OULUN YLIOPISTO
UNIVERSITY of OULU

YLIOPISTOTENTTILOMAKEPOHJA / UNIVERSITY EXAM TEMPLATE

Koskee tiedekuntia LuTK, OyKKK, KaTK, TTK, TST ja BMTK (Linnanmaan tentit) /
Concerns Faculties SCI, OBS, OMS, TECH, ITEE and BMM (Linnanmaa campus)

2.11.2015	
Tiedekunta / Faculty:	**Oulun yliopiston kauppakorkeakoulu**
Opintojakson koodi, nimi ja tentin numero / The code and the name of the course and number of the exam: 721957S Fundamentals of Finance	
Tentaattori(t) / Examiner(s): **Jukka Perttunen**	**Sisäinen postios. / Internal address:**

Sallitut apuvälineet / The devices allowed in the exam:

☒ Nelilaskin / Standard calculator
☒ Funktiolaskin / Scientific calculator
☒ Ohjelmoitava laskin / Programmable calculator
☐ Muu materiaali, tarkennettu alla / Other material, specified below:

Tenttiin vastaaminen / Please answer the questions:

☒ Suomeksi / in Finnish
☒ Englanniksi / in English

Kysymyspaperi on palautettava / Paper with exam questions must be returned:

☐ Kyllä / Yes
☒ Ei / No

1. Probability density function $f(x) = \frac{3x^2}{8}$ describes the relative likelihood of the random variable x within the range from $x = 0$ to $x = 2$.

   a) Show that the total probability between $x = 0$ and $x = 2$ equals to one.

   b) Determine the expected value of x.

   c) Determine the variance of x.

   d) Determine the probability $P(x \geq 1)$.

2. Asset price S follows Geometric Brownian Motion with the expected return of $\mu = 0.12$ and the volatility of $\sigma = 0.40$. The current asset price is 10 euros.

   a) Determine the expected asset price at the end of a one-year period.

   b) Determine the standard deviation of the asset price at the end of a one-year period.

   c) Determine the probability that the asset price is at or above 10 euros at the end of a one-year period.

3. Three stocks together form a tangent portfolio corresponding to the risk-free rate of 3%. The weights of the three stocks in the tangent portfolio are $w_1 = 0.472$, $w_2 = 0.286$, and $w_3 = 0.242$, and the stocks trade currently at $S_1 = 11.80$, $S_2 = 8.25$, and $S_3 = 14.40$. The expected return and the volatility of the tangent portfolio are 12.5% and 28.4%, respectively. Suppose that you create an efficient portfolio, worth of one million euros, at the expected return level of 8.7%.

   a) Determine the amount of cash invested in the risk-free asset.

   b) Determine the volatility of the portfolio.

   c) Determine the number of shares of asset #1 in the portfolio.

4. The realized daily return of an asset is 2.25%. Correspondingly, the realized daily market return is 1.00%. The parameters of the market model $R_{it} = \hat{\alpha}_i + \hat{\beta}_i R_{mt} + \epsilon_{it}$ are estimated over the preceding 500-days period, and are $\hat{\alpha}_i = 0.0001$ and $\hat{\beta}_i = 1.4000$.

   a) Determine the daily market-adjusted abnormal percentage return.

   b) Determine the daily risk-adjusted abnormal percentage return.

5. The table below contains the expected free unlevered cash flows of a firm over a period of six years. The growth rate of the cash flow is expected to stabilize at a constant level 8%. The required rate of return on assets is 10% in terms of annual compounding. Determine the value of the firm.

Year	2016	2017	2018	2019	2020	2021
Unlevered free cash flow	100.00	111.60	122.75	132.80	143.42	154.90

$$y = f(x) = ax^n \qquad y' = f'(x) = \frac{dy}{dx} = anx^{n-1}$$

$$y = f(x) = ae^x \qquad y' = f'(x) = \frac{dy}{dx} = ae^x$$

$$y = f(x) = a\ln x \qquad y' = f'(x) = \frac{dy}{dx} = \frac{a}{x}$$

$$y = f(x)g(x) \qquad y' = f'(x)g(x) + f(x)g'(x)$$

$$y = f[g(x)] \qquad y' = f'[g(x)]g'(x)$$

$$y = af(x)^n \qquad y' = anf(x)^{n-1}f'(x)$$

$$y = ae^{f(x)} \qquad y' = ae^{f(x)}f'(x)$$

$$y = a\ln f(x) \qquad y' = \frac{a}{f(x)}f'(x)$$

$$\int_{-\infty}^{\infty} f(x)dx = 1$$

$$E(x) = \int_{-\infty}^{\infty} x\, f(x)dx$$

$$Var(x) = \int_{-\infty}^{\infty} [x - E(x)]^2 f(x)dx$$

$$P(x \le a) = \int_{-\infty}^{a} f(x)dx$$

$$E(S_T) = S_0 e^{\mu T}$$

$$Std(S_T) = S_0 e^{\mu T}\sqrt{e^{\sigma^2 T} - 1}$$

$$E(\ln S_T) = \ln S_0 + \left(\mu - \frac{\sigma^2}{2}\right)T$$

$$Std(\ln S_T) = \sigma\sqrt{T}$$

$$E(R_p) = \sum_{i=1}^{n} w_i E(R_i)$$

$$Var(R_p) = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \sigma_{ij}$$

$$\sum_{t=1}^{\infty} \frac{(1+g)^t D_0}{(1+k)^t} = \frac{(1+g)D_0}{k-g} = \frac{D_1}{k-g}$$

	00	05	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
−2.4	0.0082	0.0081	0.0080	0.0079	0.0078	0.0077	0.0075	0.0074	0.0073	0.0072	0.0071	0.0070	0.0069	0.0069	0.0068	0.0067	0.0066	0.0065	0.0064	0.0063
−2.3	0.0107	0.0106	0.0104	0.0103	0.0102	0.0100	0.0099	0.0098	0.0096	0.0095	0.0094	0.0093	0.0091	0.0090	0.0089	0.0088	0.0087	0.0085	0.0084	0.0083
−2.2	0.0139	0.0137	0.0136	0.0134	0.0132	0.0130	0.0129	0.0127	0.0125	0.0124	0.0122	0.0121	0.0119	0.0118	0.0116	0.0115	0.0113	0.0112	0.0110	0.0109
−2.1	0.0179	0.0176	0.0174	0.0172	0.0170	0.0168	0.0166	0.0164	0.0162	0.0160	0.0158	0.0156	0.0154	0.0152	0.0150	0.0148	0.0146	0.0144	0.0143	0.0141
−2.0	0.0228	0.0225	0.0222	0.0220	0.0217	0.0214	0.0212	0.0209	0.0207	0.0204	0.0202	0.0199	0.0197	0.0195	0.0192	0.0190	0.0188	0.0185	0.0183	0.0181
−1.9	0.0287	0.0284	0.0281	0.0277	0.0274	0.0271	0.0268	0.0265	0.0262	0.0259	0.0256	0.0253	0.0250	0.0247	0.0244	0.0241	0.0239	0.0236	0.0233	0.0230
−1.8	0.0359	0.0355	0.0351	0.0348	0.0344	0.0340	0.0336	0.0333	0.0329	0.0325	0.0322	0.0318	0.0314	0.0311	0.0307	0.0304	0.0301	0.0297	0.0294	0.0290
−1.7	0.0446	0.0441	0.0436	0.0432	0.0427	0.0423	0.0418	0.0414	0.0409	0.0405	0.0401	0.0396	0.0392	0.0388	0.0384	0.0379	0.0375	0.0371	0.0367	0.0363
−1.6	0.0548	0.0542	0.0537	0.0532	0.0526	0.0521	0.0516	0.0510	0.0505	0.0500	0.0495	0.0490	0.0485	0.0480	0.0475	0.0470	0.0465	0.0460	0.0455	0.0450
−1.5	0.0668	0.0662	0.0655	0.0649	0.0643	0.0636	0.0630	0.0624	0.0618	0.0612	0.0606	0.0600	0.0594	0.0588	0.0582	0.0576	0.0571	0.0565	0.0559	0.0554
−1.4	0.0808	0.0800	0.0793	0.0785	0.0778	0.0771	0.0764	0.0756	0.0749	0.0742	0.0735	0.0728	0.0721	0.0715	0.0708	0.0701	0.0694	0.0688	0.0681	0.0675
−1.3	0.0968	0.0959	0.0951	0.0943	0.0934	0.0926	0.0918	0.0909	0.0901	0.0893	0.0885	0.0877	0.0869	0.0861	0.0853	0.0846	0.0838	0.0830	0.0823	0.0815
−1.2	0.1151	0.1141	0.1131	0.1122	0.1112	0.1103	0.1093	0.1084	0.1075	0.1066	0.1056	0.1047	0.1038	0.1029	0.1020	0.1012	0.1003	0.0994	0.0985	0.0977
−1.1	0.1357	0.1346	0.1335	0.1324	0.1314	0.1303	0.1292	0.1282	0.1271	0.1261	0.1251	0.1240	0.1230	0.1220	0.1210	0.1200	0.1190	0.1180	0.1170	0.1160
−1.0	0.1587	0.1574	0.1562	0.1551	0.1539	0.1527	0.1515	0.1503	0.1492	0.1480	0.1469	0.1457	0.1446	0.1434	0.1423	0.1412	0.1401	0.1390	0.1379	0.1368
−0.9	0.1841	0.1827	0.1814	0.1801	0.1788	0.1775	0.1762	0.1749	0.1736	0.1723	0.1711	0.1698	0.1685	0.1673	0.1660	0.1648	0.1635	0.1623	0.1611	0.1599
−0.8	0.2119	0.2104	0.2090	0.2075	0.2061	0.2047	0.2033	0.2019	0.2005	0.1991	0.1977	0.1963	0.1949	0.1935	0.1922	0.1908	0.1894	0.1881	0.1867	0.1854
−0.7	0.2420	0.2404	0.2389	0.2373	0.2358	0.2342	0.2327	0.2312	0.2296	0.2281	0.2266	0.2251	0.2236	0.2221	0.2206	0.2192	0.2177	0.2162	0.2148	0.2133
−0.6	0.2743	0.2726	0.2709	0.2693	0.2676	0.2660	0.2643	0.2627	0.2611	0.2595	0.2578	0.2562	0.2546	0.2530	0.2514	0.2498	0.2483	0.2467	0.2451	0.2435
−0.5	0.3085	0.3068	0.3050	0.3033	0.3015	0.2998	0.2981	0.2963	0.2946	0.2929	0.2912	0.2894	0.2877	0.2860	0.2843	0.2826	0.2810	0.2793	0.2776	0.2759
−0.4	0.3446	0.3427	0.3409	0.3391	0.3372	0.3354	0.3336	0.3318	0.3300	0.3282	0.3264	0.3246	0.3228	0.3210	0.3192	0.3174	0.3156	0.3138	0.3121	0.3103
−0.3	0.3821	0.3802	0.3783	0.3764	0.3745	0.3726	0.3707	0.3688	0.3669	0.3650	0.3632	0.3613	0.3594	0.3576	0.3557	0.3538	0.3520	0.3501	0.3483	0.3464
−0.2	0.4207	0.4188	0.4168	0.4149	0.4129	0.4110	0.4090	0.4071	0.4052	0.4032	0.4013	0.3994	0.3974	0.3955	0.3936	0.3917	0.3897	0.3878	0.3859	0.3840
−0.1	0.4602	0.4582	0.4562	0.4542	0.4522	0.4503	0.4483	0.4463	0.4443	0.4424	0.4404	0.4384	0.4364	0.4345	0.4325	0.4305	0.4286	0.4266	0.4247	0.4227
−0.0	0.5000	0.4980	0.4960	0.4940	0.4920	0.4900	0.4880	0.4860	0.4840	0.4821	0.4801	0.4781	0.4761	0.4741	0.4721	0.4701	0.4681	0.4661	0.4641	0.4622
0.0	0.5000	0.5020	0.5040	0.5060	0.5080	0.5100	0.5120	0.5140	0.5160	0.5179	0.5199	0.5219	0.5239	0.5259	0.5279	0.5299	0.5319	0.5339	0.5359	0.5378
0.1	0.5398	0.5418	0.5438	0.5458	0.5478	0.5497	0.5517	0.5537	0.5557	0.5576	0.5596	0.5616	0.5636	0.5655	0.5675	0.5695	0.5714	0.5734	0.5753	0.5773
0.2	0.5793	0.5812	0.5832	0.5851	0.5871	0.5890	0.5910	0.5929	0.5948	0.5968	0.5987	0.6006	0.6026	0.6045	0.6064	0.6083	0.6103	0.6122	0.6141	0.6160
0.3	0.6179	0.6198	0.6217	0.6236	0.6255	0.6274	0.6293	0.6312	0.6331	0.6350	0.6368	0.6387	0.6406	0.6424	0.6443	0.6462	0.6480	0.6499	0.6517	0.6536
0.4	0.6554	0.6573	0.6591	0.6609	0.6628	0.6646	0.6664	0.6682	0.6700	0.6718	0.6736	0.6754	0.6772	0.6790	0.6808	0.6826	0.6844	0.6862	0.6879	0.6897
0.5	0.6915	0.6932	0.6950	0.6967	0.6985	0.7002	0.7019	0.7037	0.7054	0.7071	0.7088	0.7106	0.7123	0.7140	0.7157	0.7174	0.7190	0.7207	0.7224	0.7241
0.6	0.7257	0.7274	0.7291	0.7307	0.7324	0.7340	0.7357	0.7373	0.7389	0.7405	0.7422	0.7438	0.7454	0.7470	0.7486	0.7502	0.7517	0.7533	0.7549	0.7565
0.7	0.7580	0.7596	0.7611	0.7627	0.7642	0.7658	0.7673	0.7688	0.7704	0.7719	0.7734	0.7749	0.7764	0.7779	0.7794	0.7808	0.7823	0.7838	0.7852	0.7867
0.8	0.7881	0.7896	0.7910	0.7925	0.7939	0.7953	0.7967	0.7981	0.7995	0.8009	0.8023	0.8037	0.8051	0.8065	0.8078	0.8092	0.8106	0.8119	0.8133	0.8146
0.9	0.8159	0.8173	0.8186	0.8199	0.8212	0.8225	0.8238	0.8251	0.8264	0.8277	0.8289	0.8302	0.8315	0.8327	0.8340	0.8352	0.8365	0.8377	0.8389	0.8401
1.0	0.8413	0.8426	0.8438	0.8449	0.8461	0.8473	0.8485	0.8497	0.8508	0.8520	0.8531	0.8543	0.8554	0.8566	0.8577	0.8588	0.8599	0.8610	0.8621	0.8632
1.1	0.8643	0.8654	0.8665	0.8676	0.8686	0.8697	0.8708	0.8718	0.8729	0.8739	0.8749	0.8760	0.8770	0.8780	0.8790	0.8800	0.8810	0.8820	0.8830	0.8840
1.2	0.8849	0.8859	0.8869	0.8878	0.8888	0.8897	0.8907	0.8916	0.8925	0.8934	0.8944	0.8953	0.8962	0.8971	0.8980	0.8988	0.8997	0.9006	0.9015	0.9023
1.3	0.9032	0.9041	0.9049	0.9057	0.9066	0.9074	0.9082	0.9091	0.9099	0.9107	0.9115	0.9123	0.9131	0.9139	0.9147	0.9154	0.9162	0.9170	0.9177	0.9185
1.4	0.9192	0.9200	0.9207	0.9215	0.9222	0.9229	0.9236	0.9244	0.9251	0.9258	0.9265	0.9272	0.9279	0.9285	0.9292	0.9299	0.9306	0.9312	0.9319	0.9325
1.5	0.9332	0.9338	0.9345	0.9351	0.9357	0.9364	0.9370	0.9376	0.9382	0.9388	0.9394	0.9400	0.9406	0.9412	0.9418	0.9424	0.9429	0.9435	0.9441	0.9446
1.6	0.9452	0.9458	0.9463	0.9468	0.9474	0.9479	0.9484	0.9490	0.9495	0.9500	0.9505	0.9510	0.9515	0.9520	0.9525	0.9530	0.9535	0.9540	0.9545	0.9550
1.7	0.9554	0.9559	0.9564	0.9568	0.9573	0.9577	0.9582	0.9586	0.9591	0.9595	0.9599	0.9604	0.9608	0.9612	0.9616	0.9621	0.9625	0.9629	0.9633	0.9637
1.8	0.9641	0.9645	0.9649	0.9652	0.9656	0.9660	0.9664	0.9667	0.9671	0.9675	0.9678	0.9682	0.9686	0.9689	0.9693	0.9696	0.9699	0.9703	0.9706	0.9710
1.9	0.9713	0.9716	0.9719	0.9723	0.9726	0.9729	0.9732	0.9735	0.9738	0.9741	0.9744	0.9747	0.9750	0.9753	0.9756	0.9759	0.9761	0.9764	0.9767	0.9770
2.0	0.9772	0.9775	0.9778	0.9780	0.9783	0.9786	0.9788	0.9791	0.9793	0.9796	0.9798	0.9801	0.9803	0.9805	0.9808	0.9810	0.9812	0.9815	0.9817	0.9819
2.1	0.9821	0.9824	0.9826	0.9828	0.9830	0.9832	0.9834	0.9836	0.9838	0.9840	0.9842	0.9844	0.9846	0.9848	0.9850	0.9852	0.9854	0.9856	0.9857	0.9859
2.2	0.9861	0.9863	0.9864	0.9866	0.9868	0.9870	0.9871	0.9873	0.9875	0.9876	0.9878	0.9879	0.9881	0.9882	0.9884	0.9885	0.9887	0.9888	0.9890	0.9891
2.3	0.9893	0.9894	0.9896	0.9897	0.9898	0.9900	0.9901	0.9902	0.9904	0.9905	0.9906	0.9907	0.9909	0.9910	0.9911	0.9912	0.9913	0.9915	0.9916	0.9917
2.4	0.9918	0.9919	0.9920	0.9921	0.9922	0.9923	0.9925	0.9926	0.9927	0.9928	0.9929	0.9930	0.9931	0.9931	0.9932	0.9933	0.9934	0.9935	0.9936	0.9937