Metaheurystyki i Technologie Wieloagentowe - Lab3

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Organizational information

e-learning part

```
e_learning_part <- function(student) {
 if(student.missing_classes > 1) {
   TRUE
 } else {
    FALSE // ;-)
 }
}
```

Lab3 - Exercise

Data preparation

Simple analysis

Predict feature with metaheuristic

Data preparation

Go to Polish Stock Exchange website:

`http://www.gpwinfostrefa.pl/GPWIS2/pl/quotes/archive/1`

Download historical data

Choose one year period (e.g. from *2013/01/01* to *2014/01/01*) and download data for selected company (e.g. *IVMX*).

Data will be downloaded in Excel file named like: *PLMATRX00017.xls*

TODO: Open Excel and look at the downloaded data.

Load data to R

To load data from Excel to R we can use package *xlsx*.

```
install.packages('xlsx')
```

Reading data into R:

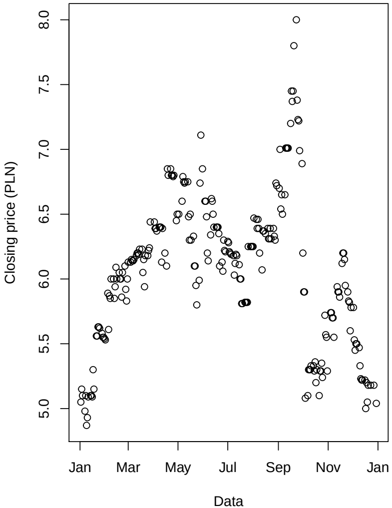
```
require('xlsx')
stock_data <- read.xlsx('../data/PLMATRX00017.xls', 1)
# Date type conversion
stock_data$Data=as.Date(stock_data$Data,format="%Y-%m-%d")
```

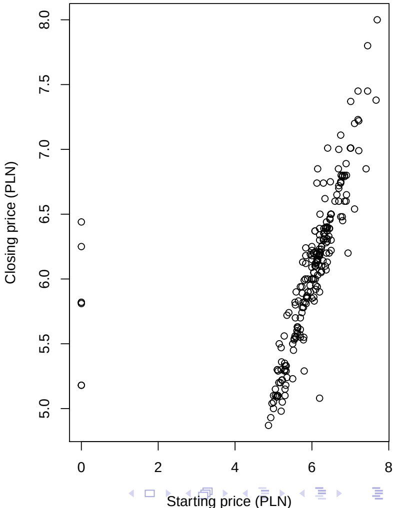
Look what's inside dataframe:

```
summary(stock_data)
head(stock_data)
```

Analysis - Plot the data

```
par(mfrow=c(1,2))
plot(stock_data$Kurs.zamkniecia~stock_data$Data, xlab="Data
plot(stock_data$Kurs.zamkniecia~stock_data$Kurs.otwarcia, x
```



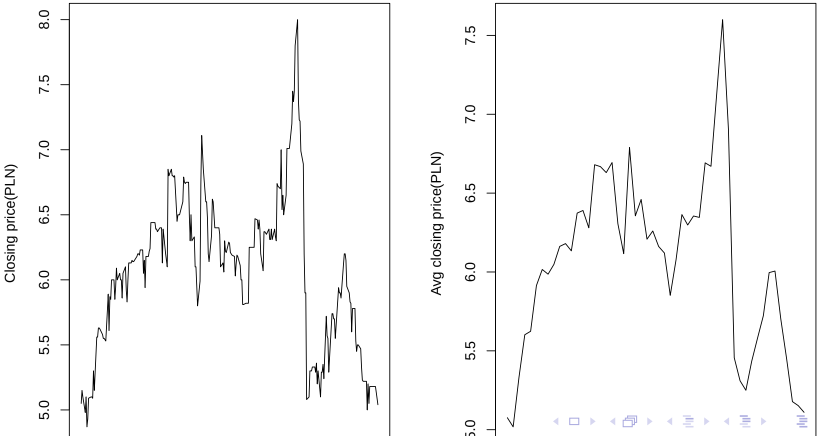


Aggregate data by week

```
stock.week.avg <- as.numeric(
    aggregate(
      stock_data$Kurs.zamkniecia,
      by=list(floor((stock_data$Data-stock_data$Data[1])/7)
      FUN=mean)$x
  )
```

Plot the result

```
par(mfrow=c(1,2))
with(stock_data, {
  plot(Kurs.zamkniecia~Data,type='l',xlab="Date",ylab="Clos
})
plot(stock.week.avg,type='l',xlab="Week",ylab="Avg closing
```



Predicting avarage week price

Predicting week price base on waighted avarage from last weeks. Parameters of prediction are *weights* for avarage.

```
predict_price <- function(weights=c(w1,w2,w3,w4), weekNum,
  prediction <- 0
  weight_sum <-0
  for(i in 1:length(weights)) {
    if(weekNum>i) {
      prediction <- prediction + weights[i]*weekAvg[weekNu
      weight_sum <- weight_sum + weights[i]
    }
  }
  return (prediction/weight_sum)
}
```

Predicting avarage week price - example

Simple avarage from last 4 weeks:

```
test_week_num <- 10
predict_price(c(1,1,1,1),test_week_num, stock.week.avg)
```

```
## [1] 5.991
```

```
stock.week.avg[test_week_num]
```

```
## [1] 6.162
```

Parameters evealuation

Cost function will be Mean Root Square function calculated on all dataset for given parameters (weights for our prediction).

```
predict_eval <- function(weights=c(w1,w2,w3,w4), weekAvg =
  predictions <-as.numeric(lapply(4:length(weekAvg),
                  FUN=function(w) predict_price(weights,w
                  )
                )

  ## data normalization!
  max_val=max(abs(c(weekAvg[-(1:3)],predictions)))
  return(sqrt(mean((weekAvg[-(1:3)]/max_val-predictions/max
}
```

Finding best weights

Optimization task -> CRAN Task View: Optimization and Mathematical Programming

To find weights for our prediction which best fits the model we us one of metaheuristic algorithm: **Particle Swarm Optimization** from package **pso**.

```
install.packages('pso')
?pso::psoptim
```

Particle Swarm Optimization

- optimizes a problem by iteratively trying to improve a candidate solution
- population -> swarm, candidate solutions -> called particles
- movements of the particles are guided by their own best known position in the search-space as well as the entire swarm's best known position
- example visualization: `http://vimeo.com/17407010`
- nice lecture about stochastic optimization `https://www.youtube.com/watch?v=C3jyhZhyNE4`

Running optimizer

```
library(pso)
#random initial weights
init_weights=runif(4,0,1)
result_pso<-psoptim(init_weights, predict_eval, gr=NULL, st
                lower=rep(0,length(init_weights)),
                upper=rep(1,length(init_weights)),
                control=list(maxit=100,type='SPSO2011',
                             reltol=1e-8,vectorize=TRUE))

result_pso$par #best weights
```

```
## [1] 0.91106957 0.00000000 0.00000000 0.01673707
```

```
result_pso$value #minimal cost(eval) function
```

```
## [1] 0.0424164
```

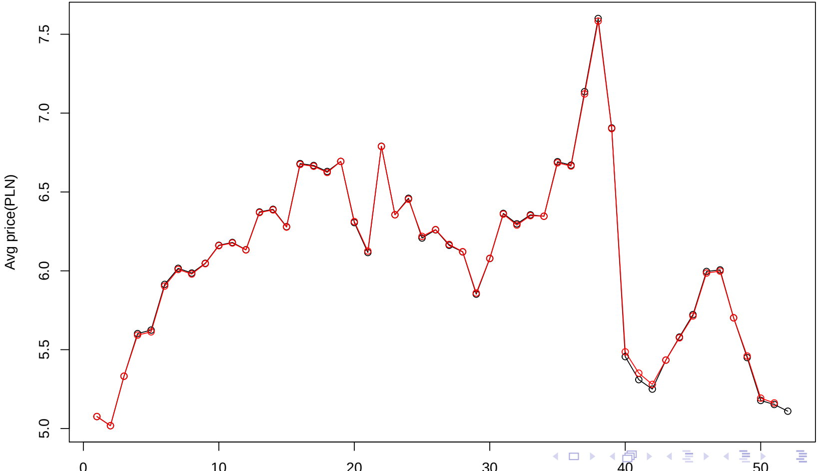
PSO Result visualization

Helping function

```
all_week_predictions<-function(par,weekAvg=stock.week.avg)
  return (as.numeric(lapply(
    2:length(weekAvg),
    FUN=function(n) predict_price(par,n,weekAvg)
  )))
}
```

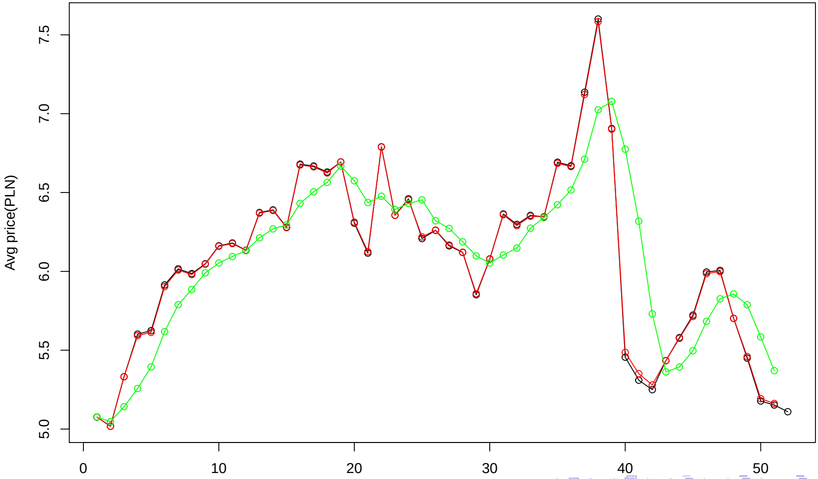
PSO Result visualization - Plot

```
plot(stock.week.avg,type='o',
     ylim=c(min(stock.week.avg),max(stock.week.avg)),xlab='
pso_predictions <- all_week_predictions(result_pso$par)
points(pso_predictions,type='o',col='red')
```



PSO Result visualization - With dummy (1,1,1,1) prediction

```
dummy_predictions <- all_week_predictions(c(1,1,1,1))
points(dummy_predictions,type='o',col='green')
```



Simulated annealing (stats::optim)

```
init_weights=runif(4,0,1)
result_sa <- optim(init_weights, predict_eval, gr=NULL, sto
                   method = "SANN",
                   control = list(maxit = 10000, temp = 100
                                  REPORT = 0, tmax=10)
)
```

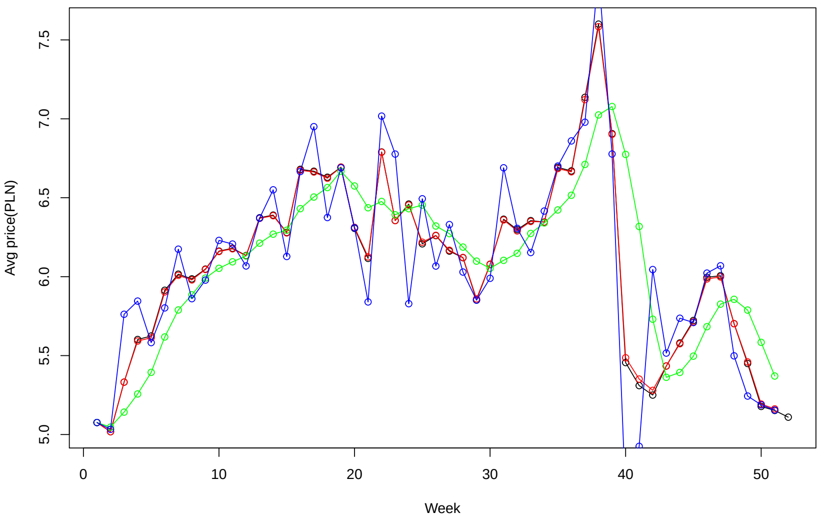
```
result_sa$par
```

```
## [1]  0.9934662  0.3511757 -1.0035440  0.5306047
```

```
result_sa$value
```

```
## [1] 0.05052377
```

Simulated annealing - Plot



Genetic Algorithms (GA::ga)

```
require(GA)
init_weights=runif(4,0,1)

result_ga <- ga("real-valued", predict_eval, stock.week.avg
                min=rep(0,length(init_weights)),
                max=rep(1,length(init_weights)),
                maxiter = 1000
                )
```

```
## Iter = 1  | Mean = 0.06334984  | Best = 0.07516057
## Iter = 2  | Mean = 0.06525658  | Best = 0.07516057
## Iter = 3  | Mean = 0.06800669  | Best = 0.07516057
## Iter = 4  | Mean = 0.06938456  | Best = 0.07516057
## Iter = 5  | Mean = 0.07099839  | Best = 0.07516057
## Iter = 6  | Mean = 0.07185902  | Best = 0.07516057
## Iter = 7  | Mean = 0.07214458  | Best = 0.07533842
## Iter = 8  | Mean = 0.07235878  | Best = 0.07533842
## Iter = 9  | Mean = 0.07320234  | Best = 0.07533842
```

Genetic Algorithms - Plot