Seminari 11

Matematika za ekonomiste 2

Damir Horvat

FOI, Varaždin

Sadržaj

prvi zadatak

Zadatak 1

Izračunajte visinu kredita ako ga dužnik mora vratiti kvartalnim otplatama od 3200 *kn tijekom* 5 *godina uz godišnju kamatnu stopu* 13.2% *i*

a) *konformno ukamaćivanje,*

b) *relativno ukamaćivanje.*

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20$ kvartala,

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r - 1)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20\ \text{kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r - 1)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20\ \text{kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20\ \text{kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

b) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala},$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

b) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad p' = \frac{13.2}{4} = 3.3$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

b) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad p' = \frac{13.2}{4} = 3.3$

$$r = 1 + \frac{p'}{100} = 1.033$$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

b) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad p' = \frac{13.2}{4} = 3.3$

$$r = 1 + \frac{p'}{100} = 1.033$$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{1.033^{20} - 1}{1.033^{20} \cdot (1.033 - 1)}$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

b) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad p' = \frac{13.2}{4} = 3.3$

$$r = 1 + \frac{p'}{100} = 1.033$$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{1.033^{20} - 1}{1.033^{20} \cdot (1.033 - 1)} = 46\,313.85$$

Rješenje

a) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad r = \sqrt[4]{1.132}$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{\sqrt[4]{1.132}^{20} - 1}{\sqrt[4]{1.132}^{20} \cdot \left(\sqrt[4]{1.132} - 1\right)} = 46\,962.15$$

b) $a = 3200\,\text{kn}, \quad n = 20 \text{ kvartala}, \quad p' = \frac{13.2}{4} = 3.3$

$$r = 1 + \frac{p'}{100} = 1.033$$

$$K = a \cdot \frac{r^n - 1}{r^n \cdot (r-1)} = 3200 \cdot \frac{1.033^{20} - 1}{1.033^{20} \cdot (1.033 - 1)} = 46\,313.85$$

Za dužnika je povoljniji konformni obračun kamata.

drugi zadatak

Zadatak 2

Kredit od 90 000 *kn treba otplatiti u roku od* 10 *godina polugodišnjim anuitetima i godišnju kamatnu stopu od* 6.47%. *Nakon točno četiri godine otplate kredita kamatna stopa je povećana za* 0.5%. *Izračunajte oba anuiteta i sastavite otplatnu tablicu za drugu godinu otplate kredita. Ukamaćivanje je cijelo vrijeme relativno.*

Rješenje

- Relativna polugodišnja kamatna stopa: $p_1 = \frac{6.47}{2} = 3.235$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna polugodišnja kamatna stopa: $p_1 = \frac{6.47}{2} = 3.235$
- Polugodišnji kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.03235$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna polugodišnja kamatna stopa: $p_1 = \frac{6.47}{2} = 3.235$
- Polugodišnji kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.03235$
- $n_1 = 20$ polugodišta

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna polugodišnja kamatna stopa: $p_1 = \frac{6.47}{2} = 3.235$
- Polugodišnji kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.03235$
- $n_1 = 20$ polugodišta
- Prvi anuitet

$$a_1 = K \cdot \frac{r_1^{n_1} \cdot (r_1 - 1)}{r_1^{n_1} - 1}$$

$$a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}$$

Rješenje

- Relativna polugodišnja kamatna stopa: $p_1 = \frac{6.47}{2} = 3.235$
- Polugodišnji kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.03235$
- $n_1 = 20$ polugodišta
- Prvi anuitet

$$a_1 = K \cdot \frac{r_1^{n_1} \cdot (r_1 - 1)}{r_1^{n_1} - 1}$$

$$a_1 = 90\,000 \cdot \frac{1.03235^{20} \cdot (1.03235 - 1)}{1.03235^{20} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}}$$

Rješenje

- Relativna polugodišnja kamatna stopa: $p_1 = \frac{6.47}{2} = 3.235$
- Polugodišnji kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.03235$
- $n_1 = 20$ polugodišta
- Prvi anuitet

$$a_1 = K \cdot \frac{r_1^{n_1} \cdot (r_1 - 1)}{r_1^{n_1} - 1}$$

$$a_1 = 90\,000 \cdot \frac{1.03235^{20} \cdot (1.03235 - 1)}{1.03235^{20} - 1}$$

$$a_1 = 6181.61$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}}$$

- Ostatak duga nakon 4 godine,

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}$$

- Ostatak duga nakon 4 godine, tj. nakon 8 polugodišnjih otplata

$$O_8 = a_1 \cdot \frac{r_1^{n_1-8} - 1}{r_1^{n_1-8} \cdot (r_1 - 1)}$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}$$

- Ostatak duga nakon 4 godine, tj. nakon 8 polugodišnjih otplata

$$O_8 = a_1 \cdot \frac{r_1^{n_1-8} - 1}{r_1^{n_1-8} \cdot (r_1 - 1)}$$

$$O_8 = 6181.61 \cdot \frac{1.03235^{20-8} - 1}{1.03235^{20-8} \cdot (1.03235 - 1)}$$

$$\boxed{O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}}$$

- Ostatak duga nakon 4 godine, tj. nakon 8 polugodišnjih otplata

$$O_8 = a_1 \cdot \frac{r_1^{n_1-8} - 1}{r_1^{n_1-8} \cdot (r_1 - 1)}$$

$$O_8 = 6181.61 \cdot \frac{1.03235^{20-8} - 1}{1.03235^{20-8} \cdot (1.03235 - 1)}$$

$$O_8 = 60\,677.46$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$
- Nova relativna polugodišnja kamatna stopa:

$$p_2 = \frac{6.97}{2} = 3.485$$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$
- Nova relativna polugodišnja kamatna stopa:

$$p_2 = \frac{6.97}{2} = 3.485$$

- Novi polugodišnji kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.03485$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$
- Nova relativna polugodišnja kamatna stopa:

$$p_2 = \frac{6.97}{2} = 3.485$$

- Novi polugodišnji kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.03485$
- $n_2 = n_1 - 8 = 20 - 8 = 12$ polugodišta

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$
- Nova relativna polugodišnja kamatna stopa:

$$p_2 = \frac{6.97}{2} = 3.485$$

- Novi polugodišnji kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.03485$
- $n_2 = n_1 - 8 = 20 - 8 = 12$ polugodišta
- Drugi anuitet

$$a_2 = O_8 \cdot \frac{r_2^{n_2} \cdot (r_2 - 1)}{r_2^{n_2} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$
- Nova relativna polugodišnja kamatna stopa:

$$p_2 = \frac{6.97}{2} = 3.485$$

- Novi polugodišnji kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.03485$
- $n_2 = n_1 - 8 = 20 - 8 = 12$ polugodišta
- Drugi anuitet

$$a_2 = O_8 \cdot \frac{r_2^{n_2} \cdot (r_2 - 1)}{r_2^{n_2} - 1}$$

$$a_2 = 60\,677.46 \cdot \frac{1.03485^{12} \cdot (1.03485 - 1)}{1.03485^{12} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}}$$

- Nova godišnja kamatna stopa: $6.47 + 0.5 = 6.97$
- Nova relativna polugodišnja kamatna stopa:

$$p_2 = \frac{6.97}{2} = 3.485$$

- Novi polugodišnji kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.03485$
- $n_2 = n_1 - 8 = 20 - 8 = 12$ polugodišta
- Drugi anuitet

$$a_2 = O_8 \cdot \frac{r_2^{n_2} \cdot (r_2 - 1)}{r_2^{n_2} - 1}$$

$$a_2 = 60\,677.46 \cdot \frac{1.03485^{12} \cdot (1.03485 - 1)}{1.03485^{12} - 1}$$

$$a_2 = 6273.60$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}}$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	
3				
4				

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	
3	6181.61			
4	6181.61			

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	
3	6181.61			
4	6181.61			

$$O_2 = 6181.61 \cdot \frac{1.03235^{20-2} - 1}{1.03235^{20-2} \cdot (1.03235 - 1)} =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61			
4	6181.61			

$$O_2 = 6181.61 \cdot \frac{1.03235^{20-2} - 1}{1.03235^{20-2} \cdot (1.03235 - 1)} = 83\,353.99$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61			
4	6181.61			

$$I_3 = O_2(r_1 - 1) = 83\,353.99 \cdot (1.03235 - 1) =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50		
4	6181.61			

$$I_3 = O_2(r_1 - 1) = 83\,353.99 \cdot (1.03235 - 1) = 2696.50$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50		
4	6181.61			

$$R_3 = a - I_3 = 6181.61 - 2696.50 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	
4	6181.61			

$$R_3 = a - I_3 = 6181.61 - 2696.50 = 3485.11$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	
4	6181.61			

$$O_3 = O_2 - R_3 = 83\,353.99 - 3485.11 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61			

$$O_3 = O_2 - R_3 = 83\,353.99 - 3485.11 = 79\,868.88$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61			

$$I_4 = O_3(r_1 - 1) = 79\,868.88 \cdot (1.03235 - 1) =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61	2583.76		

$$I_4 = O_3(r_1 - 1) = 79\,868.88 \cdot (1.03235 - 1) = 2583.76$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61	2583.76		

$$R_4 = a - I_4 = 6181.61 - 2583.76 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61	2583.76	3597.85	

$$R_4 = a - I_4 = 6181.61 - 2583.76 = 3597.85$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61	2583.76	3597.85	

$$O_4 = O_3 - R_4 = 79\,868.88 - 3597.85 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61	2583.76	3597.85	76 271.03

$$O_4 = O_3 - R_4 = 79\,868.88 - 3597.85 = 76\,271.03$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
2	–	–	–	83 353.99
3	6181.61	2696.50	3485.11	79 868.88
4	6181.61	2583.76	3597.85	76 271.03

treći zadatak

Zadatak 3

Kredit visine 85 000 *kn odobren je na pet godina uz otplatu mjesečnim anuitetima. Nakon dvije godine podigne se dopunski kredit od* 25 000 *kn koji se otplaćuje zajedno s preostalim dijelom starog kredita u dogovoreno vrijeme. Izračunajte oba anuiteta i izradite otplatnu tablicu za prva tri mjeseca četvrte godine otplate kredita. Godišnja kamatna stopa iznosi* 7.2%*, a ukamaćivanje je cijelo vrijeme relativno.*

Rješenje

- Relativna mjesečna kamatna stopa: $p' = \frac{7.2}{12} = 0.6$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna mjesečna kamatna stopa: $p' = \frac{7.2}{12} = 0.6$
- Mjesečni kamatni faktor: $r = 1 + \frac{p'}{100} = 1.006$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna mjesečna kamatna stopa: $p' = \frac{7.2}{12} = 0.6$
- Mjesečni kamatni faktor: $r = 1 + \frac{p'}{100} = 1.006$
- $n_1 = 60$ mjeseci

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna mjesečna kamatna stopa: $p' = \frac{7.2}{12} = 0.6$
- Mjesečni kamatni faktor: $r = 1 + \frac{p'}{100} = 1.006$
- $n_1 = 60$ mjeseci
- Prvi anuitet

$$a_1 = K \cdot \frac{r^{n_1} \cdot (r-1)}{r^{n_1} - 1}$$

$$\boxed{a = K \cdot \frac{r^{n} \cdot (r-1)}{r^{n} - 1}}$$

Rješenje

- Relativna mjesečna kamatna stopa: $p' = \frac{7.2}{12} = 0.6$
- Mjesečni kamatni faktor: $r = 1 + \frac{p'}{100} = 1.006$
- $n_1 = 60$ mjeseci
- Prvi anuitet

$$a_1 = K \cdot \frac{r^{n_1} \cdot (r-1)}{r^{n_1} - 1}$$

$$a_1 = 85\,000 \cdot \frac{1.006^{60} \cdot (1.006 - 1)}{1.006^{60} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}}$$

Rješenje

- Relativna mjesečna kamatna stopa: $p' = \frac{7.2}{12} = 0.6$
- Mjesečni kamatni faktor: $r = 1 + \frac{p'}{100} = 1.006$
- $n_1 = 60$ mjeseci
- Prvi anuitet

$$a_1 = K \cdot \frac{r^{n_1} \cdot (r-1)}{r^{n_1} - 1}$$

$$a_1 = 85\,000 \cdot \frac{1.006^{60} \cdot (1.006 - 1)}{1.006^{60} - 1}$$

$$a_1 = 1691.13$$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Ostatak duga nakon 2 godine,

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}$$

- Ostatak duga nakon 2 godine, tj. nakon 24 mjesečnih otplata

$$O_{24} = a_1 \cdot \frac{r^{n_1-24} - 1}{r^{n_1-24} \cdot (r-1)}$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

- Ostatak duga nakon 2 godine, tj. nakon 24 mjesečnih otplata

$$O_{24} = a_1 \cdot \frac{r^{n_1-24} - 1}{r^{n_1-24} \cdot (r-1)}$$

$$O_{24} = 1691.13 \cdot \frac{1.006^{60-24} - 1}{1.006^{60-24} \cdot (1.006 - 1)}$$

$$\boxed{O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}}$$

- Ostatak duga nakon 2 godine, tj. nakon 24 mjesečnih otplata

$$O_{24} = a_1 \cdot \frac{r^{n_1-24} - 1}{r^{n_1-24} \cdot (r-1)}$$

$$O_{24} = 1691.13 \cdot \frac{1.006^{60-24} - 1}{1.006^{60-24} \cdot (1.006 - 1)}$$

$$O_{24} = 54\,607.85$$

$$\boxed{O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}}$$

- Novi ostatak duga: $K' = O_{24} + 25\,000 = 79\,607.85$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Novi ostatak duga: $K' = O_{24} + 25\,000 = 79\,607.85$
- $n_2 = n_1 - 24 = 60 - 24 = 36$ mjeseci

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Novi ostatak duga: $K' = O_{24} + 25\,000 = 79\,607.85$
- $n_2 = n_1 - 24 = 60 - 24 = 36$ mjeseci
- Drugi anuitet

$$a_2 = K' \cdot \frac{r^{n_2} \cdot (r-1)}{r^{n_2} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}}$$

- Novi ostatak duga: $K' = O_{24} + 25\,000 = 79\,607.85$
- $n_2 = n_1 - 24 = 60 - 24 = 36$ mjeseci
- Drugi anuitet

$$a_2 = K' \cdot \frac{r^{n_2} \cdot (r-1)}{r^{n_2} - 1}$$

$$a_2 = 79\,607.85 \cdot \frac{1.006^{36} \cdot (1.006 - 1)}{1.006^{36} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}}$$

- Novi ostatak duga: $K' = O_{24} + 25\,000 = 79\,607.85$
- $n_2 = n_1 - 24 = 60 - 24 = 36$ mjeseci
- Drugi anuitet

$$a_2 = K' \cdot \frac{r^{n_2} \cdot (r-1)}{r^{n_2} - 1}$$

$$a_2 = 79\,607.85 \cdot \frac{1.006^{36} \cdot (1.006 - 1)}{1.006^{36} - 1}$$

$$a_2 = 2465.35$$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	
37				
38				
39				

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	
37	2465.35			
38	2465.35			
39	2465.35			

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	
37	2465.35			
38	2465.35			
39	2465.35			

$$O_{36\,(12)} = 2465.35 \cdot \frac{1.006^{36-12} - 1}{1.006^{36-12} \cdot (1.006 - 1)} =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35			
38	2465.35			
39	2465.35			

$$O_{36\,(12)} = 2465.35 \cdot \frac{1.006^{36-12} - 1}{1.006^{36-12} \cdot (1.006 - 1)} = 54\,952.49$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35			
38	2465.35			
39	2465.35			

$$I_{37} = O_{36}(r-1) = 54\,952.49 \cdot (1.006 - 1) =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71		
38	2465.35			
39	2465.35			

$$I_{37} = O_{36}(r-1) = 54\,952.49 \cdot (1.006 - 1) = 329.71$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71		
38	2465.35			
39	2465.35			

$$R_{37} = a - I_{37} = 2465.35 - 329.71 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	
38	2465.35			
39	2465.35			

$$R_{37} = a - I_{37} = 2465.35 - 329.71 = 2135.64$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	
38	2465.35			
39	2465.35			

$$O_{37} = O_{36} - R_{37} = 54\,952.49 - 2135.64 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35			
39	2465.35			

$$O_{37} = O_{36} - R_{37} = 54\,952.49 - 2135.64 = 52\,816.85$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35			
39	2465.35			

$$I_{38} = O_{37}(r-1) = 52\,816.85 \cdot (1.006 - 1) =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90		
39	2465.35			

$$I_{38} = O_{37}(r-1) = 52\,816.85 \cdot (1.006 - 1) = 316.90$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90		
39	2465.35			

$$R_{38} = a - I_{38} = 2465.35 - 316.90 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	
39	2465.35			

$$R_{38} = a - I_{38} = 2465.35 - 316.90 = 2148.45$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	
39	2465.35			

$$O_{38} = O_{37} - R_{38} = 52\,816.85 - 2148.45 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35			

$$O_{38} = O_{37} - R_{38} = 52\,816.85 - 2148.45 = 50\,668.41$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35			

$$I_{39} = O_{38}(r-1) = 50\,668.41 \cdot (1.006 - 1) =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35	304.01		

$$I_{39} = O_{38}(r-1) = 50\,668.41 \cdot (1.006 - 1) = 304.01$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35	304.01		

$$R_{39} = a - I_{39} = 2465.35 - 304.01 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35	304.01	2161.34	

$$R_{39} = a - I_{39} = 2465.35 - 304.01 = 2161.34$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35	304.01	2161.34	

$$O_{39} = O_{38} - R_{39} = 50\,668.41 - 2161.34 =$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35	304.01	2161.34	48 507.07

$$O_{39} = O_{38} - R_{39} = 50\,668.41 - 2161.34 = 48\,507.07$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r-1)}$$

$$I_k = O_{k-1}(r-1)$$

$$R_k = a - I_k$$

$$O_k = O_{k-1} - R_k$$

- Otplatna tablica

k	a	I_k	R_k	O_k
36	–	–	–	54 952.49
37	2465.35	329.71	2135.64	52 816.85
38	2465.35	316.90	2148.45	50 668.41
39	2465.35	304.01	2161.34	48 507.07

četvrti zadatak

Zadatak 4

Dogovoreno je da se kredit visine 190 000 *kn otplati tijekom* 7 *godina jednakim kvartalnim anuitetima i relativno ukamaćivanje uz godišnju kamatnu stopu* 10.9% *i poček od godinu dana. Nakon* 20 *otplata prijeđeno je na otplatu mjesečnim anuitetima, a kamatna stopa je smanjena na* 10.5%*. Odredite interkalarne kamate, prvi i drugi anuitet, ukupno plaćene kamate i uštedu na kamatama uslijed smanjenja kamatne stope.*

Rješenje

- Relativna kvartalna kamatna stopa: $p_1 = \frac{10.9}{4} = 2.725$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna kvartalna kamatna stopa: $p_1 = \frac{10.9}{4} = 2.725$
- Kvartalni kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.02725$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna kvartalna kamatna stopa: $p_1 = \frac{10.9}{4} = 2.725$
- Kvartalni kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.02725$
- $n_1 = 28$ kvartala

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna kvartalna kamatna stopa: $p_1 = \frac{10.9}{4} = 2.725$
- Kvartalni kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.02725$
- $n_1 = 28$ kvartala
- Prvi anuitet

$$a_1 = K \cdot \frac{r_1^{n_1} \cdot (r_1 - 1)}{r_1^{n_1} - 1}$$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

Rješenje

- Relativna kvartalna kamatna stopa: $p_1 = \frac{10.9}{4} = 2.725$
- Kvartalni kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.02725$
- $n_1 = 28$ kvartala
- Prvi anuitet

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

$$a_1 = K \cdot \frac{r_1^{n_1} \cdot (r_1 - 1)}{r_1^{n_1} - 1}$$

$$a_1 = 190\,000 \cdot \frac{1.02725^{28} \cdot (1.02725 - 1)}{1.02725^{28} - 1}$$

Rješenje

- Relativna kvartalna kamatna stopa: $p_1 = \frac{10.9}{4} = 2.725$
- Kvartalni kamatni faktor: $r_1 = 1 + \frac{p_1}{100} = 1.02725$
- $n_1 = 28$ kvartala
- Prvi anuitet

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

$$a_1 = K \cdot \frac{r_1^{n_1} \cdot (r_1 - 1)}{r_1^{n_1} - 1}$$

$$a_1 = 190\,000 \cdot \frac{1.02725^{28} \cdot (1.02725 - 1)}{1.02725^{28} - 1}$$

$$a_1 = 9788.28$$

- Ostatak duga nakon 20 kvartalnih otplata

$$O_{20} = a_1 \cdot \frac{r_1^{n_1-20} - 1}{r_1^{n_1-20} \cdot (r_1 - 1)}$$

$$O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}$$

- Ostatak duga nakon 20 kvartalnih otplata

$$O_{20} = a_1 \cdot \frac{r_1^{n_1-20} - 1}{r_1^{n_1-20} \cdot (r_1 - 1)}$$

$$O_{20} = 9788.28 \cdot \frac{1.02725^{28-20} - 1}{1.02725^{28-20} \cdot (1.02725 - 1)}$$

$$\boxed{O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}}$$

- Ostatak duga nakon 20 kvartalnih otplata

$$O_{20} = a_1 \cdot \frac{r_1^{n_1-20} - 1}{r_1^{n_1-20} \cdot (r_1 - 1)}$$

$$O_{20} = 9788.28 \cdot \frac{1.02725^{28-20} - 1}{1.02725^{28-20} \cdot (1.02725 - 1)}$$

$$O_{20} = 69\,514.82$$

$$\boxed{O_k = a \cdot \frac{r^{n-k} - 1}{r^{n-k} \cdot (r - 1)}}$$

- Relativna mjesečna kamatna stopa: $p_2 = \frac{10.5}{12} = 0.875$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Relativna mjesečna kamatna stopa: $p_2 = \frac{10.5}{12} = 0.875$
- Mjesečni kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.00875$

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Relativna mjesečna kamatna stopa: $p_2 = \frac{10.5}{12} = 0.875$
- Mjesečni kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.00875$
- $n_2 = n_1 - 20 = 28 - 20 = 8$ kvartala $= 24$ mjeseci

$$a = K \cdot \frac{r^n \cdot (r-1)}{r^n - 1}$$

- Relativna mjesečna kamatna stopa: $p_2 = \dfrac{10.5}{12} = 0.875$
- Mjesečni kamatni faktor: $r_2 = 1 + \dfrac{p_2}{100} = 1.00875$
- $n_2 = n_1 - 20 = 28 - 20 = 8$ kvartala $= 24$ mjeseci
- Drugi anuitet

$$a_2 = O_{20} \cdot \frac{r_2^{n_2} \cdot (r_2 - 1)}{r_2^{n_2} - 1}$$

$$a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}$$

- Relativna mjesečna kamatna stopa: $p_2 = \frac{10.5}{12} = 0.875$
- Mjesečni kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.00875$
- $n_2 = n_1 - 20 = 28 - 20 = 8$ kvartala $= 24$ mjeseci
- Drugi anuitet

$$a_2 = O_{20} \cdot \frac{r_2^{n_2} \cdot (r_2 - 1)}{r_2^{n_2} - 1}$$

$$a_2 = 69\,514.82 \cdot \frac{1.00875^{24} \cdot (1.00875 - 1)}{1.00875^{24} - 1}$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}}$$

- Relativna mjesečna kamatna stopa: $p_2 = \frac{10.5}{12} = 0.875$
- Mjesečni kamatni faktor: $r_2 = 1 + \frac{p_2}{100} = 1.00875$
- $n_2 = n_1 - 20 = 28 - 20 = 8$ kvartala $= 24$ mjeseci
- Drugi anuitet

$$a_2 = O_{20} \cdot \frac{r_2^{n_2} \cdot (r_2 - 1)}{r_2^{n_2} - 1}$$

$$a_2 = 69\,514.82 \cdot \frac{1.00875^{24} \cdot (1.00875 - 1)}{1.00875^{24} - 1}$$

$$a_2 = 3223.82$$

$$\boxed{a = K \cdot \frac{r^n \cdot (r - 1)}{r^n - 1}}$$

- Interkalarne kamate za jedno razdoblje (kvartal)

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100}$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100}$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4 I_{\text{ik}}^{(1)}$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4 I_{\text{ik}}^{(1)} = 4 \cdot 5177.5$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

$$I = 20 \cdot 9788.28 + 24 \cdot 3223.82 - 190\,000$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

$$I = 20 \cdot 9788.28 + 24 \cdot 3223.82 - 190\,000$$

$$I = 83\,137.28$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

$$I = 20 \cdot 9788.28 + 24 \cdot 3223.82 - 190\,000$$

$$I = 83\,137.28$$

- Ušteda na kamatama uslijed smanjenja kamatne stope

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

$$I = 20 \cdot 9788.28 + 24 \cdot 3223.82 - 190\,000$$

$$I = 83\,137.28$$

- Ušteda na kamatama uslijed smanjenja kamatne stope

$$U = 8a_1 - 24a_2$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

$$I = 20 \cdot 9788.28 + 24 \cdot 3223.82 - 190\,000$$

$$I = 83\,137.28$$

- Ušteda na kamatama uslijed smanjenja kamatne stope

$$U = 8a_1 - 24a_2$$

$$U = 8 \cdot 9788.28 - 24 \cdot 3223.82$$

- Interkalarne kamate za jedno razdoblje (kvartal)

$$I_{\text{ik}}^{(1)} = K \cdot \frac{p_1}{100} = 190\,000 \cdot \frac{2.725}{100} = 5177.5$$

- Ukupne interkalarne kamate (jedna godina)

$$I_{\text{ik}} = 4I_{\text{ik}}^{(1)} = 4 \cdot 5177.5 = 20\,710$$

- Ukupno plaćene kamate

$$I = 20a_1 + 24a_2 - 190\,000$$

$$I = 20 \cdot 9788.28 + 24 \cdot 3223.82 - 190\,000$$

$$I = 83\,137.28$$

- Ušteda na kamatama uslijed smanjenja kamatne stope

$$U = 8a_1 - 24a_2$$

$$U = 8 \cdot 9788.28 - 24 \cdot 3223.82$$

$$U = 934.56$$

peti zadatak

Zadatak 5

Kredit visine 117 000 *kn treba otplatiti mjesečnim otplatama tijekom pet godina. Kredit je dogovoren uz uvjet otplate jednakim otplatnim kvotama krajem razdoblja i godišnju dekurzivnu kamatnu stopu* 7.2%. *Izradite otplatnu tablicu za posljednja četiri mjeseca otplate kredita.*

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	
57				
58				
59				
60				

$$R = \frac{K}{n}$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	
57				
58				
59				
60				

$$R = \frac{K}{n} = \frac{117\,000}{60} = 1950$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	
57			1950	
58			1950	
59			1950	
60			1950	

$$R = \frac{K}{n} = \frac{117\,000}{60} = 1950$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	
57			1950	
58			1950	
59			1950	
60			1950	

$$O_{56} = (60 - 56) \cdot R = 4 \cdot 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	
58			1950	
59			1950	
60			1950	

$$O_{56} = (60 - 56) \cdot R = 4 \cdot 1950 = 7800$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	
58			1950	
59			1950	
60			1950	

$$O_{57} = (60 - 57) \cdot R = 3 \cdot 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	
59			1950	
60			1950	

$$O_{57} = (60 - 57) \cdot R = 3 \cdot 1950 = 5850$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	
59			1950	
60			1950	

$$O_{58} = (60 - 58) \cdot R = 2 \cdot 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	3900
59			1950	
60			1950	

$$O_{58} = (60 - 58) \cdot R = 2 \cdot 1950 = 3900$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	3900
59			1950	
60			1950	

$$O_{59} = (60 - 59) \cdot R = 1 \cdot 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	3900
59			1950	1950
60			1950	

$$O_{59} = (60 - 59) \cdot R = 1 \cdot 1950 = 1950$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	3900
59			1950	1950
60			1950	

$$O_{60} = (60 - 60) \cdot R = 0 \cdot 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	3900
59			1950	1950
60			1950	0

$$O_{60} = (60 - 60) \cdot R = 0 \cdot 1950 = 0$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57			1950	5850
58			1950	3900
59			1950	1950
60			1950	0

$$I_{57} = O_{56}(r-1) = 7800 \cdot (1.006 - 1) =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58			1950	3900
59			1950	1950
60			1950	0

$$I_{57} = O_{56}(r-1) = 7800 \cdot (1.006 - 1) = 46.80$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58			1950	3900
59			1950	1950
60			1950	0

$$I_{58} = O_{57}(r-1) = 5850 \cdot (1.006 - 1) =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58		35.10	1950	3900
59			1950	1950
60			1950	0

$$I_{58} = O_{57}(r-1) = 5850 \cdot (1.006 - 1) = 35.10$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58		35.10	1950	3900
59			1950	1950
60			1950	0

$$I_{59} = O_{58}(r-1) = 3900 \cdot (1.006 - 1) =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58		35.10	1950	3900
59		23.40	1950	1950
60			1950	0

$$I_{59} = O_{58}(r-1) = 3900 \cdot (1.006 - 1) = 23.40$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58		35.10	1950	3900
59		23.40	1950	1950
60			1950	0

$$I_{60} = O_{59}(r-1) = 1950 \cdot (1.006 - 1) =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58		35.10	1950	3900
59		23.40	1950	1950
60		11.70	1950	0

$$I_{60} = O_{59}(r-1) = 1950 \cdot (1.006 - 1) = 11.70$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57		46.80	1950	5850
58		35.10	1950	3900
59		23.40	1950	1950
60		11.70	1950	0

$$a_{57} = I_{57} + R = 46.80 + 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58		35.10	1950	3900
59		23.40	1950	1950
60		11.70	1950	0

$$a_{57} = I_{57} + R = 46.80 + 1950 = 1996.80$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58		35.10	1950	3900
59		23.40	1950	1950
60		11.70	1950	0

$$a_{58} = I_{58} + R = 35.10 + 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58	1985.10	35.10	1950	3900
59		23.40	1950	1950
60		11.70	1950	0

$$a_{58} = I_{58} + R = 35.10 + 1950 = 1985.10$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58	1985.10	35.10	1950	3900
59		23.40	1950	1950
60		11.70	1950	0

$$a_{59} = I_{59} + R = 23.40 + 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58	1985.10	35.10	1950	3900
59	1973.40	23.40	1950	1950
60		11.70	1950	0

$$a_{59} = I_{59} + R = 23.40 + 1950 = 1973.40$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58	1985.10	35.10	1950	3900
59	1973.40	23.40	1950	1950
60		11.70	1950	0

$$a_{60} = I_{60} + R = 11.70 + 1950 =$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58	1985.10	35.10	1950	3900
59	1973.40	23.40	1950	1950
60	1961.70	11.70	1950	0

$$a_{60} = I_{60} + R = 11.70 + 1950 = 1961.70$$

$$O_k = K - kR = nR - kR = (n-k)R$$

$$I_k = O_{k-1}(r-1)$$

Rješenje

$$a_k = I_k + R$$

- Mjesečni kamatni faktor

$$p' = \frac{7.2}{12} = 0.6 \qquad r = 1 + \frac{p'}{100} = 1 + \frac{0.6}{100} = 1.006$$

k	a_k	I_k	R	O_k
56	–	–	–	7800
57	1996.80	46.80	1950	5850
58	1985.10	35.10	1950	3900
59	1973.40	23.40	1950	1950
60	1961.70	11.70	1950	0