Historical Variance Let's see how we'd be calculating a covariance matrix of assets without the help of a factor model In []: import sys !{sys.executable} -m pip install -r requirements.txt In [1]: import numpy as np import pandas as pd import time import os import quiz_helper import matplotlib.pyplot as plt In [2]: %matplotlib inline plt.style.use('ggplot') plt.rcParams['figure.figsize'] = (14, 8) data bundle In [3]: import os import quiz_helper from zipline.data import bundles In [4]: os.environ['ZIPLINE ROOT'] = os.path.join(os.getcwd(), '...', 'data', 'module 4 quizzes eod') ingest func = bundles.csvdir.csvdir equities(['daily'], quiz helper.EOD BUNDLE NAME) bundles.register(quiz_helper.EOD_BUNDLE_NAME, ingest_func) print('Data Registered') Data Registered **Build pipeline engine** In [5]: from zipline.pipeline import Pipeline from zipline.pipeline.factors import AverageDollarVolume from zipline.utils.calendars import get_calendar universe = AverageDollarVolume(window length=120).top(500) trading calendar = get calendar('NYSE') bundle_data = bundles.load(quiz_helper.EOD_BUNDLE_NAME) engine = quiz helper.build pipeline engine(bundle data, trading calendar) View Data¶ With the pipeline engine built, let's get the stocks at the end of the period in the universe we're using. We'll use these tickers to generate the returns data for the our risk model. In [6]: universe end date = pd.Timestamp('2016-01-05', tz='UTC') universe tickers = engine .run pipeline(Pipeline (screen=universe), universe end date, universe end date) \ .index.get level values(1) \ .values.tolist() universe_tickers Out[6]: [Equity(0 [A]), Equity(1 [AAL]), Equity(2 [AAP]), Equity(3 [AAPL]), Equity(4 [ABBV]), Equity(5 [ABC]), Equity(6 [ABT]), Equity(7 [ACN]), Equity(8 [ADBE]), Equity(9 [ADI]), Equity(10 [ADM]), Equity(11 [ADP]), Equity(12 [ADS]), Equity(13 [ADSK]), Equity(14 [AEE]), Equity(15 [AEP]), Equity(16 [AES]), Equity(17 [AET]), Equity(18 [AFL]), Equity(19 [AGN]), Equity(20 [AIG]), Equity(21 [AIV]), Equity(22 [AIZ]), Equity(23 [AJG]), Equity(24 [AKAM]), Equity(25 [ALB]), Equity(26 [ALGN]), Equity(27 [ALK]), Equity(28 [ALL]), Equity(29 [ALLE]), Equity(30 [ALXN]), Equity(31 [AMAT]), Equity(32 [AMD]), Equity(33 [AME]), Equity(34 [AMG]), Equity(35 [AMGN]), Equity(36 [AMP]), Equity(37 [AMT]), Equity(38 [AMZN]), Equity(39 [ANDV]), Equity(40 [ANSS]), Equity(41 [ANTM]), Equity(42 [AON]), Equity(43 [AOS]), Equity(44 [APA]), Equity(45 [APC]), Equity(46 [APD]), Equity(47 [APH]), Equity(48 [ARE]), Equity(49 [ARNC]), Equity(50 [ATVI]), Equity(51 [AVB]), Equity(52 [AVGO]), Equity(53 [AVY]), Equity(54 [AWK]), Equity(55 [AXP]), Equity(56 [AYI]), Equity(57 [AZO]), Equity(58 [BA]), Equity(59 [BAC]), Equity(60 [BAX]), Equity(61 [BBT]), Equity(62 [BBY]), Equity(63 [BCR]), Equity(64 [BDX]), Equity(65 [BEN]), Equity(66 [BIIB]), Equity(67 [BK]), Equity(68 [BLK]), Equity(69 [BLL]), Equity(70 [BMY]), Equity(71 [BSX]), Equity(72 [BWA]), Equity(73 [BXP]), Equity(74 [C]), Equity(75 [CA]), Equity(76 [CAG]), Equity(77 [CAH]), Equity(78 [CAT]), Equity(79 [CB]), Equity(80 [CBG]), Equity(81 [CBOE]), Equity(82 [CBS]), Equity(83 [CCI]), Equity(84 [CCL]), Equity(85 [CELG]), Equity(86 [CERN]), Equity(87 [CF]), Equity(88 [CFG]), Equity(89 [CHD]), Equity(90 [CHK]), Equity(91 [CHRW]), Equity(92 [CHTR]), Equity(93 [CI]), Equity(94 [CINF]), Equity(95 [CL]), Equity(96 [CLX]), Equity(97 [CMA]), Equity(98 [CMCSA]), Equity(99 [CME]), Equity(100 [CMG]), Equity(101 [CMI]), Equity(102 [CMS]), Equity(103 [CNC]), Equity(104 [CNP]), Equity(105 [COF]), Equity(106 [COG]), Equity(107 [COL]), Equity(108 [COO]), Equity(109 [COP]), Equity(110 [COST]), Equity(111 [COTY]), Equity(112 [CPB]), Equity(113 [CRM]), Equity(114 [CSCO]), Equity(115 [CSRA]), Equity(116 [CSX]), Equity(117 [CTAS]), Equity(118 [CTL]), Equity(119 [CTSH]), Equity(120 [CTXS]), Equity(121 [CVS]), Equity(122 [CVX]), Equity(123 [CXO]), Equity(124 [D]), Equity(125 [DAL]), Equity(126 [DE]), Equity(127 [DFS]), Equity(128 [DG]), Equity(129 [DGX]), Equity(130 [DHI]), Equity(131 [DHR]), Equity(132 [DIS]), Equity(133 [DISCA]), Equity(134 [DISCK]), Equity(135 [DISH]), Equity(136 [DLR]), Equity(137 [DLTR]), Equity(138 [DOV]), Equity(139 [DPS]), Equity(140 [DRE]), Equity(141 [DRI]), Equity(142 [DTE]), Equity(143 [DUK]), Equity(144 [DVA]), Equity(145 [DVN]), Equity(146 [EA]), Equity(147 [EBAY]), Equity(148 [ECL]), Equity(149 [ED]), Equity(150 [EFX]), Equity(151 [EIX]), Equity(152 [EL]), Equity(153 [EMN]), Equity(154 [EMR]), Equity(155 [EOG]), Equity(156 [EQIX]), Equity(157 [EQR]), Equity(158 [EQT]), Equity(159 [ES]), Equity(160 [ESRX]), Equity(161 [ESS]), Equity(162 [ETFC]), Equity(163 [ETN]), Equity(164 [ETR]), Equity(165 [EVHC]), Equity(166 [EW]), Equity(167 [EXC]), Equity(168 [EXPD]), Equity(169 [EXPE]), Equity(170 [EXR]), Equity(171 [F]), Equity(172 [FAST]), Equity(173 [FB]), Equity(174 [FBHS]), Equity(175 [FCX]), Equity(176 [FDX]), Equity(177 [FE]), Equity(178 [FFIV]), Equity(179 [FIS]), Equity(180 [FISV]), Equity(181 [FITB]), Equity(182 [FL]), Equity(183 [FLIR]), Equity(184 [FLR]), Equity(185 [FLS]), Equity(186 [FMC]), Equity(187 [FOX]), Equity(188 [FOXA]), Equity(189 [FRT]), Equity(190 [FTI]), Equity(191 [GD]), Equity(192 [GE]), Equity(193 [GGP]), Equity(194 [GILD]), Equity(195 [GIS]), Equity(196 [GLW]), Equity(197 [GM]), Equity(198 [GOOG]), Equity(199 [GOOGL]), Equity(200 [GPC]), Equity(201 [GPN]), Equity(202 [GPS]), Equity(203 [GRMN]), Equity(204 [GS]), Equity(205 [GT]), Equity(206 [GWW]), Equity(207 [HAL]), Equity(208 [HAS]), Equity(209 [HBAN]), Equity(210 [HBI]), Equity(211 [HCA]), Equity(212 [HCN]), Equity(213 [HCP]), Equity(214 [HD]), Equity(215 [HES]), Equity(216 [HIG]), Equity(217 [HLT]), Equity(218 [HOG]), Equity(219 [HOLX]), Equity(220 [HON]), Equity(221 [HP]), Equity(222 [HPE]), Equity(223 [HPQ]), Equity(224 [HRB]), Equity(225 [HRL]), Equity(226 [HRS]), Equity(227 [HSIC]), Equity(228 [HST]), Equity(229 [HSY]), Equity(230 [HUM]), Equity(231 [IBM]), Equity(232 [ICE]), Equity(233 [IDXX]), Equity(234 [IFF]), Equity(235 [ILMN]), Equity(236 [INCY]), Equity(237 [INFO]), Equity(238 [INTC]), Equity(239 [INTU]), Equity(240 [IP]), Equity(241 [IPG]), Equity(242 [IR]), Equity(243 [IRM]), Equity(244 [ISRG]), Equity(245 [IT]), Equity(246 [ITW]), Equity(247 [IVZ]), Equity(248 [JBHT]), Equity(249 [JCI]), Equity(250 [JEC]), Equity(251 [JNJ]), Equity(252 [JNPR]), Equity(253 [JPM]), Equity(254 [JWN]), Equity(255 [K]), Equity(256 [KEY]), Equity(257 [KHC]), Equity(258 [KIM]), Equity(259 [KLAC]), Equity(260 [KMB]), Equity(261 [KMI]), Equity(262 [KMX]), Equity(263 [KO]), Equity(264 [KORS]), Equity(265 [KR]), Equity(266 [KSS]), Equity(267 [KSU]), Equity(268 [L]), Equity(269 [LB]), Equity(270 [LEG]), Equity(271 [LEN]), Equity(272 [LH]), Equity(273 [LKQ]), Equity(274 [LLL]), Equity(275 [LLY]), Equity(276 [LMT]), Equity(277 [LNC]), Equity(278 [LNT]), Equity(279 [LOW]), Equity(280 [LRCX]), Equity(281 [LUK]), Equity(282 [LUV]), Equity(283 [LVLT]), Equity(284 [LYB]), Equity(285 [M]), Equity(286 [MA]), Equity(287 [MAA]), Equity(288 [MAC]), Equity(289 [MAR]), Equity(290 [MAS]), Equity(291 [MAT]), Equity(292 [MCD]), Equity(293 [MCHP]), Equity(294 [MCK]), Equity(295 [MCO]), Equity(296 [MDLZ]), Equity(297 [MDT]), Equity(298 [MET]), Equity(299 [MGM]), Equity(300 [MHK]), Equity(301 [MKC]), Equity(302 [MLM]), Equity(303 [MMC]), Equity(304 [MNST]), Equity(305 [MO]), Equity(306 [MON]), Equity(307 [MOS]), Equity(308 [MPC]), Equity(309 [MRK]), Equity(310 [MRO]), Equity(311 [MS]), Equity(312 [MSFT]), Equity(313 [MSI]), Equity(314 [MTB]), Equity(315 [MTD]), Equity(316 [MU]), Equity(317 [MYL]), Equity(318 [NAVI]), Equity(319 [NBL]), Equity(320 [NDAQ]), Equity(321 [NEE]), Equity(322 [NEM]), Equity(323 [NFLX]), Equity(324 [NFX]), Equity(325 [NI]), Equity(326 [NKE]), Equity(327 [NLSN]), Equity(328 [NOC]), Equity(329 [NOV]), Equity(330 [NRG]), Equity(331 [NSC]), Equity(332 [NTAP]), Equity(333 [NTRS]), Equity(334 [NUE]), Equity(335 [NVDA]), Equity(336 [NWL]), Equity(337 [NWS]), Equity(338 [NWSA]), Equity(339 [O]), Equity(340 [OKE]), Equity(341 [OMC]), Equity(342 [ORCL]), Equity(343 [ORLY]), Equity(344 [OXY]), Equity(345 [PAYX]), Equity(346 [PBCT]), Equity(347 [PCAR]), Equity(348 [PCG]), Equity(349 [PDCO]), Equity(350 [PEG]), Equity(351 [PEP]), Equity(352 [PFE]), Equity(353 [PFG]), Equity(354 [PG]), Equity(355 [PGR]), Equity(356 [PH]), Equity(357 [PHM]), Equity(358 [PKG]), Equity(359 [PKI]), Equity(360 [PLD]), Equity(361 [PM]), Equity(362 [PNC]), Equity(363 [PNR]), Equity(364 [PNW]), Equity(365 [PPG]), Equity(366 [PPL]), Equity(367 [PRGO]), Equity(368 [PRU]), Equity(369 [PSA]), Equity(370 [PSX]), Equity(371 [PVH]), Equity(372 [PWR]), Equity(373 [PX]), Equity(374 [PXD]), Equity(375 [PYPL]), Equity(376 [QCOM]), Equity(377 [QRVO]), Equity(378 [RCL]), Equity(379 [RE]), Equity(380 [REG]), Equity(381 [REGN]), Equity(382 [RF]), Equity(383 [RHI]), Equity(384 [RHT]), Equity(385 [RJF]), Equity(386 [RL]), Equity(387 [RMD]), Equity(388 [ROK]), Equity(389 [ROP]), Equity(390 [ROST]), Equity(391 [RRC]), Equity(392 [RSG]), Equity(393 [RTN]), Equity(394 [SBAC]), Equity(395 [SBUX]), Equity(396 [SCG]), Equity(397 [SCHW]), Equity(398 [SEE]), Equity(399 [SHW]), Equity(400 [SIG]), Equity(401 [SJM]), Equity(402 [SLB]), Equity(403 [SLG]), Equity(404 [SNA]), Equity(405 [SNI]), Equity(406 [SNPS]), Equity(407 [SO]), Equity(408 [SPG]), Equity(409 [SPLS]), Equity(410 [SRCL]), Equity(411 [SRE]), Equity(412 [STI]), Equity(413 [STT]), Equity(414 [STX]), Equity(415 [STZ]), Equity(416 [SWK]), Equity(417 [SWKS]), Equity(418 [SYF]), Equity(419 [SYK]), Equity(420 [SYMC]), Equity(421 [SYY]), Equity(422 [T]), Equity(423 [TAP]), Equity(424 [TDG]), Equity(425 [TEL]), Equity(426 [TGT]), Equity(427 [TIF]), Equity(428 [TJX]), Equity(429 [TMK]), Equity(430 [TMO]), Equity(431 [TRIP]), Equity(432 [TROW]), Equity(433 [TRV]), Equity(434 [TSCO]), Equity(435 [TSN]), Equity(436 [TSS]), Equity(437 [TWX]), Equity(438 [TXN]), Equity(439 [TXT]), Equity(440 [UAA]), Equity(441 [UAL]), Equity(442 [UDR]), Equity(443 [UHS]), Equity(444 [ULTA]), Equity(445 [UNH]), Equity(446 [UNM]), Equity(447 [UNP]), Equity(448 [UPS]), Equity(449 [URI]), Equity(450 [USB]), Equity(451 [UTX]), Equity(452 [V]), Equity(453 [VAR]), Equity(454 [VFC]), Equity(455 [VIAB]), Equity(456 [VLO]), Equity(457 [VMC]), Equity(458 [VNO]), Equity(459 [VRSK]), Equity(460 [VRSN]), Equity(461 [VRTX]), Equity(462 [VTR]), Equity(463 [VZ]), Equity(464 [WAT]), Equity(465 [WBA]), Equity(466 [WDC]), Equity(467 [WEC]), Equity(468 [WFC]), Equity(469 [WHR]), Equity(471 [WM]), Equity(472 [WMB]), Equity(473 [WMT]), Equity(474 [WRK]), Equity(475 [WU]), Equity(476 [WY]), Equity(477 [WYN]), Equity(478 [WYNN]), Equity(479 [XEC]), Equity(480 [XEL]), Equity(481 [XL]), Equity(482 [XLNX]), Equity(483 [XOM]), Equity(484 [XRAY]), Equity(485 [XRX]), Equity(486 [XYL]), Equity(487 [YUM]), Equity(488 [ZBH]), Equity(489 [ZION]), Equity(490 [ZTS])] In [7]: len(universe tickers) Out[7]: 490 In [8]: from zipline.data.data_portal import DataPortal data_portal = DataPortal(bundle_data.asset_finder, trading_calendar=trading_calendar, first_trading_day=bundle_data.equity_daily_bar_reader.first_trading_day, equity_minute_reader=None, equity_daily_reader=bundle_data.equity_daily_bar_reader, adjustment reader=bundle data.adjustment reader) Get pricing data helper function In [9]: from quiz_helper import get_pricing get pricing data into a dataframe In [10]: returns_df = \ get_pricing(data_portal, trading_calendar, universe tickers, universe_end_date - pd.DateOffset(years=5), universe end date) \ .pct_change()[1:].fillna(0) #convert prices into returns returns df Out[10]: Equity(4 Equity(0 Equity(1 Equity(2 Equity(3 Equity(5 Equity(6 Equity(7 Equity(8 Equity(9 Equity(481 Equity(482 Equit [AAL]) [AAP]) [AAPL]) [ABBV]) [ABC]) [ABT]) [ACN]) [ADBE]) [ADI]) [XL]) [XLNX]) 2011-01-07 0.014230 0.026702 0.007146 0.000000 0.001994 0.004165 0.001648 -0.007127 -0.005818 -0.001838 -0.005619 00:00:00+00:00 2011-01-10 $-0.004174 \quad 0.006195 \quad 0.007435 \quad 0.018852 \quad 0.000000 \quad -0.005714 \quad -0.008896 \quad -0.008854 \quad 0.028714 \quad 0.002926 \quad \dots \quad 0.000947 \quad 0.007814 \quad -0.008896 \quad -0.00889$ 00:00:00+00:00 2011-01-11 $-0.001886 \quad -0.043644 \quad -0.005927 \quad -0.002367 \quad 0.000000 \quad 0.009783 \quad -0.002067 \quad 0.013717 \quad 0.000607 \quad 0.008753 \quad \dots \\$ 00:00:00+00:00 2011-01-12 $0.017254 \quad -0.008237 \quad 0.013387 \quad 0.008133 \quad 0.000000 \quad -0.005979 \quad -0.001011 \quad 0.022969 \quad 0.017950 \quad 0.0017950 \quad 0.0017950$ 0.000257 ... 0.004986 0.015666 0.0 00:00:00+00:00 2011-01-13 -0.004559 0.000955 0.003031 0.003657 0.000000 0.014925 -0.004451 -0.000400 -0.005719 -0.005012 ... 0.030499 -0.0032170.0 00:00:00+00:00 2011-01-14 $0.003439 \quad -0.009156 \quad 0.003022 \quad 0.008106 \quad 0.000000 \quad 0.001395 \quad -0.010111 \quad 0.002590 \quad 0.012283 \quad 0.019827 \quad \dots$ 0.0 00:00:00+00:00 2011-01-18 0.034254 -0.062085 -0.004286 -0.022474 0.000000 0.020889 0.006621 0.006998 0.011542 0.032645 ... 0.001678 0.00250100:00:00+00:00 2011-01-19 -0.010224 -0.008929 0.008754 -0.005314 0.000000 -0.017144 0.002753 -0.002962 -0.007899 -0.020575 ... -0.014834 -0.02359000:00:00+00:00 2011-01-20 0.021953 -0.004732 -0.018189 0.000000 0.004794 0.013322 0.018713 -0.012386 -0.002818 ... -0.024512 0.007744 00:00:00+00:00 2011-01-21 00:00:00+00:00 2011-01-24 $0.014646 \quad 0.027473 \quad -0.001106 \quad 0.032837 \quad 0.000000 \quad 0.005249 \quad 0.005223 \quad 0.008420 \quad 0.022843 \quad 0.014974 \quad \dots \quad 0.012359 \quad 0.008420 \quad 0.00$ 00:00:00+00:00 2011-01-25 0.002178 -0.006736 0.006273 0.0 00:00:00+00:00 2011-01-26 -0.030736 0.066133 0.003593 0.007193 0.000000 0.012227 -0.025241 0.012192 -0.001192 0.002837 ... 0.002628 0.00593400:00:00+00:00 2011-01-27 $0.007721 \quad 0.023178 \quad -0.001553 \quad -0.001877 \quad 0.000000 \quad 0.011833 \quad -0.007928 \quad 0.000179 \quad 0.009845 \quad 0.007480 \quad \dots \quad 0.014267 \quad 0.021169$ 00:00:00+00:00 2011-01-28 $0.003608 \quad -0.023615 \quad -0.002351 \quad 0.009578 \quad 0.000000 \quad -0.003893 \quad -0.007248 \quad -0.000980 \quad 0.017236 \quad 0.013818 \quad \dots \quad 0.004846 \quad 0.000298$ 00:00:00+00:00 2011-02-01 $0.011654 \quad -0.001047 \quad -0.009218 \quad 0.016818 \quad 0.000000 \quad 0.011976 \quad 0.001546 \quad 0.017498 \quad 0.013918 \quad 0.021624 \quad \dots \quad 0.015687 \quad 0.032003 \quad 0.018818 \quad 0.0$ 00:00:00+00:00 $0.010112 \quad -0.039304 \quad -0.027477 \quad -0.002053 \quad 0.000000 \quad -0.021197 \quad 0.011068 \quad 0.003632 \quad -0.002387 \quad 0.002280 \quad \dots \quad -0.012846 \quad -0.004518 \quad -0.0012846 \quad -0.004518 \quad -0.00418 \quad -0.00418 \quad -0.00418 \quad -0.$ 00:00:00+00:00 $-0.000289 \quad 0.007310 \quad 0.014126 \quad -0.002560 \quad 0.000000 \quad -0.003662 \quad 0.005894 \quad 0.004178 \quad 0.002991 \quad -0.013341 \quad ... \quad 0.010430 \quad -0.008169 \quad -0.00$ $0.005627 \quad -0.036500 \quad 0.024014 \quad 0.008915 \quad 0.000000 \quad 0.033047 \quad 0.002616 \quad -0.004360 \quad -0.005070 \quad 0.019659 \ \dots$ 0.009471 0.024709 -0.0 00:00:00+00:00 2011-02-07 00:00:00+00:00 00:00:00+00:00 2011-02-09 $0.004664 \quad 0.000000 \quad 0.016955 \quad 0.008332 \quad 0.000000 \quad 0.003006 \quad -0.001530 \quad 0.001138 \quad -0.016682 \quad 0.004781 \quad \dots \quad -0.011837 \quad -0.001792 \quad -0.00179$ 0.000413 -0.003048 -0.011367 -0.010109 0.000000 0.001101 -0.001110 0.005503 0.016965 0.004513 ... -0.00894700:00:00+00:00 2011-02-11 00:00:00+00:00 $0.001663 \quad -0.015790 \quad -0.023274 \quad 0.006529 \quad 0.000000 \quad 0.005750 \quad 0.009245 \quad 0.000202 \quad 0.005643 \quad 0.009877 \quad \dots \quad -0.011616 \quad 0.000318 \quad 0.008879 \quad \dots \quad -0.0011616 \quad 0.000318 \quad 0.008899 \quad 0.0088999 \quad 0.008899 \quad 0.008899 \quad 0.008899 \quad 0.008899 \quad 0.008899 \quad 0.008999 \quad 0.0089999 \quad 0.008999999$ 00:00:00+00:00 $0.015123 \quad 0.001958 \quad 0.013860 \quad 0.008967 \quad 0.000000 \quad -0.003554 \quad -0.010502 \quad 0.027329 \quad 0.022098 \quad -0.003905 \quad \dots \\$ 00:00:00+00:00 2011-02-17 $-0.003311 \quad -0.017791 \quad -0.024844 \quad -0.013309 \quad 0.000000 \quad 0.029148 \quad 0.001301 \quad 0.011784 \quad 0.008360 \quad 0.008559 \quad \dots \quad 0.015656 \quad 0.000318 \quad 0.0017791 \quad 0.0017991 \quad 0.001799$ $0.011078 \quad -0.020103 \quad -0.006693 \quad -0.021595 \quad 0.000000 \quad 0.009620 \quad 0.012106 \quad -0.007953 \quad 0.011721 \quad -0.001691 \quad \dots \quad 0.053404 \quad 0.001447 \quad 0.001691 \quad \dots \quad 0.001691 \quad \dots$ 00:00:00+00:00 $0.001072 \quad -0.002373 \quad 0.002767 \quad 0.004381 \quad 0.009256 \quad -0.000905 \quad 0.006113 \quad 0.006430 \quad 0.000545 \quad -0.005843 \quad \dots \quad 0.008131 \quad 0.000412 \quad -0.008131 \quad -$ 00:00:00+00:00 2015-11-23 00:00:00+00:00 00:00:00+00:00 $-0.008206 \quad 0.001938 \quad 0.006805 \quad -0.007151 \quad -0.013744 \quad 0.004365 \quad -0.000862 \quad -0.002338 \quad -0.002500 \quad -0.002810 \quad \dots \quad -0.008888 \quad -0.004458 \quad -0.008888 \quad -0.0088888 \quad -0.00888$ 00:00:00+00:00 $-0.003256 \quad 0.009201 \quad 0.003285 \quad -0.001863 \quad -0.004803 \quad 0.000612 \quad 0.000210 \quad 0.003363 \quad 0.004359 \quad 0.003315 \quad \dots \\$ 00:00:00+00:00 2015-11-30 $-0.010209 \quad -0.010321 \quad -0.012798 \quad 0.004159 \quad -0.030838 \quad -0.003542 \quad -0.011004 \quad -0.002228 \quad -0.007703 \quad 0.019522 \quad \dots \quad 0.004212 \quad 0.009348 \quad 0.004212 \quad 0.009348 \quad 0.004212 \quad 0.009348 \quad 0.004212 \quad 0.004212$ 00:00:00+00:00 $0.015748 \quad 0.048493 \quad -0.002396 \quad -0.008116 \quad 0.014957 \quad 0.008718 \quad 0.012022 \quad 0.008480 \quad 0.011918 \quad -0.000970 \quad \dots \quad 0.015192 \quad 0.011075 \quad 0.$ 00:00:00+00:00 2015-12-02 00:00:00+00:00 $-0.009521 \quad -0.012555 \quad -0.019944 \quad -0.009292 \quad -0.027724 \quad -0.001415 \quad -0.023650 \quad -0.015429 \quad -0.022930 \quad -0.027826 \quad \dots \quad -0.008294 \quad -0.010820 \quad$ 00:00:00+00:00 2015-12-04 $0.020199 \quad 0.039303 \quad 0.006779 \quad 0.033246 \quad 0.018899 \quad 0.011957 \quad 0.026046 \quad 0.029924 \quad 0.029696 \quad 0.002713 \quad \dots \quad 0.022211 \quad 0.010326 \quad 0.010$ 00:00:00+00:00 $-0.000340 \quad 0.018020 \quad -0.029578 \quad -0.006298 \quad -0.015921 \quad 0.000898 \quad 0.005727 \quad -0.001463 \quad -0.032188 \quad -0.011988 \quad \dots \quad 0.000000 \quad -0.008791 \quad -0.0$ 00:00:00+00:00 $-0.023307 \quad -0.026876 \quad -0.008866 \quad -0.000425 \quad 0.007114 \quad 0.004906 \quad -0.000209 \quad -0.000280 \quad 0.023661 \quad -0.008216 \quad \dots \quad -0.004606 \quad -0.003910 \quad -0.00816 \quad -0.008816 \quad -0.0$ -0.005170 -0.020213 0.022223 -0.022077 -0.011303 0.001984 -0.012948 -0.014876 -0.023550 -0.023608 ... -0.013092 -0.00993400:00:00+00:00 2015-12-10 $0.015039 \quad 0.010092 \quad -0.009466 \quad 0.004763 \quad -0.004463 \quad 0.012720 \quad 0.007772 \quad 0.002897 \quad -0.006699 \quad 0.008821 \quad \dots \quad -0.006757 \quad 0.001883 \quad 0.012720 \quad 0.001883 \quad 0.001883 \quad 0.0018200 \quad 0.001$ 00:00:00+00:00 $-0.012227 \quad -0.045356 \quad -0.019179 \quad -0.025740 \quad -0.031185 \quad 0.001280 \quad -0.020962 \quad -0.021380 \quad 0.027653 \quad -0.003843 \quad \dots \quad -0.014938 \quad -0$ 00:00:00+00:00 -0.011197 -0.007618 -0.008325 -0.006189 0.025898 0.004406 0.010145 0.010071 0.020127 -0.001938 ... 0.007216 -0.00094100:00:00+00:00 2015-12-15 0.024683 0.019768 0.057990 -0.017686 0.017133 -0.008194 0.017415 0.003386 0.008149 -0.004743 ... 0.015392 0.013516 00:00:00+00:00 2015-12-16 $0.010780 \quad 0.014190 \quad 0.029771 \quad 0.007685 \quad 0.021998 \quad -0.000985 \quad 0.010080 \quad 0.022107 \quad 0.016379 \quad 0.017336 \quad \dots \quad 0.004713 \quad 0.000531 \quad -0.0010780 \quad 0.010780 \quad 0.010770 \quad 0.010780 \quad 0.$ 00:00:00+00:00 $-0.017212 \quad -0.017122 \quad -0.048190 \quad -0.021196 \quad -0.021696 \quad 0.007386 \quad -0.017153 \quad -0.053355 \quad -0.014232 \quad -0.024510 \quad \dots \quad -0.001564 \quad -0.018147 \quad -0.0018147 \quad$ 00:00:00+00:00 2015-12-18 $-0.041084 -0.032259 -0.022863 -0.027064 -0.011342 -0.004497 -0.034461 -0.012883 -0.030679 -0.016940 \dots -0.019013 -0.012314 -0$ 00:00:00+00:00 2015-12-21 $0.009455 \quad 0.031863 \quad 0.000531 \quad 0.012254 \quad 0.008245 \quad 0.009916 \quad 0.007778 \quad 0.010404 \quad 0.003395 \quad 0.011962 \quad \dots \quad 0.006358$ 00:00:00+00:00 2015-12-22 $0.010502 \quad 0.011670 \quad -0.011760 \quad -0.000927 \quad 0.024746 \quad 0.002617 \quad 0.009978 \quad 0.007473 \quad 0.024012 \quad 0.003326 \quad \dots \quad 0.031671 \quad 0.002735 \quad 0.024746 \quad 0.002735 \quad 0.0$ 00:00:00+00:00 $0.011803 \quad 0.009219 \quad 0.008325 \quad 0.012869 \quad 0.017178 \quad 0.007567 \quad 0.013950 \quad 0.006365 \quad 0.009380 \quad 0.008296 \ \dots$ 00:00:00+00:00 2015-12-24 -0.003682 0.012022 0.000465 -0.005341 -0.002041 0.000090 0.000000 -0.001820 -0.004224 0.005673 ... 0.009623 -0.00062000:00:00+00:00 2015-12-28 $0.007040 \quad -0.013259 \quad 0.009526 \quad -0.011204 \quad 0.004953 \quad 0.002309 \quad -0.001550 \quad -0.001441 \quad -0.001060 \quad -0.006164 \quad \dots \quad 0.000503 \quad -0.001064 \quad -0.001064 \quad -0.001069 \quad -0.00$ 00:00:00+00:00 2015-12-29 00:00:00+00:00 -0.006384 -0.016085 -0.005254 -0.013056 0.005904 0.002391 -0.012017 0.005124 -0.000524 -0.013256 ... -0.014617 -0.007064 -0.01820700:00:00+00:00 2015-12-31 $-0.012432 \quad -0.010532 \quad -0.005879 \quad -0.019199 \quad -0.009372 \quad -0.012481 \quad -0.007953 \quad -0.012844 \quad -0.014064 \quad -0.021745 \quad \dots \quad -0.016052 \quad -0.018175 \quad$ 00:00:00+00:00 2016-01-04 -0.028282 -0.033988 0.011494 0.000855 -0.027512 -0.017741 -0.044067 -0.025551 -0.020971 -0.015919 ... -0.024767 -0.02492200:00:00+00:00 2016-01-05 $0.004058 \quad -0.009541 \quad -0.006830 \quad -0.025054 \quad -0.004169 \quad 0.014629 \quad -0.000247 \quad 0.005207 \quad 0.004023 \quad -0.007347 \quad \dots \quad 0.002098 \quad 0.014863 \quad$ 00:00:00+00:00 1256 rows × 490 columns Quiz 1 Check out the <u>numpy.cov documentation</u>. Then think about what's wrong with the following use of numpy.cov In [11]: # What's wrong with this? annualization factor = 252covariance_assets_not_correct = annualization_factor*np.cov(returns_df) In [12]: | ## TODO: Check the shape of the covariance matrix covariance_assets_not_correct.shape Out[12]: (1256, 1256) Answer 1 here: np.cov default rows as observations Quiz 2 How can you adjust the input so that we get the desired covariance matrix of assets? In [14]: | # TODO: calculate the covariance matrix of assets annualization_factor = 252 covariance_assets = annualization_factor * np.cov(returns_df.T) In [15]: covariance_assets.shape Out[15]: (490, 490) Answer 2: Visualize the covariance matrix In [16]: import seaborn as sns In [20]: # view a heatmap of the covariance matrix sns.heatmap(covariance assets,cmap='Paired'); ## If the colors aren't distinctive, please try a couple of these color schemes: ## cmap = 'tab10' # cmap = 'Accent' - 0.30 - 0.24 0.18 0.12

0.06

market. Also, the covariances are mostly below 0.10 rather than higher than 0.10.

Do you know what the <u>seaborn visualization package</u> was named after?

Looking at the colormap are covariances more likely to be positive or negative? Are covariances likely to be above 0.10 or below 0.10?

The seaborn package is named after "Samuel Norman Seaborn", a fictional character from the [TV Series "The West Wing"].

The colormap range is mostly positive, from 0 to 0.30+, so covariances are more likely to be positive than negative. In other words, stocks move with the

Quiz 3

Answer 3 here:

Fun Quiz!

Fun Answer!

Solutions

The solution notebook is here

(https://en.wikipedia.org/wiki/Sam_Seaborn)