Better Hedge Ratios
Paul Teetor
What is a hedge ratio?

- Suppose we are trading a spread: long $Y$ and short $X$.
- For each unit of $Y$, how many units of $X$ should we sell short?
- That number is the hedge ratio.
- We calculate the spread as $S_t = Y_t - \beta X_t$ where $\beta$ is the hedge ratio.
Hedge ratios are often calculated using ordinary least squares (OLS)

- Restate $X$, $Y$ relationship: $Y_t = \alpha + \beta X_t + \varepsilon_t$.
- So spread is $S_t = Y_t - \beta X_t = \alpha + \varepsilon_t$.
- Hedge ratio is the $\beta$ coefficient from linear regression. In R:
  
  ```
  m <- lm(y ~ x)
  beta <- coef(m)[2]
  ```
OLS is asymmetric: switching role of \( X, Y \) gives inconsistent H.R.
Total Least Squares calculates a hedge ratio which is symmetric.

- TLS minimizes orthogonal distance to regression line.
- Treats $X$, $Y$ symmetrically: both are sources of variance.
TLS is easily calculated in R using principal components analysis.

- TLS for 2-asset spread:
  
  ```r
  r <- princomp(~ x + y)
  slope <- r$loadings[2,1] / r$loadings[1,1]
  ```

- Generalized TLS can handle more than 2 assets for multi-leg spreads.

- Can implement zero-intercept regression, too.
**TLS: It's cool**

- TLS treats the sides of the spread symmetrically, giving a consistent hedge ratio.
- Easily computed in R.
- See [http://quanttrader.info/public](http://quanttrader.info/public) for more details.
- paulteetor@yahoo.com or @pteetor