 10.1080/08975930.2010.526032

To link to this article: http://dx.doi.org/10.1080/08975930.2010.526032

Journal of Teaching in International Business, 21:346–357, 2010

ISSN: 0897-5930 print/1528-6991 online
DOI: 10.1080/08975930.2010.526032

Routledge
Taylor & Francis Group

Teaching the Concept of Risk: Blended Learning Using a Custom-Built Prediction Market

JOHN GARVEY and PATRICK BUCKLEY
Kemmy Business School, University of Limerick, Limerick, Ireland

There has been much research into the role of technology in promoting student engagement and learning activity in third-level education. This article documents an innovative application of technology in a large, undergraduate business class in risk management. The students' learning outcomes are reinforced by activity in a custom-designed prediction market. The content of lectures are closely aligned to the student objectives within the prediction market, thus allowing the application of risk management practice while building knowledge through traditional delivery methods.

KEYWORDS blended learning, custom-designed prediction market, peer-to-peer learning, risk management education, Insurance Loss Market

INTRODUCTION

The education literature notes that traditional modes of delivering teaching material can disengage students' critical skills and can lead to a passive learning environment (Kinchin, Chadha, & Kokotailo, 2008). In third-level education, this is more likely to arise when subject knowledge is presented to students when the content has already been carefully selected and sequenced by their lecturer. The effective use of blended learning can lead to stronger engagement by students and produce more robust

Submitted: December 2009; first revision: March 2010; second revision: June 2010; accepted: September 2010.

Address correspondence to John Garvey, Kemmy Business School, University of Limerick, Limerick, Ireland. E-mail: john.garvey@ul.ie

learning outcomes. Blended learning is generally defined as the combination of face-to-face and technology-based learning and although the notion of blended learning is not new, the continuing development of new technologies presents diverse opportunities for teaching and learning.

In this article, an introductory module in risk management and insurance provides a case study in using prediction markets as an education tool. Risk management and insurance is a subject area that does not lend itself to extensive use of technology-based learning. In many universities currently teaching this subject area, the opportunities for students to undertake realistic decision making in a dynamic environment are still quite rare. We propose the application of prediction market technology as a methodology that encourages students to think about risk in an open and flexible way. This methodology also provides students with the necessary experience to critically evaluate and stress-test quantitative risk modeling techniques later in their academic and professional careers.

In keeping with the notion of blended learning, the prediction market structure encourages students to think about risk outside the confines of the lecture theater. The competitive nature of the market and the sparse historical information that is made available require students to explore the strengths and limitations of traditional risk management techniques. The design of the prediction market and the manner in which it was presented to students was strongly influenced by the experiences of teaching this subject area for a number of years. The design of this module was influenced by the recommendations of previous research on blended learning in practice. Consistent with the general recommendations of O'Toole and Absalom (2003), the prediction market technology is integrated into traditional communication channels and it thus reinforces progress toward the stated learning outcomes.

Our core insight is that the structure of an online prediction market can be used to create decision scenarios that allow students to evaluate and undertake decisions in an uncertain and competitive environment. This experience enriches the students' learning experience and allows students to approach traditional economic theory and risk management techniques with a fresh perspective.

At this point it is useful to briefly outline the structure of the prediction market and the context in which it was used. The prediction market, called here the Insurance Loss Market (ILM), required students to forecast the weekly Gross Property Loss Estimates incurred by the insurance firms in each of three U.S. States—California, Florida, and New York. Each student was provided with a unique code that could be used to access an online market interface. They allocated a notional amount capital to each loss prediction and their performance was linked to the accuracy of their loss forecasts. This basic structure formed a starting point for a dynamic and engaging market that reflects many of the decision-making challenges that

are observed in the insurance system. The ILM was used in an undergraduate risk management module in the 2009 Autumn Semester.[1] The module is an introduction to a specialty stream in risk management and insurance and graduates in this specialty go on to work in roles as varied as risk analysis, insurance and reinsurance underwriting, and fund management. These roles primarily require an ability to accurately identify and assess risks using historical data in a variety of quantitative risk models. Importantly, risk decision making is also influenced by the existing risk profile of the organization, the requirements of regulators, as well as pressures relating to performance.

THE NOTION OF RISK AND THE DISCIPLINE OF RISK MANAGEMENT

The economist Frank Knight (1921) defined risk as a situation where an individual is faced with unknown outcomes but where the ex-ante probability distribution is known. Decision making under conditions of uncertainty is defined by the existence on an unknown probability distribution. This importance of this distinction was widely recognized and a variety of disciplines, from psychology and sociology to economics and finance have explored decision making under conditions of risk and uncertainty. Within the education environment and business schools in particular, the constraints of time within undergraduate degree programs means that practical and technical knowledge is very often prioritized. This leaves little space for the exploration of how decisions are made in the absence of known ex-ante probability distributions.

For academics, both as researchers and as teachers, there is a recognition that effective business education at the third level should provide students with the opportunity to actively apply and evaluate decision making in an environment that closely approximates real-world decisions. A number of techniques have been developed and applied within the various business disciplines that allow students the opportunity to apply their knowledge of relevant theory in a realistic setting. Many of these approaches are applied with greatest effect in a small-group environment. However, universities are increasingly facing the challenge of dealing with class sizes that are very large (Philips, 2005). Full-time academics face many competing demands on their time that contribute to their reduced availability to students. If used effectively, information technology can deliver rich multimedia applications instantaneously to large diverse groups of students and it carries with it the ability to handle large amounts of data rapidly and efficiently. In this case study we show that with careful pedagogical design, the strengths of information technology can be applied effectively to create a dynamic environment of uncertainty that allows students to undertake decisions.

PREDICTION MARKETS AS A TOOL IN RISK MANAGEMENT EDUCATION

Outside of the educational context, a prediction market is a tool used to make forecasts about the outcome of large, complex systems. Rather than attempting to create a formalized model to evaluate an event probability, a market mechanism is used to aggregate the opinions of a diverse pool of individuals. Prediction markets have been defined as, "markets that are designed and run for the primary purpose of mining and aggregating information scattered among traders and subsequently using this information in the form of market values in order to make predictions about specific future events" (Tziralis & Tatsiopoulos, 2007, p. 75).

The application prediction market technology in business education has not been documented previously.[2] The technology is applied most effectively to large groups since it can be delivered via a website and administration such as managing user accounts; trades and forecast values are all handled by the prediction market automatically. Importantly, in a teaching and learning context, the performance of students in evaluating and trading risks within the market are assessed through an automated data download from the market. The structure of prediction markets allows students to engage in a dynamic and complex environment and it impacts on the learning experience of students in both the cognitive and affective domains. A number of other benefits arise from applying this methodology in large groups. Importantly, prediction markets facilitate problem-based learning where students learn how to apply information and to contextualize academic knowledge and theories.

In this case study, the students' participation in this dynamic and complex environment coincides with their introduction to formal ways of thinking about risk management. Because of this, the market activity provides a reference point during lectures so that students engage in dialogue and listen in an open and flexible way. The dynamic nature of the market and its direct and timely link with the course content encourages students to learn at a "deep" level. It provides them with skills that they can bring to bear in the learning process outside of the specifics of this module. Information literacy can be described as the ability to recognize when information is needed and have the ability to locate, evaluate, and use the appropriate information effectively. An individual that is information literate will be able to determine the nature and extent of information required, access the required information, and apply it in the decision-making process. The increasing importance of the information technology in the modern world and the rise of the Internet as an information source has meant that information literacy is increasingly seen as being a key skill set in the modern world (Hoffman & Blake, 2003). The dynamic complexity of the prediction market structure means that a range of information literacy skills are developed

including comprehending, analyzing, and applying information; and students are required to re-visit and update decisions as market dynamics and new information alter the environment.

CASE STUDY: THE INSURANCE LOSS MARKET (ILM)

The Insurance Loss Market (ILM) is the prediction market we created specifically for an undergraduate module in risk management. This module introduces students to the qualitative and quantitative skills required in risk assessment, risk control, and risk financing. The learning outcomes for this module are reinforced by the ILM, a customized market that creates a specific series of decision scenarios drawn from risk management and insurance. These scenarios are real-world problems that allow students to activate their skills in mathematical competency and qualitative risk assessment in real time. Specifically, students are required to predict Weekly Insured Property Losses Estimates for California, New York, and Florida.[3] The selection of these risks fulfilled a number of criteria. Primarily, they allowed a set of predictions directly related to the module content and they were also suitable for assessment and research by the students using a wide variety of information. Variation in regional insured losses is influenced by easily observed phenomena such as hurricane activity, wildfires, or subzero temperatures. With the availability of limited historical data, students were thus required to undertake decisions under conditions of uncertainty. This uncertainty was occurring within a well-understood system, where only weather-related events and earthquakes were likely to impact on State-wide insurance losses.

The ILM was live for a 10-week period from Monday, September 21st to Friday, November 20th. Each week, the market opened on Monday at 9:00 a.m. and closed on Friday at 5:00 p.m. During each 5-day period, each student was required to submit a minimum of one forecast for each of the three States. At the market close on each Friday, their forecasts were evaluated against the Gross Property Loss Estimate as notified by Insurance Data Provider, Xactware. The simplicity of the ILM interface and data provided by Xactware concealed a sophisticated process that allowed for the provision of highly accurate data at the end of each week.[4]

At the beginning of every week, Monday 9:00 a.m., each participant is provided with €5,000 in notional "risk" capital that they must allocate by predicting insured property losses in each of the three U.S. States. This is made operational by providing a series of loss bands where students can allocate their capital in the ratio they consider to be optimal. Figure 1 provides a screenshot of the ILM interface. As trading activity commences, the market dynamic will produce an expected distribution of likely outcomes as students evaluate historical information such as recent weather patterns,

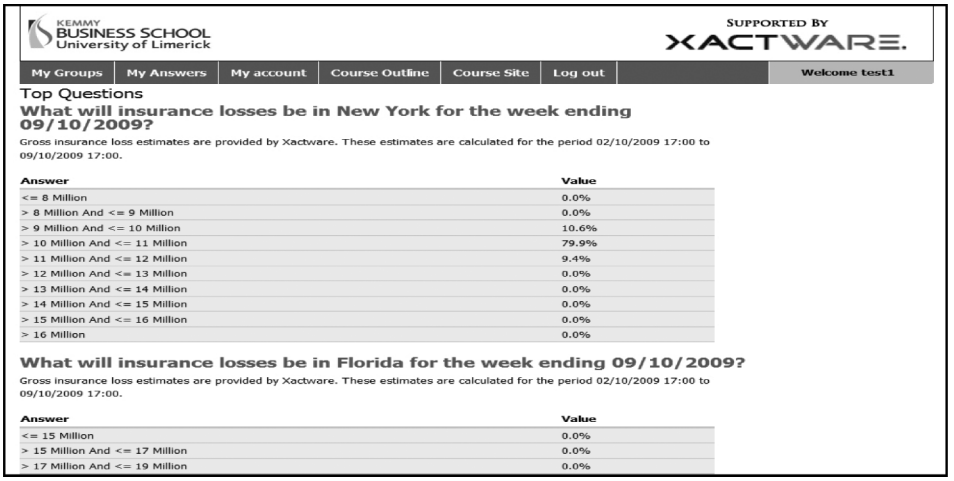

FIGURE 1 ILM Screenshot: the New York Market Is Shown; Trading Activity by Students Implies That There Is a 10.6% Probability That Losses in New York Will Be >$9 Million and ≤$10 Million for the Week Ending October 9, 2009.

insurance hazards, and loss statistics; as well as forward-looking information such as hurricane development, weather forecasts, and potential hazards such as wildfires posed by prolonged period of data. In keeping with the findings of related research into education and online learning (Krantz & Eagley, 1996), the students' activity in the ILM is thus strongly linked to the content of lectures and tutorials.

Many aspects of market activity are similar to that carried out in the insurance markets each day as insurance and reinsurance underwriters allocate, trade, and transfer insurance risks. The ILM interface makes a number of information sources available to students; these include research articles on insurance and risk management, theoretical models that are applied in risk management and forecasting, and news information on risk levels associated weather patterns. Students are also motivated to search for and submit relevant information to the website. Success in the prediction market is directly linked to the participant's understanding of the available information and their ability to evaluate its relevance in the decision-making process. This approach encourages students to develop the full range of skills associated with information literacy.

Importantly, students in the ILM are predicting events in "real time." This overcomes many of the weaknesses of alternative risk-decision methodologies used in education and industry, such as simulations using an historical event or historical asset-behavior. The type and level of activity in the market is at the discretion of each participant and the decisions they make in this regard are seen as key part of the learning process. In order to retain participation throughout the semester, ILM participants must undertake one

trade in each State each week. There is no upper limit on the number of trades they can undertake and they can continue to trade as often as they like ("buying" or "selling" risks) throughout the week until the ILM closes on Friday at 5:00 p.m. Later that day or early the following week the actual loss estimates for that trading period are received from Xactware. The closing position of each participant is reconciled against the actual loss data and is used to estimate the value of each student's portfolio, as shown in Equation 1:

$$\begin{aligned}\text{Portfolio}_A = {} & \text{Cash Balance} + (\text{Units}_{CA} \times 100) + (\text{Units}_{FL} \times 100) \\ & + (\text{Units}_{NY} \times 100)\,. \end{aligned} \tag{1}$$

The portfolio value for Participant A is calculated as the number of units they hold in the correct loss band for each U.S. State multiplied by 100 (100%) plus the cash they did not allocate. The metric for evaluating activity and decision making in the ILM places primary importance on the forecasting accuracy.

RESULTS

The primary objective of this research is to create a challenging learning environment for risk management students. This environment should encourage a more critical perspective on risk decision making and the popular quantitative techniques that are applied in practice. One of the interesting aspects of using the prediction market was the immediate change in mindset that it produced among the students taking the module in Principles of Risk Management. The simplicity of the questions and the nature of the underlying risks being evaluated facilitated immediate participation by a large proportion of the class. Assessment for the module was designed to promote a high level participation in the ILM structure.[5] The level of activity in the ILM is also revealed in Figure 2 which summarizes the average number of trades undertaken in California, Florida, and New York. We can observe that in the initial week, there were 13.12 trades undertaken by students in the California market, 12.74 in the Florida market, and 10.11 in the New York market. In the 10-week period, the average number of trades undertaken showed a marginal decrease. In the final week of the market, the average number of trades for California was 7.61 and for Florida and New York trades undertaken averaged 6.29 and 9.22, respectively. It is worth noting that throughout the entire 10 weeks, participation in the market exceeded the minimum participation limits that were set as part of the module requirement.

Students were encouraged to examine the historical loss data and explore how it could be used in their ILM decisions. An experienced risk

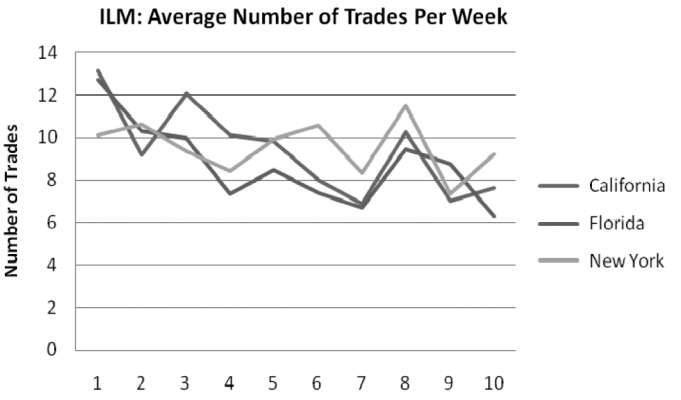

FIGURE 2 ILM Trade Volume.

management professional would immediately recognize that the historical data would provide only very crude predictive information. For those participating in the ILM, the recognition that historical data must be used carefully was learned though the interactive experience of evaluating and undertaking and reversing decisions.

As the weeks progressed and students became more familiar with the dynamic of the ILM, we reduced the width of the loss bands.[6] From the 5th week of live trading on the ILM, loss bands were held constant. This allowed us to evaluate progress in students' ability to undertake decisions and control their risk exposure. A comparison of the distinct trends in trading behavior between Figure 2 and Figure 3 demonstrates a strong learning dynamic among the student population. Figure 3 shows the average number of positions (loss bands) held within each region. We can see quite clearly that there is a strong trend among students to decrease exposure to

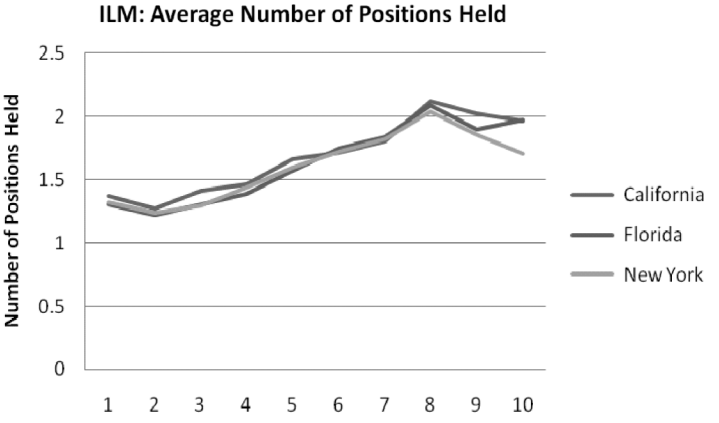

FIGURE 3 Average Number of Positions (Loss Bands) Held.

a specific loss band. This trend coincides with drop in the number of trades undertaken in each week, observed in Figure 2. This shows that students are recognizing the uncertainty of the environment and although they may use historical data as a guide, they are managing their exposure by selecting a wider range of loss bands. In this context, the fall in the number of trades undertaken by students appears to be a recognition of the difficulty in profiting by actively trading insurance exposures based on sparse information that is available to all students.

Active learning among students is demonstrated by clear behavioral shift following their recognition that early participation in the market was overconfident and risky. The increasing use of diversification as a mechanism for managing risk is one of the key outcomes from the market. Furthermore, when students are grouped according to performance, we can see that those who performed strongest over the 10-week period demonstrated the greatest engagement in overall diversification.

Weekly performance was based on the value of each participant's portfolio when the markets were resolved at 5:00 p.m. GMT each Friday as summarized in Equation 1. Figure 4 illustrates the trading behaviors of students ranked by their overall performance. Those who performed strongest, the top 20th percentile, engaged in a markedly higher level of diversification. This provides robust evidence of the validity of the ILM as a teaching methodology in risk assessment and risk management. The active learning of a group of students allowed them to outperform the market by applying simple principles of risk management that emerged through their own intuition and experience in the ILM.

Student interaction with the ILM and the continuing levels of motivation throughout the semester can be examined by looking at the number

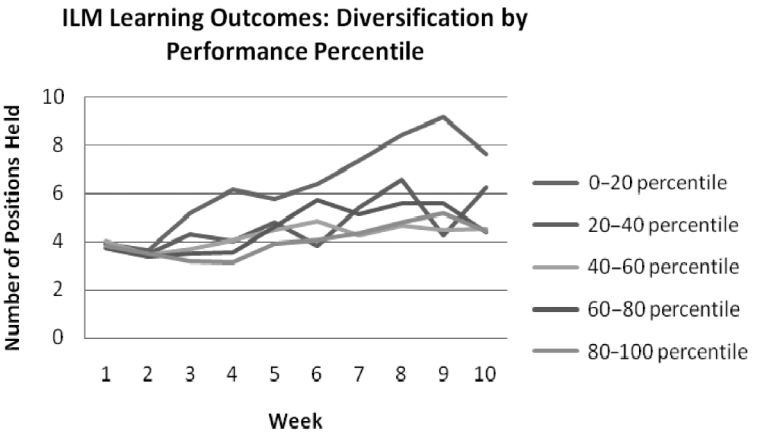

FIGURE 4 Average Number of Positions Held; Students Are Ranked and Grouped by Performance.

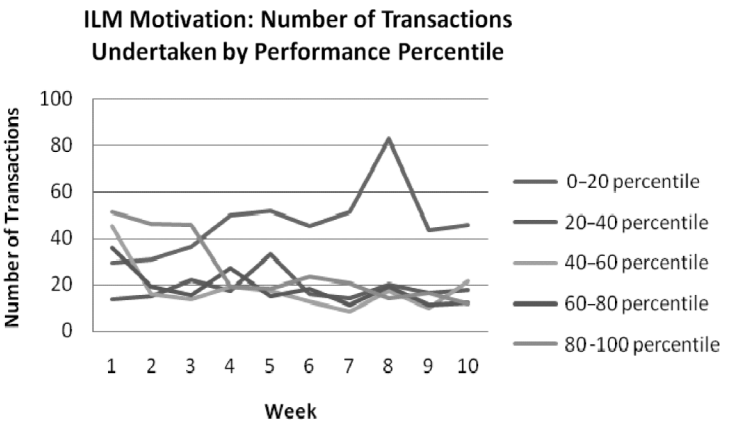

FIGURE 5 Student Motivation as Measured by the Number of Transactions Undertaken Each Week; Students Categorized by Their Overall Performance.

of transactions undertaken each week. In Figure 5 we can observe that the most successful students, those populating the top 20th percentile, traded most actively throughout the semester. Interestingly, they exhibit a degree of caution during the early weeks of the ILM, reflected in relatively moderate transaction volume. We can surmize that their early success, relative to their peers, sharpened the competitive aspect of this exercise and motivated a strong level of engagement and "deep learning." Their strong performance relative to their peers can be attributed to the internal market dynamic, that is, their understanding of how other students behave and the identification of possible repetitive trading patterns during the week. In addition, the performance of the top 20th percentile can be distinguished by its sensitivity to external events that are relevant to the underlying risks. This is reflected most markedly in the heightened activity among top performers following an unseasonal and severe snowstorm in New York State in Week 8. These findings are a useful insight into motivation and ability and the role of technology in measuring and mapping these two variables.

CONCLUSIONS

Based on the evidence described in this article, the application of prediction market technology can be used to positive effect in business education. Students learn to apply statistical tools in measuring risk in an interactive and competitive environment. The dynamic created by the prediction market increases the level of peer-to-peer communication and becomes

a real demonstration of the application of statistical tools in a dynamic environment.

This case study demonstrates a high level of student participation in the prediction market. More importantly, student activity in trading and evaluating insurance risks became more sophisticated as the teaching semester progressed. The findings from this research encourage greater development of this technology in a business educational setting. Prediction markets can be easily adjusted to facilitate learning objectives in other business disciplines, particularly finance and economics where the underlying asset can be tailored to the appropriate discipline. An example of a prediction market in international economics could require students to evaluate future changes in foreign exchange rates or expected amendments to international trade regulations. Furthermore, prediction market technology can allow students from different universities to participate and compete on the same platform. The model described here could be easily extended to include U.S. or other European students studying risk management. This would allow students to gain a more outward perspective on the global nature of trade and communication while also learning important aspects of their core discipline.

NOTES

1. The Principles of Risk Management was taken by 430 business students at the Kemmy Business School, University of Limerick in the Autumn Semester 2009. This is an introductory module in the specialty stream in Risk Management and Insurance that is available as part of the general business degree.

2. Prediction market platforms can be purchased from a number of commercial providers such as QMarkets. Pricing is dependent on the length of time the platform is required and the number of registered users on the platform. In this application, the charge for the use of the prediction market platform was €1,500 for a period of 12 weeks for 430 participants.

3. The insurance loss data is generated by the U.S. firm, Xactware. Xactware provides data to the insurance industry and they provided this data without charge, given the innovative nature of the project. Xactware has indicated that they are willing to engage with other Universities who are willing to develop similar approaches in risk management education.

4. The methodology used to generate these insurance loss estimates may be of interest to risk management professionals or academics. Details of the process flow can be obtained from the authors or directly from Xactware.

5. Twenty-five percent out of the total marks in Principles of Risk Management were assigned to the ILM part of the module. Marks were assigned on a weekly basis with a total of 8 marks available for participation (minimum of 1 transaction in each insurance region); 9 marks for performance relative to peers [max 9 marks (top 20% finish, relative to peers) and declining by 1 mark for 10% bands]; also, a maximum of 8 marks were available for a one-page report on their decision-making behavior in the ILM.

6. Changes to loss bands were initiated in California in Week 4 where bands were reduced from \$5 million (e.g., losses will be $\geq$\$10 million & $<$\$15 million) to \$1 million (e.g., losses will be $\geq$\$10 million & $<$\$11 million). Narrower bands were applied to all States by Week 5 and remained narrow for the remaining 5 weeks of live trading.

REFERENCES

Hoffman, M., & Blake, J. (2003). Computer literacy: Today and tomorrow. *Journal of Computing Sciences in Small Colleges, 18*(5), 221–233.

Kinchin, I. M., Chadha, D., & Kokotailo, P. (2008). Using Powerpoint as a lens to focus on linearity in teaching. *Journal of Further and Higher Education*, *32*(4), 333–346.

Knight, F. H. (1921) *Risk, uncertainty, and profit*. New York, NY: Houghton Mifflin Company.

Krantz, J. H., & Eagley, B. M. (1996). Creating psychological tutorials on the World-Wide Web. *Behaviour Research Methods, Instruments and Computers*, *28*, 156–160.

O'Toole, J. M., & Absalom, D. J. (2003). The impact of blended learning on student outcomes: Is there room on the horse for two? *Journal of Education Media*, *28*, 2–3, 179–190.

Philips, R. (2005). Challenging the primacy of lectures: The dissonance between theory and practice in university teaching. *Journal of University Teaching and Learning Practice*, *2*(1), 1–12.

Tziralis, G., & Tatsiopoulos, I. (2007). Prediction markets: An extended literature review. *The Journal of Prediction Markets*, *1*, 75–91.