AMS-IMS-SIAM Joint Summer Research Conference on Mathematics of Finance

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AMS-IMS-SIAM Joint Summer Research Conference in the Mathematical Sciences: Mathematics of Finance was held in Snowbird, Utah, June 22–27, 2003. This was the first ever conference on mathematics of finance jointly sponsored by AMS, IMS, and SIAM. The organizing committee consisted of Wendell H. Fleming (Brown University), Jean-Pierre Fouque (North Carolina State University), George Papanicolaou (Stanford University), Bozenna Pasik-Duncan (University of Kansas), Stanley R. Pliska (University of Illinois at Chicago), Ronnie Sircar (Princeton University), George Yin (Wayne State University, Co-chair), and Qing Zhang (University of Georgia, Co-chair). It was supported in part by the National Science Foundation.

The field of financial mathematics is rapidly expanding. It involves a wide spectrum of techniques that go far beyond the traditional applied mathematics; research in mathematics of finance has witnessed tremendous progress in recent years. Stochastic calculus, dynamic programming, and partial differential equations have become indispensable tools to finance– a discipline that previously relied on "... a collection of anecdotes, rules of thumb, and shuffling of accounting data ..." (see [1]). As a major impetus to the development of financial management and economics, the research in mathematics of finance has had a major impact on the global economy. On the other hand, the applications require and stimulate many new and exciting theoretical discoveries. Moreover, the development of mathematics of finance has created a large demand for mathematics graduates at both Master and Ph.D. levels in the financial industry, resulting in the introduction of this topic in the curriculum of mathematical sciences departments of many universities.

Such a rapid progress creates the need for new forms of communication and networking among researchers in different disciplines. The conference brought together researchers from mathematical sciences, finance, economics, engineering, and financial institutions to review and to update the recent advances, and to identify future directions of mathematics of finance. The five-day event attracted over sixty attendees. One of the distinct features of the conference was its international character. The participants were coming from Australia, Canada, England, France, Germany, Hong Kong, Italy, Japan, Poland, and the United States. Another distinctive feature of the conference was interdisciplinarity. A multitude of different disciplines were represented including stochastic control, probability and stochastic

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processes, finance, economics, scientific computing, and statistics. A number of prominent figures and leading experts in the mathematics of finance and financial engineering participated in the conference. Established researchers, recently graduated Ph.D.'s, and graduate students were all well represented in the meeting.

The scientific program of the conference consisted of 8 plenary talks (the speakers including Robert Elliott (University of Calgary), Wendell Fleming (Brown University), Thaleia Zariphopoulou (University of Texas, Austin), Steve Shreve (Carnegie Mellon University), Stanley Pliska (University of Illinois, Chicago), Chris Rogers (Cambridge University), Wolfgang Runggaldier (Universita of Padova), and Bozenna Pasik-Duncan (University of Kansas)) plus 34 invited talks, a poster session, and a panel discussion on research and education. While recent progress has been surveyed, reviewed, and substantially updated, new ideas, methods, models, and techniques have been explored. The invited speakers presented a spectrum of problems, models, and results involving modeling, estimation, optimization, control, risk assessment and management, contingent claim pricing, dynamic hedging, and financial derivative design. Valuation of contingent claims remains the centerpiece of modern financial theory. Its key components include financial market modeling and dynamic hedging. While the Black-Scholes models have been widely used in characterizing movements of financial markets for decades, it has been recognized that their utility is limited because it assumes deterministic rates of return and volatility, and because it ignores many aspects of the markets including transaction costs, liquidity and tax issues. In the past few years, various attempts (including stochastic volatility, jump diffusions, and hybrid market models) have emerged to modify and generalize the Black-Scholes models. Optimal portfolio management uses a stochastic control approach. Originated from Merton's pioneering work, it continues to have an important role in finance theory. The objective is to allocate financial assets dynamically among risky and fixed-income investments with the goal of maximizing expected overall return of consumption measured by some utility function. A closed form solution is possible only for the simplest models. Typically, optimal investment and consumption control policies must be found by solving a partial differential equation of Hamilton-Jacobi-Bellman type. However, nonlinearities make numerical implementations quite difficult, and efficient schemes are sorely needed. Other issues adding to the difficulty of this effort concern mathematical model selection and choice of utility function. Financial risk management has attracted growing attention in recent years. Such devastating events as the Long-Term Capital Management default and the Enron bankruptcy shook the financial world. They have indicated clearly that there is an urgent need for further research on corporation credit risks as well as the possibility to hedging these risks using financial derivatives. As a result, one of the emerging research topics is the study of credit risk management.

Because of the large number of exceptional high quality talks, the scheduling of the program was somewhat intensive. Even so, the schedule still allowed the participants to have ample time for discussion and exchange of ideas. A number of people used this opportunity to continue existing collaborations; some new and potential collaborations have also been formed.

It has been recognized by the attendees that it is important for academic researchers to understand practical issues when one models financial markets under uncertainty. To serve the current and future needs, effort must be given to bridge the gap between theory and applications, and to facilitate the communication between researchers from academia and

industry. One of the many highlights of the meeting was the panel discussion on the state of financial mathematics in academia and in industry. The structure of the panel was pretty standard: Each panelist gave a short presentation before the chair turned to the audience for questions. Nicole El Karoui (Ecole Polytechnique, Paris) and Wolfgang Runggaldier (University of Padova, Italy) reported on the French and Italian experiences, respectively, while Chris Rogers (Cambridge University) challenged the participants to seek interactions with colleagues in their Economics Departments. Even though his concerns may not be shared by some members of the financial community, Marek Musiela (Director of Fixed Income Research, BNP/Paribas, London) reminded the participants of divergence of research directions in academia and industry. A good part of the discussion gravitated around the student growing appetite for practical training in financial applications, and the steady growth of the number of professional programs in financial mathematics and financial engineering. René Carmona, Chair of the panel, emphasized the dangers of letting the desire to train students for a particular career overshadow the important responsibility that academia has to educate and prepare the students for a wide variety of research challenges, both in industry and academia. Our responsibility is to see beyond the short term fluctuations of the market place demands. He also added that one of the major issues in the current dismal job market, is the unrealistic expectations of the students seeking these professional degrees. There is still a strong demand for Ph.D. level quants, but the delicate question remains: Did we already saturate the financial job market with narrowly trained Master graduates? This concern was echoed by Marek Musiela who stressed the need for a broad and solid education. Addressing the difficulties created by the current state of the economy, Tyrone Duncan (University of Kansas) suggested the insurance industry as a safe alternative while investment banking is failing the graduate of the current masters in financial mathematics. The debates was extremely lively; the discussion lasted two hours until the dinner bell.

"June Snow" is used in Chinese to describe something that is exceptionally rare. Nevertheless, such a rare event is not all uncommon in Snowbird. During the meeting, there were heavy snow falls for two days. Although the weather was unseasonably cooler than normal, the participants enjoyed very much the snow in June and the natural beauty of Snowbird. In addition to participating in the stimulating meeting and discussions, the participants found time to do some hiking.

This year is the first time that AMS, IMS, and SIAM use Snowbird resort as the Summer Conference site. All the participants are grateful for the superb support of the AMS personnel and for the hospitality of the hotel management; they are very happy about the high quality of the service provided. A hospitality room was provided to the attendees during the conference for after-hour gathering, conversations, and social and scientific exchanges. The conference started on Sunday morning, while most people arrived on Saturday afternoon or evening. A welcome reception was given on Sunday night and a banquet was held on Wednesday night with an after-dinner speech given by Stanley Pliska on historical notes of mathematics of finance from Bachelier to the 1970's.

Overall, this conference provided an excellent and timely opportunity for mathematical scientists, researchers, scientists, and practitioners. Today's financial research predicts tomorrow's financial practice (see [1]). To inherit the past and to usher in the future, we see unprecedented challenges and opportunities. It is conceivable that this successful conference will have significant impacts on the new directions of research in the mathematics of finance.

In any case, it can be anticipated that it will continue to stimulate the research progress in mathematics and other areas of mathematics for years to come.

References

[1] J. Case, Robert Merton delivers Block Community Lecture, *SIAM News*, vol. **37** No. 7, 1998.