Gated recurrent unit(GRU) 구현 및 실험 결과 보고

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Introduction

- LSTM 모형을 이용한 자산가격의 변동성 예측이 가능해짐.

- KOSPI, NASDAQ과 같은 금융자산과, Gold, Oil과 같은 실물자산의 변동성 예측을 목표로 함. (금융자산에서부터 -> 금융자산과)

- 전통적인 시계열 예측에서 부족했던 부분을 보완해줄 것을 기대함.

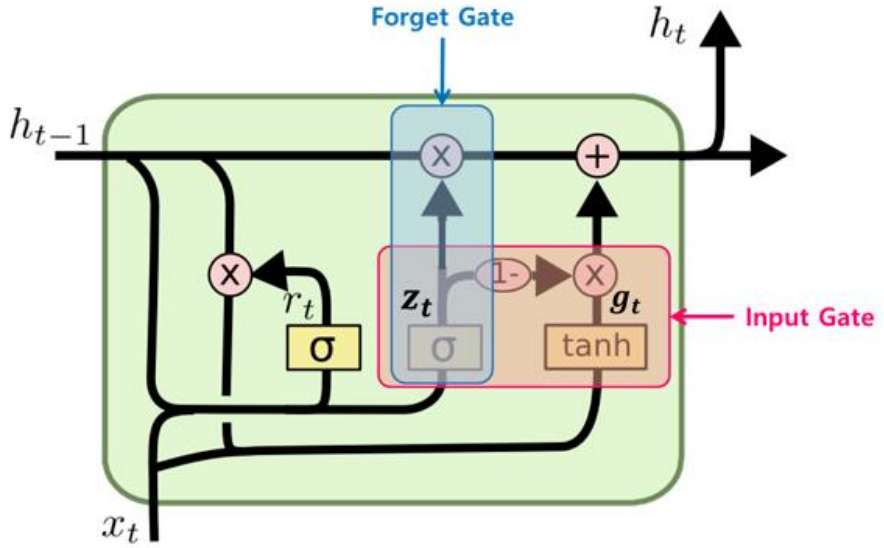
Related works

- Gated Recurrent Unit.

  - lstm은 cell state가 존재하지만,

  GRU에는 Cell state가 존재하지 않음.

  - Gate 가 2개로 lstm보다 연산량이 적음.



Proposed method

Experimental setting

- Dataset

stocks	N	Train	val	test
KOSPI INDEX	5156	3210	979	967
NASDAQ	5265	3263	1002	1000
Gold price	5050	3067	994	989
Oil price	5060	3076	994	990

Used the pandas_datareader module 2000.01.01 – 2020.12.31

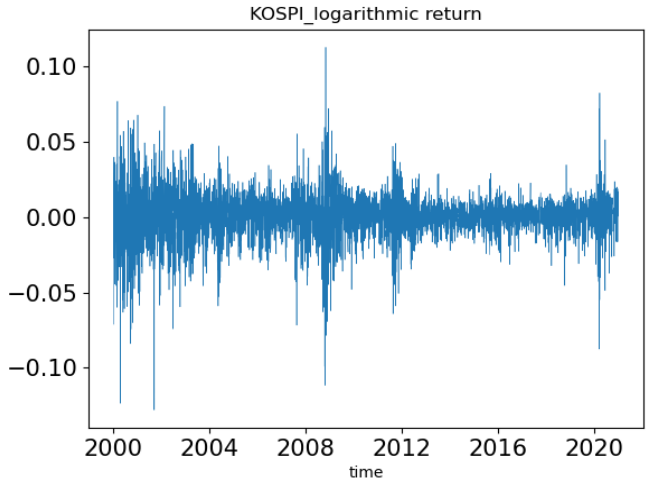
- Statistics

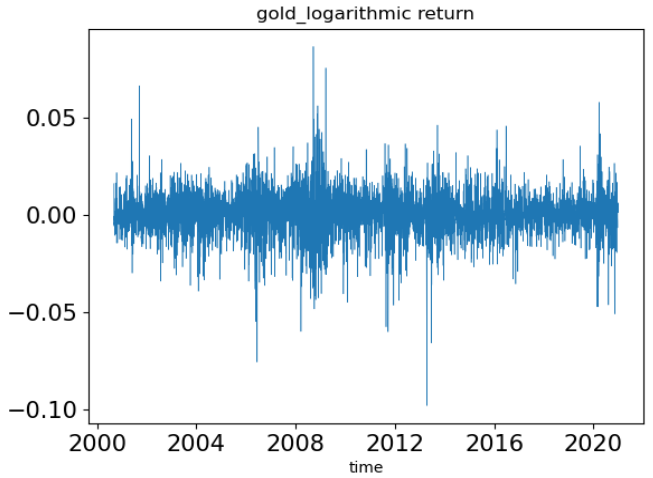
stocks	Mean	Standard deviation	Skewness	Kurtosis	Jerque Bera	ADF
KOSPI INDEX	1582.518	587.343	-0.421	1.861	432.61***	-0.438834
NASDAQ	3791.769	2367.556	1.388	4.395	2125.9183***	3.346301
Gold price	997.637	479.258	-0.105	1.796	315.6375***	-0.459757
Oil price	61.785	25.912	0.400	2.381	216.52333***	-1.997886
KOSPI INDEX log difference	0.000193	0.0149	-0.572	10.03	10943.0983***	-33.339841***

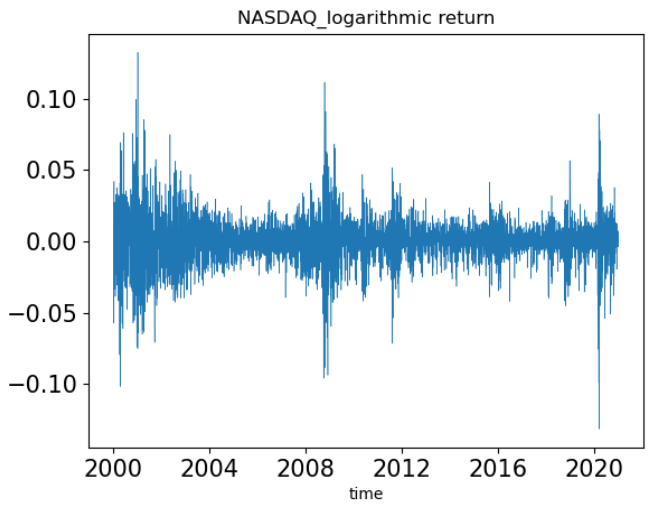
Used Close(종가) variable.

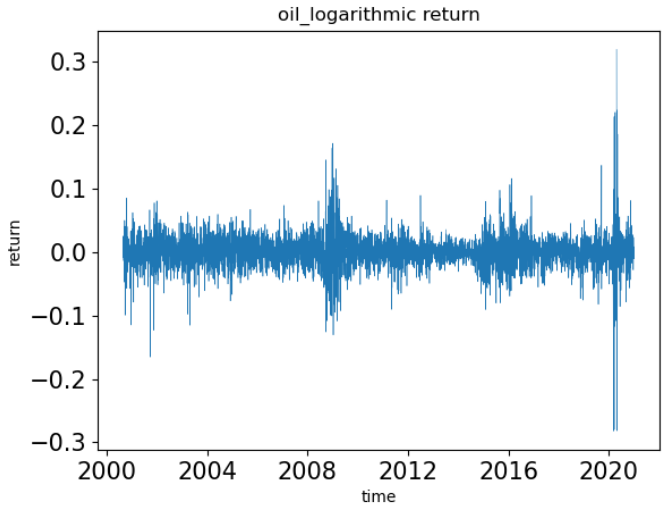
Experimental setting

- logarithmic return : ln((t+1)/t) t : 시점이 t일때 종가(close)









- logarithmic return

  - 수익률을 나타내는 지표 중의 하나.

  - 일반 수익률보다 실제 수익률에 더 가까운 지표.

Experimental setting

- Stock Dataset
  - data normalization
    - $\log(x_i + 1) - \log(x_7 + 1), i = 1, .., 8$
    - $+1$ prevents the denominator to be zero
    - Value added by 1 approximates to value without 1 added

- Metric
  - MSE($e^{predicted\ value}, e^{true\ value}$) or MAE($e^{predicted\ value}, e^{true\ value}$)

- Train, validataion
  - Used MSE, MAE Loss as loss function
  - Used metric function the same as loss function

- Test.
  - Ran model final evaluation by metric

Hyperparameters	Number
hidden state, cell state dimension	10
input sequence length	7
output sequence length	1
epoch	15
Batch size	128

Comparison results

- Results of out-of-sample forecasts with various loss function
  - Mean absolute error

Data	Proposed	RNN	LSTM	GRU
KOSPI INDEX		0.00022234	0.00000939	0.79177896
NASDAQ		0.00129461	0.00020127	0.01636003
Gold price		0.00124109	0.00120533	0.01636003
Oil price				

  - Mean squared error

Data	Proposed	RNN	LSTM	GRU
KOSPI INDEX		0.21690651	0.03744102	0.15417489
NASDAQ		0.10981855	0.02220884	0.00608178
Gold price		0.19466256	0.04409185	0.08163328
Oil price				

Reference

1 Ha Young Kim, & Chang Hyun Won (2018). Forecasting the volatility of stock price index: A hybrid model integrating LSTM with multiple GARCH-type models. Expert Systems With Applications, Vol.103. 25-37. https://doi.org/10.1016/j.eswa.2018.03.002

Appendix

Appendix

- Jarque-bera test
  - 왜도와 첨도가 정규분포와 일치하는지 판단하는 적합도 검정
- ADF test
  - 시계열 데이터가 정상성(stationary)을 만족하는지에 대한 검정
- LM-ARCH 검정
  - ARCH, GARCH와 같은 모형을 적용할 수 있는지에 대한 검정.