3. (1.5 points)

The following data shows the experience of a merit rating plan for private passenger vehicles. The merit rating plan uses multiple rating variables, including territory.

Number of Accident-Free Years	Earned Car Years (000s)	Earned Premium ($000s)	Number of Incurred Claims
5 or More	250	500,000	15,000
3 and 4	100	90,000	13,500
1 and 2	80	60,000	8,000
0	70	50,000	10,500
Total	500	700,000	47,000

Territory	Frequency	Average Premium
A	0.05	1,500
B	0.10	2,000
C	0.15	1,250

a. (0.75 point)

Recommend and justify an exposure base for this merit rating plan.

b. (0.75 point)

Calculate the relative credibility of an exposure that has been three or more years accident-free using the exposure base from part (a) above.

CONTINUED ON NEXT PAGE

QUESTION 3	
TOTAL POINT VALUE: 1.5	**LEARNING OBJECTIVE(S): A1c**

SAMPLE ANSWERS

Part a: 0.75 point

Sample 1

Using earned prem as exposure base only correct the maldistribution due to correlation between freq & territory when:

1. Territory differentials are proper, and
2. High freq territory are also high premium terr

Here: Terr C has highest frequency but not highest prem → (2) not satisfied

Hence, using EP as base does not make an improvement

➔ Use earned care year as expo base.

Sample 2

Since high frequency territories are not also high avg premium territories, using EP as a base will not correct for maldistribution. Therefore, I choose ECY as my base.

Sample 3

I would use earned car years. A premium base is appropriate when high frequency territories are also high premium territories. And when territorial differentials are proper. Here, C is the highest frequency but the lowest premium territory. So use earned car years instead.

Sample 4

Territory is a variable that tends to be correlated with other risk characteristics so it would be advisable to use earned premium as an exposure base to correct for exposure correlation, but only if high frequency territory are also high average premium.

This doesn't seem to be the case (i.e. terr C is highest freq, but lowest avg premium) but prem could reflect other vars' impact, so use EP as exposure base.

Part b: 0.75 point

If using car years as exposure base:

Sample 1

3+: (13,500+15,000)/(100+250) = 81.43
Total: 47,000/500 = 94
Rel Freq: 81.43/94 = 0.866
Z= 1 – 0.866 = 0.134

1+: (13,500+15,000+8,000)/(250+100+80) = 84.88
Rel Feq: 84.88/94 = 0.903
Z = 1-0.903 = 0.097

Rel credibility = 0.134/0.097 = 1.38

Sample 2
Mod = (28,500/350)/(47,000/500) = 0.866
Mod = 1 – Z so Z=0.1337

Assume freq = Possion
λ = 47,000/500,000 = 0.94
R 0 years claim free = 1/(1-e^(- λ)) = 11.146
Mod 0 years claim free = (10500/70)/(47,000/500) = 1.596
Mod = RZ+(1-Z) → Z = (Mod – 1)/(R-1) = (1.596-1)/(11.146-1) = 0.0587

Rel cred 3+/Cred 0 = 0.1137/0.0587 = 2.28

If using earned premium as exposure base:

Sample 3
3 or more years claim frequency: (13,500+15,000)/(500,000+90,000) = 0.048
Total claim frequency: 47,000/700,000 = 0.067
Relative claim Frequency of 3 or more years: 0.048/0.067 = 0.72
Z= 1 – 0.72 = 0.28

1 or more years claims frequency: (13,500+15,000+8,000)/(500,000+90,000+60,000) = 0.056
Relative claim frequency of 1 or more years = 0.056/0.067 = 0.84
Z = 1-0.84 = 0.16

Rel credibility = 0.28/0.16 = 1.75

Sample 4
Mod(3+) = ((13.5+15)/(500+90))/(47/700) = 0.719
Cred(3+)= 1 – Mod(3+) =0.281

Mod(0) = (10.5/50)/(47/700) = 3.128
λ = 47,000/500,000 = 0.94
R 0 years claim free = 1/(1-e^(- λ)) = 11.15
Mod(0) = Z_0 * R + (1- Z_o)
3.128 = 11.15*Z_0 + (1-Z_o)
Z_0 = 0.209

Z_{3+} / Z_0 = 1.34

EXAMINER'S REPORT

Candidates were expected to be able to demonstrate knowledge of the potential causes of distortion in the choice of an exposure base and then use that exposure base to determine relative credibility.

SAMPLE ANSWERS AND EXAMINER'S REPORT

In general, candidates did well with part (a) but were confused with the relative credibility for part (b), with many candidates only calculating the 3+ credibility and not the relative credibility to 1+. Note that full credit was given for calculating credibility relative to 0+ as well.

Part a

Candidates were expected to discuss that the maldistribution of rating variables can be corrected by earned premium, but only under two circumstances:

- High frequency territories are also high premium territories
- The territory differentials are properly priced

Candidates needed to use the data provided to build a case for the exposure base that they selected (premium or car years). This could be in the form of:

- Arguing that because the high frequency territories are not also high premium territories the first condition is not met and thus car years must be used
- Arguing that while the frequencies do not appear to be in-line with premiums by territory, that premium may still be a better choice as it addresses some maldistribution and should be still used as the exposure base

Common mistakes included:

- Selecting an exposure base without including the reasoning behind the selection

Part b

Candidates were expected to calculate the relative credibility for the class of operators who have been accident-free for 3 or more years relative to those who have been accident-free for 1 or more years. Full credit was given for using 0+ years accident-free instead, and full credit was given for using either car years or premium as the exposure base.

Common mistakes included:

- Failing to calculate a ratio of credibilities (many candidates simply calculated the credibility for 3 or more accident-free years)