4. (3 points)

An actuary is conducting a generalized linear model (GLM) analysis on historical personal automobile data in order to develop a rating plan.

a. (1.5 points)

Argue against the following factors being included as predictors in the actuary's GLM analysis:

i. Limit of liability.
ii. Number of coverage changes during the current policy period.
iii. ZIP code of the garaging location of the automobile.

b. (1 point)

The actuary is modeling pure premium with a log-link function and a Tweedie error distribution ($1 < p < 2$). Provide two arguments against the inclusion of deductible as a predictor in the actuary's GLM analysis.

c. (0.5 point)

Other than including deductible as a predictor in the GLM, describe how to determine deductible relativities and how such relativities can be incorporated in a GLM.

EXAM 8 FALL 2016 SAMPLE ANSWERS AND EXAMINER'S REPORT

QUESTION: 4	
TOTAL POINT VALUE: 3	**LEARNING OBJECTIVE(S): A3**
SAMPLE ANSWERS	

Part a: 1.5 points

Sample Responses for [i]

- Including limit of liability in the GLM can lead to counterintuitive results such as lower relativity for higher limit due to correlation with other variables not included in the model.
- Including limit may give unexpected results like lower rate for more coverage due to adverse or favorable selection.

Sample Responses for [ii]

- The information will not be available for new business since we are building a GLM for the prospective period.
- Number of coverage changes is likely to change from what it is in the current policy period and thereafter year by year.

Sample Responses for [iii]

- Too many ZIP codes to include it in the GLM; using a spatial smoothing technique would be more appropriate and include the determined value for ZIP code as an offset term in the GLM.
- Sparse data creates credibility concerns and it will add too many degrees of freedom to the model.
- There are too many ZIP codes to be used in a GLM. Furthermore, aggregating them into groups will cause a great loss of information.
- Too many ZIP codes create too many parameters which will potentially lead to overfitting.

Part b: 1 point

- Deductibles should lower frequency (small losses below deductible not reported) but increase severity (since claims that do get reported are higher average cost). This violates the assumption for Tweedie that variables move frequency and severity in the same direction.
- Deductible factors may produce higher relativities at higher deductibles due to factors other than pure losses elimination:
  1. Insureds at high loss potential and high premiums may elect high deductibles to reduce premium
  2. Underwriters may force high deductibles on high risks
- Deductible factors are likely correlated with other factors outside of the model and may give non intuitive results like paying more for less coverage; for example because underwriters force high risk insureds to purchase higher deductibles.

Part c: 0.5 point

- The deductible relativities can be calculated using a mix of experience and exposure rating and then included in the GLM model as an offset.
- Determine deductibles relativities by means loss elimination calculation with historical data [i.e., portion of loss not paid because of deductible E(x;d)/E(x)]. Include the relativities as an offset term in the GLM.

- Deductible relativities should be determined based purely of loss elimination, outside of the GLM model. Then they should be included as offset factors in the log-link function as +ln(relativity).

EXAMINER'S REPORT

Part a

Candidates were expected to recognize the limit of liability was a coverage option, and state a reason to not include them as well as an explanation.

Candidates did not recognize that the **current** policy period was not applicable within the **prospective** GLM and instead provided answers too general for what the question was asking for.

A common mistake was not providing a robust enough argument.

Part b

Candidates were expected to discuss why deductibles should not be used as a predictor in the GLM analysis. When candidates stated deductibles are a bad choice for a predictor variable they then had to state a reason to not include them as well as an explanation to receive full credit.

Some candidates tried to name features of the Tweedie or log-link distribution (such as a point mass at zero), but that does produce an argument against using deductibles in this case. For example, the Tweedie does well to model point masses at zero.

A common mistake was related to the Tweedie error distribution. Candidates often did not give a full explanation of the effect that deductibles would have on frequency and severity and relate that back to assumptions regarding the Tweedie.

Part c

Candidates were expected to explain how to calculate deductible relativities in general (e.g. Loss Elimination Ratios). Candidates were also expected to know how to include these calculated deductible relativities in a GLM; namely, as an offset.

A common mistake was an insufficient or incomplete explanation of the offset procedure to include the deductible relativities in the GLM model.