Examination: 20041 – Risk Controlling **Summer Term 2009**

Examiner: Prof. Dr. Peter Reichling

You are welcome to use non-programmable pocket calculators as well as English language dictionaries without any markings. This examination comprises 3 problems (on 4 pages). All of the problems are to be solved. Derivations of the formulas from the lecture or the exercise are **not** required.
Good luck!

Examination Questions (Total Number of Points: 60)

Problem 1. (Stochastic Dominance – 17 points)

The random future return of stock A, R_A, has the following cumulative distribution function:

$$F_A(r) = \begin{cases} 0 & ,r < -10\% \\ 8 \cdot r + 0.8 & ,-10\% \leq r < -5\% \\ 0.4 & ,-5\% \leq r < 5\% \\ 8 \cdot r & ,5\% \leq r < 10\% \\ 0.8 & ,10\% \leq r < 15\% \\ 4 \cdot r + 0.2 & ,15\% \leq r < 20\% \\ 1 & ,r > 20\% \end{cases}$$

The density function of the random future return R_B of stock B is given as follows:

$$f_B(r) = \begin{cases} \frac{20}{3} & ,-5\% \leq r < 10\% \\ 0 & ,\text{otherwise.} \end{cases}$$

(a) Compute and write down the cumulative distribution function of stock B's random future return R_B (2 points). Plot the cumulative distribution functions $F_A(r)$ and $F_B(r)$, respectively, in the same diagram (5 points).

(b) Does stochastic dominance of

(i) first,

(ii) second

order exist? If so, which cumulative distribution function dominates the other? Justify your answers. (6 points)

(c) Assuming rationality of investors according to BERNOULLI's principle of expected utility maximization, do investors exist who prefer stock A to stock B and who are

(i) "greedy" (strictly positive marginal utility),

(ii) risk-averse (strictly positive and strictly decreasing marginal utility)?

Justify your answers. (4 points)

Problem 2. (Ratings-Based Approach – 11 points)

A company plans to issue a coupon bond with a maturity of two years, a volume of 1 million €, issue price and repayment at par, and annual coupon payments. The company has been rated by a rating agency prior to the issue and got a rating of B, which corresponds to a default probability during a time interval of one year of 15 %. The rating assigned to the company is valid for a time period of two years. The expected recovery rate in case of default applies to the sum of one coupon payment and the principal owed and it equals 60 %.

The current term structure of interest rates is:

Maturity t in years	1	2
Spot rate r_t in % p. a.	3	4

(a) What coupon payment (at least) has to be chosen by the company to place the bond at the market if investors are assumed to be risk-neutral? (5 points)

(b) Compute the yield to maturity of a credit risk-free coupon bond (by using the data from part (a)) with maturity of two years. (3 points)

(c) How large is the credit spread? Is the true (realistic) credit spread larger, smaller or equal to the one computed? Justify your answer. (3 points)

Problem 3. (General Questions – 32 Points)

The following multiple choice part comprises eight questions. For each question, four answers are given, but only <u>one</u> answer is correct. You are allowed to (clearly) indicate your answers on this sheet. Every correct answer yields 4 points, every incorrect answer yields -2 points. If you do not answer a question, you will get 0 points. However, the total points for this problem cannot be negative.

(a) Consider a stock portfolio comprising of n stocks. The number of parameters that have to be estimated for the computation of the value at risk under the variance-covariance model (VCM) and the diagonal model (DM) are:

(i) VCM: $2n + 1$, DM: $\frac{n^2+n}{2}$

(ii) VCM: $2(n + 1)$, DM: $\frac{n^2}{2} + n$

(iii) VCM: $\frac{n^2+n}{2}$, DM: $2n + 1$

(iv) VCM: $n^2 - n$, DM: $\frac{2n+1}{2}$

(b) Consider a bond portfolio with the following parameters. Present value: 10.000€, duration: 5, interest rate volatility: 10 %, term structure: 5 % (flat). What is the value at risk of this bond position for 10 days (assume 250 trading days per year) and a confidence level of 99 %?

(i) 1,754.31€

(ii) 116.50€

(iii) 22.19€

(iv) 110.95€

(c) Which of the following statements is not an assumption for the value at risk computation of a forward contract (according to a simplified delta-normal method)?

(i) Changes in the price of the underlying are the only relevant risk factor (interest rate risk is neglected).

(ii) Change of the risk factor is lognormally distributed with a mean of zero.

(iii) Changes of the risk factor within different time periods of equal length are identically distributed with a covariance of zero.

(iv) There is a linear relationship between the change in the risk factor and the change in the value of the forward contract.

(d) Which types of risks have to be backed by equity according to Pillar I of the Basel II-capital requirements?

(i) Credit risk, market risk, operational risk

(ii) Credit risk, market risk, unsystematic risk

(iii) Credit risk, unsystematic risk, operational risk

(iv) Unsystematic risk, market risk, operational risk

(e) The rating function of rating company A exhibits an area under curve value of 0.624. The rating function of rating company B exhibits an accuracy ratio of 0.248. Which of the rating functions exhibits a higher discriminative power?

(i) A has a higher discriminative power.

(ii) B has a higher discriminative power.

(iii) More information is needed for a decision.

(iv) Both rating functions have the same discriminative power.

(f) Suppose we have a subordinated loan with a zero bond structure and a (positive) face value of $K_2 - K_1$. According to the MERTON model, which of the following duplication portfolios does **not** describe the payoff structure of the above described loan?

(i) Long call with strike K_1 and a short call with strike K_2.

(ii) Long stock position, a short zero bond position with face value K_1, a long put with strike K_1, and a short call with strike K_2.

(iii) Short stock position, a long zero bond position with face value K_2, a short put with strike K_1, two long calls with strike K_1, and a short call with strike K_2.

(iv) Short put with strike K_2, a long put with strike K_1 and a long zero bond with face value $K_2 - K_1$.

(g) Suppose the whole stock market only consists of two stocks A and B with expected returns $E(R_A) = 0.07$ and $E(R_B) = 0.1$. The corresponding volatilities are $\sigma_A = 0.15$ and $\sigma_B = 0.25$. Assume that short selling is not allowed, what is the shortfall probability of the optimal portfolio according to the ROY criterion given a target of 4 %?

(i) 20 %

(ii) 16 %

(iii) 84 %

(iv) 80 %

(h) Downside expectation equals which of the following lower partial moments?

(i) LPM_0

(ii) LPM_1

(iii) LPM_2

(iv) An asset-weighted combination of LPM_0 and LPM_1

Distribution Function N(x) of the Standard Normal Distribution for Non-negative Arguments x

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