CHAPTER

9

Data Representation

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Variable Precision and Storage Information

This section discusses variable precision in the OpenVMS operating environment and how numeric and character variables are stored. Note that the issue of numeric precision affects the return values of almost all SAS math functions and many numeric values returned from SAS procedures.

Numeric Variables in the Alpha Environment

The default length of numeric variables in SAS data sets is 8 bytes. (You can change the length of SAS numeric variables with the LENGTH statement in the DATA step.) In the SAS System under OpenVMS Alpha, the data type of numeric variables is IEEE double precision or T_FLOATING. The precision of an OpenVMS Alpha T_FLOATING value is expressed as 15 decimal digits, with a range for T_FLOATING numeric variables of 1.7E+308 to 2.3E–308.

In addition, with Alpha T_FLOATING numbers, you can specify a minimum length of 3 bytes using the LENGTH statement in the DATA step. However, with VAX D_FLOATING numbers, the minimum length you can specify is 2 bytes.

Table 9.1 on page 199 shows the number of nontruncated significant digits and largest integers that can be represented exactly with no loss of precision for each of the specified lengths.

Table 9.1 Significant Digits and Largest Integer for SAS Variables in the Alpha Environment

Length in Bytes	Significant Digits Retained	Largest Integer Represented Exactly
3	3	8,191
4	6	2,097,151

Length in Bytes	Significant Digits Retained	Largest Integer Represented Exactly
5	8	536,870,911
6	11	137,438,953,471
7	13	35,184,372,088,831
8	15	9,007,199,254,740,991

For more information about converting 2-byte numeric variables from VAX environments to 3-byte numeric variables for use in Alpha environments, see the procedure “VAXTOAXP” on page 350.

Numeric Variables in the VAX Environment

The default length of numeric variables in SAS data sets is 8 bytes. (You can control the length of SAS numeric variables with the LENGTH statement in the DATA step.) In the SAS System under OpenVMS VAX, the VAX data type of numeric values is D_FLOATING. The precision of this type of floating-point value is 16 decimal digits. For more information about the representation of the D_FLOATING VAX data type, refer to *Architecture Reference Manual for VAX*.

Table 9.2 on page 200 specifies the significant digits and largest integers that can be stored in SAS numeric variables.

Table 9.2 Significant Digits and Largest Integer by Length for SAS Variables in the VAX Environment

Length in Bytes	Significant Digits Retained	Largest Integer Represented Exactly
2	2	256
3	4	65,536
4	7	16,777,316
5	9	4,294,967,296
6	12	1,099,511,627,776
7	14	281,474,946,710,656
8	16	72,057,594,037,927,936

For example, if you know that the values of a numeric variable are between 0 and 100, you can use a length of 2 bytes to store the number. This saves space in your data set. The following is an example:

```
data mydata;
   length num 2;
   input num;
run;
```

Note: *Dummy variables* (those whose only purpose is to hold a value of 0 or 1) can be stored in a variable whose length is 2 bytes. △

CAUTION:

Only use the 2-byte limit for variables whose values are small, preferably integers. If the value of a variable becomes large or has many significant digits, you may lose precision during arithmetic calculations if the length is only 2 bytes. △

Missing Values

In the SAS System under OpenVMS Alpha, missing values are represented by IEEE Not-a-Number values. An IEEE Not-a-Number is an IEEE floating-point bit pattern that represents something other than a valid numeric value. These numbers are not computationally derivable, meaning that the numeric representation for a Not-a-Number is artificially set. The bit pattern will never be generated by an arithmetic operation.

Note: In the OpenVMS VAX environment, the missing value representation can be generated by a large operation (magnitude of operations) and is thus computationally derivable. △

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