Reading: Fisher.ExperienceRating

Model: 2018.Q9

Problem Type: Apply the efficiency test

Given

Insurer 1's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	58.6%	83.3%
2	65.6%	85.5%
3	80.2%	90.0%
4	91.6%	95.0%
5	109.2%	100.1%

Insurer 2's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	58.6%	94.5%
2	65.7%	90.0%
3	80.2%	85.3%
4	91.6%	79.7%
5	109.2%	75.3%

Sample Variance	0.0411	0.0059

Find   Use the Efficiency Test to determine which experience rating plan is better.

Solution

$$\text{Efficiency Test Statistic} = \frac{\text{Standard Loss Ratio Sample Variance}}{\text{Manual Loss Ratio Sample Variance}}$$

Insurer 1's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	58.6%	83.3%
2	65.6%	85.5%
3	80.2%	90.0%
4	91.6%	95.0%
5	109.2%	100.1%
Sample Variance	0.04118	0.00473

Efficiency Test Statistic: = 0.00473 / 0.04118
= 0.1148

Insurer 2's Plan

Efficiency Test Statistic: = 0.00590 / 0.04110
= 0.1436

Since 0.1148 < 0.1436 Insurer 1's plan is better

Note: Here we are using the following formula for the sample variance:

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$$

Alice: "The efficiency test is defined using sample variance even though you'll get the same answer if you use the population variance calculation instead. It's hard to say if the CAS would penalize you for using population variance in the exam."

Alice: "Notice here we're using the Var.S() Excel function. This is okay because we're not provided with any other information. However, if we were told the quintiles had different manual premium volumes then you need to calculate the sample variance by hand by finding the first and second moments. This is because Var.S() assumes all values have the same weight."

Given Insurer 1's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	55.5%	111.3%
2	74.2%	103.1%
3	90.8%	102.1%
4	97.7%	101.5%
5	106.2%	97.6%

Insurer 2's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	70.8%	86.6%
2	89.1%	97.4%
3	97.7%	95.0%
4	101.5%	99.0%
5	107.4%	99.6%

Sample Variance	0.0202	0.0028

Find Use the Efficiency Test to determine which experience rating plan is better.

Solution

$$\text{Efficiency Test Statistic} = \frac{\text{Standard Loss Ratio Sample Variance}}{\text{Manual Loss Ratio Sample Variance}}$$

Insurer 1's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	55.5%	111.3%
2	74.2%	103.1%
3	90.8%	102.1%
4	97.7%	101.5%
5	106.2%	97.6%
Sample Variance	0.04078	0.00253

Alice: "The efficiency test is defined using sample variance even though you'll get the same answer if you use the population variance calculation instead. It's hard to say if the CAS would penalize you for using population variance in the exam."

Efficiency Test Statistic: = 0.00253 / 0.04078

= 0.0619

Insurer 2's Plan

Efficiency Test Statistic: = 0.00280 / 0.02023

= 0.1385

Since 0.0619 < 0.1385 Insurer 1's plan is better

Note: Here we are using the following formula for the sample variance: $s^2 = \dfrac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$

Alice: "Notice here we're using the Var.S() Excel function. This is okay because we're not provided with any other information. However, if we were told the quintiles had different manual premium volumes then you need to calculate the sample variance by hand by finding the first and second moments. This is because Var.S() assumes all values have the same weight."

Given

Insurer 1's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	74.2%	103.0%
2	79.4%	85.3%
3	90.2%	98.6%
4	100.7%	98.5%
5	106.7%	87.1%

Insurer 2's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	65.0%	90.9%
2	88.8%	98.3%
3	96.5%	103.9%
4	97.4%	88.5%
5	108.3%	101.1%

Sample Variance	0.0263	0.0044

Find Use the Efficiency Test to determine which experience rating plan is better.

Solution

$$\text{Efficiency Test Statistic} = \frac{\text{Standard Loss Ratio Sample Variance}}{\text{Manual Loss Ratio Sample Variance}}$$

Insurer 1's Plan

Quintile	Manual Loss Ratio	Standard Loss Ratio
1	74.2%	103.0%
2	79.4%	85.3%
3	90.2%	98.6%
4	100.7%	98.5%
5	106.7%	87.1%
Sample Variance	0.01888	0.00611

Alice: "The efficiency test is defined using sample variance even though you'll get the same answer if you use the population variance calculation instead. It's hard to say if the CAS would penalize you for using population variance in the exam."

Efficiency Test Statistic: = 0.00611 / 0.01888
= 0.3237

Insurer 2's Plan

Efficiency Test Statistic: = 0.00436 / 0.02628
= 0.1660

Since 0.3237 > 0.166 Insurer 2's plan is better

Note: Here we are using the following formula for the sample variance: $s^2 = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$

Alice: "Notice here we're using the Var.S() Excel function. This is okay because we're not provided with any other information. However, if we were told the quintiles had different manual premium volumes then you need to calculate the sample variance by hand by finding the first and second moments. This is because Var.S() assumes all values have the same weight."