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## Questions 5 and 6: Insurance rates, part 3

Question 5, which has 4 parts, continues the pandemic scenario from Questions 3 and 4.

Suppose that there is a massive demand for life insurance due to the pandemic, and the company wants to find a premium cost for which the probability of losing money is under 5%, assuming the death rate stays stable at p=0.015.

### Question 5a

1.0/1.0 point (graded)

Calculate the premium required for a 5% chance of losing money given n=1000 loans, probability of death p=0.015, and loss per claim l=-150000. Save this premium as  $\overline{\mathbf{x}}$  for use in further questions.

3268.063 **✓** Answer: 3268

#### **Explanation**

The premium can be calculated using the following code:

```
p <- .015
n <- 1000
l <- -150000
z <- qnorm(.05)
x <- -l*( n*p - z*sqrt(n*p*(1-p)))/ ( n*(1-p) + z*sqrt(n*p*(1-p)))
x</pre>
```

Submit

You have used 2 of 10 attempts

• Answers are displayed within the problem

## Question 5b

1.0/1.0 point (graded)

What is the expected profit per policy at this rate?

969.0422

✓ Answer: 969

969.0422

#### **Explanation**

The expected profit can be calculated using the following code:

1\*p + x\*(1-p)

Submit

You have used 2 of 10 attempts

**1** Answers are displayed within the problem

# Question 5c

1.0/1.0 point (graded)

What is the expected profit over 1,000 policies?

969042.2

**✓ Answer:** 969042

969042.2

#### **Explanation**

The expected profit can be calculated using the following code:

 $mu \leftarrow n*(1*p + x*(1-p))$ 

mu

Submit

You have used 1 of 10 attempts

**1** Answers are displayed within the problem

# Question 5d

1.0/1.0 point (graded)

Run a Monte Carlo simulation with <code>B=10000</code> to determine the probability of losing money on 1,000 policies given the new premium <code>x</code>, loss on a claim of \$150,000, and probability of claim p=.015. Set the seed to 28 before running your simulation.

(IMPORTANT! If you use R 3.6 or later, you will need to use the command
 set.seed(x, sample.kind = "Rounding") instead of set.seed(x). Your R version will be
 printed at the top of the Console window when you start RStudio.)

What is the probability of losing money here?



#### **Explanation**

The probability can be calculated using the following code:

Submit

You have used 2 of 10 attempts

• Answers are displayed within the problem

The company cannot predict whether the pandemic death rate will stay stable. Set the seed to 29, then write a Monte Carlo simulation that for each of B=10000 iterations:

- randomly changes p by adding a value between -0.01 and 0.01 with sample(seq(-0.01, 0.01, length = 100), 1)
- ullet uses the new random p to generate a sample of n=1,000 policies with premium  ${f x}$  and loss per claim l=-150000
- ullet returns the profit over n policies (sum of random variable)

(IMPORTANT! If you use R 3.6 or later, you will need to use the command set.seed(x), sample.kind = "Rounding") instead of set.seed(x). Your R version will be printed at the top of the Console window when you start RStudio.)

The outcome should be a vector of  $\boldsymbol{B}$  total profits. Use the results of the Monte Carlo simulation to answer the following three questions.

(Hint: Use the process from lecture for modeling a situation for loans that changes the probability of default for all borrowers simultaneously.)

## Question 6a

0.0/1.0 point (graded)

What is the expected value over 1,000 policies?

989687

**X** Answer: 968306

989687

#### **Explanation**

This code will run the Monte Carlo simulation:

This code gives the expected value for the profit:

mean(profit)

Submit

You have used 10 of 10 attempts

**1** Answers are displayed within the problem

## Question 6b

0.0/1.0 point (graded)

What is the probability of losing money?

0.0484 **X** Answer: 0.191

#### **Explanation**

This probability can be calculated using this code:

mean(profit < 0)

Submit You have used 10 of 10 attempts

**1** Answers are displayed within the problem

### Question 6c

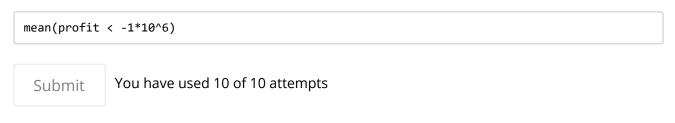
0.0/1.0 point (graded)

What is the probability of losing more than \$1 million?



#### **Explanation**

This probability can be calculated using this code:



**1** Answers are displayed within the problem

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