

# Monthly Presentation of Drawdown project

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# Overview

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# Asset Description

## US Equity

- AGG: iShares Core US Aggregate Bond
- HYG: iShares iBoxx \$ High Yield Corporate Bd
- TIP: iShares TIPS Bond

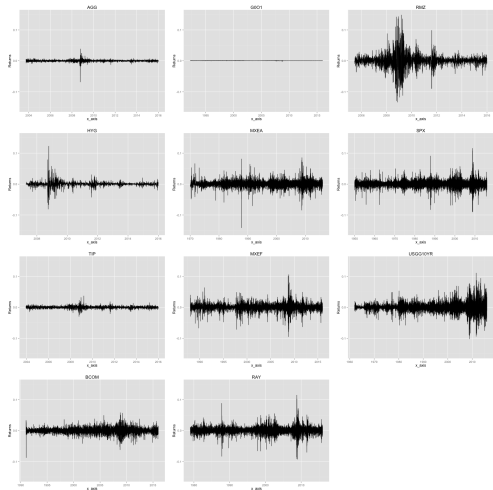
## Index

- BCOM: Bloomberg Commodity Index
- G001: 3-Month U.S. Treasury Bill Index
- MXEA: MSCI EAFE Index
- MXEF: MSCI Emerging Markets Index
- RAY: Russell 3000 Index
- RMZ: MSCI US REIT Index
- SPX: S&P 500 Index
- USGG10YR: US Generic Govt 10 Year

# Returns

## Heading

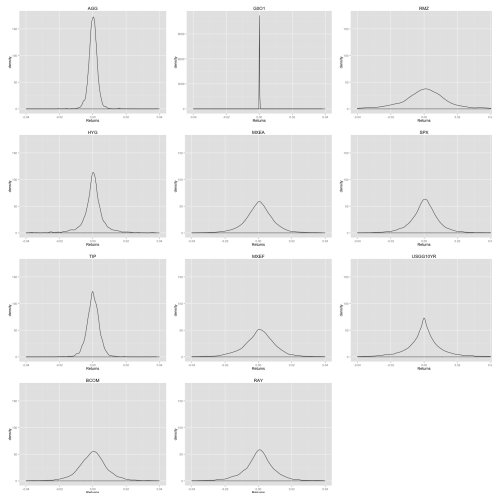
- ① Statement
- ② Explanation
- ③ Example



# Return Distribution

## Heading

- ① Statement
- ② Explanation
- ③ Example



# Sharpe Ratio, Standard deviation, Skewness and Kurtosis

- Sharpe Ratio

$$sharpe\_ratio = \frac{\bar{r}_i - Rf}{\sigma_i} \quad (1)$$

Here we let  $Rf = 0$

- Standard deviation

$$standard\_deviation_i = \sqrt{\frac{1}{n-1} \sum_{t=1}^n (r_i^t - \bar{r}_i)^2} \quad (2)$$

- Skewness

$$skewness_i = E_t \left[ \left( \frac{r_i^t - \bar{r}_i}{\sigma_i} \right)^3 \right] \quad (3)$$

- Kurtosis

$$kurtosis_i = \frac{E_t \left[ (r_i^t - \bar{r}_i)^4 \right]}{\left( E_t \left[ (r_i^t - \bar{r}_i)^2 \right] \right)^2} \quad (4)$$

i: represents different index.

t: time period.

# Sharpe Ratio, Standard deviation, Skewness and Kurtosis

Table: Statistical Summary of Assets

Asset	Sharpe	Sd.	Skewness	Kurtosis
AGG	0.052	0.003	-2.51	81.36
HYG	0.025	0.008	0.87	36.74
TIP	0.040	0.004	0.10	6.49
BCOM	0.001	0.009	-0.27	4.34
G001	0.717	0.000	0.69	26.77
MXEA	0.030	0.010	-0.32	10.75
MXEF	0.031	0.011	-0.39	7.71
RAY	0.036	0.011	-0.66	17.22
RMZ	0.016	0.023	0.36	13.69
SPX	0.035	0.010	-0.65	21.12
USGG10YR	0.003	0.013	0.12	8.81

# VaR & ES

- *Value at Risk (VaR)*

$$VaR_{\alpha}(L) = \inf\{l \in \mathbb{R} : P(L > l) \leq 1 - \alpha\} = \inf\{l \in \mathbb{R} : F_L(l) \geq \alpha\} \quad (5)$$

- *Expected shortfall (ES)*

$$ES_{\alpha}(L) = E[L | L < VaR_{\alpha}(L)] \quad (6)$$



# VaR & ES

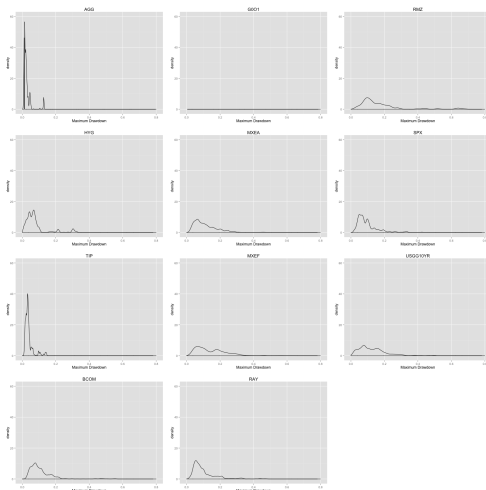
Table: VaR and ES under various probabilities

Asset	VaR(%)			ES(%)		
	0.90	0.95	0.99	0.90	0.95	0.99
AGG	-0.29	-0.40	-0.69	-0.50	-0.66	-1.23
HYG	-0.62	-1.03	-2.50	-1.41	-2.03	-4.01
TIP	-0.44	-0.62	-1.01	-0.72	-0.91	-1.47
BCOM	-1.04	-1.47	-2.62	-1.71	-2.20	-3.55
G0O1	0.00	0.00	-0.01	-0.01	-0.01	-0.03
MXEA	-1.02	-1.46	-2.59	-1.74	-2.26	-3.76
MXEF	-1.21	-1.76	-3.32	-2.11	-2.75	-4.67
RAY	-1.11	-1.62	-2.97	-1.95	-2.56	-4.42
RMZ	-1.91	-3.00	-7.56	-3.99	-5.62	-9.99
SPX	-0.99	-1.43	-2.58	-1.71	-2.23	-3.80
USGG10YR	-1.26	-1.95	-3.59	-2.28	-2.99	-4.89

# Maximum Drawdown Distribution

## Heading

- 1 Statement
- 2 Empirical distribution of maximum drawdown under 6 month rolling window
- 3 Example



# Tail Mean of Maximum Drawown Distribution

Table: tail mean of maximum drawdown distribution under 3-month and 6-month rolling window

Asset	3 month			6 month		
	0.9	0.95	0.99	0.9	0.95	0.99
AGG	5.60	7.72	12.84	8.12	11.45	12.84
HYG	18.41	24.07	29.67	26.43	30.77	32.26
TIP	7.48	9.90	13.10	11.14	12.91	14.39
BCOM	18.14	22.54	38.03	26.61	33.66	51.74
G0O1	0.10	0.145	0.26	0.14	0.23	0.26
MXEA	20.39	23.73	33.32	27.21	31.79	47.11
MXEF	26.21	30.80	48.03	36.35	43.30	59.63
RAY	20.65	25.64	35.95	27.81	34.08	45.08
RMZ	37.30	48.41	63.45	52.04	62.41	67.61
SPX	18.35	22.67	32.46	25.18	30.65	40.69
USGG10YR	23.28	28.11	41.83	32.78	39.00	49.28

# Conditional Expected Drawdown

The conditional expected drawdown is defined as:

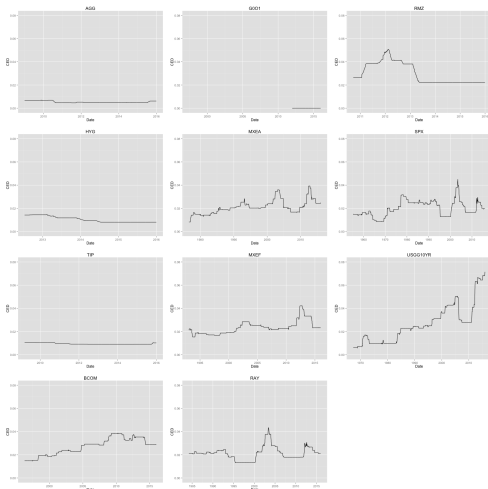
$$CED_{\alpha}(X_{T_n}) = \mathbf{E}(\mu(X_{T_n}) | \mu(X_{T_n}) > DT_{\alpha}) \quad (7)$$

where  $\mu(X_{T_n})$  is the maximum drawdown distribution over a finite path. We calculate the CED of various assets under 0.9, 0.95, 0.99 confidence level for different path length (3 months, 6 months, 1 year, 2 years, 5 years) separately.

# Conditional Expected Drawdown

## Heading

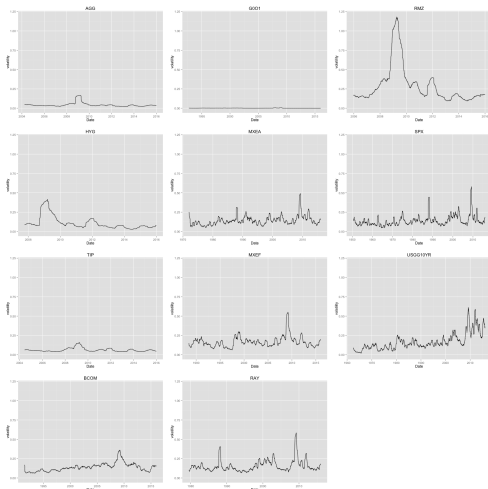
- ① Statement CED under 3month5year Rolling Window (confidence level = 0.95)
- ② Example



# Time Varying Volatility

## Heading

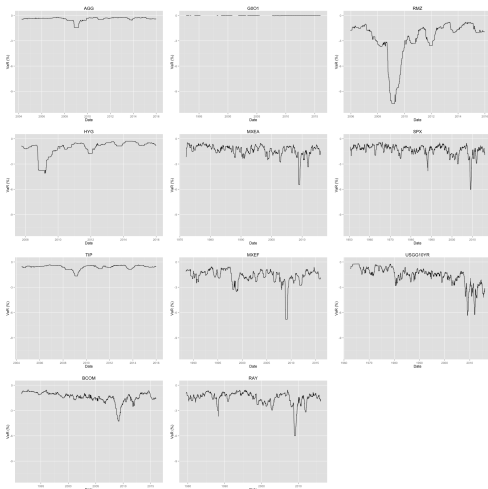
- ① Volatility under 6month rolling window
- ② Example



# Time Varying VaR

## Heading

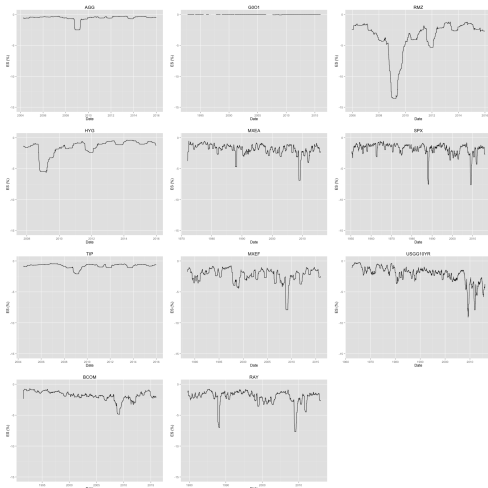
- ① VaR(%) under 6month rolling window
- ② Example



# Time varying ES

## Heading

- ① ES(%) under 6month rolling window
- ② Example





# The End