

Risk Measurement (ACTSC 991) – Part two: implied dependence measures for equity markets

Content of the course and course material

In the second part of the course, I (Daniël Linders) will consider the problem of measuring dependence between equity prices using derivative prices. Although the theory is more general and can be applied in other fields, the focus will be on financial markets (equity + options) and its particularities.

Having a notion about today's dependence structure between stock prices is of utmost importance because it gives market participants the opportunity to take the necessary, cautionary, actions. However, today's dependence model may be inappropriate for tomorrow. Indeed, dependence between risks changes randomly over time and therefore, it is a hard task to determine dependence using historical data. Indeed, such approach results in a backwards looking dependence measure and is only a good proxy if the future is sufficiently similar to the past.

In a first part, we consider the pricing and hedging of **index options**. These exotic derivatives are very similar to a European vanilla option, but now the underlying is a linear combination of stock prices. Therefore, pricing and hedging involves modeling the dependence between the stock prices involved. We consider a model-free and a model-based approach to tackle this problem.

In a second part, we develop a new approach to extract the **implied dependence** between equity prices using traded vanilla and index options. The resulting implied dependence measures are forward looking. Moreover, by using prices of traded options, up-to-date market information is included in the estimates and we avoid working with past data which may not be relevant for the future. Our approach is closely related to the approach proposed by the CBOE for the calculation of the well-known Implied Volatility Index (VIX).

- Risk ordering and the theory of comonotonicity.
- Pricing index options in the multivariate Black & Scholes model.
- Pricing index options in a model-free way.
- The implied Black & Scholes volatility and correlation.
- The Herd Behavior Index: A model-free measure for the implied degree of dependence.

Slides will be provided for each lecture. These slides are based on the course notes:

- Dhaene, J. & Linders, D. (2015) 'Measuring co-movement using index options'.

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Evaluation

The evaluation will be based on an assignment which can be made in groups (max 2 persons) and a regular exam. Both parts count for 50% of the total of the second part of this course.

Planning

Below I provide a provisionally schedule for the second part of this course.

Lecture	Content
1 + 2	Arbitrage pricing, the multivariate Black & Scholes model and risk ordering
3	Comonotonicity
4 + 5	Pricing index options in the multivariate Black & Scholes model
6 + 7	Pricing index options in a model-free way
8 + 9	Implied volatility and correlation in the Black & Scholes model
10 + 11	Model-free measures for implied volatility and implied herd behavior.