Interaction terms with Metric Cars Data

```
/********************** mcarsreg2.sas ************************/
options linesize=79 pagesize=100 noovp formdlim='-';
title 'Regression with Metric Cars Data:  Part Two';
title2 'With interaction terms';

data auto;
     infile 'mcars2.dat' firstobs=2 ;      /* Skipping the header on line 1 */
     input id country $ kpl weight length;
/* Indicator dummy vars: Ref category is Japanese */
     if country = 'US' then c1=1;
        else if country = 'Japan' then c1=0;
        else if country = 'Europ' then c1=0;
     if country = 'Europ' then c2=1;
        else if country = 'US' then c2=0;
        else if country = 'Japan' then c2=0;
     /* Interaction Terms */
     cw1 = c1*weight; cw2 = c2*weight;
     label country = 'Country of Origin'
           kpl = 'Kilometers per Litre'
           weight = 'Weight in kg'
           length = 'Length in cm';
proc reg;
     title2 'Test parallel slopes (Interaction)';
     model kpl = weight c1 c2 cw1 cw2;
     interac:  test cw1 = cw2 = 0;
     country:  test c1 = c2 = 0;        /* Does this make sense? */
     eqreg:    test c1=c2=cw1=cw2=0;
     USvsEuSL: test cw1=cw2;

proc iml;
     title3 'Calculate the slopes and intercepts from regression output';
    /* US cars */
     b0 = 29.19482 + -12.97367;
     b1 = -0.01827 + 0.01304;
     print "US Cars    " b0 b1;
    /* European cars */
     b0 = 29.19482 + -4.89198;
     b1 = -0.01827 + 0.00611;
     print "European Cars   " b0 b1;
    /* Japanese cars */
     b0 = 29.19482;
     b1 = -0.01827;
     print "Japanese Cars    " b0 b1;

/* Get the 3 regression lines another way, but tests are different because the
first approach uses ALL the data to estimate the common variance of the
conditional distributions */

proc sort;
     by country;

proc reg;
     model kpl=weight;
     by country;
```

                   Regression with Metric Cars Data: Part Two   1
                      Test parallel slopes (Interaction)
                                           09:52 Sunday, February 11, 2007

                            The REG Procedure
                             Model: MODEL1
                   Dependent Variable: kpl Kilometers per Litre

                          Analysis of Variance

                                 Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   5   489.27223   97.85445   42.46   <.0001
Error   94   216.61706   2.30444
Corrected Total   99   705.88930

              Root MSE   1.51804   R-Square   0.6931
              Dependent Mean   8.79480   Adj R-Sq   0.6768
              Coeff Var   17.26062

                          Parameter Estimates

                                      Parameter   Standard
         Variable   Label   DF   Estimate   Error   t Value

         Intercept   Intercept   1   29.19482   4.45188   6.56
         weight   Weight in kg 1   -0.01827   0.00418   -4.37
         c1   1   -12.97367   4.53404   -2.86
         c2   1   -4.89198   4.85268   -1.01
         cw1   1   0.01304   0.00422   3.09
         cw2   1   0.00611   0.00453   1.35

                          Parameter Estimates

            Variable   Label   DF   Pr > |t|

            Intercept   Intercept   1   <.0001
            weight   Weight in kg   1   <.0001
            c1   1   0.0052
            c2   1   0.3160
            cw1   1   0.0026
            cw2   1   0.1810

```
--------------------------------------------------------------------------------
                 Regression with Metric Cars Data:  Part Two              2
                    Test parallel slopes (Interaction)
                                            09:52 Sunday, February 11, 2007

                          The REG Procedure
                           Model: MODEL1


           Test interac Results for Dependent Variable kpl

                                   Mean
            Source          DF     Square    F Value    Pr > F

            Numerator        2    26.53036     11.51     <.0001
            Denominator     94     2.30444


--------------------------------------------------------------------------------
                 Regression with Metric Cars Data:  Part Two              3
                    Test parallel slopes (Interaction)
                                            09:52 Sunday, February 11, 2007

                          The REG Procedure
                           Model: MODEL1


           Test country Results for Dependent Variable kpl

                                   Mean
            Source          DF     Square    F Value    Pr > F

            Numerator        2    24.48191     10.62     <.0001
            Denominator     94     2.30444


--------------------------------------------------------------------------------
                 Regression with Metric Cars Data:  Part Two              4
                    Test parallel slopes (Interaction)
                                            09:52 Sunday, February 11, 2007

                          The REG Procedure
                           Model: MODEL1


           Test eqreg Results for Dependent Variable kpl

                                   Mean
            Source          DF     Square    F Value    Pr > F

            Numerator        4    17.57360      7.63     <.0001
            Denominator     94     2.30444
```

Handout 4: Regression Part 2   3

                      The REG Procedure
                       Model: MODEL1

        Test USvsEuSL Results for Dependent Variable kpl

                               Mean
        Source   DF   Square   F Value   Pr > F

        Numerator   1   33.02284   14.33   0.0003
        Denominator   94   2.30444

              Regression with Metric Cars Data: Part Two   6
                 Test parallel slopes (Interaction)
          Calculate the slopes and intercepts from regression output
                                       09:52 Sunday, February 11, 2007

                           B0   B1

              US Cars   16.22115   -0.00523

                                B0   B1

              European Cars   24.30284   -0.01216

                                B0   B1

              Japanese Cars   29.19482   -0.01827

                    Regression with Metric Cars Data: Part Two   7
                       Test parallel slopes (Interaction)
                  Calculate the slopes and intercepts from regression output
                                        09:52 Sunday, February 11, 2007

------------------------- Country of Origin=Europ --------------------------

                              The REG Procedure
                               Model: MODEL1
                      Dependent Variable: kpl Kilometers per Litre

                           Analysis of Variance

                                   Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   1   111.66775   111.66775   10.94   0.0063
Error   12   122.49065   10.20755
Corrected Total   13   234.15840

            Root MSE   3.19493   R-Square   0.4769
            Dependent Mean   11.16000   Adj R-Sq   0.4333
            Coeff Var   28.62837

                          Parameter Estimates

                                        Parameter   Standard
      Variable   Label   DF   Estimate   Error   t Value

      Intercept   Intercept   1   24.30284   4.06433   5.98
      weight   Weight in kg   1   -0.01217   0.00368   -3.31

                          Parameter Estimates

            Variable   Label   DF   Pr > |t|

            Intercept   Intercept   1   <.0001
            weight   Weight in kg   1   0.0063

```
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                    Regression with Metric Cars Data:  Part Two                8
                          Test parallel slopes (Interaction)
                  Calculate the slopes and intercepts from regression output
                                       09:52 Sunday, February 11, 2007


------------------------- Country of Origin=Japan -------------------------

                              The REG Procedure
                                Model: MODEL1
                    Dependent Variable: kpl Kilometers per Litre

                              Analysis of Variance

                                     Sum of          Mean
    Source                  DF      Squares        Square     F Value    Pr > F

    Model                    1     44.03370      44.03370       19.41    0.0011
    Error                   11     24.95227       2.26839
    Corrected Total         12     68.98597


              Root MSE                 1.50612     R-Square     0.6383
              Dependent Mean           9.82154     Adj R-Sq     0.6054
              Coeff Var               15.33484


                              Parameter Estimates

                                          Parameter      Standard
     Variable    Label              DF     Estimate         Error    t Value

     Intercept   Intercept           1     29.19482       4.41693       6.61
     weight      Weight in kg        1     -0.01827       0.00415      -4.41

                              Parameter Estimates

              Variable    Label              DF    Pr > |t|

              Intercept   Intercept           1     <.0001
              weight      Weight in kg        1     0.0011

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```

                     Regression with Metric Cars Data: Part Two   9
                         Test parallel slopes (Interaction)
              Calculate the slopes and intercepts from regression output
                                            09:52 Sunday, February 11, 2007

------------------------- Country of Origin=US --------------------------

                             The REG Procedure
                               Model: MODEL1
                   Dependent Variable: kpl Kilometers per Litre

                             Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   1   211.97846   211.97846   217.57   <.0001
Error   71   69.17414   0.97428
Corrected Total   72   281.15260

             Root MSE   0.98706   R-Square   0.7540
             Dependent Mean   8.15836   Adj R-Sq   0.7505
             Coeff Var   12.09874

                            Parameter Estimates

                                         Parameter   Standard
      Variable   Label   DF   Estimate   Error   t Value

      Intercept   Intercept   1   16.22115   0.55869   29.03
      weight   Weight in kg   1   -0.00523   0.00035489   -14.75

                            Parameter Estimates

               Variable   Label   DF   Pr > |t|

               Intercept   Intercept   1   <.0001
               weight   Weight in kg   1   <.0001.01827