concatenating_predictions

Concatenating Predictions

```
library(keras)
library(tensorflow)
library(tidyverse)
library(dplyr)
```

Loading options_call and options_put from black_scholes_final

```
options_call <- read.csv("calls_w_bs.csv")
options_call[,1] <- NULL
options_put <- read.csv("puts_w_bs.csv")
options_put[,1] <- NULL
```

MLP1

```
# call options
model_call_saved <- load_model_hdf5("mlp1-call30.h5")

all_calls <- options_call[, c("strike_price", "date_ndiff", "treasury_rate", "closing_price", "s
igma_20")]
all_calls$strike_price <- all_calls$strike_price / 1000
head(all_calls)
```

```
##   strike_price date_ndiff treasury_rate closing_price   sigma_20
## 1         37.5        719          0.86         28.41 0.01521071
## 2         22.5        719          0.86         28.41 0.01521071
## 3         35.0        719          0.86         28.41 0.01521071
## 4         45.0        719          0.86         28.41 0.01521071
## 5         27.0         75          0.10         28.41 0.01521071
## 6         29.0        166          0.17         28.41 0.01521071
```

```
all_calls_mat <- as.matrix(all_calls)

mcs_pred <- predict(object=model_call_saved, all_calls_mat)
mcs_pred <- as.data.frame(mcs_pred)

# put options
model_put_saved <- load_model_hdf5("mlp1-put30.h5")

all_puts <- options_put[, c("strike_price", "date_ndiff", "treasury_rate", "closing_price", "sig
ma_20")]
all_puts$strike_price <- all_puts$strike_price / 1000
all_puts_mat <- as.matrix(all_puts)

mps_pred <- predict(object=model_put_saved, all_puts_mat)
mps_pred <- as.data.frame(mps_pred)
```

MLP2

```
# call options
model2_call_saved <- load_model_hdf5("mlp2-call60.h5")

m2cs_pred <- predict(object=model2_call_saved, all_calls_mat)
m2cs_pred <- as.data.frame(m2cs_pred)
m2cs_pred <- rowMeans(m2cs_pred)
m2cs_pred <- as.data.frame(m2cs_pred)

# put options
model2_put_saved <- load_model_hdf5("mlp2-put60.h5")

m2ps_pred <- predict(object=model2_put_saved, all_puts_mat)
m2ps_pred <- as.data.frame(m2ps_pred)
m2ps_pred <- rowMeans(m2ps_pred)
m2ps_pred <- as.data.frame(m2ps_pred)
```

Concatenating

```
final_options_call <- cbind(options_call, mcs_pred, m2cs_pred)
final_options_put <- cbind(options_put, mps_pred, m2ps_pred)

sam1 <- read.csv("data_to_sam.csv")
sam1_call <- sam1 %>% filter(cp_flag == "C")
sam1_lstm_pred <- sam1_call$LSTM_pred
sam1_lstm_pred <- as.data.frame(sam1_lstm_pred)

sam1_put <- sam1 %>% filter(cp_flag == "P")
sam1_lstm_pred_put <- sam1_put$LSTM_pred
sam1_lstm_pred_put <- as.data.frame(sam1_lstm_pred_put)

real_final_call <- cbind(final_options_call, sam1_lstm_pred)
real_final_put <- cbind(final_options_put, sam1_lstm_pred_put)

colnames(real_final_call) <- c("date", "strike_price", "best_bid", "best_offer", "volume", "open
_interest", "date_ndiff", "treasury_rate", "closing_price", "sigma_20", "black_scholes_pred", "m
lp1_pred", "mlp2_pred", "lstm_pred")

colnames(real_final_put) <- c("date", "strike_price", "best_bid", "best_offer", "volume", "open_
interest", "date_ndiff", "treasury_rate", "closing_price", "sigma_20", "black_scholes_pred", "ml
p1_pred", "mlp2_pred", "lstm_pred")

tail(real_final_call)
```

```
##              date strike_price best_bid best_offer volume open_interest
## 716073 2019-12-31        70000    85.80      90.00      5           194
## 716074 2019-12-31        75000    81.05      85.50      0            13
## 716075 2019-12-31        80000    76.40      80.85      0           209
## 716076 2019-12-31        85000    71.90      76.35      0           135
## 716077 2019-12-31        90000    68.90      71.90      3           113
## 716078 2019-12-31        95000    63.20      67.50      3           130
##        date_ndiff treasury_rate closing_price    sigma_20 black_scholes_pred
## 716073        752          1.58         157.7 0.005837897           89.94197
## 716074        752          1.58         157.7 0.005837897           85.10212
## 716075        752          1.58         157.7 0.005837897           80.26226
## 716076        752          1.58         157.7 0.005837897           75.42240
## 716077        752          1.58         157.7 0.005837897           70.58254
## 716078        752          1.58         157.7 0.005837897           65.74268
##        mlp1_pred mlp2_pred lstm_pred
## 716073  89.97689  87.97758  88.79884
## 716074  85.26649  83.26133  84.13886
## 716075  80.64498  78.56840  79.52066
## 716076  76.06620  73.99889  74.96915
## 716077  71.46751  69.49527  70.48207
## 716078  66.95819  65.14622  66.04987
```

```
tail(real_final_put)
```

```
##             date strike_price best_bid best_offer volume open_interest
## 772766 2019-12-31        70000     0.30       1.00      0          1621
## 772767 2019-12-31        75000     0.47       1.63      0            77
## 772768 2019-12-31        80000     1.00       1.97     17            97
## 772769 2019-12-31        85000     1.04       2.49    113           183
## 772770 2019-12-31        90000     2.15       2.45      4           969
## 772771 2019-12-31        95000     2.70       3.65      0           479
##        date_ndiff treasury_rate closing_price    sigma_20 black_scholes_pred
## 772766        752          1.58         157.7 0.005837897                  0
## 772767        752          1.58         157.7 0.005837897                  0
## 772768        752          1.58         157.7 0.005837897                  0
## 772769        752          1.58         157.7 0.005837897                  0
## 772770        752          1.58         157.7 0.005837897                  0
## 772771        752          1.58         157.7 0.005837897                  0
##        mlp1_pred mlp2_pred lstm_pred
## 772766  1.021837 0.8956771 0.8361056
## 772767  1.435433 1.3667198 1.3324390
## 772768  1.828581 1.7999735 1.8104470
## 772769  2.221164 2.2077530 2.2877980
## 772770  2.628717 2.6274238 2.7775790
## 772771  3.091984 3.0780458 3.2744550
```

```
#write.csv(real_final_call, "C:/Users/robin/Desktop/RStudio/calls_all_predictions.csv")

#write.csv(real_final_put, "C:/Users/robin/Desktop/RStudio/puts_all_predictions.csv")
```

Reporting MSE

```
# the following includes the MSE values obtained from the test data for MLP1, MLP2, and LSTM cal
l and put options
models <- c("Black Scholes", "MLP1", "MLP2", "LSTM")
mse_vals_call <- c(3.336878, 0.2456122, 0.08773857, 0.1348956)
mse_vals_put <- c(5.619199, 0.08994421, 0.07796273, 0.08686366)

call_mse_vals <- data.frame(models, mse_vals_call)
colnames(call_mse_vals) <- c("Model", "MSE")

put_mse_vals <- data.frame(models, mse_vals_put)
colnames(put_mse_vals) <- c("Model", "MSE")

# Call options
call_mse_vals
```

```
##           Model        MSE
## 1 Black Scholes 3.33687800
## 2          MLP1 0.24561220
## 3          MLP2 0.08773857
## 4          LSTM 0.13489560
```

```
# Put options
put_mse_vals
```

```
##           Model        MSE
## 1 Black Scholes 5.61919900
## 2          MLP1 0.08994421
## 3          MLP2 0.07796273
## 4          LSTM 0.08686366
```