

Matematika osiguranja

FINANCIJSKA MATEMATIKA, IPS

Damir Horvat

FOI, Varaždin

Sadržaj

Teorija

prvi zadatak

drugi zadatak

treći zadatak

četvrti zadatak

peti zadatak

Teorija

Oznake

- $D_x \rightarrow$ diskontirani broj živih osoba starosti x

$$D_x = \ell_x \cdot v^x, \quad v = \frac{1}{r}$$

- $N_x \rightarrow$ zbroj diskontiranih živih osoba starijih od x godina

$$N_x = D_x + D_{x+1} + \cdots + D_\omega$$

- $C_x \rightarrow$ diskontirani broj umrlih osoba starosti x

$$C_x = d_x \cdot v^{x+1}$$

- $M_x \rightarrow$ zbroj diskontiranih umrlih osoba starijih od x godina

$$M_x = C_x + C_{x+1} + \cdots + C_\omega$$

Princip ekvivalencije

- **Premija** → uplata osiguranika (kotizacija)

- **Princip ekvivalencije**

Sadašnja vrijednost matematički očekivanih uplata mora biti jednaka sadašnjoj vrijednosti matematički očekivanih isplata.

- **premija = osigurana svota · koeficijent**

Kod različitih vrsta osiguranja **koeficijent** se računa po drukčijoj formuli i ima drukčiju oznaku.

$$B = S \cdot \text{koeficijent}$$

Premije u osiguranju života

Poopćenje osobnih renti (periodskih isplata)

- Neodgođena doživotna osobna renta
- Neodgođena osobna renta trajanja n godina
- Za n godina odgođena doživotna renta (starosna renta)

Nekoliko posebnih vrsta osiguranja

- Osiguranje za slučaj doživljenja
- Osiguranje za slučaj smrti
 - Doživotno osiguranje za slučaj smrti
 - Privremeno osiguranje za slučaj smrti
- Mješovito osiguranje

Neodgođena doživotna osobna renta

- Nakon uplate premije osiguraniku se doživotno isplaćuje renta

$$\ddot{a}_x = 1 + \frac{D_{x+1}}{D_x} + \frac{D_{x+2}}{D_x} + \dots + \frac{D_{\omega}}{D_x} = \frac{N_x}{D_x}$$

$$B = S \cdot \ddot{a}_x$$

Neodgođena osobna renta trajanja n godina

- Nakon uplate premije osiguraniku se n godina isplaćuje renta

$$\ddot{a}_{x:n] } = 1 + \frac{D_{x+1}}{D_x} + \frac{D_{x+2}}{D_x} + \dots + \frac{D_{x+n-1}}{D_x} = \frac{N_x - N_{x+n}}{D_x}$$

$$B = S \cdot \ddot{a}_{x:n] }$$

Za n godina odgođena doživotna renta (starosna renta)

- Nakon uplate premije osiguraniku se doživotno isplaćuje renta tek nakon isteka n godina

$${}_n|\ddot{a}_x = \frac{D_{x+n}}{D_x} + \frac{D_{x+n+1}}{D_x} + \dots + \frac{D_{\omega}}{D_x} = \frac{N_{x+n}}{D_x}$$

$$B = S \cdot {}_n|\ddot{a}_x$$

Osiguranje za slučaj doživljenja

- Nakon uplate premije osiguraniku se nakon n godina isplaćuje osigurana svota.

$${}_nE_x = \frac{D_{x+n}}{D_x}, \quad B = S \cdot {}_nE_x$$

Doživotno osiguranje za slučaj smrti

- Nakon uplate premije osiguranikovo se obitelji nakon njegove smrti isplaćuje osigurana svota

$$A_x = \frac{C_x}{D_x} + \frac{C_{x+1}}{D_x} + \dots + \frac{C_\omega}{D_x} = \frac{M_x}{D_x}$$
$$B = S \cdot A_x$$

Privremeno osiguranje za slučaj smrti s trajanjem n godina

- Nakon uplate premije, u slučaju smrti osiguranika u idućih n godina, osiguranikovo se obitelji isplaćuje osigurana svota

$${}_nA_x = \frac{C_x}{D_x} + \frac{C_{x+1}}{D_x} + \dots + \frac{C_{x+n-1}}{D_x} = \frac{M_x - M_{x+n}}{D_x}$$
$$B = S \cdot {}_nA_x$$

Mješovito osiguranje

- osiguranje za slučaj doživljenja + osiguranje za slučaj smrti

Jednokratna uplata

$$A_{x:n] } = {}_nE_x + {}_nA_x = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$B = S \cdot A_{x:n] }$$

Godišnja uplata

$$B = S \cdot \frac{A_{x:n] }}{\ddot{a}_{x:n] }}$$

Dostatna premija mješovitog osiguranja – uključuje troškove

- troškovi zaključenja (akvizicijski) – jednokratni
– stopa troškova α
- inkaso troškovi – troškovi prikupljanja premija
– stopa troškova β
- upravni troškovi – stopa troškova γ

Jednokratna uplata

$$A_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{1 - \beta}, \quad B = S \cdot A_{x:n]}^a$$

Godišnja uplata

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}, \quad B = S \cdot P_{x:n]}^a$$

prvi zadatak

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} =$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \underline{\hspace{2cm}}$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{8000}$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50}$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50} = 0.338379$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50} = 0.338379$$

$$B = S \cdot {}_{25}E_{40} =$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50} = 0.338379$$

$$B = S \cdot {}_{25}E_{40} = 8000$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50} = 0.338379$$

$$B = S \cdot {}_{25}E_{40} = 8000 \cdot 0.338379$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50} = 0.338379$$

$$B = S \cdot {}_{25}E_{40} = 8000 \cdot 0.338379 = 2707.03$$

$$B = S \cdot {}_nE_x$$

$${}_nE_x = \frac{D_{x+n}}{D_x}$$

Zadatak 1

Koliku jednokratnu premiju mora uplatiti osiguranik starosti 40 godina kako bi nakon navršene 65 godine raspolagao osiguranom svotom visine 8000 €?

Rješenje

$${}_{25}E_{40} = \frac{D_{65}(m)}{D_{40}(m)} = \frac{8322.27}{24\,594.50} = 0.338379$$

$$B = S \cdot {}_{25}E_{40} = 8000 \cdot 0.338379 = 2707.03$$

Osiguranik mora uplatiti jednokratnu premiju visine 2707.03 €.

drugi zadatak

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} =$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \text{—————}$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{20000}$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07}$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07} = 0.352557$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07} = 0.352557$$

$$B = S \cdot A_{50} =$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07} = 0.352557$$

$$B = S \cdot A_{50} = 20\,000$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07} = 0.352557$$

$$B = S \cdot A_{50} = 20\,000 \cdot 0.352557$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07} = 0.352557$$

$$B = S \cdot A_{50} = 20\,000 \cdot 0.352557 = 7051.14$$

$$B = S \cdot A_x$$

$$A_x = \frac{M_x}{D_x}$$

Zadatak 2

Koliku jednokratnu premiju mora uplatiti osiguranica starosti 50 godina kako bi u slučaju njezine smrti osiguravajuće društvo njezinoj obitelji isplatilo 20 000 €?

Rješenje

$$A_{50} = \frac{M_{50}(f)}{D_{50}(f)} = \frac{6146.51}{17\,434.07} = 0.352557$$

$$B = S \cdot A_{50} = 20\,000 \cdot 0.352557 = 7051.14$$

Osiguranica mora uplatiti jednokratnu premiju visine 7051.14 €.

treći zadatak

Zadatak 3

Osiguranica starosti 35 godina uplati mješovito životno osiguranje s istekom osiguranja po navršenih 65 godina života. Osigurana svota iznosi 15 000 €.

- a) Koliku jednokratnu premiju mora uplatiti osiguranica?*
- b) Ukoliko umjesto jednokratne premije osiguranica želi uplaćivati godišnje premije, kolika je visina godišnjih premija?*

Rješenje

a)

$$B = S \cdot A_{x:n|}$$

$$A_{x:n|} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$A_{35:30|} = \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} =$$

Rješenje

a)

$$B = S \cdot A_{x:n|}$$

$$A_{x:n|} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$A_{35:30|} = \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} =$$

= _____

a)

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

12 / 22

a)

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$A_{35:30|} = \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} =$$
$$= \frac{9\,662.06 + 6\,515.84}{}$$

Rješenje

a)

$$B = S \cdot A_{x:n}]$$

$$A_{x:n}] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30}] &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{} \end{aligned}$$

Rješenje

a)

$$B = S \cdot A_{x:n}]$$

$$A_{x:n}] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30}] &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} \end{aligned}$$

Rješenje

a)

$$B = S \cdot A_{x:n}]$$

$$A_{x:n}] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30}] &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

Rješenje

a)

$$B = S \cdot A_{x:n|}$$

$$A_{x:n|} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30|} &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30|} =$$

Rješenje

a)

$$B = S \cdot A_{x:n}]$$

$$A_{x:n}] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30}] &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30}] = 15\,000$$

Rješenje

a)

$$B = S \cdot A_{x:n}]$$

$$A_{x:n}] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30}] &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30}] = 15\,000 \cdot 0.368216$$

Rješenje

a)

$$B = S \cdot A_{x:n}]$$

$$A_{x:n}] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30}] &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30}] = 15\,000 \cdot 0.368216 = 5523.24$$

Rješenje

a)

$$B = S \cdot A_{x:n|}$$

$$A_{x:n|} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30|} &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30|} = 15\,000 \cdot 0.368216 = 5523.24$$

Osiguranica mora uplatiti jednokratnu premiju visine 5523.24 €.

Rješenje

a)

$$B = S \cdot A_{x:n|}$$

$$A_{x:n|} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30|} &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30|} = 15\,000 \cdot 0.368216 = 5523.24$$

Osiguranica mora uplatiti jednokratnu premiju visine 5523.24 €.

Interpretacija broja $A_{35:30|}$

Rješenje

a)

$$B = S \cdot A_{x:n|}$$

$$A_{x:n|} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\begin{aligned} A_{35:30|} &= \frac{D_{65}(f) + M_{35}(f) - M_{65}(f)}{D_{35}(f)} = \\ &= \frac{9\,662.06 + 6\,515.84 - 5\,232.91}{29\,724.41} = 0.368216 \end{aligned}$$

$$B = S \cdot A_{35:30|} = 15\,000 \cdot 0.368216 = 5523.24$$

Osiguranica mora uplatiti jednokratnu premiju visine 5523.24 €.

Interpretacija broja $A_{35:30|}$

Uplati li osiguranica premiju visine 0.37 €, u slučaju da u idućih 30 godina nastupi osigurani slučaj, obitelj ili ona sama će raspolagati osiguranom svotom visine 1 €.

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\ddot{a}_{35:30]} = \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} =$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \underline{\hspace{10cm}}\end{aligned}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\ddot{a}_{35:30]} = \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \frac{686\,310.58}{\dots}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\ddot{a}_{35:\overline{30}|} = \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} =$$
$$= \frac{686\,310.58 - 130\,976.15}{}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41}\end{aligned}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} =$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000 \cdot \text{—————}}$$

b)

$$B = S \cdot \frac{A_{x:n}] }{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n] } = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30] } &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30] }}{\ddot{a}_{35:30] }} = 15\,000 \cdot \frac{0.368216}{18.682774}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000 \cdot \frac{0.368216}{18.682774}$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000 \cdot \frac{0.368216}{18.682774} = 295.63$$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000 \cdot \frac{0.368216}{18.682774} = 295.63$$

Osiguranica mora tijekom 30 godina godišnje uplaćivati 295.63 €.

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000 \cdot \frac{0.368216}{18.682774} = 295.63$$

Osiguranica mora tijekom 30 godina godišnje uplaćivati 295.63 €.

Interpretacija broja $\ddot{a}_{35:30]}$

b)

$$B = S \cdot \frac{A_{x:n]}{\ddot{a}_{x:n]}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{35:30]} &= \frac{N_{35}(f) - N_{65}(f)}{D_{35}(f)} = \\ &= \frac{686\,310.58 - 130\,976.15}{29\,724.41} = 18.682774\end{aligned}$$

$$B = S \cdot \frac{A_{35:30]}}{\ddot{a}_{35:30]} = 15\,000 \cdot \frac{0.368216}{18.682774} = 295.63$$

Osiguranica mora tijekom 30 godina godišnje uplaćivati 295.63 €.

Interpretacija broja $\ddot{a}_{35:30]}$

Uplati li osiguranica odmah 18.68 €, idućih 30 godina može dobivati godišnje rente visine 1 €.

čtvrti zadatak

Zadatak 4

Osiguranik starosti 28 godina uplati mješovito životno osiguranje s istekom osiguranja po navršenih 65 godina života. Godišnja premija iznosi 5 000 kn, a osigurana svota je 250 000 kn.

- a) Izračunajte iznos premije privremene jedinične neodgođene osobne rente osiguranika i objasnite značenje dobivenog rezultata.*
- b) Izračunajte iznos jednokratne premije mješovitog osiguranja za jediničnu osiguranu svotu i objasnite značenje dobivenog rezultata.*
- c) Ako su zadani α i γ troškovi osiguranja $\alpha = 0.032$ i $\gamma = 0.0022$, izračunajte β troškove.*
- d) Ukoliko osiguranik umjesto godišnjih premija odluči uplatiti jednokratnu premiju, koliko bi iznosila ta premija?*

Rješenje

a)

$$\ddot{a}_{28:37|} = \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} =$$

$$\ddot{a}_{x:n|} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$\ddot{a}_{x:n] = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{28:37]} &= \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} = \\ &= \underline{\hspace{4cm}}\end{aligned}$$

Rješenje

a)

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{28:37]} &= \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} = \\ &= \underline{\underline{869\,668.78}}\end{aligned}$$

Rješenje

a)

$$\ddot{a}_{x:n] = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{28:37]} &= \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} = \\ &= \underline{\underline{869\,668.78 - 95\,725.33}}\end{aligned}$$

Rješenje

a)

$$\ddot{a}_{x:n] = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{28:37]} &= \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} = \\ &= \frac{869\,668.78 - 95\,725.33}{37\,654.02}\end{aligned}$$

Rješenje

a)

$$\ddot{a}_{x:n] = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{28:37]} &= \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} = \\ &= \frac{869\,668.78 - 95\,725.33}{37\,654.02} = 20.554072\end{aligned}$$

Rješenje

a)

$$\ddot{a}_{x:n] = \frac{N_x - N_{x+n}}{D_x}$$

$$\begin{aligned}\ddot{a}_{28:37]} &= \frac{N_{28}(m) - N_{65}(m)}{D_{28}(m)} = \\ &= \frac{869\,668.78 - 95\,725.33}{37\,654.02} = 20.554072\end{aligned}$$

Uplati li osiguranik odmah 20.55 kn, idućih 37 godina može dobivati godišnje rente visine 1 kn.

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$A_{28:37]} = \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} =$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$A_{28:37]} = \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} =$$

$$= \underline{\hspace{10cm}}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$\begin{aligned} A_{28:37]} &= \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} = \\ &= \underline{\underline{8\,322.27}} \end{aligned}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$\begin{aligned} A_{28:37]} &= \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} = \\ &= \frac{8\,322.27 + 8\,244.93 - 5\,085.18}{} \end{aligned}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$\begin{aligned} A_{28:37]} &= \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} = \\ &= \frac{8\,322.27 + 8\,244.93 - 5\,085.18}{37\,654.02} \end{aligned}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$\begin{aligned} A_{28:37]} &= \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} = \\ &= \frac{8\,322.27 + 8\,244.93 - 5\,085.18}{37\,654.02} = 0.304935 \end{aligned}$$

$$A_{x:n] = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

b)

$$\begin{aligned} A_{28:37] &= \frac{D_{65}(m) + M_{28}(m) - M_{65}(m)}{D_{28}(m)} = \\ &= \frac{8\,322.27 + 8\,244.93 - 5\,085.18}{37\,654.02} = 0.304935 \end{aligned}$$

Uplati li osiguranik premiju visine 0.30 kn, u slučaju da u idućih 37 godina nastupi osigurani slučaj, obitelj ili on sam će raspolagati osiguranom svotom visine 1 kn.

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} =$$

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} = \text{—————}$$

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} = \frac{5\,000}{S}$$

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} = \frac{5\,000}{250\,000}$$

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }}$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \bigg/ \cdot (1 - \beta) \ddot{a}_{28:37] }$$

c)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{28:37}^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37}^a = \frac{A_{28:37} + \alpha + \gamma \cdot \ddot{a}_{28:37}}{(1 - \beta) \ddot{a}_{28:37}} \quad / \cdot (1 - \beta) \ddot{a}_{28:37}$$

$$P_{28:37}^a \cdot (1 - \beta) \ddot{a}_{28:37} =$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad / : P_{28:37] }^a \ddot{a}_{28:37] }$$

c)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{28:37}^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37}^a = \frac{A_{28:37} + \alpha + \gamma \cdot \ddot{a}_{28:37}}{(1 - \beta) \ddot{a}_{28:37}} \quad / \cdot (1 - \beta) \ddot{a}_{28:37}$$

$$P_{28:37}^a \cdot (1 - \beta) \ddot{a}_{28:37} = A_{28:37} + \alpha + \gamma \cdot \ddot{a}_{28:37} \quad / : P_{28:37}^a \ddot{a}_{28:37}$$

$$1 - \beta =$$

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37]}^a = \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{(1 - \beta) \ddot{a}_{28:37]}} \quad / \cdot (1 - \beta) \ddot{a}_{28:37]}$$

$$P_{28:37]}^a \cdot (1 - \beta) \ddot{a}_{28:37]} = A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]} \quad / : P_{28:37]}^a \ddot{a}_{28:37]}$$

$$1 - \beta = \underline{\hspace{2cm}}$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad / : P_{28:37] }^a \ddot{a}_{28:37] }$$

$$1 - \beta = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad / : P_{28:37] }^a \ddot{a}_{28:37] }$$

$$1 - \beta = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

c)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{28:37]}^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37]}^a = \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{(1 - \beta) \ddot{a}_{28:37]}} \quad / \cdot (1 - \beta) \ddot{a}_{28:37]}$$

$$P_{28:37]}^a \cdot (1 - \beta) \ddot{a}_{28:37]} = A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]} \quad / : P_{28:37]}^a \ddot{a}_{28:37]}$$

$$1 - \beta = \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$- \beta =$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad / : P_{28:37] }^a \ddot{a}_{28:37] }$$

$$1 - \beta = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

$$- \beta = - 1$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad / : P_{28:37] }^a \ddot{a}_{28:37] }$$

$$1 - \beta = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

$$- \beta = -1 + \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad / \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad / : P_{28:37] }^a \ddot{a}_{28:37] }$$

$$1 - \beta = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

$$- \beta = -1 + \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }} \quad / \cdot (-1)$$

c)

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

$$P_{28:37] }^a = \frac{B}{S} = \frac{5\,000}{250\,000} = 0.02$$

$$P_{28:37] }^a = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{(1 - \beta) \ddot{a}_{28:37] }} \quad \bigg/ \cdot (1 - \beta) \ddot{a}_{28:37] }$$

$$P_{28:37] }^a \cdot (1 - \beta) \ddot{a}_{28:37] } = A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] } \quad \bigg/ : P_{28:37] }^a \ddot{a}_{28:37] }$$

$$1 - \beta = \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

$$- \beta = -1 + \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }} \quad \bigg/ \cdot (-1)$$

$$\beta = 1 - \frac{A_{28:37] } + \alpha + \gamma \cdot \ddot{a}_{28:37] }}{P_{28:37] }^a \ddot{a}_{28:37] }}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{\quad}{\quad}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935}{\rule{10cm}{0.4pt}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 +}{}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032}{\rule{10cm}{0.4pt}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + \quad}{\quad}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022}{\rule{10cm}{0.4pt}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot}{}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{}$$

$$\beta = 1 - \frac{A_{28:37] + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$A_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{1 - \beta}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$B = S \cdot P_{x:n]}^a$$

$$B' = S \cdot A_{x:n]}^a$$

d)

$$A_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{1 - \beta}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$B = S \cdot P_{x:n]}^a$$

$$B' = S \cdot A_{x:n]}^a$$

d)

$$B' = B \cdot \ddot{a}_{28:37]} =$$

$$A_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{1 - \beta}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$B = S \cdot P_{x:n]}^a$$

$$B' = S \cdot A_{x:n]}^a$$

d)

$$B' = B \cdot \ddot{a}_{28:37]} = 5\,000$$

$$A_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{1 - \beta}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$B = S \cdot P_{x:n]}^a$$

$$B' = S \cdot A_{x:n]}^a$$

d)

$$B' = B \cdot \ddot{a}_{28:37]} = 5\,000 \cdot 20.554072$$

$$A_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{1 - \beta}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\beta = 1 - \frac{A_{28:37]} + \alpha + \gamma \cdot \ddot{a}_{28:37]}}{P_{28:37]}^a \ddot{a}_{28:37]}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$B = S \cdot P_{x:n]}^a$$

$$B' = S \cdot A_{x:n]}^a$$

d)

$$B' = B \cdot \ddot{a}_{28:37]} = 5\,000 \cdot 20.554072 = 102\,770.36$$

$$A_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{1 - \beta}$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\beta = 1 - \frac{A_{28:37} + \alpha + \gamma \cdot \ddot{a}_{28:37}}{P_{28:37}^a \ddot{a}_{28:37}}$$

$$\beta = 1 - \frac{0.304935 + 0.032 + 0.0022 \cdot 20.554072}{0.02 \cdot 20.554072}$$

$$\beta = 0.070369$$

$$B = S \cdot P_{x:n}^a$$

$$B' = S \cdot A_{x:n}^a$$

d) Jednokratna premija iznosi 102 770.36 kn.

$$B' = B \cdot \ddot{a}_{28:37} = 5\,000 \cdot 20.554072 = 102\,770.36$$

peti zadatak

Zadatak 5

Osiguranica starosti 42 godine uplati mješovito životno osiguranje s istekom osiguranja nakon navršenih 65 godina života. Godišnja premija iznosi 3 050 kn, a osigurana svota 74 500 kn.

- a) *Ako su β i γ troškovi osiguranja $\beta = 0.03$ i $\gamma = 0.004$, izračunajte α troškove.*
- b) *Ako se svi troškovi udvostruče, koliko bi uz trostruko veću osiguranu svotu iznosila godišnja premija?*
- c) *Koliko iznosi premija koju osiguranica mora uplatiti odmah da bi iduće 23 godine mogla dobivati osobnu rentu visine godišnje premije mješovitog osiguranja?*

Rješenje

a)

$$P_{42:23] }^a = \frac{B}{S}$$

$$B = S \cdot P_{x:n] }^a$$

$$P_{x:n] }^a = \frac{A_{x:n] } + \alpha + \gamma \cdot \ddot{a}_{x:n] }}{(1 - \beta) \cdot \ddot{a}_{x:n] }}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \text{————}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3050}{S}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

Rješenje

a)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \underline{\hspace{10cm}}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41}{\quad}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 -}{\quad}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{D_{42}(f)}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$A_{42:23} = \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)}$$

$$A_{x:n} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$A_{42:23} = \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} =$$

$$= \underline{\hspace{10cm}}$$

$$A_{x:n} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

a)

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$\begin{aligned} A_{42:23} &= \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} = \\ &= \underline{\underline{9\,662.06}} \end{aligned}$$

$$A_{x:n} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

a)

$$B = S \cdot P_{x:n}^a$$

$$p_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23] }^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$A_{42:23|} = \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} =$$
$$= \frac{9\,662.06 +}{}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

a)

$$B = S \cdot P_{x:n}^a$$

$$p_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

a)

$$P_{42:23] }^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$A_{42:23]} = \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} =$$
$$= \frac{9\,662.06 + 6\,395.84}{}$$

$$A_{x:n]} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

a)

$$p_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\ddot{a}_{42:23]} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$A_{42:23]} = \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} =$$

$$= \frac{9\,662.06 + 6\,395.84 -}{}$$

$$\ddot{a}_{x:n]} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$\begin{aligned} A_{42:23} &= \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} = \\ &= \frac{9\,662.06 + 6\,395.84 - 5\,232.91}{\phantom{D_{42}(f)}} \end{aligned}$$

$$A_{x:n} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$\begin{aligned} A_{42:23} &= \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} = \\ &= \frac{9\,662.06 + 6\,395.84 - 5\,232.91}{23\,253.48} \end{aligned}$$

$$A_{x:n} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

Rješenje

a)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{B}{S} = \frac{3\,050}{74\,500} = 0.040940$$

$$\ddot{a}_{42:23} = \frac{N_{42}(f) - N_{65}(f)}{D_{42}(f)} = \frac{498\,504.41 - 130\,976.15}{23\,253.48} = 15.805301$$

$$\begin{aligned} A_{42:23} &= \frac{D_{65}(f) + M_{42}(f) - M_{65}(f)}{D_{42}(f)} = \\ &= \frac{9\,662.06 + 6\,395.84 - 5\,232.91}{23\,253.48} = 0.465521 \end{aligned}$$

$$A_{x:n} = \frac{D_{x+n} + M_x - M_{x+n}}{D_x}$$

$$\ddot{a}_{x:n} = \frac{N_x - N_{x+n}}{D_x}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} =$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha =$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha =$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha =$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \Big/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \Big/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03)$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 -$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 - 0.465521$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \Big/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \Big/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 - 0.465521 -$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \Big/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \Big/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 - 0.465521 - 0.004$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \Big/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \Big/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 - 0.465521 - 0.004 \cdot$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \Big/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \Big/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 - 0.465521 - 0.004 \cdot 15.805301$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}}{(1 - \beta) \ddot{a}_{42:23]}} \bigg/ \cdot (1 - \beta) \ddot{a}_{42:23]}$$

$$P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} = A_{42:23]} + \alpha + \gamma \cdot \ddot{a}_{42:23]}$$

$$- \alpha = A_{42:23]} + \gamma \cdot \ddot{a}_{42:23]} - P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} \bigg/ \cdot (-1)$$

$$\alpha = P_{42:23]}^a \cdot (1 - \beta) \ddot{a}_{42:23]} - A_{42:23]} - \gamma \cdot \ddot{a}_{42:23]}$$

$$\alpha = 0.040940 \cdot (1 - 0.03) \cdot 15.805301 - 0.465521 - 0.004 \cdot 15.805301$$

$$\alpha = 0.098915$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} =$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$P_{42:23]}^a = \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} =$$

$$= \underline{\hspace{15cm}}$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \underline{0.465521} \end{aligned}$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$P_{42:23}^a = \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} =$$

$$= \frac{0.465521 + \quad}{\quad}$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915}{} \end{aligned}$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 +}{} \end{aligned}$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004}{} \end{aligned}$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot}{} \end{aligned}$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{} \end{aligned}$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03)} \end{aligned}$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot} \end{aligned}$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} \end{aligned}$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a =$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500$$

b)

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23]}^a = 3 \cdot 74\,500 \cdot$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta) \ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

b)

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23]}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

c)

$$B = S \cdot \ddot{a}_{42:23]} =$$

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

b)

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

c)

$$B = S \cdot \ddot{a}_{42:23} = 3\,050$$

$$B = S \cdot P_{x:n]}^a$$

$$P_{x:n]}^a = \frac{A_{x:n]} + \alpha + \gamma \cdot \ddot{a}_{x:n]}}{(1 - \beta) \cdot \ddot{a}_{x:n]}}$$

b)

$$\begin{aligned} P_{42:23]}^a &= \frac{A_{42:23]} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23]}}{(1 - 2\beta)\ddot{a}_{42:23]}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23]}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

c)

$$B = S \cdot \ddot{a}_{42:23]} = 3\,050 \cdot$$

b)

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

c)

$$B = S \cdot \ddot{a}_{42:23} = 3\,050 \cdot 15.805301$$

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

b)

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

c)

$$B = S \cdot \ddot{a}_{42:23} = 3\,050 \cdot 15.805301 = 48\,206.17$$

$$B = S \cdot P_{x:n}^a$$

$$P_{x:n}^a = \frac{A_{x:n} + \alpha + \gamma \cdot \ddot{a}_{x:n}}{(1 - \beta) \cdot \ddot{a}_{x:n}}$$

b)

$$\begin{aligned} P_{42:23}^a &= \frac{A_{42:23} + 2\alpha + 2\gamma \cdot \ddot{a}_{42:23}}{(1 - 2\beta)\ddot{a}_{42:23}} = \\ &= \frac{0.465521 + 2 \cdot 0.098915 + 2 \cdot 0.004 \cdot 15.805301}{(1 - 2 \cdot 0.03) \cdot 15.805301} = \\ &= 0.053160 \end{aligned}$$

$$B = 3S \cdot P_{42:23}^a = 3 \cdot 74\,500 \cdot 0.053160 = 11\,881.26$$

Godišnja premija iznosila bi 11 881.26 kn.

c)

$$B = S \cdot \ddot{a}_{42:23} = 3\,050 \cdot 15.805301 = 48\,206.17$$

Osiguranica bi morala odmah uplatiti premiju visine 48 206.17 kn.