The ANOVA Procedure

To create a categorical explanatory variable I divided the data based on whether the crater was in the Northern or Southern hemisphere. To do this I created a new variable called HEMISPHERE. I assigned the Northern hemisphere (latutude 0 or greater) the dummy code 1 and the Southern hemisphere (latitude less than 0) the dummy code 0. Because all 384,343 crater records included a latitude value, all 384,343 records we assigned a HEMISPHERE value.

The SAS statement for assigning the HEMISPHERE variable:

```
if LATITUDE_CIRCLE_IMAGE lt 0 then HEMISPHERE = 0;
else HEMISPHERE = 1;
```

The ANOVA Procedure

Class Level Information		
Class	Levels	Values
HEMISPHERE	2	0 1

Number of Observations Read	384343
Number of Observations Used	384343

Dependent Variable: DIAM_CIRCLE_IMAGE Crater Diameter (in km)

Next, I ran the ANOVA procedure using the HEMUSPHERE and DIAM_CIRCLE_IMAGE (diameter) variables. The SAS command was

PROC ANOVA;
class HEMISPHERE;
model DIAM_CIRCLE_IMAGE = HEMISPHERE;
means HEMISPHERE;

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	44732.57	44732.57	606.90	<.0001
Error	384341	28328293.15	73.71		
Corrected Total	384342	28373025.73			

R-Square	Coeff Var	Root MSE	DIAM_CIRCLE_IMAGE Mean
0.001577	241.3828	8.585228	3.556686

Source	DF	Anova SS	Mean Square	F Value	Pr > F
HEMISPHERE	1	44732.57046	44732.57046	606.90	<.0001

Diameter Hypothesis

H_0 There is no association between the hemisphere where a crater is located and its diameter.
H_A There is an association between the hemisphere where a crater is located and its diameter.

F = 696.90
P < .0001

South (0) Mean 3.83096531 Std Dev 9.47716900
North (1) Mean 3.13234787 Std Dev 6.98436108

Accept H_A

When examining the association between crater diameter (quantitative response variable) and hemisphere (North or South) in which a crater is located (categorical explanatory variable), an Analysis of Variance (ANOVA) revealed that craters in the Southern hemisphere are significantly larger (Mean 3.83 km, s.d. ±9.48 km) compared to those in the Northern hemisphere (Mean 3.13 km, s.d. ±6.98 km), F(1, 384343) = 696.90, p < 0.0001.

Level of HEMISPHERE	N	DIAM_CIRCLE_IMAGE	
		Mean	Std Dev
0	233449	3.83096531	9.47716900
1	150894	3.13234787	6.98436108

Dependent Variable: DEPTH_RIMFLOOR_TOPOG Average Elevation of Crater Rim (in km)

Next, I ran the ANOVA procedure using the HEMUSPHERE and DEPTH_RIMFLOOR_TOPOG (depth) variables. The SAS command was

PROC ANOVA;
class HEMISPHERE;
model DEPTH_RIMFLOOR_TOPOG = HEMISPHERE;
means HEMISPHERE;

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	22.11186	22.11186	451.15	<.0001
Error	384341	18837.55491	0.04901		
Corrected Total	384342	18859.66676			

R-Square	Coeff Var	Root MSE	DEPTH_RIMFLOOR_TOPOG Mean
0.001172	291.9239	0.221388	0.075838

Source	DF	Anova SS	Mean Square	F Value	Pr > F
HEMISPHERE	1	22.11185935	22.11185935	451.15	<.0001

Depth Hypothesis

H_0 There is no association between the hemisphere where a crater is located and its depth.
H_A There is an association between the hemisphere where a crater is located and its depth.

F = 451.15
P < .0001

South (0) Mean 0.08193563 Std Dev 0.23190740
North (1) Mean 0.06640317 Std Dev 0.20404722

Accept H_A

When examining the association between crater dwpth (quantitative response variable) and hemisphere (North or South) in which a crater is located (categorical explanatory variable), an Analysis of Variance (ANOVA) revealed that craters in the Southern hemisphere are significantly deeper (Mean 81.9 m, s.d. ±231.9 m) compared to those in the Northern hemisphere (Mean 66.4 m, s.d. ±204.0 m), F(1, 384343) = 451.15, p < 0.0001.

Level of HEMISPHERE	N	DEPTH_RIMFLOOR_TOPOG	
		Mean	Std Dev
0	233449	0.08193563	0.23190747
1	150894	0.06640317	0.20404722