SB2_AC2_MLP

September 11, 2021

[1]:
```
import warnings
warnings.filterwarnings(action='ignore',
                        category=DeprecationWarning,
                        module='stable_baselines')
warnings.filterwarnings(action='ignore',
                        category=UserWarning,
                        module='stable_baselines')
warnings.filterwarnings("ignore", category=FutureWarning, module='tensorflow')
warnings.filterwarnings("ignore", category=FutureWarning, module='tensorboard')
warnings.filterwarnings("ignore", category=UserWarning, module='gym')

import gym
import PortfolioAllocationGym
import numpy as np
from stable_baselines import A2C
from stable_baselines.common.policies import MlpLnLstmPolicy #, MlpPolicy,␣
 ↪MlpLstmPolicy
from stable_baselines.common.evaluation import evaluate_policy
from stable_baselines.common.env_checker import check_env
from stable_baselines.bench import Monitor
from tensorflow import nn as nn

import pandas as pd
pd.options.mode.chained_assignment = None  # default='warn'

from datetime import datetime
```

[2]:
```
reward_fn = 'benchmark'
sample_size=100
observations = ['daily_returns', 'ema_50', 'ema_200', 'bb_bbm', 'bb_bbh',␣
 ↪'bb_bbl','bb_bbhi', 'bb_bbli', 'stoch', 'stoch_signal', 'macd','macd_signal',␣
 ↪'obv']
env_kwargs = {'filename':'sp500.csv',
    'date_from':'2008-01-01',
    'date_to':'2017-12-31',
    'investment':1000000,
    'risk_free_rate': 0.5, # approx US Treasury Note return
```

```
    'sample_size':sample_size,
    'random_sample':True,
    'observations' : observations,
    'save_info' : True,
    #'report_point' : 252,
    'reward_function':reward_fn}

train_env = gym.make('PortfolioAllocation-v0', **env_kwargs)
train_env = Monitor(train_env, 'monitor')
```

[3]:
```
check_env(train_env)
```

[4]:
```
venv, obs = train_env.get_sb_env()
```

[5]:
```
#{'gamma': 0.9999, 'n_steps': 1, 'lr_schedule': 'constant', 'lr': 0.001,␣
 ↪'ent_coef': 0.1, 'vf_coef': 0, 'max_grad_norm': 5, 'n_lstm': 128,␣
 ↪'activation_fn': 'tanh', 'net_arch': 'medium'}.
model_kwargs =   {
    'gamma': 0.9999,
    'n_steps': 1,
    'lr_schedule': 'linear',
    'learning_rate': 0.001,
    'ent_coef': 0.1,
    'vf_coef': 0,
    'max_grad_norm': 5,
    'full_tensorboard_log': True,
    'policy_kwargs' : dict (
        n_lstm=128,
        act_fun=nn.tanh,
        net_arch=[64, 'lstm', dict(pi=[256, 256], vf=[256, 256])]
        )
    }

a2c_model = A2C(policy = MlpLnLstmPolicy, tensorboard_log="tensorboard",env =␣
 ↪venv, **model_kwargs)
```

[6]:
```
ts_factor = 40
total_timesteps = ts_factor* (len(venv.venv.envs[0].data.date.unique()))
```

[7]:
```
trained_a2c_model= a2c_model.learn(total_timesteps=total_timesteps,
                                   ␣
 ↪tb_log_name='A2C_'+str(sample_size)+'_'+reward_fn+'_'+datetime.now().
 ↪strftime("%H-%M"))
```

```
WARNING:tensorflow:From C:\Users\kbine\anaconda3\envs\stable2\lib\site-
packages\stable_baselines\common\base_class.py:1169: The name
tf.summary.FileWriter is deprecated. Please use tf.compat.v1.summary.FileWriter
```

```
instead.

day: 2516                sharpe: 9.002                index : 18.340
excess mean: 0.433               cum. rtns: 122.542               portf val:
2,225,424.88
day: 2516                sharpe: 12.440                index : 18.340
excess mean: 1.825               cum. rtns: 216.213               portf val:
3,162,130.13
day: 2516                sharpe: 9.765                index : 18.340
excess mean: 0.767               cum. rtns: 138.078               portf val:
2,380,784.30
day: 2516                sharpe: 11.826                index : 18.340
excess mean: 1.245               cum. rtns: 179.282               portf val:
2,792,823.34
day: 2516                sharpe: 11.979                index : 18.340
excess mean: 1.105               cum. rtns: 166.133               portf val:
2,661,332.58
day: 2516                sharpe: 10.637                index : 18.340
excess mean: 1.078               cum. rtns: 165.530               portf val:
2,655,298.81
day: 2516                sharpe: 12.575                index : 18.340
excess mean: 1.681               cum. rtns: 213.286               portf val:
3,132,857.33
day: 2516                sharpe: 10.509                index : 18.340
excess mean: 0.898               cum. rtns: 152.415               portf val:
2,524,150.24
day: 2516                sharpe: 13.204                index : 18.340
excess mean: 1.825               cum. rtns: 209.484               portf val:
3,094,835.67
day: 2516                sharpe: 10.744                index : 18.340
excess mean: 1.663               cum. rtns: 203.899               portf val:
3,038,989.56
day: 2516                sharpe: 8.263                index : 18.340
excess mean: 0.577               cum. rtns: 123.949               portf val:
2,239,489.38
day: 2516                sharpe: 11.690                index : 18.340
excess mean: 1.575               cum. rtns: 189.356               portf val:
2,893,558.79
day: 2516                sharpe: 12.717                index : 18.340
excess mean: 1.967               cum. rtns: 222.632               portf val:
3,226,322.52
day: 2516                sharpe: 10.976                index : 18.340
excess mean: 1.286               cum. rtns: 172.204               portf val:
2,722,039.33
day: 2516                sharpe: 10.604                index : 18.340
excess mean: 1.595               cum. rtns: 185.469               portf val:
2,854,686.39
day: 2516                sharpe: 11.687                index : 18.340
```

```
excess mean: 0.971                cum. rtns: 162.576                portf val:
2,625,760.90
day: 2516                sharpe: 10.048                 index : 18.340
excess mean: 0.908                cum. rtns: 150.089                portf val:
2,500,889.50
day: 2516                sharpe: 10.937                 index : 18.340
excess mean: 1.290                cum. rtns: 168.523                portf val:
2,685,232.99
day: 2516                sharpe: 13.142                 index : 18.340
excess mean: 1.322                cum. rtns: 183.532                portf val:
2,835,324.10
day: 2516                sharpe: 11.753                 index : 18.340
excess mean: 1.279                cum. rtns: 178.661                portf val:
2,786,607.16
day: 2516                sharpe: 11.980                 index : 18.340
excess mean: 1.701                cum. rtns: 199.054                portf val:
2,990,539.37
day: 2516                sharpe: 8.722                index : 18.340
excess mean: 0.186                cum. rtns: 114.684                portf val:
2,146,841.05
day: 2516                sharpe: 11.579                 index : 18.340
excess mean: 1.310                cum. rtns: 176.949                portf val:
2,769,487.51
day: 2516                sharpe: 11.743                 index : 18.340
excess mean: 2.063                cum. rtns: 229.734                portf val:
3,297,344.10
day: 2516                sharpe: 9.378                index : 18.340
excess mean: -0.186                cum. rtns: 101.100                portf
val: 2,010,997.09
day: 2516                sharpe: 12.446                 index : 18.340
excess mean: 1.112                cum. rtns: 173.428                portf val:
2,734,275.07
day: 2516                sharpe: 10.948                 index : 18.340
excess mean: 1.585                cum. rtns: 196.420                portf val:
2,964,201.39
day: 2516                sharpe: 12.035                 index : 18.340
excess mean: 1.775                cum. rtns: 211.599                portf val:
3,115,985.60
day: 2516                sharpe: 11.282                 index : 18.340
excess mean: 1.565                cum. rtns: 198.076                portf val:
2,980,762.83
day: 2516                sharpe: 12.687                 index : 18.340
excess mean: 1.526                cum. rtns: 197.354                portf val:
2,973,543.75
day: 2516                sharpe: 6.657                index : 18.340
excess mean: -0.095                cum. rtns: 97.281                portf val:
1,972,813.53
day: 2516                sharpe: 12.762                 index : 18.340
```

```
excess mean: 1.783                cum. rtns: 213.556                portf val:
3,135,555.64
day: 2516                 sharpe: 9.266                index : 18.340
excess mean: 0.091                cum. rtns: 112.693                portf val:
2,126,929.85
day: 2516                 sharpe: 11.183                index : 18.340
excess mean: 1.495                cum. rtns: 188.299                portf val:
2,882,986.59
day: 2516                 sharpe: 11.143                index : 18.340
excess mean: 1.587                cum. rtns: 191.964                portf val:
2,919,637.28
day: 2516                 sharpe: 14.376                index : 18.340
excess mean: 1.820                cum. rtns: 217.935                portf val:
3,179,349.40
day: 2516                 sharpe: 12.013                index : 18.340
excess mean: 1.228                cum. rtns: 173.129                portf val:
2,731,290.18
day: 2516                 sharpe: 12.035                index : 18.340
excess mean: 1.467                cum. rtns: 191.518                portf val:
2,915,179.14
day: 2516                 sharpe: 13.468                index : 18.340
excess mean: 1.573                cum. rtns: 202.940                portf val:
3,029,400.29
day: 2516                 sharpe: 11.631                index : 18.340
excess mean: 1.767                cum. rtns: 207.199                portf val:
3,071,988.22
```

[8]:
```
trained_a2c_model.
 ↪save('ac2_mlplnltsm_'+str(sample_size)+'_'+str(ts_factor)+'_'+reward_fn+'.zip')
```

[9]:
```
eval_kwargs = {'filename':'sp500.csv',
    'date_from':'2019-01-01',
    'date_to':'2020-12-31',
    'investment':1000000,
    'risk_free_rate': 0.5, # approx US Treasury Note return
    'sample_size':100,
    'random_sample':False,
    'observations' : observations,
    'save_info' : True,
    #'report_point' : 252,
    'reward_function':'benchmark_mean'}

eval_env =  gym.make('PortfolioAllocation-v0', **eval_kwargs)
```

[10]:
```
eval_venv, obs = eval_env.get_sb_env()
```

[11]:
```
# Random Agent, before training
mean_reward, std_reward = evaluate_policy(a2c_model, eval_venv,␣
 ↪n_eval_episodes=5)
print(f"mean_reward:{mean_reward:.2f} +/- {std_reward:.2f}")
```

```
day: 402                  sharpe: 4.417                  index : 64.277
excess mean: 0.727                  cum. rtns: 38.115                  portf val:
1,381,154.73
day: 402                  sharpe: 4.615                  index : 64.277
excess mean: 1.133                  cum. rtns: 40.375                  portf val:
1,403,754.24
day: 402                  sharpe: 4.583                  index : 64.277
excess mean: 1.077                  cum. rtns: 40.044                  portf val:
1,400,435.08
day: 402                  sharpe: 4.511                  index : 64.277
excess mean: 0.930                  cum. rtns: 39.215                  portf val:
1,392,153.15
day: 402                  sharpe: 4.594                  index : 64.277
excess mean: 1.094                  cum. rtns: 40.140                  portf val:
1,401,403.42
mean_reward:16.12 +/- 9.41
```

[12]:
```
obs = eval_venv.reset()
mean_reward, std_reward = evaluate_policy(trained_a2c_model, eval_venv,␣
 ↪n_eval_episodes=10)
print(f"mean_reward:{mean_reward:.2f} +/- {std_reward:.2f}")
```

```
day: 402                  sharpe: 4.675                  index : 64.277
excess mean: 1.261                  cum. rtns: 41.078                  portf val:
1,410,782.22
day: 402                  sharpe: 4.649                  index : 64.277
excess mean: 1.208                  cum. rtns: 40.777                  portf val:
1,407,767.86
day: 402                  sharpe: 4.634                  index : 64.277
excess mean: 1.178                  cum. rtns: 40.608                  portf val:
1,406,080.95
day: 402                  sharpe: 4.626                  index : 64.277
excess mean: 1.160                  cum. rtns: 40.508                  portf val:
1,405,084.63
day: 402                  sharpe: 4.629                  index : 64.277
excess mean: 1.166                  cum. rtns: 40.547                  portf val:
1,405,465.49
day: 402                  sharpe: 4.627                  index : 64.277
excess mean: 1.162                  cum. rtns: 40.528                  portf val:
1,405,280.70
day: 402                  sharpe: 4.622                  index : 64.277
excess mean: 1.152                  cum. rtns: 40.478                  portf val:
```

```
1,404,783.27
day: 402                sharpe: 4.590                index : 64.277
excess mean: 1.086                cum. rtns: 40.102                portf val:
1,401,017.14
day: 402                sharpe: 4.566                index : 64.277
excess mean: 1.039                cum. rtns: 39.839                portf val:
1,398,388.49
day: 402                sharpe: 4.546                index : 64.277
excess mean: 0.998                cum. rtns: 39.610                portf val:
1,396,100.41
mean_reward:10.03 +/- 1.18
```