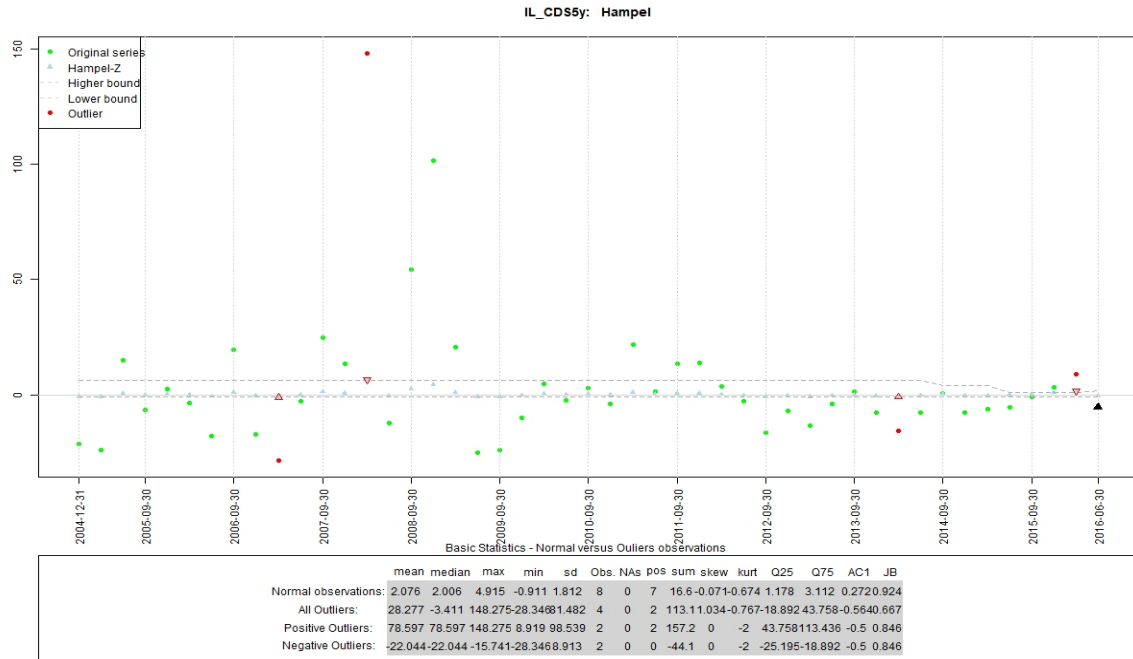**Help on Hampel (1971) method**

Hampel's method is a robust version of outliers detection as it is based on medians rather than means. It is based on robust estimators for the location and the scale of the distribution, i.e. median and MAD (Median Absolute Deviations) rather than the mean and standard deviation. Hampel's limits are:

$$Limit = Median(x) \pm z_{1-\alpha/2} MAD(x)$$

where $MAD = 1.4826 \cdot Median(|x - Median(x)|)$ is a scale estimator and $z_{1-\alpha/2}$ is the $1-\alpha/2$ percentile of the z distribution. For a normally distributed sample, MAD is a consistent estimator of the standard deviation, and α is the type 1 error for detecting outliers. For each observation in the series, x, an $Hampel_Z = \frac{x - Median(x)}{MAD_x}$ is calculated and if that mark is higher (lower) than the upper (lower) limit it is considered an outlier. Screen example with high and low percentiles of 0.995 and 0.005 (i.e., $\alpha/2 = 0.995$ and $1 - \alpha/2 = 0.005$), respectively based on the 100 last observations (weeks), is depicted below. Note that the limits (gray broken lines) are not constant. For instance, after a period (100 weeks in our case) of high volatility MAD grows, thus the limits become narrower. Gray triangles represent the $Hampel_Z$ of the respective normal observations while red circled triangles point to outliers (in red). Particularly, upward (red circled) triangles point to respective negative outliers while downward ones point to respective positive outliers. A summary statistics of both normal observations, positive outliers, negative outliers, and all outliers are exhibited at the bottom of the figure.

IL_CDS5y: Hampel

Basic Statistics - Normal versus Ouliers observations

	mean	median	max	min	sd	Obs.	NAs	pos	sum	skew	kurt	Q25	Q75	AC1	JB
Normal observations:	2.076	2.006	4.915	-0.911	1.812	8	0	7	16.6	-0.071	-0.674	1.178	3.112	0.272	0.924
All Outliers:	28.277	-3.411	148.275	-28.346	81.482	4	0	2	113.11	0.034	-0.767	-18.892	43.758	-0.564	0.667
Positive Outliers:	78.597	78.597	148.275	8.919	98.539	2	0	2	157.2	0	-2	43.758	113.436	-0.5	0.846
Negative Outliers:	-22.044	-22.044	-15.741	-28.346	8.913	2	0	0	-44.1	0	-2	-25.195	-18.892	-0.5	0.846

References

Hampel, R.F. (1971), "A General Qualitative Definition of Robustness," The Annals of Mathematical Statistics, 42, 1887–1896.