

Examination: 20041 – Risk Controlling
Examiner: Prof. Dr. Peter Reichling
Time available: 60 minutes

Summer Semester 2011

Aids permitted: non-programmable pocket calculators; English dictionaries without any markings. The examination consists of **three** problems. All of them are to be solved. Answers must be given in **English**. **Good luck!**

Examination Questions (60 Points Total):

Problem 1 (Value at Risk of a Binary Option – 19 Points)

There is a long position in 5,000 asset-or-nothing European put options on stock X with strike price \$45 and maturity four months. Stock X has a current price of \$50 and a volatility of 22%. The (discretely compounded) risk-free interest rate equals 3.562% p.a. Using the Black-Scholes model, the price of an asset-or-nothing put, P^{AoN} , can be computed as:

$$P^{AoN} = S \cdot N(-d_1)$$

- a) Compute the option's delta and gamma. (12 points)
- b) Compute the option's volatility using the following assumptions: the stock price is the only relevant risk factor; there is a quadratic relation between the change in the stock price and the change in the value of the option; the change in the stock price is normally distributed with a mean of zero. (5 points)
- c) Use your results of part (b) and the Black-Scholes formula to compute the value at risk of the bank's total position in dollars for a period of 5 trading days (assume 250 trading days per year) and a confidence level of 97.5%. (2 points)

Problem 2 (Loan Valuation – 20 Points)

The assets of a corporation are worth \$4 million. The expected (continuously compounded) return on assets is 12% p.a. whereas the volatility of total assets amounts to 25%. Four years ago, a loan was raised at bank A . This loan was issued as a zero bond with a maturity of seven years and a repayment of \$2.5 million. There is no further debt. Neither further equity or debt issuance nor dividend payments or share buy-backs are planned. Bank A would like to transfer the loan to bank B . The current term structure of (continuously compounded) interest rates is:

Maturity	1 year	2 years	3 years	4 years	5 years
Spot Rate	1.59% p.a.	1.80% p.a.	2.03% p.a.	2.21% p.a.	2.33% p.a.

- a) How can the loan and the equity of the corporation be described and illustrated in a pay-off diagram as a portfolio of default-free bonds and options? (7 points)

- b) Which amount does bank *A* receive from bank *B* if both value the loan according to Merton's (1974) model? What is the value of the equity of this corporation? What is the required rate of return of bank *B*? Interpret this rate of return in comparison to the appropriate spot rate. (8 points)
- c) Compute the default probability of this loan as well as its expected loss (in dollars as well as a fraction of the principal). (5 points)

Problem 3 (General Questions – 21 Points)

The following multiple choice part consists of seven questions. For each question, four answers are given, but only one answer is correct. You are allowed to clearly indicate your answers on this sheet. Every correct answer yields 3 points; for every incorrect answer 1 point will be subtracted. In case you do not answer a question, 0 points are given. Note: the total number of points for this problem cannot be negative.

- (1) According to the Basel II framework, total capital requirement is calculated as at least (RWA stands for risk-weighted assets):
 - (a) $0.08 * (\text{credit risk RWA} + \text{market risk RWA} + \text{operational risk RWA})$
 - (b) $0.08 * (\text{credit risk RWA} + \text{market risk RWA})$
 - (c) $0.08 * (\text{credit risk RWA})$
 - (d) none of the above
- (2) A calculation error in the option pricing model represents
 - (a) a credit risk event.
 - (b) an operational risk event.
 - (c) a market risk event.
 - (d) none of the above.
- (3) The value at risk of a portfolio for a period of 10 trading days and confidence level of 99% is computed to be \$10 million. How is this value to be interpreted?
 - (a) The loss on the portfolio will exceed \$10 million only in 1% of all cases in the next 10 days.
 - (b) The maximum loss on the portfolio within the next 10 days will not exceed \$10 million.
 - (c) The portfolio will lose \$1 million per day within the next 10 days.
 - (d) None of the above.

- (4) Consider the following bond portfolio: present value €5.000; duration 6 years; interest rate volatility 15%; term structure 2% (flat). What is the value at risk of this bond position for 10 days (assume 250 trading days) and a confidence level of 99%?
- (a) €41.12
 - (b) €6.85
 - (c) €41.94
 - (d) none of the above
- (5) Which of the following statement about rating accuracy is correct?
- (a) The cumulative accuracy profile is obtained by plotting cumulative hit rates against cumulative false alarm rates.
 - (b) The area under curve is always smaller or equal to the corresponding accuracy ratio.
 - (c) If rating function A has a higher accuracy ratio than rating function B , it follows that A possesses discriminative power.
 - (d) None of the above.
- (6) Which of the following statements about the Sortino ratio is correct?
- (a) The Sortino ratio is only an appropriate performance measure in case of normally distributed rates of return.
 - (b) The Sortino ratio measures the excess return over a specified target per unit of downside risk.
 - (c) The Sortino ratio measures the excess return over a specified target per unit of systematic risk.
 - (d) None of the above.
- (7) Which of the following assumptions does not belong to the assumptions of the Merton model:
- (a) Capital markets are complete.
 - (b) Capital markets are arbitrage-free.
 - (c) Company's rates of return are normally distributed.
 - (d) All of the above assumptions belong to the assumptions of the Merton model.

Standard Normal Distribution Function for Non-negative Arguments

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7034	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9983	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000