Questions 1 and 2: Insurance rates, part 1

Use the information below as you answer this 6-part question.

An insurance company offers a one-year term life insurance policy that pays $150,000 in the event of death within one year. The premium (annual cost) for this policy for a 50 year old female is $1,150. Suppose that in the event of a claim, the company forfeits the premium and loses a total of $150,000, and if there is no claim the company gains the premium amount of $1,150. The company plans to sell 1,000 policies to this demographic.

Question 1a

1/1 point (graded)

The `death_prob` data frame from the **dslabs** package contains information about the estimated probability of death within 1 year (`prob`) for different ages and sexes.

Use `death_prob` to determine the death probability of a 50 year old female, `p` .

0.003193 ✔ **Answer:** 0.00319

0.003193

Explanation

The probability can be calculated using the following code:

```
p <- death_prob %>%
  filter(sex == "Female" & age == "50") %>%
  pull(prob)
p
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 1b

1/1 point (graded)

The loss in the event of the policy holder's death is -$150,000 and the gain if the policy holder remains alive is the premium $1,150.

What is the expected value of the company's net profit on one policy for a 50 year old female?

667.3781 ✔ **Answer:** 667

667.3781

Explanation

The expected value can be calculated using the following code:

```
a <- -150000
b <- 1150

mu <- a*p + b*(1-p)
mu
```

Submit You have used 2 of 10 attempts

Answers are displayed within the problem

Question 1c

1/1 point (graded)

Calculate the standard error of the profit on one policy for a 50 year old female.

8527.332 ✔ **Answer:** 8527

8527.332

Explanation

The standard error can be calculated using the following code:

```
sigma <- abs(b-a) * sqrt(p*(1-p))
sigma
```

You have used 1 of 10 attempts

Submit

Answers are displayed within the problem

Question 1d

1/1 point (graded)

What is the expected value of the company's profit over all 1,000 policies for 50 year old females?

667378.1 ✔ **Answer:** 667378

667378.1

Explanation

The expected value can be calculated using the following code:

```
n <- 1000
n*mu
```

Submit You have used 2 of 10 attempts

Answers are displayed within the problem

Question 1e

1/1 point (graded)

What is the standard error of the sum of the expected value over all 1,000 policies for 50 year old females?

269657.9 ✔ **Answer:** 269658

269657.9

Explanation

The standard error can be calculated using the following code:

```
sqrt(n) * sigma
```

You have used 2 of 10 attempts

Submit

Answers are displayed within the problem

Question 1f

1/1 point (graded)

Use the Central Limit Theorem to calculate the probability that the insurance company loses money on this set of 1,000 policies.

0.006663556 ✔ **Answer:** 0.00666

$$0.006663556$$

Explanation

The probability can be calculated using the following code:

```
pnorm(0, n*mu, sqrt(n)*sigma)
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

50 year old males have a different probability of death than 50 year old females. We will calculate a profitable premium for 50 year old males in the following four-part question.

Question 2a

1/1 point (graded)

Use `death_prob` to determine the probability of death within one year for a 50 year old male.

0.005013 ✔ **Answer:** 0.00501

$$0.005013$$

Explanation

The probability can be calculated using the following code:

```
p_male <- death_prob %>%
  filter(sex == "Male" & age == "50") %>%
  pull(prob)
p_male
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 2b

1/1 point (graded)

Suppose the company wants its expected profits from 1,000 50 year old males with $150,000 life insurance policies to be $700,000. Use the formula for expected value of the sum of draws with the following values and solve for the premium b:

$$\mathrm{E}\left[S\right] = \mu_S = 700000$$

$$n = 1000$$

$$p = \text{death probability of age 50 male}$$

$$a = 150000$$

$$b = \text{premium}$$

What premium should be charged?

1459.265 ✔ **Answer:** 1459

1459.265

Explanation

Start with the formula for expected value of the sum and solve for b:

$\mu_S = n\left(ap + b\left(1-p\right)\right)$

$\frac{\mu_S}{n} = ap + b\left(1-p\right)$

$\frac{\frac{\mu_S}{n} - ap}{1-p} = b$

Then substitute known values for μ_S, n, a, p using the following code:

```
p <- p_male
mu_sum <- 700000
n <- 1000
a <- -150000

b <- (mu_sum/n-a*p)/(1-p)
b
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 2c

1/1 point (graded)

Using the new 50 year old male premium rate, calculate the standard error of the sum of 1,000 premiums.

338262.1 ✔ **Answer:** 338262

$$338262.1$$

Explanation

The standard error can be calculated using the following code:

```
sigma_sum <- sqrt(n)*abs(b-a)*sqrt(p*(1-p))
sigma_sum
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 2d

1/1 point (graded)

What is the probability of losing money on a series of 1,000 policies to 50 year old males?
Use the Central Limit Theorem.

0.01925424 ✔ **Answer:** 0.0193

0.01925424

Explanation

The probability can be calculated using the following code:

```
pnorm(0, mu_sum, sigma_sum)
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem