

MS Module 24 Least squares bias function practice exam questions

(The attached PDF file has better formatting.)

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

<i>Means</i>	<i>Column 1</i>	<i>Column 2</i>	<i>Observations</i>	<i>Column 1</i>	<i>Column 2</i>
<i>Row 1</i>	71	59	<i>Row 1</i>	11	12
<i>Row 2</i>	36	25	<i>Row 2</i>	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 24.1: Multiplicative model least squares implied relativity row 1

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

Answer 24.1: $(71 \times 11 \times 1.0 + 59 \times 12 \times 1.2) / (10 \times (1.0^2 \times 11 + 1.2^2 \times 12)) = 5.766$

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

Question 24.2: Multiplicative model least squares implied relativity row 2

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

Answer 24.2: $(36 \times 14 \times 1.0 + 25 \times 19 \times 1.2) / (10 \times (1.0^2 \times 14 + 1.2^2 \times 19)) = 2.597$

Question 24.3: Multiplicative model least squares implied relativity column 1

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

Answer 24.3: $(71 \times 11 \times 5.766 + 36 \times 14 \times 2.597) / (10 \times (5.766^2 \times 11 + 2.597^2 \times 14)) = 1.263$

Question 24.4: Multiplicative model least squares implied relativity column 2

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

Answer 24.4: $(59 \times 12 \times 5.766 + 25 \times 19 \times 2.597) / (10 \times (5.766^2 \times 12 + 2.597^2 \times 19)) = 1.009$