

1 OBX shares

The OBX index is an index of 25 large Norwegian Companies. Table 1 shows the composition of the index in September of 2022.

Table 1 OBX composition Sep 2022

Company	MNEMO	Sector (ICB)	Weight (%)
EQUINOR	EQNR	Energy	31.45
DNB BANK	DNB	Financials	12.80
AKER BP	AKRBP	Energy	7.87
NORSK HYDRO	NHY	Basic Materials	6.30
YARA INTERNATIONAL	YAR	Basic Materials	5.05
TELENOR	TEL	Telecommunications	5.00
MOWI	MOWI	Consumer Staples	4.85
ORKLA	ORK	Consumer Staples	4.74
TOMRA SYSTEMS	TOM	Industrials	3.63
STOREBRAND	STB	Financials	2.84
KONGSBERG GRUPPEN	KOG	Industrials	2.34
NORDIC SEMICONDUCT	NOD	Technology	2.01
SALMAR	SALM	Consumer Staples	1.72
SUBSEA 7	SUBC	Energy	1.55
NEL	NEL	Energy	1.51
VÅR ENERGI	VAR	Energy	1.06
AUTOSTORE HOLDINGS	AUTO	Industrials	0.98
SCHIBSTED SER. A	SCHA	Technology	0.86
FRONTLINE	FRO	Industrials	0.85
KAHOOT!	KAHOT	Technology	0.52
GOLDEN OCEAN GROUP	GOGL	Industrials	0.52
MPC CONTAINER SHIP	MPCC	Industrials	0.48
NORWEGIAN AIR SHUT	NAS	Consumer Discretionary	0.40
REC SILICON	RECSI	Basic Materials	0.40
PGS	PGS	Energy	0.28

We will use these stocks for various examples where we read the history of stock returns, and do analysis.

1.1 Reading the OBX stocks history

First, show the R code for creating a time series object (xts) containing time series of monthly returns for the 25 stocks in the index.

```
library(quantmod)
symbols <- read.table("../misc/obx.txt",header=FALSE)
names(symbols) <- "symbols" # list with index constituents
started <- FALSE
all_obx_returns <- NULL
for (i in 1:nrow(symbols)){
```

```

symbol <- trimws(symbols[i,1]) # the first date (fdate) needs to be defined
data <- getSymbols(symbol, source="yahoo", auto.assign=FALSE, from=fdate)
daily_prices <- na.omit(data[,6])
monthly_returns <- monthlyReturn(daily_prices)
names(monthly_returns) <- symbol
index(monthly_returns) <- as.yearmon(index(monthly_returns))
if (nrow(monthly_returns)>1) {
  if (!started){
    all_obx_returns <- monthly_returns
    started <- TRUE
  }
  else {
    all_obx_returns <- merge(all_obx_returns,monthly_returns,all=TRUE)
  }
}
}

```

1.2 Correlation structure

Using monthly returns for the 15 largest OBX shares for the period 2017–2022, calculate the correlation matrix of the returns.

```

fdate <- as.Date("2015-01-01")
ldate <- as.Date("2022-12-31")
source (" ../2023_01_read_data/read_obx_stocks.R")
all_obx_returns <- window(all_obx_returns,
                          start=as.yearmon(fdate),
                          end=as.yearmon(ldate))
CorrMat <- cor(all_obx_returns,use="pairwise.complete.obs")
CorrMat[upper.tri(CorrMat,diag=TRUE)]<-NA
outdir <- " ../results/2023_01_correlation_matrix/"
ofilename <- paste0(outdir,"corr_matr_15.tex")
print(xtable(CorrMat[1:15,1:15]),file=ofilename)

```

2 Constructing the mean variance set

Exercise

Using historical monthly returns for OBX in the period 2015 to 2022 to estimate means and covariances, illustrate the mean-variance frontier constructed using respectively

1. the five largest shares in the OBX index.
2. the fifteen largest shares in the OBX index.

To do this, need to pull price series for the OBX shares, calculate returns, pick the returns in the given window, and estimate means and variances.

First, the average returns over the period, shown in table 3.

Table 2 Correlation matrix 15 largest OBX stocks

	EQNR	DNB	AKRBP	NHY	YAR	TEL	MOWI	ORK	TOM	STB	KOG	NOD	SALM	SUBC	NEL
DNB	0.48														
AKRBP	0.64	0.57													
NHY	0.43	0.45	0.35												
YAR	0.33	0.50	0.25	0.45											
TEL	-0.08	0.09	-0.03	-0.09	0.14										
MOWI	0.18	0.33	0.30	0.31	0.13	0.06									
ORK	-0.08	-0.20	-0.23	-0.13	-0.04	0.21	0.04								
TOM	0.12	0.10	0.12	0.07	0.00	-0.03	0.04	0.21							
STB	0.37	0.71	0.53	0.52	0.30	0.00	0.36	-0.11	0.07						
KOG	0.11	0.32	0.16	0.26	0.15	0.05	0.24	-0.11	0.04	0.22					
NOD	0.22	0.42	0.18	0.38	0.25	0.14	0.08	-0.01	0.33	0.31	0.22				
SALM	0.08	0.12	0.13	0.08	-0.07	0.02	0.77	0.20	0.11	0.15	0.14	-0.02			
SUBC	0.61	0.59	0.73	0.47	0.36	-0.05	0.25	-0.23	0.10	0.49	0.18	0.26	0.04		
NEL	-0.01	0.11	0.09	0.15	0.09	-0.12	0.06	-0.06	0.28	0.28	0.08	0.13	-0.04	0.07	

Table 3 Average returns 15 largest OBX shares, 2015–2022

EQNR.OL	19.3
DNB.OL	15.4
AKRBP.OL	39.0
NHY.OL	16.8
YAR.OL	11.2
TEL.OL	1.3
MOWI.OL	12.9
ORK.OL	10.4
TOM.OL	28.4
STB.OL	21.4
KOG.OL	23.8
NOD.OL	23.5
SALM.OL	24.6
SUBC.OL	14.8
NEL.OL	51.4

Returns are annualized, and in percent.

Figure 1 Mean variance frontiers

