7. (1.5 points)

A company is considering modifying its rating plan to include factors by age group. Below are statistics for the base model and for the new model.

Statistic	Base Model	New Model
Loglikelihood	-750	-737.5
Deviance	500	475
Parameters	10	15
Data points	1,000,000	1,000,000

a. (1 point)

Calculate the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) for both models.

b. (0.25 point)

Explain whether AIC or BIC is a more reliable test statistic as an indicator of whether to adopt the new model.

c. (0.25 point)

Recommend and briefly justify whether to adopt the new model.

CONTINUED ON NEXT PAGE

QUESTION: 7	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): A4**
SAMPLE ANSWERS	
Part a: 1 point	

Sample 1

AIC = -2LL + 2p
BIC = -2LL + plog(n)
Base Model:
AIC = -2(-750) + 2(10) = 1520
BIC = -2(-750) + 10log(1M) = 1560
New Model:
AIC = -2(-737.5) + 2(15) = 1505
BIC = -2(-737.5) + 15log(1M) = 1565

Sample 2

AIC Base = -2(-750) + 2(10) = 1520
AIC New = -2(-737.5) + 2(15) = 1505
BIC Base = -2(-750) + 10ln(1,000,000) = 1638.16
BIC New = -2(-737.5) + 15ln(1,000,000) = 1682.23

Sample 3

AIC = D+2p
AIC Base = 500 + 2(10) = 520
AIC New = 475 + 2(15) = 505
BIC = D + pln(n)
BIC Base = 500 + 10ln(1,000,000) = 638.155
BIC New = 475 + 15ln(1,000,000) = 682.23

Sample 4

AIC = Deviance + 2p
AIC Old = 500 + 2x10 = 520
AIC New = 475 + 2x15 = 505
BIC = Deviance + plog(n)
BIC Old = 500 + 10x6 = 560
BIC New = 475 + 15x6 = 565

Part b: 0.25 point

- With such a high number of data points, the BIC is over influenced by the ln(data points) term. The AIC is a preferable statistic for such a high sampling.
- AIC is generally more reliable because insurance models are typically built on very large datasets. BIC heavily penalizes for additional parameters and thus will normally recommend exclusion of additional variables.
- AIC is a better indicator because BIC penalizes more heavily and can cause predictive variables to be excluded.

Part c: 0.25 point

- AIC says to adopt since new AIC is lower. BIC says not to. Since AIC is more reliable, I conclude that the new model should be adopted.
- I select the new model because it has the lower AIC result. Deviance is not a good indicator here because adding parameters will necessarily improve deviance. BIC is not appropriate due to above.
- BIC New > BIC Base.
  So do not adopt the new model.
- Given that the AIC is only slightly higher than the AIC for the new model and that the BIC is lower than the BIC for the new model, I would not recommend to adopt the new model.

EXAMINER'S REPORT

Candidates were expected to calculate the AIC and BIC for 2 different models and then use these results to evaluate which model performed better.

Part a

Candidates were expected to calculate AIC and BIC for both the Base Model and the New Model. Full credit was given to candidates that used the correct AIC and BIC formulas.

Candidates could use either ln() or log() in the BIC formula and receive full credit. Deviance could be used to replace -2xLL in both formulas.

Common mistakes include:

- Using an incorrect formula (leaving out the negative or the 2x in the -2xLL portion)
- Mixing up the given information (e.g. using Deviance instead of # of parameters)
- Only calculating one AIC and one BIC statistic, using information from both models

Part b

Candidates were expected to identify why AIC was the more reliable test statistic in this situation.

Common mistakes include:

- Identifying that AIC was the better test statistic, but giving no explanation or an inadequate explanation as to why AIC is better here.
- Identifying BIC as the more reliable test statistic.
- Candidates that identified BIC as the more reliable test statistic were not given credit. Page 63 of the GLM paper clearly states that AIC is better on large datasets.

Part c

Candidates were expected to make a recommendation about which model to adopt and justify their selection.

Full credit was given for recommending either model, as long as it was supported by the AIC or BIC statistics as to why the model was chosen.

Common mistakes include:

- Giving no justification for why the New or Base model was chosen
- Giving no recommendation for which model should be used.
- Saying a higher AIC or BIC was better.
- Correctly identifying that lower AIC or BIC was better, but the conclusion listed in c) didn't match the calculations in part a)
- Using only decreasing Deviance as a reason to adopt the New model. Since Deviance always reduces when new parameters are added, it is not an appropriate metric to use (in isolation) to justify adopting a new model.
- Claiming that the statistics didn't decrease enough to justify the additional parameters. This misinterprets the statistics as they both already penalize for the additional parameters.