

The background of the slide is a close-up, high-angle photograph of numerous gold and silver bars. The bars are arranged in a grid-like pattern, with some gold bars (yellowish) and some silver bars (greyish) interspersed. The lighting creates strong highlights and shadows, emphasizing the metallic texture and the rectangular shape of the bars. The text is overlaid on this image.

# Hypothesis Testing with Gold and Silver Exchange-Traded Funds

Anastasia Kharina, Alyssa Liguori, Jalal Kiani

**NED**



# BACKGROUND

Ned, our neighbor, won the lottery and is interested in investing his riches into the precious metal market. He asked us for advice on how to do that:

What is the best time to put money in the market?

Is there a significant difference between the means of GLD, SLV, and SIL?

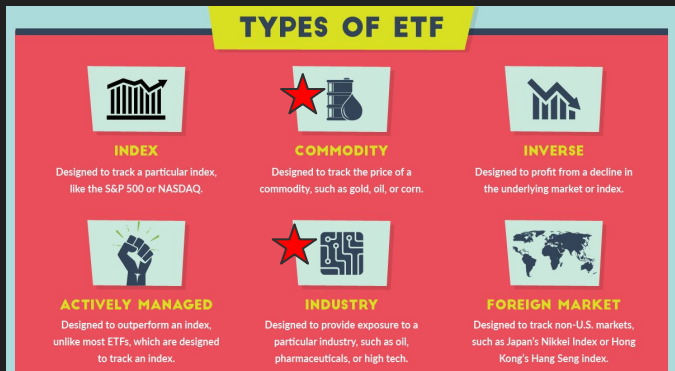
Is Gold or Silver a better investment for long vs short term?

Dataset: [Alpha Vantage API](#)



# Tickers and Terms to Know

<b>Silver ETFs</b>	SLV (Bullion)	SIL (Mining)
<b>Gold ETFs</b>	GLD (Bullion)	GDX (Mining)
<b>Market Index</b>	DJI (Dow Jones Industrial Average)	

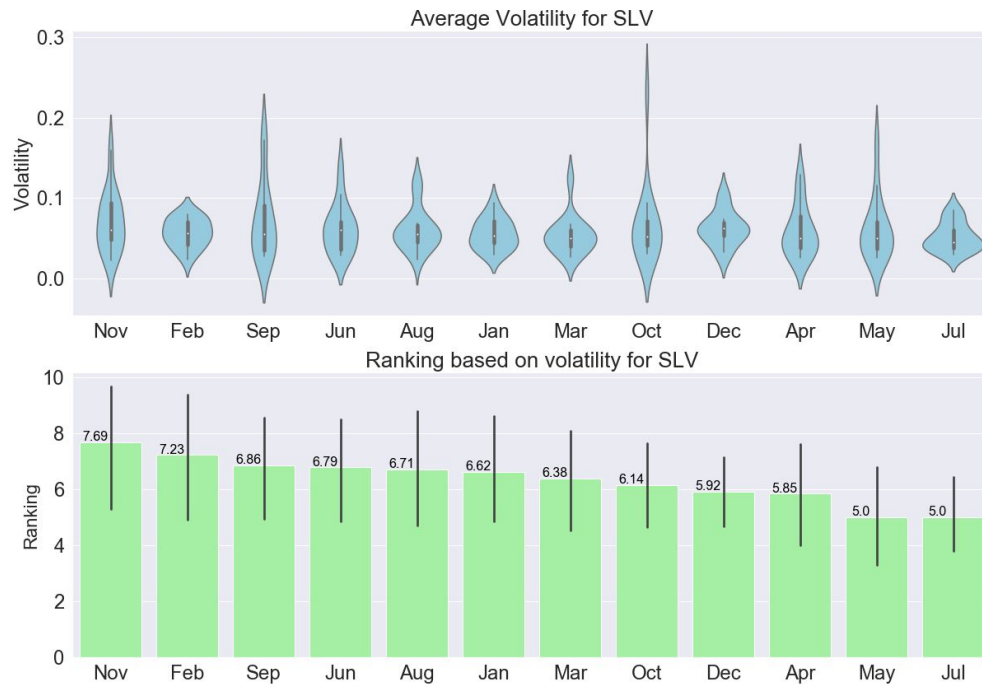


\*ETF = Exchange-Traded Fund

# SLV, SIL, GLD, GDX Price Over Time



November is the most volatile month on average over the past 20 years.  
Is this real or just because of the chance?

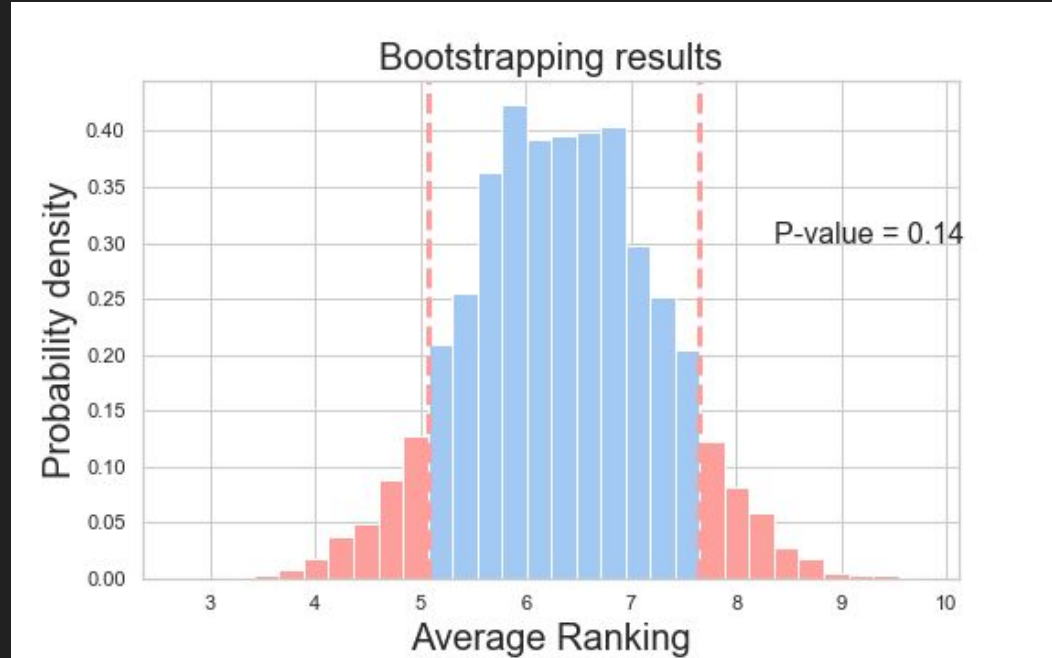


# Hypothesis test #1: Is there a monthly effect?

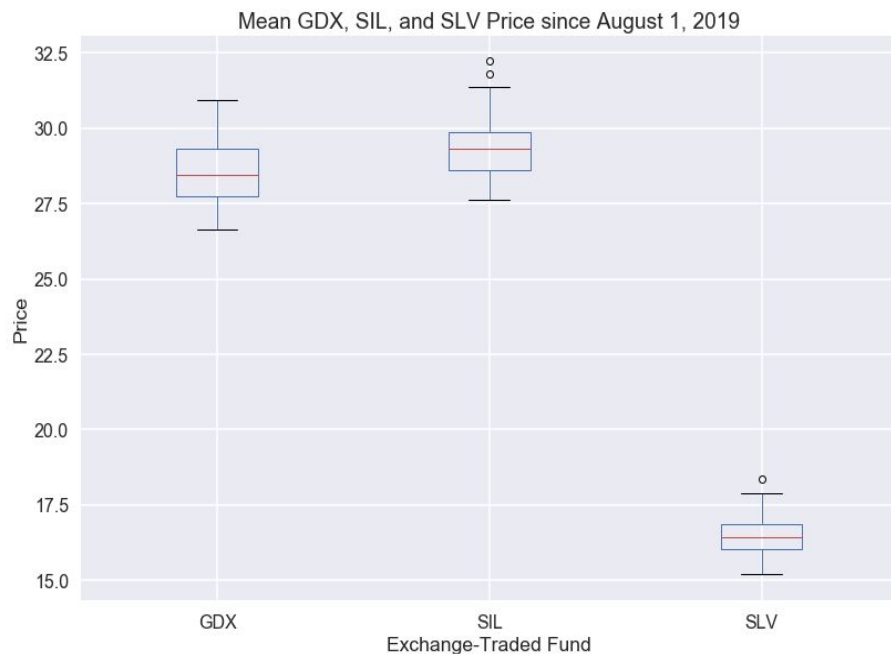
Bootstrapping Method

$H_0$ : No monthly effects are present

$H_A$ : Monthly effects are present



# Hypothesis test #2: Is there a significant difference between means of GDX, SIL, and SLV?



$$H_o : \mu_1 = \mu_2 = \mu_3$$

$H_a$  : At least one of the means differs from the other means

GDX - \$28.53 (Gold Mining)  
VanEck Vectors Gold Miners ETF

SIL \$29.42 (Silver Mining)  
Global X Silver Miners

SLV \$16.50 (Silver Bullion)  
iShares Silver Trust

	sum_sq	df	F	PR(>F)
symbol	4788.269694	2.0	2656.474363	3.997616e-109
Residual	121.668106	135.0	NaN	NaN

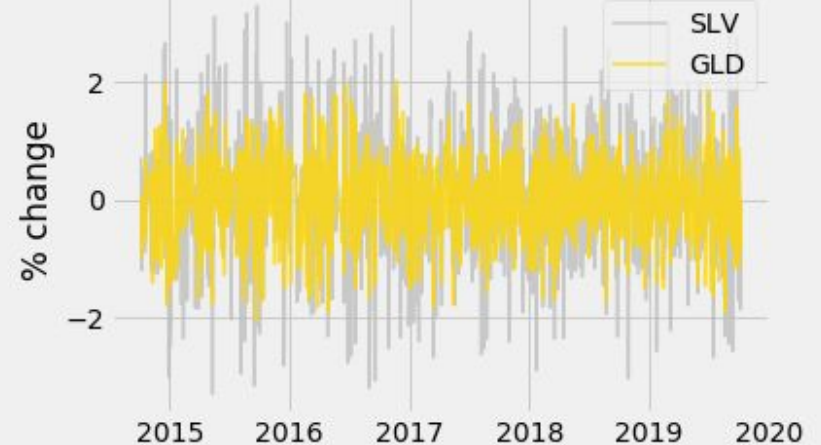


# Hypothesis test # 3 : Invest long term or short-term in SLV and GLD?

SLV ETF Price vs GLD ETF Price, Normalized to 2014/10/06



Daily Price Change Over Time



# Paired T-Test

$H_0$  : movement\_SLV - movement\_GLD = 0

$H_a$  : movement\_SLV - movement\_GLD > 0

	Statistically different? (p-val)	By how much? (coh_d)	Conf Interval (alpha = 0.05)
Daily Movement	No	n/a	
Weekly Movement	Yes	0.13	0.01 - 0.06
Monthly Movement	Yes	0.25	0.01 - 0.06

If Ned wants to do short-term investment, on average SLV moves slightly better than GLD on a weekly- and monthly- basis

# INSIGHTS

- There is a significantly low probability that average closing prices for GDX, SLV, and SIL are not all equal one another for the past few months
- We failed to find sufficient evidence to support the existence of a pattern of monthly volatility for all symbols
- GLD is a good investment on a long-term basis

# FUTURE WORK

- Perform analyses using time-series model
- Set parameters for ARIMA to investigate hypothesis that during the financial crisis, GDX follows DJI closer than GLD follows DJI