Reading: GLM.Basics
Model: Source text
Problem Type: Offset deductibles in a GLM

Given A loss elimination ratio (LER) analysis was performed to calculate relativities for Auto Collision deductibles.

Deductible	Factor
$500	1.000
$1,000	0.900
$1,500	0.830

← This is the base level as it has a relativity of 1.000

A GLM is being built to model collision pure premium. The GLM will use a Gamma distribution with a log-link function.

Find a.) Briefly explain how the modeler can account for the impact of the insured's choice of deductible.

b.) The modeler was also provided with a curve which relates household income to collision pure premiums. Briefly describe how the modeler can also account for this data in the model.

Solution

a.) The modeler can offset the deductible. This is done as follows:

1.) Transform the deductible relativities to the same scale as the link function.
Here, the log-link function is used, so we get

Deductible	Factor	Log(Factor)
$500	1.000	0.000
$1,000	0.900	-0.105
$1,500	0.830	-0.186

2.) Add this to the **linear predictor**, i.e. the right hand side of the GLM equation: $g(\mu_i) = \ln(\mu_i) = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2$

That is, $g(\mu_i) = \ln(\mu_i) = \beta_0 + \beta_1 \cdot x_1 + \beta_2 \cdot x_2 + 1 \cdot \text{offset}_i$

Do this for each record in the data set.
Offset_i is 0 if the record had a $500 deductible, -0.105 if it had a $1,000 deductible, and -0.186 if it had a $1,500 deductible.

b.) The modeler can offset the household income curve as well as the deductible in the model.
It is important to match the scale of each offset to the link function. In this case, we would take the log of the household income for each record in the data set. When there are two or more variables to be offset in the model, the offsets may be added together.

For example, suppose a record in the data set has a $1,000 collision deductible and a household income of $75,000.
Further, when the household income is applied to the curve, it results in a factor of 1.025.
The offset for this record would be ln(0.9) + ln(1.025) = -0.081