3. (1.75 points)

An actuary is creating a workers compensation classification rating plan. The actuary has access to frequency data from years 2002-2012 for fatal claims, which he believes may have low credibility.

After developing and testing a multivariate credibility procedure, the actuary finds the following results:

	Sum of Squared Prediction Errors – Fatal Claims		
Hazard Group	Prediction based on Hazard Group	Prediction based on raw data less the holdout sample	Prediction based on credibility procedure
A	100	90	80
B	110	70	105
C	90	115	75

a. (0.25 point)

Briefly describe the purpose of a holdout sample.

b. (0.5 point)

Justify an appropriate holdout sample from the available frequency data for the actuary to use in the classification analysis.

c. (0.5 point)

Discuss what the actuary's predicted results imply about his credibility procedure.

d. (0.5 point)

Suppose the actuary suspects that there may be an intrinsic downward trend in frequencies of fatal claims between 2002 and 2012 due to improved safety in his clients' workplaces. Propose a way for the actuary to test this theory.

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Question 3:

Model Solution 1

a. The holdout sample allows a model to be tested on real data which it hasn't been fitted to. This gives the best estimate of its predictive power.
b. Even years as holdout (odd years as model fit). Using even years (as opposed to say using the last 6) will correct for changes in risk profiles over time.
c. SSE(HG): 300 (= 100 + 110 + 90)
   SSE(Raw): 275
   SSE(Cred): 260
   The credibility procedure has the best SSE for hazard groups A and C (i.e. lowest). The raw data has the best for B.
d. Mahler provides a correlations test for this by comparing the correlation between years and lag. Less correlation as lag increases would imply shifting risk parameters. Looking at the raw data should be sufficient to confirm the direction of the shift.

Model Solution 2

a. The purpose of the holdout sample is to get an estimate of the unobserved population mean, to compare model results to.
b. Use odd years as the holdout sample and even years for estimation. This way any emerging trends in the data will likely be present in both even and odd years.
c. The credibility procedure produces an improvement for hazard group A and C but not for hazard group B. The SSE for hazard group B is greater for the credibility procedure than for the hazard group mean.
d. Calculate the Chi-squared test statistic = sum of (O – E)^2/E and compare it to a selected critical value threshold. If the test statistic > the critical value then the frequency is shifting over time.
   H(0): Parameters do not shift
   H(A): Parameters shift

Examiner's Comments:

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Part a

For full credit, the candidate must display understanding that the holdout sample is not part of the data used to develop the model and its parameters or is representative of an independent mean. The candidate must state its purpose is to test or validate model results.

Common errors include failing adequately display such understanding.

Part b
For full credit, the candidate must identify a holdout sample and provide adequate justification for it.

The most common error is providing inadequate justification, such as holdout and training samples are similar in size.

Part c
For full credit, the candidate must observe that the method with the lowest sum of squared errors provided the best estimate of the three shown. Comparisons provided in total as well as separately by hazard group are acceptable.

Part d
For full credit, the candidate must identify a method to test the theory and how to apply its accept or reject criterion. Candidates did not have to provide a way to identify the direction of the trend.

The most common error was failing to provide an accept or reject criterion.
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