

Předpokládejme, že kapitálový trh je v rovnováze. Je dáno

$$r_f = 0,04,$$

$$r_M = 0,10 \text{ a}$$

$$\sigma_M = 0,09$$

a) Popište a nakreslete přímku kapitálového trhu (CML)

b) Mějme tři CP mající následující kovariance s výnosem tržního portfolia:

$$\sigma_{r_1, r_M} = 0,0108$$

$$\sigma_{r_2, r_M} = -0,0027$$

$$\sigma_{r_3, r_M} = 0,0054$$

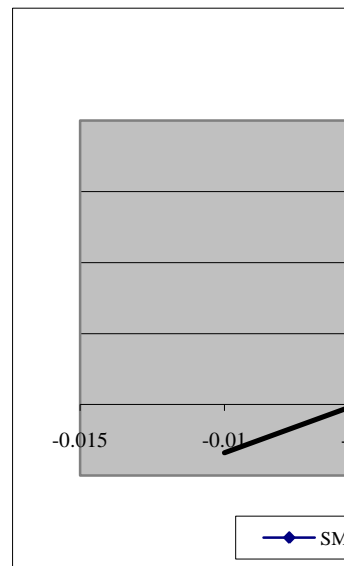
. Popište a nakreslete přímku SML. Zaneste CP na přímku SML

rf	0.04
rm	0.1
sigmaM	0.09
sigma1M	0.0108
sigma2M	-0.0027
sigma3M	0.0054

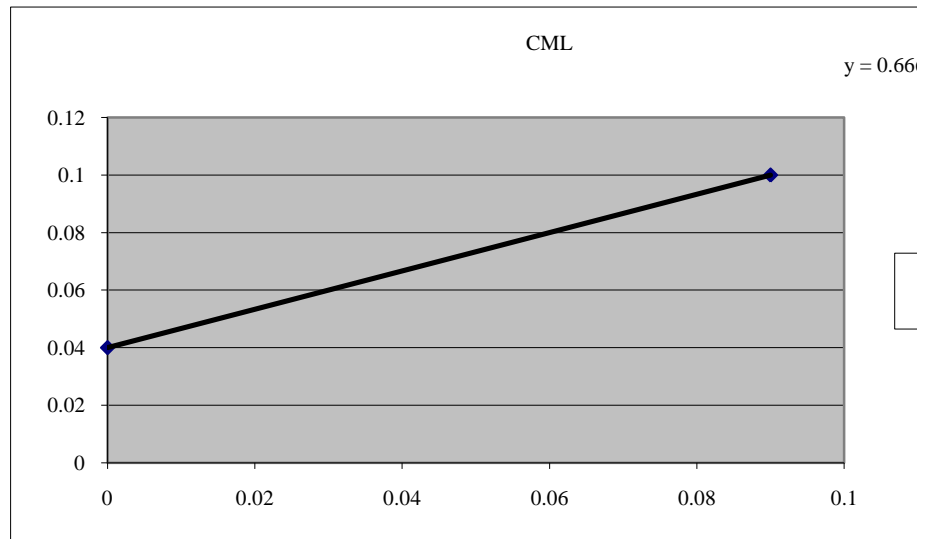
CML	
$rp = rf + ((r_M - rf) / \sigma_M) * \sigma_P$	
$rp = 0,04 + ((0,1 - 0,04) / 0,09) * \sigma_P$	
data pro CML	
0.04	0
0.1	0.09

CP	sigmaIM	ri
1	0.0108	0.12
2	-0.0027	0.02
3	0.0054	0.08
rf	0	0.04
rm	0.0081	0.1

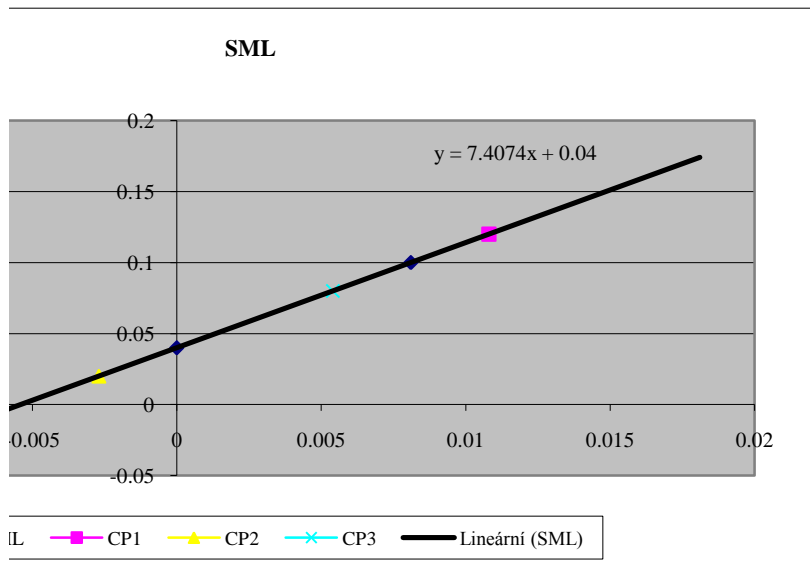
SML	
$ri = rf + ((r_M - rf) / \sigma_M^2) * \sigma_{iM}$	
$ri = 0,04 + ((0,1 - 0,04) / 0,0081) * \sigma_{iM}$	
7.407407	



$$=0,66667 \cdot \sigma_P + 0,04$$



$$IM = 7,407407 \cdot \sigma_M + 0,04$$



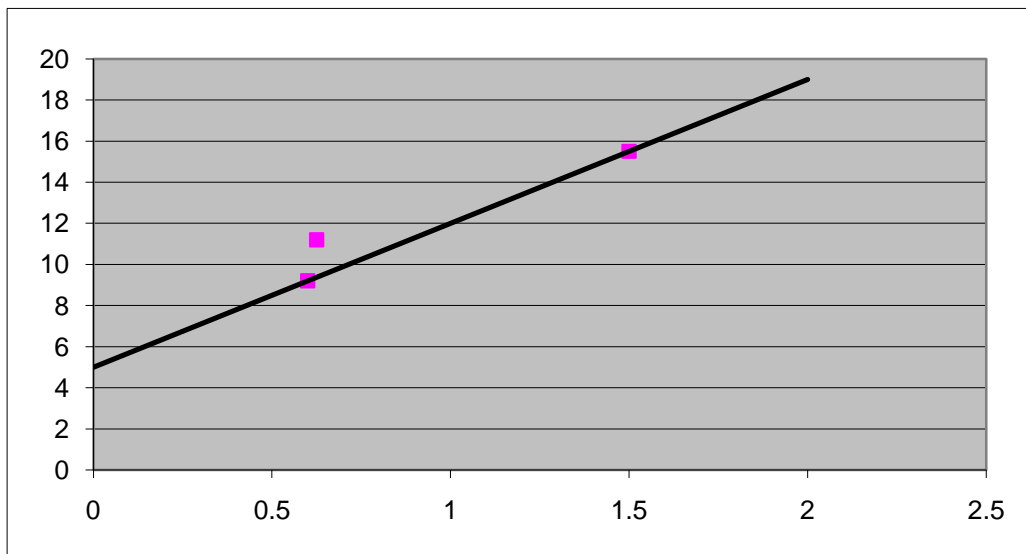
$67x + 0.04$

—◆— CML
— Lineární (CML)

Mějme tři cenné papíry, tržní portfolio a bezrizikovou investici.

	korelace i a			kovariance	beta	rovnovážné výnosnosti
	r_i	M	sigma i			
C1	15.5	0.9	20	216	1.5	15.5
C2	9.2	0.8	9	86.4	0.6	9.2
C3	11.2	0.5	15	90	0.625	9.375
TP	12	1	12	144	1	
r_f	5	0	0		0	

Nakreslete SML, zobrazte cenné papíry na této přímce a určete beta cenných papírů.



delta (v %)

0

0

1.825

den	Český Telecom	ČEZ	Komerční bank	UNIPETROL	IPB
1	570	98.4	669.1	53.9	103.5
2	569	98.2	715	53.8	103
3	563.8	96.6	725	53.2	101.9
4	575.3	96.5	716	53.9	100
5	595.1	97	725	55.6	101.6
6	602.8	98.4	727.5	57	101.2
7	601.8	99	716.6	54.7	102
8	601.3	105.4	721.5	55.6	101.6
9	614.8	116.9	718.6	55.9	101.7
10	628.1	119.6	717.8	56.5	100.5
11	629	113.2	729.5	56.4	103.4
12	618.6	109.5	702.6	54.9	102.3
13	638	105	750.8	55	102.8
14	656	104.9	789.7	56.6	99.8
15	662	105.3	799.1	56.9	101.4
16	669.4	105.7	805	56	100.9
17	700.7	108.5	870	56.7	95.3
18	709	110.3	937.6	57	65.7
19	713	112.6	948.8	56.8	99.4
20	708	113.9	951.5	56.5	99.2

Odhadněte beta a výnosnosti jednotlivých akcií. Vypočítejte výnosnost a riziko optimálního portfolia těchto akcií (sell short povolen), systematické a nesystematické riziko tohoto portfolia.

$$\beta_i = \frac{\sigma_{iM}}{\sigma_M^2} = \frac{\sum_{t=1}^T [(r_{i,t} - \bar{r}_{i,t})(r_{M,t} - \bar{r}_{M,t})]}{\sum_{t=1}^T (r_{M,t} - \bar{r}_{M,t})^2} \quad \alpha_i = \bar{r}_{i,t} - \beta_i \cdot \bar{r}_{M,t}$$

kovarianční matice

	Český Telecom	ČEZ	Komerční banka	UNIPETROL	IPB
Český Telecom	0.00027459	0.00012473	0.00026794	0.00019227	-0.00028602
ČEZ	0.00012473	0.00128007	-0.00011910	0.00016901	0.00008753
Komerční banka	0.00026794	-0.00011910	0.00113401	0.00020279	-0.00139867
UNIPETROL	0.00019227	0.00016901	0.00020279	0.00032797	-0.00028373
IPB	-0.00028602	0.00008753	-0.00139867	-0.00028373	0.02027601
PX50	-0.00007939	-0.00001990	-0.00014854	-0.00006012	-0.00044348

$$\sqrt{\beta_i^2 \cdot \sigma_M^2} \quad \sigma_{\varepsilon_i} = \sqrt{\sigma_i^2 - \beta_i^2 \cdot \sigma_M^2}$$

	celkové riziko	systematické riziko	nesystematické riziko	koef
Český Telecom	0.016570836	0.004400566	0.015975845	
ČEZ	0.03577803	0.001103301	0.035761015	
Komerční banka	0.03367500	0.008233991	0.03265283	
UNIPETROL	0.01810998	0.003332488	0.017800731	
IPB	0.14239386	0.024582902	0.14025581	
PX50	0.01804005			

	matice soustavy = A		vektor pravých stran
Český Telecom	19	0.188622199	0.220484867
	0.188622199	0.007730528	0.000759904
ČEZ	19	0.188622199	0.158045968
	0.188622199	0.007730528	0.001210734
Komerční banka	19	0.188622199	0.365275401
	0.188622199	0.007730528	0.000952516
UNIPETROL	19	0.188622199	0.050131996
	0.188622199	0.007730528	-0.000584444
IPB	19	0.188622199	0.120925286
	0.188622199	0.007730528	-0.0067821

	beta	alfa
Český Telecom	-0.243933092	0.014026109
ČEZ	-0.061158425	0.008925358
Komerční banka	-0.45642826	0.023756205
UNIPETROL	-0.184727167	0.004472402
IPB	-1.362684405	0.019892517

	celkové riziko	systematické riziko	nesystematické riziko	koef
Český Telecom	0.016570836	0.004400566	0.015975845	
ČEZ	0.035778031	0.001103301	0.035761015	
Komerční banka	0.033675004	0.008233991	0.03265283	
UNIPETROL	0.018109984	0.003332488	0.017800731	
IPB	0.14239386	0.024582902	0.14025581	
PX50	0.018040055			

	matice soustavy=A				
Český Telecom	0.000549185	0.000249452	0.000535876	0.00038454	-0.000572041
ČEZ	0.000249452	0.002560135	-0.000238198	0.000338028	0.000175053
Komerční banka	0.000535876	-0.000238198	0.002268012	0.000405577	-0.002797334
UNIPETROL	0.00038454	0.000338028	0.000405577	0.000655943	-0.000567465
IPB	-0.000572041	0.000175053	-0.002797334	-0.000567465	0.040552023
	1	1	1	1	1

	matice soustavy=A				
	0.00027459	0.00012473	0.00026794	0.00019227	-0.00028602
	0.00012473	0.00128007	-0.00011910	0.00016901	0.00008753
	0.00026794	-0.00011910	0.00113401	0.00020279	-0.00139867
	0.00019227	0.00016901	0.00020279	0.00032797	-0.00028373

-0.00028602 0.00008753 -0.00139867 -0.00028373 0.02027601

	beta		alfa		podíl v
	historické	MNČ	historické	MNČ	bez rf
Český Telecom	-0.24393309	-0.243933092	0.01402611	0.014026109	0.517979494
ČEZ	-0.06115842	-0.061158425	0.00892536	0.008925358	0.084323627
Komerční banka	-0.45642826	-0.45642826	0.02375621	0.023756205	0.05757765
UNIPETROL	-0.18472717	-0.184727167	0.00447240	0.004472402	0.313910523
IPB	-1.36268440	-1.362684405	0.01989252	0.019892517	0.026208705

$$\underbrace{\sum_{i=1}^n X_i \beta_i}_{\beta_p}$$

portfolio	systematické riziko			
	bez rf		s rf	
	historické	MNČ	historické	MNČ
odhad beta				
Český Telecom	-0.12635234	-0.12635234	-0.306785511	-0.306785511
ČEZ	-0.0051571	-0.0051571	-0.01079904	-0.01079904
Komerční banka	-0.026280067	-0.026280067	-0.155352059	-0.155352059
UNIPETROL	-0.057987802	-0.057987802	0.149912261	0.149912261
IPB	-0.035714194	-0.035714194	-0.050325723	-0.050325723
	-0.251491502	-0.251491502	-0.373350071	-0.373350071

PX50
333.4
338.9
346.8
347.8
350.9
348.1
349.4
354.2
361.1
372.7
371.6
395.9
397.6
406.1
400.7
396.6
398.2
400.9
399.1
401.1

	výnosnosti			
	Český Telecom	ČEZ	Komerční banka	UNIPETROL
	-0.001754386	-0.00203252	0.068599611	-0.0018553
	-0.00913884	-0.016293279	0.013986014	-0.0111524
	0.020397304	-0.001035197	-0.012413793	0.01315789
	0.034416826	0.005181347	0.012569832	0.03153989
	0.012939002	0.01443299	0.003448276	0.02517986
	-0.001658925	0.006097561	-0.014982818	-0.0403509
	-0.000830841	0.064646465	0.006837845	0.01645338
	0.022451355	0.109108159	-0.004019404	0.00539568
	0.021633051	0.023096664	-0.001113276	0.01073345
	0.001432893	-0.053511706	0.016299805	-0.0017699
	-0.016534181	-0.032685512	-0.036874572	-0.0265957
	0.031361138	-0.04109589	0.068602334	0.00182149
	0.028213166	-0.000952381	0.051811401	0.02909091
	0.009146341	0.003813155	0.011903254	0.00530035
	0.011178248	0.00379867	0.007383306	-0.0158172
	0.046758291	0.026490066	0.080745342	0.0125
	0.011845298	0.016589862	0.077701149	0.00529101
	0.005641749	0.020852221	0.011945392	-0.0035088
	-0.007012623	0.011545293	0.0028457	-0.0052817
očekávané	1.16%	0.83%	1.92%	0.26%
roční		na bázi obchod	na bázi dnů v roce	
rf	3.00%	0.012%	0.008%	
počet obchodů	251			
počet dnů v roce	360			

ortfolia složeného z

historické (ex-post) beta a alfa

$$\bar{r}_{i,t} - \beta_i \cdot \bar{r}_{M,t}$$

PX50	průměrné ri	beta	alfa	rovnovážné rie	delta=ri-rie
-0.00007939	1.16%	-0.24393309	0.01402611	-0.23%	0.01387743
-0.00001990	0.83%	-0.06115842	0.00892536	-0.05%	0.00879853
-0.00014854	1.92%	-0.45642826	0.02375621	-0.44%	0.02358213
-0.00006012	0.26%	-0.18472717	0.00447240	-0.17%	0.00433080
-0.00044348	0.64%	-1.36268440	0.01989252	-1.32%	0.01961012
0.00032544	0.99%	1.00000000			
	0.012%	0			

$$\beta_i^2 \cdot \frac{\sigma_M^2}{\sigma_i^2}$$

eficient determinance

0.070523	0.265561
0.000951	0.030837
0.059787	0.244513
0.033861	0.184014
0.029805	0.172640

metoda nejmenších čtverců

inverzní matice		a=odhad alfy	řešení soustavy
0.069455615	-1.694693	0.014026109	0.014026109
-1.694692808	170.70718	b=odhad bety	-0.243933092
0.069455615	-1.694693	a=odhad alfy	0.008925358
-1.694692808	170.70718	b=odhad bety	-0.061158425
0.069455615	-1.694693	a=odhad alfy	0.023756205
-1.694692808	170.70718	b=odhad bety	-0.45642826
0.069455615	-1.694693	a=odhad alfy	0.004472402
-1.694692808	170.70718	b=odhad bety	-0.184727167
0.069455615	-1.694693	a=odhad alfy	0.019892517
-1.694692808	170.70718	b=odhad bety	-1.362684405



koeficient determinace

0.070523	0.265561
0.000951	0.030837
0.059787	0.244513
0.033861	0.184014
0.029805	0.172640

optimální portfolio (bez rf)

	vektor pravých stran	inverzní matice		
1	0	3052.801274	-287.0530503	-665.11598
1	0	-287.0530503	430.920765	117.780775
1	0	-665.1159821	117.7807745	647.449589
1	0	-2057.489995	-258.1716019	-131.62381
1	0	-43.14224628	-3.476887393	31.509433
0	1	0.517979494	0.084323627	0.05757765

optimální portfolio (s rf)

	vektor pravých stran	inverzní matice		
	0.011485	7319.437777	-376.5017727	-1195.3043
	0.008199	-376.5017727	894.0102046	257.526884
	0.019105	-1195.304267	257.5268836	1309.89749
	0.002519	-3379.360807	-396.5892776	-181.47755

0.006245

-24.86690682

3.04460099 69.8459322

přehled

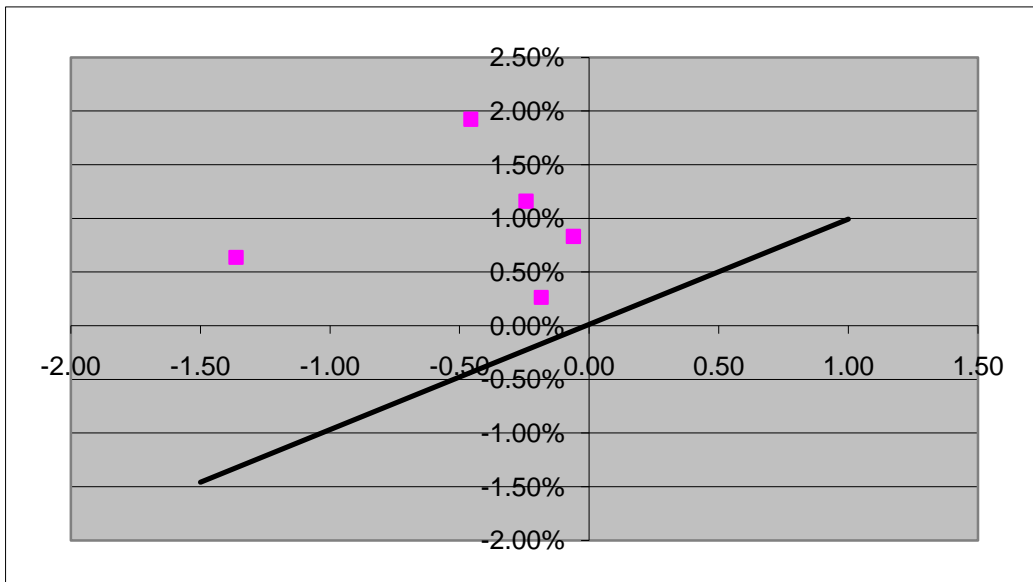
portfoliu	systematické riziko		nesystematické riziko	
	s rf	historické	MNČ	historické
1.257662533	0.0044006	0.004400566	0.015975845	0.015975845
0.176574848	0.0011033	0.001103301	0.035761015	0.035761015
0.340364682	0.008234	0.008233991	0.03265283	0.03265283
-0.811533375	0.0033325	0.003332488	0.017800731	0.017800731
0.036931312	0.0245829	0.024582902	0.14025581	0.14025581

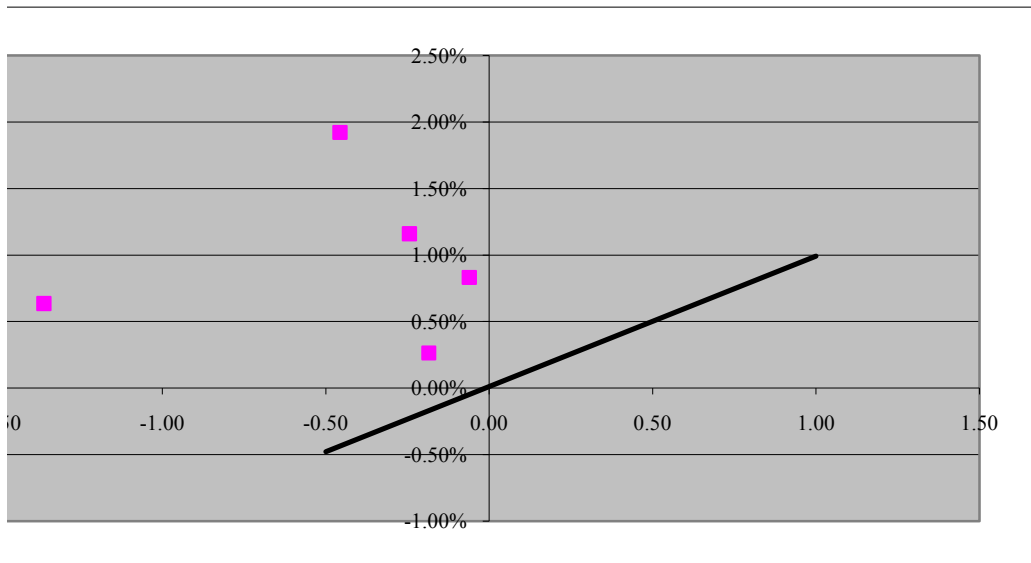
systematické a nesystematické riziko portfolia

$$\sigma_{\varepsilon_p}^2 = \sum_{i=1}^n X_i^2 \cdot \sigma_{\varepsilon_i}^2$$

nesystematické riziko			
bez rf		s rf	
historické	MNČ	historické	MNČ
6.84783E-05	6.848E-05	0.000403697	0.000403697
9.09323E-06	9.093E-06	3.98729E-05	3.98729E-05
3.53468E-06	3.535E-06	0.000123518	0.000123518
3.12239E-05	3.122E-05	0.000208684	0.000208684
1.35124E-05	1.351E-05	2.68307E-05	2.68307E-05
0.011217955	0.011218	0.028330243	0.028330243

IPB	PX50
-0.004831	0.016497
-0.01068	0.023311
-0.018646	0.002884
0.016	0.008913
-0.003937	-0.007979
0.007905	0.003735
-0.003922	0.013738
0.000984	0.019481
-0.011799	0.032124
0.028856	-0.002951
-0.010638	0.065393
0.004888	0.004294
-0.029183	0.021378
0.016032	-0.013297
-0.004931	-0.010232
-0.0555	0.004034
-0.310598	0.006781
0.512938	-0.00449
-0.002012	0.005011
0.64%	0.99%





-2057.49	-43.14225	0.517979	řešení soustavy=váhy				
-258.1716	-3.476887	0.084324	Český Telecc	0.517979			
-131.6238	31.50943	0.057578	ČEZ	0.084324			
2457.624	-10.339	0.313911	Komerční ban	0.057578			
-10.339	25.4487	0.026209	UNIPETROI	0.313911			
0.313911	0.026209	-0.00044	IPB	0.026209			
				-0.00044			
			výnos portfol	0.88%			
			riziko portfoli	1.49%	0.000221	0.000133	4.08188E-05
			řešení soustavy=Z				
-3379.361	-24.86691			49.47172			1.257663
-396.5893	3.044601			6.945791			0.176575
-181.4776	69.84593			13.38867			0.340365
5361.055	16.54284			-31.9227			-0.81153

16.54284 54.005

	1.452739	0.036931
suma $Z=k\varepsilon$	39.33624	
	výnos portfol	2.07%
	riziko portfoli	2.29%

kovarianční matice

0.00027459	0.00012473	0.00026794	0.00019227	-0.00028602
0.00012473	0.00128007	-0.00011910	0.00016901	0.00008753
0.00026794	-0.00011910	0.00113401	0.00020279	-0.00139867
0.00019227	0.00016901	0.00020279	0.00032797	-0.00028373
-0.00028602	0.00008753	-0.00139867	-0.00028373	0.02027601

4.089E-06

-7.7971E-07

1.257662533	0.176574848	0.340364682	-0.8115334	0.03693131
0.00027459	0.00012473	0.00026794	0.00019227	-0.00028602
0.00012473	0.00128007	-0.00011910	0.00016901	0.00008753
0.00026794	-0.00011910	0.00113401	0.00020279	-0.00139867
0.00019227	0.00016901	0.00020279	0.00032797	-0.00028373

-0.00028602 0.00008753 -0.00139867 -0.00028373 0.02027601

0.000434327	2.77E-05	0.000115	-0.0002	-1.3E-05
2.76981E-05	3.99E-05	-7.2E-06	-2.4E-05	5.71E-07
0.000114695	-7.2E-06	0.000131	-5.6E-05	-1.8E-05
-0.000196237	-2.4E-05	-5.6E-05	0.000216	8.5E-06

-1.32848E-05 5.71E-07 -1.8E-05 8.5E-06 2.77E-05

0.000523

0.022874

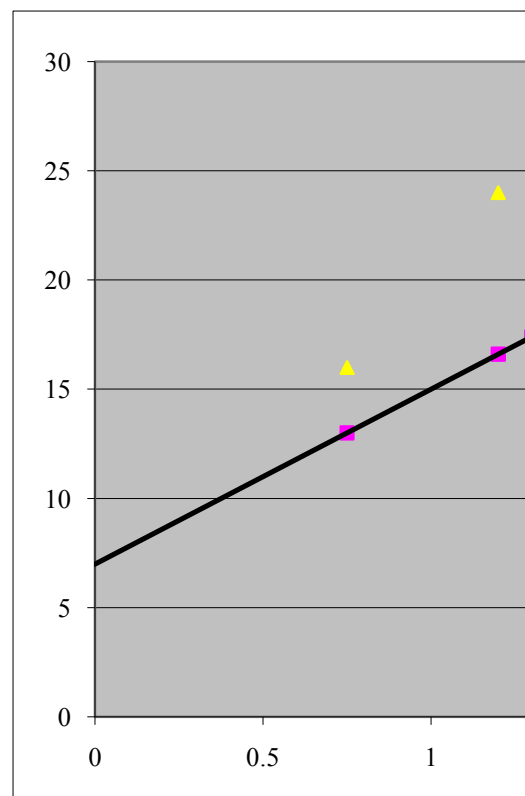
Mějme CP:

Cenný papír	β_i	r_i
CP ₁	1.75	16.7
CP ₂	1.2	24
CP ₃	1.3	17.4
CP ₄	0.75	16

$r_f = 7\%$
 $r_M = 15\%$

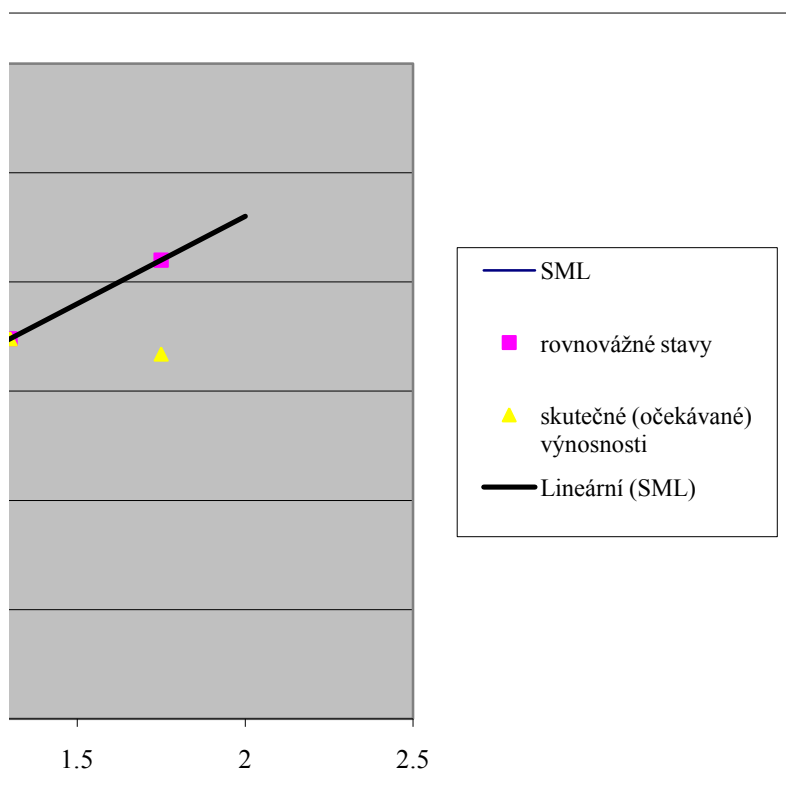
rf		7
rm		15
	beta	
rf		0
rm		1

- Vypočítejte hodnoty δ
- Nakreslete přímkou SML, očekávané výnosnosti CP a rovnovážné očekávané výnosnos
- Jaké budou investiční akce do CP



rie	delta=ri-rie akce
21	-4.3 prodat
16.6	7.4 koupit
17.4	0 držet
13	3 koupit

sti

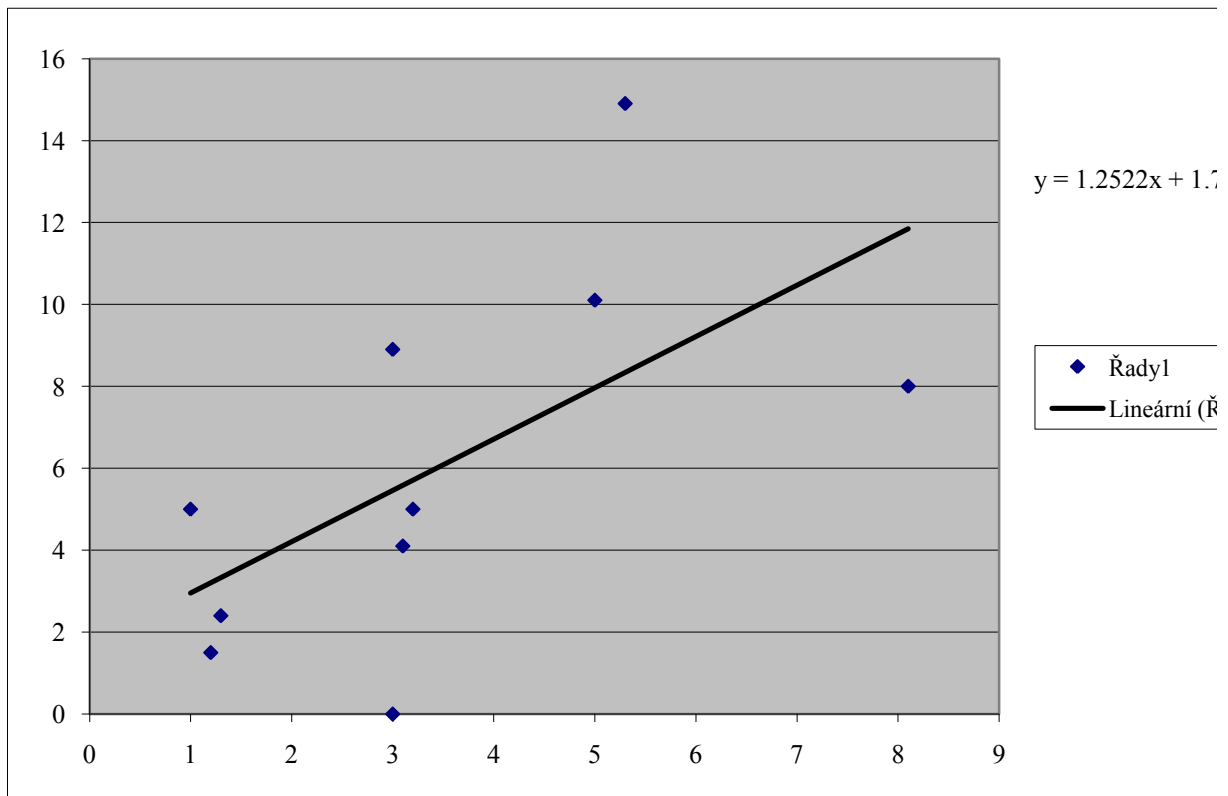
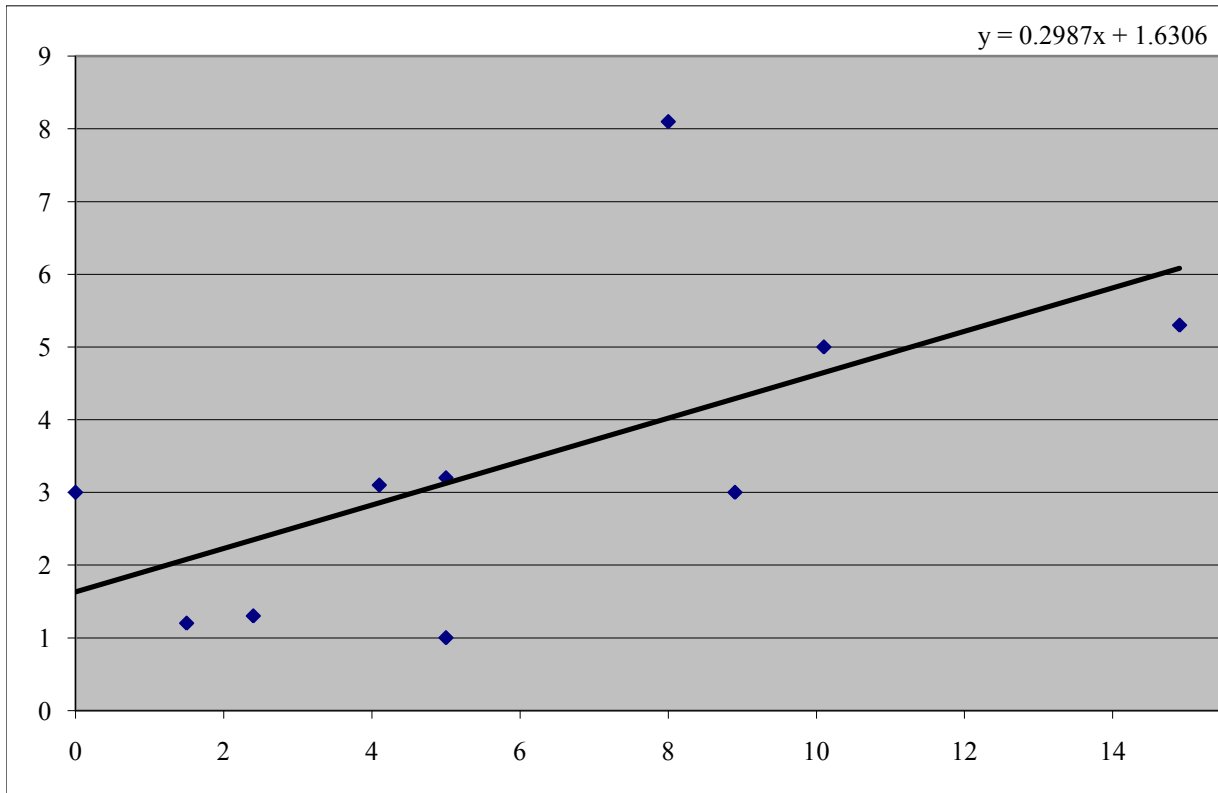


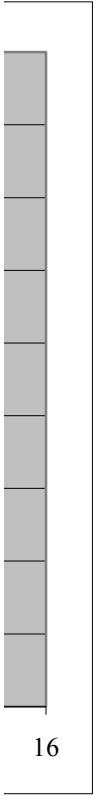
V tabulce jsou uvedeny výnosnosti společnosti S_1 a tržního portfolia za deset let. Zakreslete tyto výnosnosti do grafu, kde na vodorovné ose budou výnosnosti tržního portfolia a na svislé společnosti S_1 . Vypočítejte α a β

β

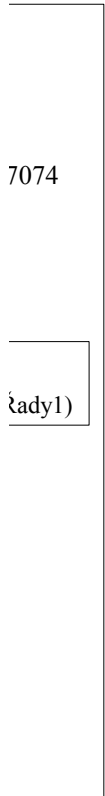
Rok	Tržní portfolio	Společnost S_1
1	8	8.1
2	0	3
3	14.9	5.3
4	5	1
5	4.1	3.1
6	8.9	3
7	10.1	5
8	5	3.2
9	1.5	1.2
10	2.4	1.3

10	59.9	34.2	
59.9	542.05	259.6	
			správné řešení
0.295799704	-0.032687764	1.630606	α
-0.032687764	0.005457056	0.29873	β
10	34.2	59.9	
34.2	160.68	259.6	
			nesprávné řešení
0.367554214	-0.078232226	1.707411	α
-0.078232226	0.02287492	1.252219	β





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7074

ξady1)