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Initial stocks: TAVHL, ARCLK, ALBRK, BJKAS, TRKCM, HURGZ, PETKM, JANTS.

Additional stocks: BIMAS, ENKAI, TTKOM, YATAS.

Report

- Q1.** 1. TAVHL: TAV Havalimanları Holding A. Ş. is one of the leading airport operators in Turkey and Eastern Europe, providing services in the areas of airport operations encompassing duty-free, food, beverage and IT. Its weight in BIST 100 index is 1.536% and its market capitalization is 8900.4 million Turkish liras (TRY). The earnings per share ratio of TAVHL stock equals to 4.00 TRY. Its current ratio is 1.1 and quick ratio is 1, expressing the availability of bare minimum of required liquidity. The debt-to-assets ratio is equal to 32.6%, which depicts that the firm is not leveraged much, meaning that the firm's assets are almost as three times as its liabilities (whenever needed the firm can pay off its obligations by selling its assets). The return on equity ratio is 28.3%, implying that the company is profitable, which is a positive sign of financial performance.
2. ARCLK: Arçelik A. Ş. is a Turkish company that manufactures household appliances and other types of electronics under numerous brand names, such as Arçelik, Beko and Grundig, selling its products mostly in Europe and Turkey. Its weight in BIST 100 index is 1.492% and its market capitalization is 13825.4 million TRY. The earnings per share ratio of ARCLK stock equals to 1.26 TRY. Its current ratio is 1.5 and quick ratio is 1, indicating the minimum availability of required liquidity. The debt-to-assets ratio is equal to 42.1%, which demonstrates that the firm is not highly leveraged, turning out to be a good financial indicator. The return on equity ratio is 11.3%, suggesting that the company is profitable.
3. ALBRK: Albaraka Türk Katılım Bankası A. Ş. is a participation bank (Turkish Islamic bank) providing full banking services, mainly serving in Turkey. Its weight in BIST 100 index is 0.127% and its market capitalization is 1413 million TRY. The earnings per share ratio of ALBRK stocks equals to 0.28 TRY. The profit margin of the bank is 18.5%, demonstrating efficient and profitable financial performance.¹

¹ Some ratios were not available in Bloomberg.

4. BJKAS: Beşiktaş Futbol Yatırımları Sanayi ve Ticaret A. Ş. is a Turkish professional football club that is a part of the Turkish super league. Its weight in BIST 100 index is 0.08% and its market capitalization is 386.4 million TRY. The earnings per share ratio of BJKAS stock equals to 0.04 TRY. Its current ratio is 0.5 and quick ratio is 0.2, illustrating shortages of liquidity in the organization. The debt-to-assets ratio is equal to 83.9%, which demonstrates that the club is highly leveraged. The profit margin of BJKAS is 2.2%, expressing relatively low profitability and, therefore, a weak financial performance.

5. TRKCM: Trakya Cam Sanayii A. Ş. is a Turkish firm that manufactures glass, especially for automobiles, producing it domestically as well as exporting it. Its weight in BIST 100 index is 0.577% and its market capitalization is 4775 million TRY. The earnings per share ratio of TRKCM stock equals to 0.77 TRY. Its current ratio is 1.8 and quick ratio is 1.1, which shows that Trakya Cam is a firm with enough liquidity. The debt-to-assets ratio is equal to 32.2%, which reflects that Trakya Cam is not financially leveraging itself with financial backups. The return on equity ratio is 20.6%, suggesting that the company is profitable.

6. HURGZ: Hürriyet Gazetecilik ve Matbaacılık A. Ş. is a company that mainly publishes weekly newspapers and provides printing and advertising services, operating in Turkey and Germany. Its weight in BIST 100 index is 0.05% and its market capitalization is 550.6 million TRY. The earnings per share ratio of Hürriyet Gazetecilik stock equals to 0.46 TRY. Its current ratio is 1.2 and quick ratio is 1.1, showing that the firm meets the bare minimum of the needed liquidity. The debt-to-assets ratio is equal to 34.1%, depicting that Hürriyet is not a risky firm in terms of paying its liabilities. The return on equity ratio is 39.1%, which indicates that HURGZ stocks are turning the investment almost 40% more valuable.

7. PETKM: Petkim Petrokimya Holding A. Ş. is a Turkish company that manufactures petrochemicals used in a number of daily products. Its weight in BIST 100 index is 1.529% and its market capitalization is 8052 million TRY. The earnings per share ratio of Petkim's stock equals to 0.53 TRY. Its current ratio is 2.1 and quick ratio is 1.1, so the company is capable of paying its obligations. The debt-to-assets ratio is equal to 58.2%, which indicates that firm is mostly leveraged. The return on equity ratio is 22.1%, implying that the firm is profitable.

8. JANTS: Jant Sanayi ve Ticaret A. Ş. is a firm that was founded in 1977, which manufactures motor vehicle parts and accessories in Turkey. Its weight in BIST ALL SHARE index is 0.015% and its market capitalization 319.2 million TRY. The earnings per share ratio of JANTS stock equals to 5.20 TRY. Its current ratio is 1.8 and quick ratio is 1, showing the minimum availability of required liquidity. The debt-to-asset ratio is equal to 15.7%, which indicates that the firm's degree of

leverage is low and they are quite out of financial risk. The return on equity ratio is 30.5%, revealing that the firm is highly profitable.

9. BIMAS: BİM Birleşik Mağazalar A. Ş. is a Turkish company that operates basic consumer goods and food discount stores. Its weight in BIST 100 index is 6.981% and its market cap is 26974.9 million TRY. The earnings per share ratio of BIMAS stock equals to 4.12 TRY. Its current ratio is 0.9, quick ratio is 0.4, expressing the low availability of essential liquidity. The debt-to-asset ratio is equal to 0%, which shows that the firm's degree of leverage is zero. In other words, they do not have any debts. The return on equity ratio is 38.7%, expressing that the firm is highly profitable.

10. ENKAI: Enka İnşaat ve Sanayi A. Ş. is a Turkish firm that provides construction services around the world. Its weight in BIST 100 index is 1.279% and its market capitalization is 24750 million TRY. The earnings per share ratio of ENKAI stock equals to 0.32 TRY. Its current ratio is 2.8 and quick ratio is 2.2, indicating the high amount of liquidity in the firm. However this ratios show a positive situation for the firm, they are not highly efficient in investing their assets. The debt-to-asset ratio is equal to 3.2%, which shows that the firm's degree of leverage is very low. The return on equity ratio is 5.7%, showing that the firm is not so profitable.

11. TTKOM: Türk Telekomünikasyon A. Ş. is a Turkish firm that provides telecommunications and Internet services to individuals and businesses. Its weight in BIST 100 index is 1.01% and its market capitalization is 17990 million TRY. The earnings per share ratio of TTKOM stock equals to -0.40 TRY, which is not a good sign. Its current ratio is 0.8 and quick ratio is 0.7, meaning that the amount of liquidity is slightly low than needed. The debt-to-asset ratio is equal to 55%, which shows that the firm's degree of leverage is high and indicates that the firm's assets are almost two times as its liabilities. The return on equity ratio is -23.2%, shows that the firm is not profitable, they are in a loss.

12. YATAS: Yatak ve Yorgan Sanayi ve Ticaret A. Ş. is a Turkish company that manufactures home furniture, mattresses, textile and sofas, also exporting them to Europe and the USA. Its weight in BIST 100 index is 0.191% and its market capitalization is 819.4 million TRY. The earnings per share ratio of YATAS stock equals to 0.46 TRY. Its current ratio is 1.3 and quick ratio is 0.5, indicating the minimum availability of required liquidity. The debt-to-asset ratio is equal to 19.1%, which shows that the firm's degree of leverage are not very high, depicting that the firm's assets are almost five times as its liabilities. The return on equity ratio is 27.9%. Thus, the firm is profitable, which gives positive financial expectations for the future.

- Q2.** All the required measures, which are mean, standard deviation, skewness, kurtosis, 5% Value at Risk (VaR) and 5% expected shortfall (ES) with Sharpe ratio of the monthly returns of each stock, were calculated as follows:

Jan 2014- Dec 2018	TAVHL	ARCLK	ALBRK	BJKAS	TRKCM	HURGZ	PETKM	JANTS	BIMAS	YATAS	ENKAI	TTKOM
Mean	0,011	0,007	-0,001	0,007	0,017	0,016	0,023	0,010	0,013	0,060	0,004	-0,004
StDev	0,090	0,071	0,078	0,136	0,091	0,141	0,091	0,117	0,060	0,150	0,053	0,077
Skewness	-0,097	0,253	1,716	1,104	-0,630	0,900	-0,758	1,832	0,337	0,200	0,279	0,142
Kurtosis	1,705	1,023	6,126	5,616	0,436	1,061	3,589	6,509	-0,391	0,099	0,311	1,650
VaR	-0,137	-0,110	-0,130	-0,217	-0,133	-0,216	-0,127	-0,182	-0,085	-0,187	-0,083	-0,131
ES	-0,203	-0,134	-0,127	-0,277	-0,205	-0,214	-0,198	-0,156	-0,091	-0,244	-0,100	-0,172
Sharpe r.	0,031	-0,025	-0,124	-0,012	0,089	0,056	0,158	0,010	0,080	0,344	-0,082	-0,165

The indicator of risk is standard deviation of a security. As seen in the table above, throughout the 5 years of monthly returns, among the riskiest stocks are YATAS, HURGZ and BJKAS. The least risky stock is ENKAI.

Although some measures of statistical moments diverge from those of the normal distribution, since the number of observations is high, standard normal distribution is assumed in all the calculations. Even if it is not the case, 5% VaR and 5% expected shortfall can be used as alternatives to evaluate the risk of given securities.

In the Sharpe ratio calculations, annual risk-free rate in Turkey was assumed to be 10.3%. Therefore, the monthly risk-free rate was calculated to be 0.858%. YATAS's financial performance was quite noticeable in terms of Sharpe ratio, being the highest one, 0.344.

- Q3.** The sample was divided into two parts covering 2.5 years each. Their mean, standard deviation, skewness, kurtosis, 5% VaR, 5% expected shortfall and Sharpe ratios were separately calculated as follows:

Jan 2014- Jun 2016	TAVHL	ARCLK	ALBRK	BJKAS	TRKCM	HURGZ	PETKM	JANTS	BIMAS	YATAS	ENKAI	TTKOM
Mean	-0,005	0,017	-0,003	0,033	0,008	0,001	0,027	0,002	0,011	0,055	0,000	0,002
StDev	0,071	0,071	0,060	0,156	0,093	0,096	0,066	0,121	0,067	0,136	0,049	0,063
Skewness	-0,341	0,907	0,331	1,202	-0,577	0,762	0,110	3,105	0,471	0,855	0,211	0,297
Kurtosis	0,228	2,136	-0,229	6,075	-0,230	1,615	-0,223	13,968	-0,192	1,820	-0,344	0,068
VaR	-0,122	-0,099	-0,102	-0,223	-0,145	-0,157	-0,081	-0,197	-0,099	-0,169	-0,081	-0,101
ES	-0,134	-0,088	-0,098	-0,207	-0,176	-0,150	-0,088	-0,145	-0,085	-0,143	-0,081	-0,103
Sharpe r.	-0,191	0,122	-0,196	0,158	-0,001	-0,081	0,284	-0,056	0,031	0,340	-0,181	-0,099

Jul 2016- Dec 2018	TAVHL	ARCLK	ALBRK	BJKAS	TRKCM	HURGZ	PETKM	JANTS	BIMAS	YATAS	ENKAI	TTKOM
Mean	0,028	-0,004	0,001	-0,019	0,025	0,032	0,019	0,018	0,016	0,066	0,009	-0,011
StDev	0,104	0,071	0,094	0,109	0,090	0,176	0,112	0,113	0,054	0,165	0,057	0,090
Skewness	-0,294	-0,370	1,953	0,196	-0,717	0,660	-0,805	0,451	0,184	-0,195	0,269	0,206
Kurtosis	1,855	-0,441	6,003	0,365	1,581	-0,090	2,832	-0,394	-0,878	-0,598	0,713	1,742
VaR	-0,144	-0,120	-0,153	-0,199	-0,122	-0,257	-0,165	-0,169	-0,072	-0,206	-0,085	-0,158
ES	-0,179	-0,125	-0,125	-0,223	-0,158	-0,214	-0,198	-0,148	-0,063	-0,218	-0,093	-0,172
Sharpe r.	0,183	-0,171	-0,081	-0,255	0,181	0,134	0,091	0,079	0,141	0,345	0,004	-0,214

Apparently, the equality of the mean returns and risk measures of both sub-periods cannot be assumed. It can be easily observed from the above tables that some measures have different signs leading to various conclusions.

- Q4.** A portfolio with equal weights of twelve stocks from the initial sample of the 5 years period was formed. The weight for each stock is $1/12 = 0.0833$. The mean returns and several other measures of this portfolio were calculated:

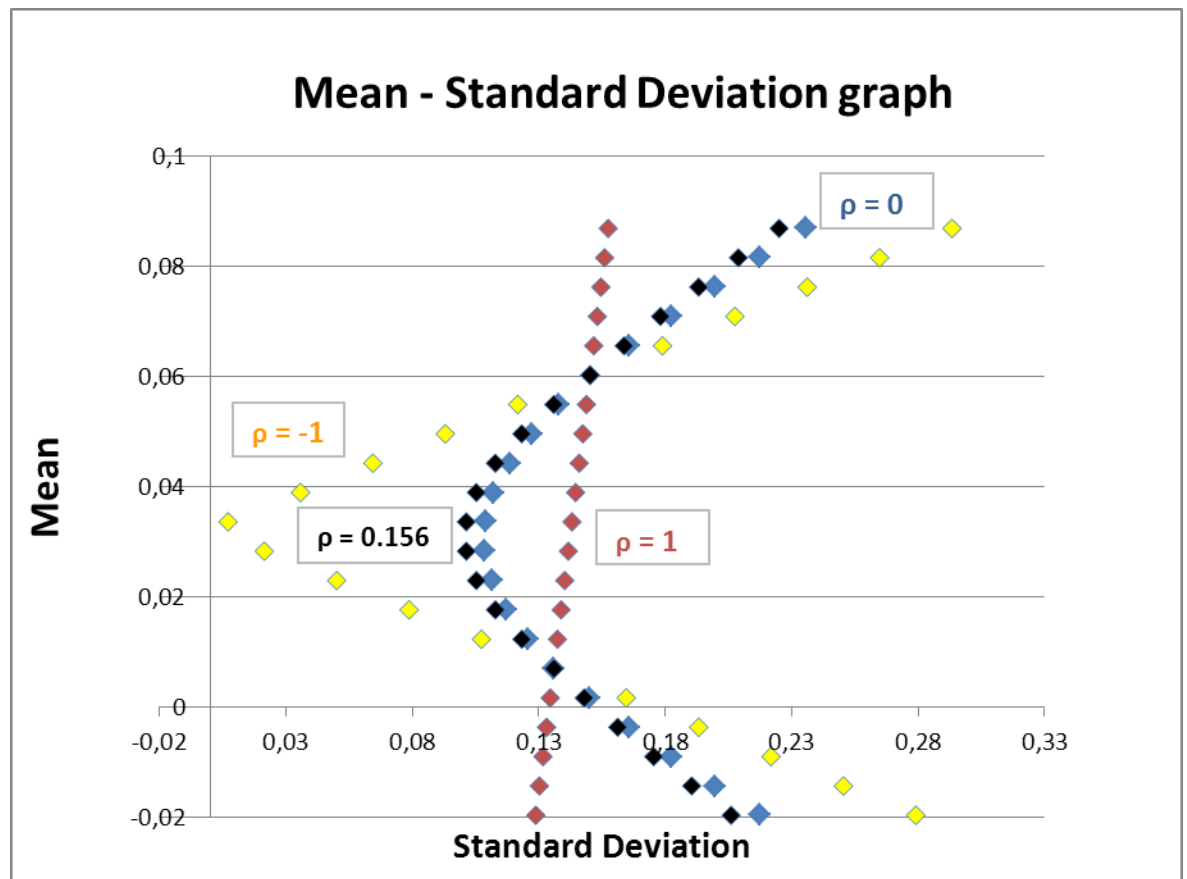
	Portfolio
Mean	0,0136
StDev	0,0546
Skewness	-0,1514
Kurtosis	-0,1399
VaR	-0,0762
ES	-0,1041
Sharpe ratio	0,0927

Taking each individual stock into consideration, it can be concluded that the standard deviation of newly formed portfolio is among the lowest ones, showing the diversification effect of portfolio formation with low risk. Not only the standard deviation, but also 5% VaR and 5% expected shortfall are very low compared to the individual stocks. The mean observed expresses the average of expected returns of all individual securities.

- Q5.** The stocks of BJKAS and YATAS were chosen for the last part. Their mean, standard deviation, actual correlation and covariance are as follows:

	BJKAS TI Equity (R2)	YATAS TI Equity (L2)
Mean	0,007011573	0,060270952
StDev	0,135985546	0,150303649
Correlation	0,156274411	
Covariance	0,003194112	

Using these two stocks, 21 portfolios with different weights for correlations of +1, -1, 0 and the actual correlation of both were formed. As a result, the mean returns and standard deviation of these portfolios were plotted on the graph below:



Apparently, when the securities are perfectly negatively correlated, their risk approaches to zero, as can be seen in the graph.

Q6. Using the actual correlation coefficient between the returns of BJKAS and YATAS, their minimum variance weights were calculated:

Wmin of BJKAS	Wmin of YATAS
0,559073561	0,440926439

The mean and standard deviation of the portfolio, using minimum variance weights, are illustrated below:

	Optimal Portfolio
Mean	0,030495041
StDev	0,108382633

To sum up, the risk (standard deviation) of the optimal portfolio of two stocks has been minimized.

References

- Bloomberg databases were used to obtain the financial data on the securities.