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); % Or (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); % Mean squared error
LSS.sigma_hat         = sqrt(LSS.sigma_hat_squared);
%% 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);
LSS.B_hat_SEE        = sqrt(diag(LSS.B_hat_VCE));
%% Var-covar. estimator of 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 to heteroskedasticity
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
```