

Empirical exercise – Function – Least squares statistics – Robust

This function calculates, among other statistics, the variance-covariance estimates of the OLS coefficient estimates that are not robust to heteroskedasticity, and those that are robust. Compare the matrix operations used to construct the two types of variance-covariance estimators. This comparison aims at clarifying the meaning of ‘robust’.

```
function LSS = exercisefunctionlssrobust(y,X)
%% Number of observations and column dimension of X
LSS.N      = length(y);
LSS.K      = size(X,2);
%% Coefficient estimates, predictions, residuals
LSS.B_hat  = inv(X'*X)*(X'*y);
LSS.y_hat  = X*LSS.B_hat;
LSS.u_hat  = y-LSS.y_hat;
%% Total, explained, and residual sum of squares
LSS.TSS    = y'*y;
LSS.ESS    = LSS.y_hat'*LSS.y_hat;
LSS.RSS    = LSS.u_hat'*LSS.u_hat;
%% Model fit
LSS.R2_uc   = 1-LSS.RSS/LSS.TSS;
LSS.Mi      = eye(LSS.N)-ones(LSS.N)./LSS.N;
LSS.TSS_c   = y'*LSS.Mi*y;
LSS.R2_c    = 1-LSS.RSS/LSS.TSS_c;
%% The estimator of the variance of the regression error
LSS.sigma_hat_squared = LSS.RSS/(LSS.N-LSS.K);
LSS.sigma_hat      = sqrt(LSS.sigma_hat_squared); % Referred to as the root MSE.
%% The variance-covariance estimator of the OLS estimator
LSS.B_hat_VCE      = inv(X'*X)*X'* ...
    (1/(LSS.N-LSS.K)*LSS.u_hat'*LSS.u_hat.*eye(LSS.N))* ...
    X*inv(X'*X); % inv(X'*X)*X'*X is redundant. See the notes.
LSS.B_hat_SEE      = sqrt(diag(LSS.B_hat_VCE));
%% The variance-covariance estimator of the OLS estimator robust to heteroskedasticity
LSS.B_hat_VCE_robust = inv(X'*X)*X'* ...
    (LSS.u_hat.*LSS.u_hat.*eye(LSS.N))* ...
    X*inv(X'*X)* ...
    LSS.N/(LSS.N-LSS.K);
LSS.B_hat_SEE_robust = sqrt(diag(LSS.B_hat_VCE_robust));
%% Inference
LSS.t      = LSS.B_hat./LSS.B_hat_SEE;
LSS.t_df   = LSS.N-LSS.K;
LSS.p      = tcdf(abs(LSS.t),LSS.t_df,'upper')*2;
%% Inference robust
LSS.t_robust = LSS.B_hat./LSS.B_hat_SEE_robust;
LSS.p_robust = tcdf(abs(LSS.t_robust),LSS.t_df,'upper')*2;
end
```