Final Assessment due Jun 11, 2021 14:37 +03

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

1/1 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 `x` for use in further questions.

3268

✔ **Answer:** 3268

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
```

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You have used 1 of 10 attempts

Answers are displayed within the problem

Question 5b

1/1 point (graded)

What is the expected profit per policy at this rate?

969 ✔ **Answer:** 969

969

Explanation

The expected profit can be calculated using the following code:

```
l*p + x*(1-p)
```

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Question 5c

1/1 point (graded)

What is the expected profit over 1,000 policies?

969042 ✔ **Answer:** 969042

969042

Explanation

The expected profit can be calculated using the following code:

```
mu <- n*(l*p + x*(1-p))
mu
```

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Question 5d

1/1 point (graded)

Run a Monte Carlo simulation with `B=10000` to determine the probability of losing money on 1,000 policies given the new premium `x`, 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?

0.05554

✔ **Answer:** 0.0554

0.05554

Explanation

The probability can be calculated using the following code:

```
            set.seed(28)
B <- 10000
profit <- replicate(B, {
  draws <- sample(c(x, 1), n,
                  prob=c(1-p, p), replace = TRUE)
  sum(draws)
})

mean(profit < 0)
```

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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)`
- uses the new random p to generate a sample of $n = 1,000$ policies with premium $\mathbf{x}$ and loss per claim $l = -150000$
- 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 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

1/1 point (graded)
What is the expected value over 1,000 policies?

968306 ✔ **Answer:** 968306

968306

Explanation
This code will run the Monte Carlo simulation:

```
          # n, p, l and x as defined in the problem information
set.seed(29)    # in R 3.6, set.seed(29, sample.kind="Rounding")

profit <- replicate(B, {
    new_p <- p + sample(seq(-0.01, 0.01, length = 100), 1)
    draws <- sample(c(x, l), n,
                    prob=c(1-new_p, new_p), replace = TRUE)
    sum(draws)
})
```

This code gives the expected value for the profit:

```
          mean(profit)
```

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Answers are displayed within the problem

Question 6b

1/1 point (graded)

What is the probability of losing money?

0.191 ✔ **Answer:** 0.191

0.191

Explanation

This probability can be calculated using this code:

```
          mean(profit < 0)
```

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Answers are displayed within the problem

Question 6c

1/1 point (graded)

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

0.0424

✔ **Answer:** 0.0424

0.0424

Explanation

This probability can be calculated using this code:

```
mean(profit < -1*10^6)
```

Submit

You have used 1 of 10 attempts

Answers are displayed within the problem