MS Module 24 Least squares bias function practice exam questions

(The attached PDF file has better formatting.)

[The practice problems in the 24 modules explain the statistical procedures; the practice exam questions in this thread shows what you will be asked on the final exam.]

The mean value and the number of observations in each cell of a 2 × 2 classification table are

Means	*Column 1*	*Column 2*	*Observations*	*Column 1*	*Column 2*
Row 1	71	59	*Row 1*	11	12
Row 2	36	25	*Row 2*	14	19

Illustration: The cell in row 1 column 1 has a mean of 71 from a sample of 11 observations.

An actuary is setting class relativities for insurance pricing using a multiplicative model and a least squares bias function with

- a base rate of 10
- a starting relativity for column 1 of 1
- a starting relativity for column 2 of 1.2

Question 1.2: Multiplicative model least squares implied relativity row 1

What is the implied relativity for Row 1, given the starting relativities by column?

Answer 1.2: $(71 \times 11 \times 1.0 + 59 \times 12 \times 1.2) / (10 \times (1.0^2 \times 11 + 1.2^2 \times 12)) = 5.766$

(relativities computed by taking partial derivatives to minimize the sum of the squared errors; see practice problems for the derivation)

Question 1.3: Multiplicative model least squares implied relativity row 2

What is the implied relativity for Row 2, given the starting relativities by column?

Answer 1.3: $(36 \times 14 \times 1.0 + 25 \times 19 \times 1.2) / (10 \times (1.0^2 \times 14 + 1.2^2 \times 19)) = 2.597$

Question 1.4: Multiplicative model least squares implied relativity column 1

What is the implied relativity for Column 1, given the computed relativities by row?

Answer 1.4: $(71 \times 11 \times 5.766 + 36 \times 14 \times 2.597) / (10 \times (5.766^2 \times 11 + 2.597^2 \times 14)) = 1.263$

Question 1.5: Multiplicative model least squares implied relativity column 2

What is the implied relativity for Column 2, given the computed relativities by row?

Answer 1.5: $(59 \times 12 \times 5.766 + 25 \times 19 \times 2.597) / (10 \times (5.766^2 \times 12 + 2.597^2 \times 19)) = 1.009$