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;
%% 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);
%% Variance-covariance estimator of 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));
%% Variance-covariance estimator of OLS estimator robust to heterosked.
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
```