DIRECTED RISK RESEARCH PROPOSAL

Risk Theme	Market Risk

Client Info: *(only applicable if proposal is in response to a client problem statement)*

Problem Title	Efficient, practical methods for pricing and risk-managing derivatives in dynamic markets.		
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University	UP	**Classification**	Restricted
Problem Nr.	PS15014	**Type**	Technology-Pull
Proposal Nr.	RP15023	**Date**	3 August 2015

PROJECT TITLE: Incorporating dynamic volatility surfaces in risk management applications using a principal component analysis (PCA) methodology with Monte Carlo simulation

PROJECT GOAL:

Extend risk management methodology realistically by using PCA combined with Monte Carlo simulation.

PROJECT SCOPE

Monte Carlo simulation has become the standard framework for valuing and risk managing large derivative books in practice, due to the recent rise of available computing power as well as the lack of analytical tractability for a range of exotic derivatives. Within this framework, there exists many competing stochastic and deterministic valuation models, with particular models suiting particular types of derivatives. Literature in both areas is vast, ranging from the computational through to the highly mathematical. Within both deterministic and stochastic frameworks an implied volatility surface is assumed known at the outset and is either used directly within the simulation or in the calibration of a stochastic volatility process. The use of a given surface or stochastic process embeds certain

volatility dynamics within the simulation process. However, these dynamics are assumed constant throughout the entire simulation. In practice, a volatility surface is generally neither constant in value nor static throughout the life of a derivative. A simulation framework, particularly for the generated paths that show significant deviation should incorporate this change in surface dynamics. In this research, we propose using Principal Components Analysis (PCA) to uncover the number and form of shocks which drive the deformation of the volatility surface over time

PROJECT OBJECTIVES

A time- series model linked to moves in the underlying asset is suggested for the retained PCA components. We incorporate this model into the general simulation framework, thus inducing a dynamic volatility surface which can be used to replace the deterministic volatility surface or recalibrate stochastic process parameters. Time-based, delta-based and underlying-asset-based implemented is tested for a range of vanilla and exotic derivatives. Our hypothesis is that intra-period portfolio values, downside risk statistics such as VaR and Expected Shortfall, and certain derivative Greeks will be significantly affected.

RESEARCH OUTPUTS / DELIVERABLES

PUBLICATIONS:	**Name(s) / Title(s)**
Articles	1
STUDENTS:	**Name(s) of Student(s)**
Ph.D.	
OTHER:	

APPROACH TO BE FOLLOWED

1) Study relevant literature
2) Implement data analysis and coding for simulation
3) Examine practical risk management reports and compare with traditional results.

STRATEGIC VALUE TO DIRECTED RISK RESEARCH

This research will contribute to practical risk management methodology and extend the literature combining PCA and simulation based analysis.