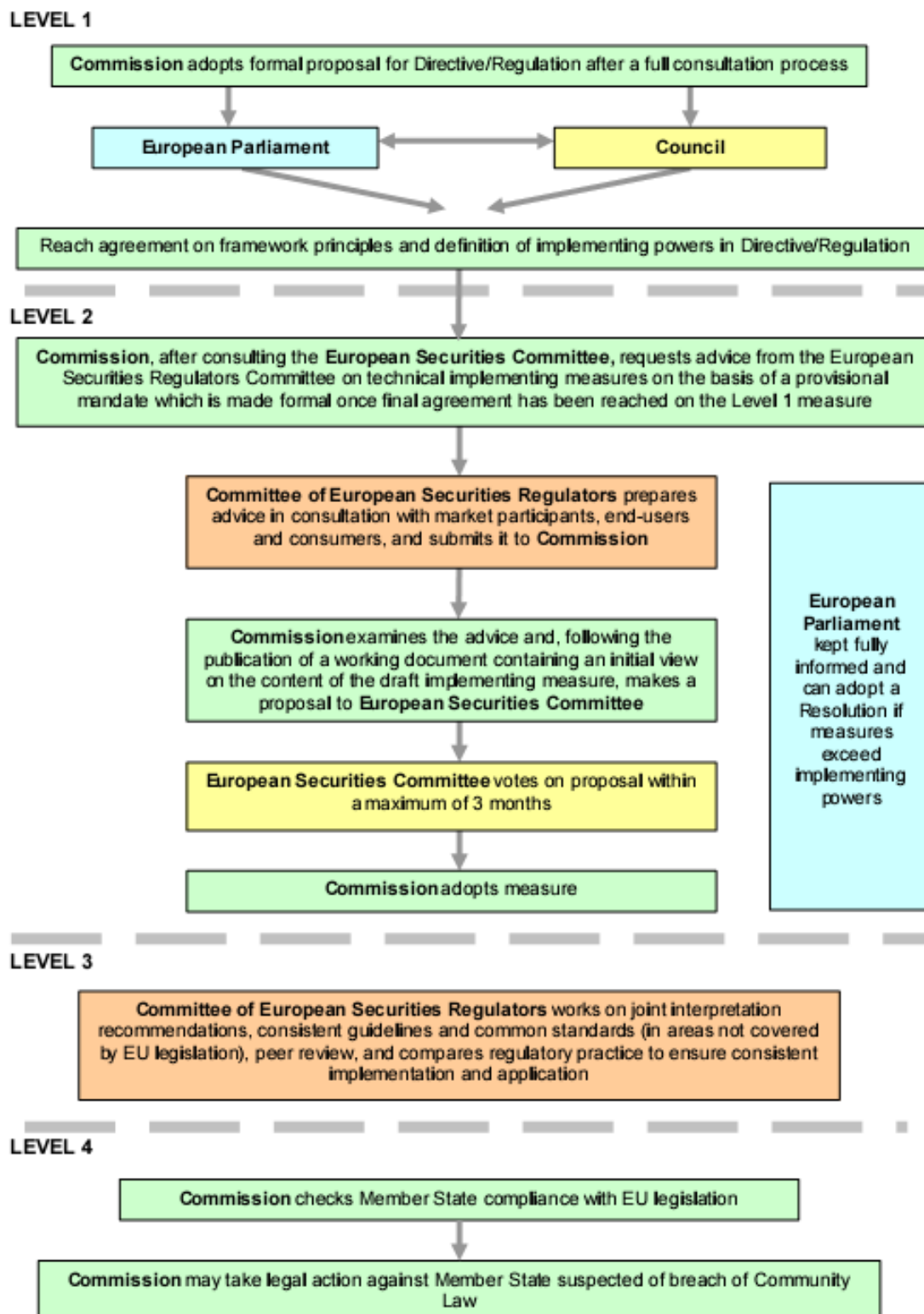


Příloha A

Lemfalussyho schéma



Obrázek A.1: Lamfalussyho čtyřúrovňové schéma.

Příloha B

Modelování stornovosti

Výpočetní podklady

Při výpočtu cash flow jednotlivých generací v Mathematice byly použity stejné výpočetní podklady jako v [11] s výjimkou následujících ekonomických veličin B.1 a úmrtnostních tabulek. Základem pro výpočet pravděpodobností úmrtí q_x byly úmrtnostní tabulky ČSÚ z roku 2009. Jejich hodnoty jsou uvedené na obrázku B.1.

| | |
|------------------------|-------|
| Ekonomická inflace | 0,02 |
| Nákladová inflace | 0,03 |
| Technická úroková míra | 0,024 |

Tabulka B.1: Použité ekonomické veličiny.

| modelpoint č. | vstupní věk | pojistná doba | pohlaví | frekvence placení | pojistná částka |
|---------------|-------------|---------------|---------|-------------------|-----------------|
| 1 | 35 | 24 | 0 | 1 | 50 000 |
| 2 | 34 | 25 | 1 | 2 | 100 000 |
| 3 | 27 | 26 | 0 | 4 | 150 000 |
| 4 | 31 | 22 | 1 | 12 | 200 000 |
| 5 | 30 | 25 | 0 | 1 | 200 000 |
| 6 | 32 | 24 | 1 | 4 | 100 000 |
| 7 | 30 | 22 | 0 | 12 | 50 000 |
| 8 | 32 | 26 | 1 | 2 | 150 000 |
| 9 | 33 | 25 | 0 | 4 | 150 000 |
| 10 | 29 | 21 | 1 | 1 | 50 000 |

Tabulka B.2: Použité modelpointy.

| x | qxMuzi | qxZeny | x | qxMuzi | qxZeny | x | qxMuzi | qxZeny |
|----|------------|------------|----|------------|------------|-----|------------|------------|
| 0 | 0.00306454 | 0.00269058 | 36 | 0.00128702 | 0.00053787 | 72 | 0.03917141 | 0.02048649 |
| 1 | 0.00024946 | 0.00033062 | 37 | 0.00147430 | 0.00064107 | 73 | 0.04260070 | 0.02351964 |
| 2 | 0.00028122 | 0.00012952 | 38 | 0.00165145 | 0.00065377 | 74 | 0.04560801 | 0.02672625 |
| 3 | 0.00009247 | 0.00007839 | 39 | 0.00177737 | 0.00072372 | 75 | 0.05040977 | 0.03036871 |
| 4 | 0.00012035 | 0.00008107 | 40 | 0.00189268 | 0.00083816 | 76 | 0.05613322 | 0.03498822 |
| 5 | 0.00008749 | 0.00010480 | 41 | 0.00201967 | 0.00093978 | 77 | 0.06154335 | 0.03947452 |
| 6 | 0.00010945 | 0.00013072 | 42 | 0.00233700 | 0.00107850 | 78 | 0.06772826 | 0.04460630 |
| 7 | 0.00010853 | 0.00012133 | 43 | 0.00256712 | 0.00132401 | 79 | 0.07493203 | 0.05067316 |
| 8 | 0.00010411 | 0.00010763 | 44 | 0.00278305 | 0.00140416 | 80 | 0.08282778 | 0.05765720 |
| 9 | 0.00010905 | 0.00007950 | 45 | 0.00312204 | 0.00155113 | 81 | 0.09142741 | 0.06603234 |
| 10 | 0.00015618 | 0.00009669 | 46 | 0.00339887 | 0.00172716 | 82 | 0.10049835 | 0.07559742 |
| 11 | 0.00013713 | 0.00008567 | 47 | 0.00394906 | 0.00188925 | 83 | 0.11092700 | 0.08616409 |
| 12 | 0.00018024 | 0.00009872 | 48 | 0.00448983 | 0.00210299 | 84 | 0.12279772 | 0.09818266 |
| 13 | 0.00021529 | 0.00010907 | 49 | 0.00502017 | 0.00234043 | 85 | 0.13643352 | 0.11241427 |
| 14 | 0.00026340 | 0.00014135 | 50 | 0.00550576 | 0.00251999 | 86 | 0.15026365 | 0.12837668 |
| 15 | 0.00029702 | 0.00018347 | 51 | 0.00623800 | 0.00278177 | 87 | 0.16514124 | 0.14737706 |
| 16 | 0.00037406 | 0.00017638 | 52 | 0.00697990 | 0.00309495 | 88 | 0.18229722 | 0.16810016 |
| 17 | 0.00044764 | 0.00017548 | 53 | 0.00804720 | 0.00332879 | 89 | 0.20111820 | 0.19147897 |
| 18 | 0.00051307 | 0.00020578 | 54 | 0.00885699 | 0.00361909 | 90 | 0.22171061 | 0.21774311 |
| 19 | 0.00059524 | 0.00026498 | 55 | 0.00963545 | 0.00398699 | 91 | 0.24417373 | 0.24710528 |
| 20 | 0.00068860 | 0.00032597 | 56 | 0.01041769 | 0.00438186 | 92 | 0.26859522 | 0.27974615 |
| 21 | 0.00075768 | 0.00037092 | 57 | 0.01160868 | 0.00496501 | 93 | 0.29504588 | 0.31579542 |
| 22 | 0.00084473 | 0.00033246 | 58 | 0.01272168 | 0.00541008 | 94 | 0.32357341 | 0.35530864 |
| 23 | 0.00082929 | 0.00028327 | 59 | 0.01414566 | 0.00600385 | 95 | 0.35419530 | 0.39824048 |
| 24 | 0.00071178 | 0.00025302 | 60 | 0.01534240 | 0.00660004 | 96 | 0.38689099 | 0.44441525 |
| 25 | 0.00069834 | 0.00023163 | 61 | 0.01676100 | 0.00716616 | 97 | 0.42159334 | 0.49349703 |
| 26 | 0.00071893 | 0.00024639 | 62 | 0.01845549 | 0.00785960 | 98 | 0.45818003 | 0.54496277 |
| 27 | 0.00080745 | 0.00024930 | 63 | 0.02056814 | 0.00891008 | 99 | 0.49646524 | 0.59808335 |
| 28 | 0.00091245 | 0.00026754 | 64 | 0.02243465 | 0.00970094 | 100 | 0.53619238 | 0.65191919 |
| 29 | 0.00088385 | 0.00027877 | 65 | 0.02424342 | 0.01064900 | 101 | 0.57702895 | 0.70533753 |
| 30 | 0.00085708 | 0.00028802 | 66 | 0.02526745 | 0.01128742 | 102 | 0.61856453 | 0.75705882 |
| 31 | 0.00093354 | 0.00036093 | 67 | 0.02719606 | 0.01245616 | 103 | 0.66031331 | 0.80573647 |
| 32 | 0.00101973 | 0.00043686 | 68 | 0.02891402 | 0.01378540 | 104 | 0.70172244 | 0.85006972 |
| 33 | 0.00106190 | 0.00047904 | 69 | 0.03128006 | 0.01543305 | 105 | 1.00000000 | 1.00000000 |
| 34 | 0.00111148 | 0.00053583 | 70 | 0.03428743 | 0.01713852 | | | |
| 35 | 0.00113349 | 0.00056922 | 71 | 0.03724793 | 0.01858005 | | | |

Obrázek B.1: Úmrtnost - podklady 2. řádu.

Empirické hodnoty stornovostí (Kooperativa)

Měsíční a roční stornovosti jednotlivých odbytových kanálů

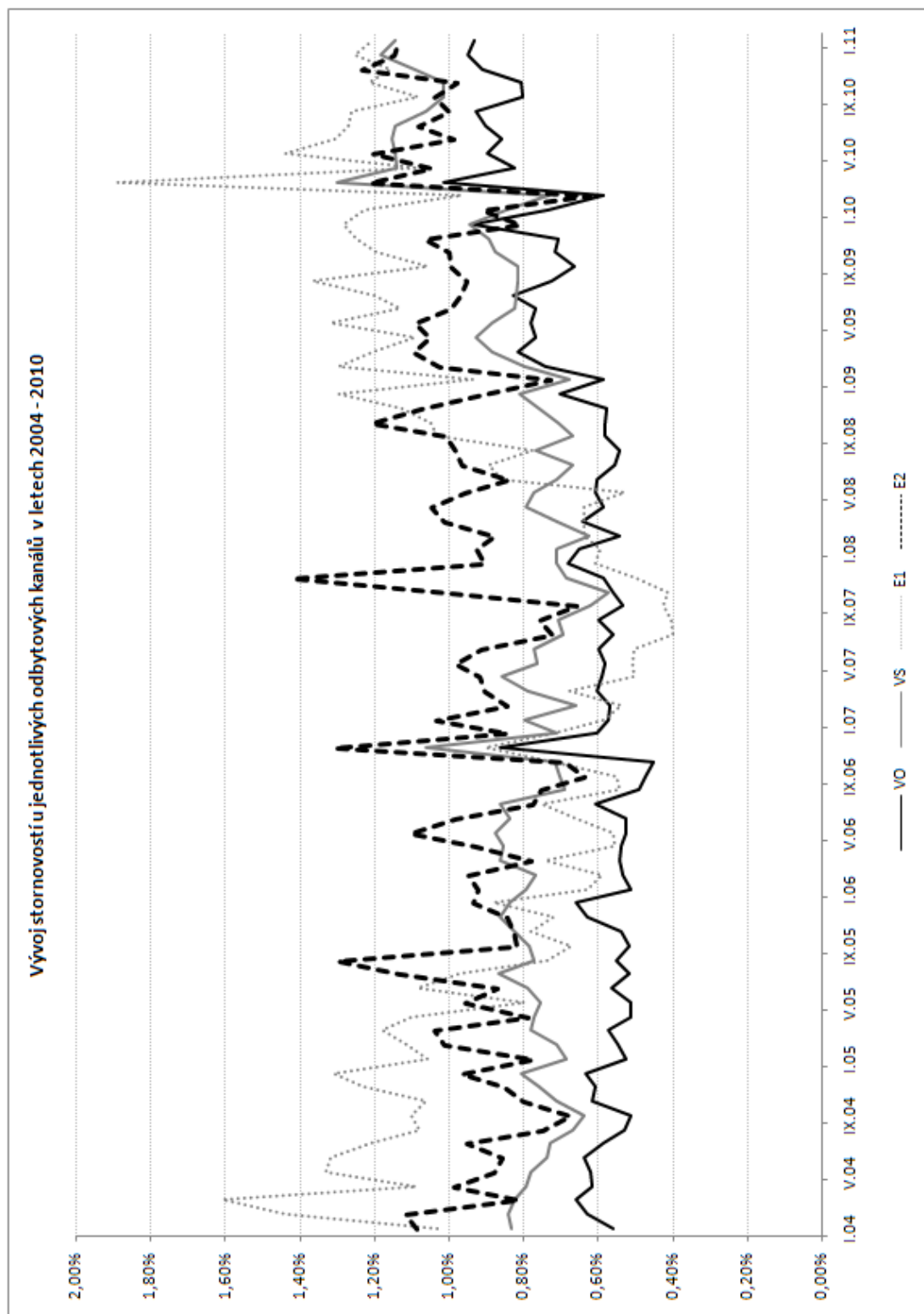
| období | VO | | VS | | E1 | | E2 | |
|---------|---------|-------|---------|-------|---------|--------|---------|--------|
| | měsíční | roční | měsíční | roční | měsíční | roční | měsíční | roční |
| I.04 | 0.55% | 0.55% | 0.82% | 0.82% | 1.01% | 1.01% | 1.07% | 1.07% |
| II.04 | 0.62% | 1.16% | 0.82% | 1.63% | 1.41% | 2.40% | 1.09% | 2.15% |
| III.04 | 0.65% | 1.80% | 0.81% | 2.43% | 1.57% | 3.94% | 0.80% | 2.93% |
| IV.04 | 0.60% | 2.39% | 0.78% | 3.19% | 1.07% | 4.96% | 0.97% | 3.87% |
| V.04 | 0.61% | 2.98% | 0.76% | 3.93% | 1.30% | 6.20% | 0.86% | 4.70% |
| VI.04 | 0.62% | 3.59% | 0.72% | 4.62% | 1.29% | 7.41% | 0.84% | 5.50% |
| VII.04 | 0.57% | 4.14% | 0.71% | 5.30% | 1.18% | 8.50% | 0.94% | 6.38% |
| VIII.04 | 0.52% | 4.64% | 0.65% | 5.92% | 1.05% | 9.47% | 0.73% | 7.07% |
| IX.04 | 0.50% | 5.12% | 0.63% | 6.51% | 1.08% | 10.44% | 0.66% | 7.68% |
| X.04 | 0.60% | 5.69% | 0.70% | 7.16% | 1.04% | 11.37% | 0.79% | 8.41% |
| XI.04 | 0.60% | 6.25% | 0.74% | 7.85% | 1.20% | 12.44% | 0.83% | 9.17% |
| XII.04 | 0.62% | 6.83% | 0.79% | 8.58% | 1.28% | 13.56% | 0.94% | 10.03% |
| I.05 | 0.51% | 0.51% | 0.67% | 0.67% | 1.03% | 1.03% | 0.76% | 0.76% |
| II.05 | 0.54% | 1.05% | 0.70% | 1.37% | 1.09% | 2.11% | 0.99% | 1.74% |
| III.05 | 0.56% | 1.60% | 0.76% | 2.12% | 1.15% | 3.24% | 1.02% | 2.74% |
| IV.05 | 0.50% | 2.10% | 0.76% | 2.86% | 1.08% | 4.28% | 0.77% | 3.49% |
| V.05 | 0.50% | 2.59% | 0.74% | 3.58% | 0.78% | 5.03% | 0.94% | 4.40% |
| VI.05 | 0.55% | 3.12% | 0.77% | 4.32% | 1.06% | 6.03% | 0.85% | 5.21% |
| VII.05 | 0.51% | 3.61% | 0.85% | 5.13% | 0.95% | 6.93% | 1.11% | 6.26% |
| VIII.05 | 0.54% | 4.13% | 0.76% | 5.85% | 0.72% | 7.60% | 1.27% | 7.46% |
| IX.05 | 0.50% | 4.62% | 0.77% | 6.58% | 0.66% | 8.20% | 0.80% | 8.20% |
| X.05 | 0.53% | 5.12% | 0.81% | 7.33% | 0.76% | 8.90% | 0.81% | 8.94% |
| XI.05 | 0.61% | 5.70% | 0.84% | 8.11% | 0.71% | 9.54% | 0.83% | 9.69% |
| XII.05 | 0.64% | 6.31% | 0.82% | 8.87% | 0.86% | 10.32% | 0.91% | 10.52% |
| I.06 | 0.50% | 0.50% | 0.78% | 0.78% | 0.61% | 0.61% | 0.91% | 0.91% |
| II.06 | 0.52% | 1.02% | 0.75% | 1.52% | 0.58% | 1.19% | 0.93% | 1.83% |
| III.06 | 0.53% | 1.55% | 0.85% | 2.36% | 0.73% | 1.90% | 0.77% | 2.58% |
| IV.06 | 0.53% | 2.07% | 0.84% | 3.17% | 0.54% | 2.44% | 0.91% | 3.47% |
| V.06 | 0.52% | 2.57% | 0.86% | 4.01% | 0.55% | 2.97% | 1.08% | 4.51% |
| VI.06 | 0.51% | 3.07% | 0.82% | 4.79% | 0.65% | 3.60% | 0.96% | 5.43% |
| VII.06 | 0.59% | 3.65% | 0.85% | 5.60% | 0.73% | 4.30% | 0.76% | 6.15% |
| VIII.06 | 0.48% | 4.11% | 0.68% | 6.24% | 0.53% | 4.81% | 0.74% | 6.85% |
| IX.06 | 0.46% | 4.56% | 0.69% | 6.89% | 0.54% | 5.32% | 0.62% | 7.43% |
| X.06 | 0.44% | 4.98% | 0.70% | 7.54% | 0.70% | 5.99% | 0.67% | 8.05% |
| XI.06 | 0.85% | 5.78% | 1.04% | 8.50% | 0.88% | 6.82% | 1.28% | 9.23% |
| XII.06 | 0.59% | 6.34% | 0.70% | 9.14% | 0.70% | 7.47% | 0.83% | 9.98% |

Obrázek B.2: Pozorované hodnoty měsíčních a ročních stornovostí pojišťovny Kooperativa v letech 2004-2006.

Měsíční a roční stornovosti jednotlivých odbytových kanálů

| období | VO | | V5 | | E1 | | E2 | |
|---------|---------|-------|---------|--------|---------|--------|---------|--------|
| | měsíční | roční | měsíční | roční | měsíční | roční | měsíční | roční |
| I.07 | 0.56% | 0.56% | 0.78% | 0.78% | 0.57% | 0.57% | 1.02% | 1.02% |
| II.07 | 0.56% | 1.12% | 0.64% | 1.42% | 0.52% | 1.09% | 0.83% | 1.83% |
| III.07 | 0.59% | 1.70% | 0.77% | 2.18% | 0.66% | 1.74% | 0.89% | 2.71% |
| IV.07 | 0.58% | 2.27% | 0.84% | 3.01% | 0.49% | 2.23% | 0.90% | 3.58% |
| V.07 | 0.57% | 2.82% | 0.75% | 3.73% | 0.50% | 2.71% | 0.96% | 4.51% |
| VI.07 | 0.58% | 3.39% | 0.75% | 4.46% | 0.49% | 3.19% | 0.89% | 5.36% |
| VII.07 | 0.55% | 3.92% | 0.68% | 5.11% | 0.39% | 3.56% | 0.71% | 6.03% |
| VIII.07 | 0.58% | 4.48% | 0.69% | 5.76% | 0.40% | 3.95% | 0.74% | 6.73% |
| IX.07 | 0.52% | 4.98% | 0.61% | 6.34% | 0.41% | 4.34% | 0.65% | 7.33% |
| X.07 | 0.55% | 5.50% | 0.56% | 6.87% | 0.40% | 4.73% | 0.98% | 8.24% |
| XI.07 | 0.57% | 6.04% | 0.67% | 7.49% | 0.48% | 5.19% | 1.39% | 9.52% |
| XII.07 | 0.67% | 6.67% | 0.70% | 8.14% | 0.59% | 5.76% | 0.88% | 10.32% |
| I.08 | 0.64% | 0.64% | 0.70% | 0.70% | 0.58% | 0.58% | 0.91% | 0.91% |
| II.08 | 0.53% | 1.17% | 0.61% | 1.30% | 0.62% | 1.20% | 0.86% | 1.76% |
| III.08 | 0.63% | 1.79% | 0.70% | 1.99% | 0.62% | 1.81% | 0.99% | 2.74% |
| IV.08 | 0.57% | 2.35% | 0.78% | 2.75% | 0.62% | 2.43% | 1.03% | 3.74% |
| V.08 | 0.59% | 2.93% | 0.76% | 3.49% | 0.52% | 2.93% | 0.94% | 4.64% |
| VI.08 | 0.59% | 3.50% | 0.70% | 4.16% | 0.84% | 3.74% | 0.82% | 5.43% |
| VII.08 | 0.54% | 4.03% | 0.65% | 4.79% | 0.87% | 4.58% | 0.94% | 6.32% |
| VIII.08 | 0.53% | 4.54% | 0.75% | 5.51% | 0.76% | 5.31% | 0.96% | 7.22% |
| IX.08 | 0.57% | 5.08% | 0.65% | 6.12% | 1.01% | 6.26% | 0.99% | 8.14% |
| X.08 | 0.57% | 5.62% | 0.69% | 6.77% | 1.03% | 7.22% | 1.18% | 9.22% |
| XI.08 | 0.57% | 6.16% | 0.74% | 7.47% | 1.10% | 8.25% | 1.05% | 10.18% |
| XII.08 | 0.69% | 6.80% | 0.79% | 8.20% | 1.27% | 9.41% | 0.89% | 10.98% |
| I.09 | 0.57% | 0.57% | 0.66% | 0.66% | 0.92% | 0.92% | 0.71% | 0.71% |
| II.09 | 0.73% | 1.29% | 0.78% | 1.44% | 1.27% | 2.17% | 1.01% | 1.71% |
| III.09 | 0.80% | 2.08% | 0.87% | 2.29% | 1.18% | 3.33% | 1.07% | 2.77% |
| IV.09 | 0.75% | 2.82% | 0.91% | 3.18% | 1.07% | 4.36% | 1.03% | 3.77% |
| V.09 | 0.76% | 3.56% | 0.86% | 4.02% | 1.29% | 5.59% | 1.07% | 4.80% |
| VI.09 | 0.75% | 4.28% | 0.81% | 4.79% | 1.11% | 6.64% | 0.98% | 5.73% |
| VII.09 | 0.81% | 5.06% | 0.80% | 5.56% | 1.18% | 7.74% | 0.95% | 6.63% |
| VIII.09 | 0.71% | 5.73% | 0.80% | 6.32% | 1.34% | 8.97% | 0.93% | 7.50% |
| IX.09 | 0.65% | 6.35% | 0.80% | 7.06% | 1.03% | 9.92% | 0.98% | 8.40% |
| X.09 | 0.70% | 7.00% | 0.86% | 7.86% | 1.17% | 10.97% | 0.98% | 9.30% |
| XI.09 | 0.69% | 7.64% | 0.88% | 8.67% | 1.22% | 12.06% | 1.04% | 10.25% |
| XII.09 | 0.92% | 8.49% | 0.93% | 9.51% | 1.26% | 13.16% | 0.79% | 10.96% |
| I.10 | 0.72% | 0.72% | 0.83% | 0.83% | 1.20% | 1.20% | 0.89% | 0.89% |
| II.10 | 0.58% | 1.29% | 0.72% | 1.54% | 0.95% | 2.14% | 0.61% | 1.49% |
| III.10 | 0.99% | 2.27% | 1.27% | 2.79% | 1.85% | 3.95% | 1.19% | 2.67% |
| IV.10 | 0.80% | 3.05% | 1.12% | 3.88% | 1.06% | 4.96% | 1.03% | 3.66% |
| V.10 | 0.88% | 3.91% | 1.12% | 4.96% | 1.41% | 6.30% | 1.18% | 4.80% |
| VI.10 | 0.84% | 4.71% | 1.13% | 6.03% | 1.28% | 7.50% | 0.97% | 5.72% |
| VII.10 | 0.88% | 5.55% | 1.12% | 7.09% | 1.24% | 8.65% | 1.06% | 6.72% |
| VIII.10 | 0.91% | 6.41% | 1.04% | 8.05% | 1.23% | 9.78% | 0.98% | 7.64% |
| IX.10 | 0.78% | 7.14% | 1.00% | 8.97% | 1.06% | 10.73% | 1.02% | 8.58% |
| X.10 | 0.79% | 7.87% | 0.99% | 9.87% | 1.19% | 11.79% | 0.96% | 9.45% |
| XI.10 | 0.89% | 8.69% | 1.07% | 10.84% | 1.13% | 12.79% | 1.21% | 10.55% |
| XII.10 | 0.93% | 9.54% | 1.16% | 11.87% | 1.22% | 13.86% | 1.12% | 11.56% |
| I.11 | 0.91% | 0.91% | 1.12% | 1.12% | 1.18% | 1.18% | 1.11% | 1.11% |

Obrázek B.3: Pozorované hodnoty měsíčních a ročních stornovostí pojišťovny Kooperativa v letech 2007-2011.



Obrázek B.4: Graf hodnot měsíčních stornovostí pojišťovny Kooperativa v letech 2004-2011.

Modelování vývoje stornovosti

Předpokládáme, že hodnoty stornovostí jednotlivých odbytových kanálů jsou korelované. Pro odhad parametrů (b^z , ϵ^z , m_1, \dots, m_{12}) jsme použili Seemingly unrelated regression, jejímž prostřednictvím se počítají 4 různé obyčejné lineární regrese, ale zároveň se předpokládá korelace mezi jednotlivými odchylkami.

Na obrázcích B.5 a B.6 jsou uvedené kompletní výsledky z programu STATA.

Seemingly unrelated regression - part 1

| Equation | Obs | Parms | RMSE | "R-sq" | chi2 | P |
|----------|-----|-------|----------|--------|-------|--------|
| W0 | 84 | 13 | .0008067 | 0.3492 | 57.52 | 0.0000 |
| VS | 84 | 13 | .0008566 | 0.3432 | 61.90 | 0.0000 |
| E1 | 84 | 13 | .0017211 | 0.3561 | 53.16 | 0.0000 |
| E2 | 84 | 13 | .001369 | 0.5060 | 89.25 | 0.0000 |

| | Coef. | Std. Err. | z | P> z | [95% Conf. Interval] |
|----------|-----------|-----------|-------|-------|----------------------|
| W0 | | | | | |
| b | -.2419848 | .053534 | -4.52 | 0.000 | -.3469095 - .1370602 |
| leden | -.0007053 | .0003085 | -2.29 | 0.022 | -.0013099 - .0001007 |
| unor | -.0001121 | .000306 | -0.37 | 0.714 | -.0007118 .0004876 |
| brezen | .0008668 | .0003059 | 2.83 | 0.005 | .0002673 .0014664 |
| duben | -.0004814 | .0003056 | -1.58 | 0.115 | -.0010804 .0001176 |
| kveten | .0001012 | .0003047 | 0.33 | 0.740 | -.0004959 .0006984 |
| cerven | .0000438 | .0003046 | 0.14 | 0.886 | -.0005532 .0006408 |
| cervenec | .0000135 | .0003046 | 0.04 | 0.965 | -.0005836 .0006105 |
| srpen | -.0002641 | .0003046 | -0.87 | 0.386 | -.0008611 .000333 |
| zari | -.0004538 | .0003048 | -1.49 | 0.137 | -.0010513 .0001436 |
| rijen | .0001185 | .0003064 | 0.39 | 0.699 | -.0004821 .0007191 |
| listopad | .0007827 | .0003052 | 2.56 | 0.010 | .0001845 .0013809 |
| prosinec | .0005227 | .0003058 | 1.71 | 0.087 | -.0000767 .0011222 |
| VS | | | | | |
| b1 | -.240663 | .0491861 | -4.89 | 0.000 | -.3370661 - .1442599 |
| v19 | -.0004111 | .0003231 | -1.27 | 0.203 | -.0010444 .0002223 |
| v20 | -.0004459 | .0003239 | -1.38 | 0.169 | -.0010806 .0001889 |
| v21 | .0012492 | .0003255 | 3.84 | 0.000 | .0006112 .0018873 |
| v22 | .000123 | .0003239 | 0.38 | 0.704 | -.0005119 .0007578 |
| v23 | -.0001031 | .0003238 | -0.32 | 0.750 | -.0007378 .0005316 |
| v24 | -.0001322 | .000323 | -0.41 | 0.682 | -.0007653 .0005009 |
| v25 | -.0000278 | .0003227 | -0.09 | 0.931 | -.0006602 .0006047 |
| v26 | -.000414 | .0003226 | -1.28 | 0.199 | -.0010463 .0002184 |
| v27 | -.0004294 | .0003231 | -1.33 | 0.184 | -.0010628 .0002039 |
| v28 | .0000715 | .0003245 | 0.22 | 0.826 | -.0005646 .0007075 |
| v29 | .0008799 | .0003235 | 2.72 | 0.007 | .0002459 .0015139 |
| v30 | -.0000284 | .0003237 | -0.09 | 0.930 | -.0006627 .000606 |

Obrázek B.5: Výsledky seemingly unrelated regression 1. část.

Seemingly unrelated regression - part 2

| | | | | | | | |
|-------|-----|-----------|----------|-------|-------|-----------|-----------|
| ----- | | | | | | | |
| E1 | b2 | -.1847419 | .0503858 | -3.67 | 0.000 | -.2834962 | -.0859875 |
| | v34 | -.0014022 | .0006518 | -2.15 | 0.031 | -.0026797 | -.0001247 |
| | v35 | .0005946 | .0006512 | 0.91 | 0.361 | -.0006816 | .0018709 |
| | v36 | .0019164 | .0006498 | 2.95 | 0.003 | .0006427 | .00319 |
| | v37 | -.0023366 | .0006565 | -3.56 | 0.000 | -.0036232 | -.00105 |
| | v38 | .0004505 | .0006511 | 0.69 | 0.489 | -.0008258 | .0017267 |
| | v39 | .0004984 | .0006499 | 0.77 | 0.443 | -.0007754 | .0017722 |
| | v40 | -.0001776 | .00065 | -0.27 | 0.785 | -.0014515 | .0010964 |
| | v41 | -.000748 | .0006498 | -1.15 | 0.250 | -.0020216 | .0005256 |
| | v42 | -.0004662 | .0006507 | -0.72 | 0.474 | -.0017416 | .0008092 |
| | v43 | .0005393 | .0006519 | 0.83 | 0.408 | -.0007383 | .0018169 |
| | v44 | .0005892 | .00065 | 0.91 | 0.365 | -.0006847 | .0018632 |
| | v45 | .0007219 | .00065 | 1.11 | 0.267 | -.0005522 | .001996 |
| ----- | | | | | | | |
| E2 | b3 | -.6450915 | .0915058 | -7.05 | 0.000 | -.8244397 | -.4657434 |
| | v49 | -.0002513 | .0005158 | -0.49 | 0.626 | -.0012623 | .0007597 |
| | v50 | -.0001655 | .0005167 | -0.32 | 0.749 | -.0011782 | .0008472 |
| | v51 | .000387 | .0005162 | 0.75 | 0.453 | -.0006246 | .0013987 |
| | v52 | .0000461 | .000516 | 0.09 | 0.929 | -.0009652 | .0010575 |
| | v53 | .0006765 | .0005156 | 1.31 | 0.189 | -.000334 | .001687 |
| | v54 | -.0005653 | .0005197 | -1.09 | 0.277 | -.0015838 | .0004532 |
| | v55 | .0000138 | .0005161 | 0.03 | 0.979 | -.0009979 | .0010254 |
| | v56 | -.0002135 | .0005155 | -0.41 | 0.679 | -.0012238 | .0007967 |
| | v57 | -.0011093 | .0005159 | -2.15 | 0.032 | -.0021204 | -.0000982 |
| | v58 | .0001884 | .0005269 | 0.36 | 0.721 | -.0008443 | .0012211 |
| | v59 | .0016968 | .0005158 | 3.29 | 0.001 | .0006858 | .0027079 |
| | v60 | -.0008035 | .0005361 | -1.50 | 0.134 | -.0018543 | .0002472 |
| ----- | | | | | | | |

Correlation matrix of residuals:

| | V0 | VS | E1 | E2 |
|----|--------|--------|--------|--------|
| V0 | 1.0000 | | | |
| VS | 0.7890 | 1.0000 | | |
| E1 | 0.5454 | 0.5613 | 1.0000 | |
| E2 | 0.4545 | 0.5173 | 0.2399 | 1.0000 |

Breusch-Pagan test of independence: $\chi^2(6) = 148.414$, Pr = 0.0000

Obrázek B.6: Výsledky seemingly unrelated regression 2. část.

V rámci výpočtu parametrů byl proveden Breusch-Paganův test na závislost jednotlivých odchylek ϵ^z a výsledkem je nulová pravděpodobnost, že jednotlivé epsilony jsou nezávislé.

Známe standardní odchylky σ_z náhodných chyb pro každého zprostředkovatele. S jejich použitím vygenerujeme pomocné vektory pro všechna predikovaná t

$$\bar{\epsilon}_t = (\bar{\epsilon}_t^{VO}, \bar{\epsilon}_t^{VS}, \bar{\epsilon}_t^{E1}, \bar{\epsilon}_t^{E2})$$

s rozdělením $N(O, \sigma_z^2)$. Tyto epsilony nejsou vzájemně korelované. Abychom mohli vygenerovat korelované náhodné veličiny odchylek s korelační maticí uvedanou pod tabulkou na obrázku B.6, musíme provést Choleského rozklad korelační matice, označme tedy

- C = korelační matice pro jednotlivé epsilony,
- A = dolní trojúhelníková matice.

Choleského rozklad matic je definován jako $C = AA^T$. Použitím implementované funkce v Mathematice získáme konkrétní matici

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0,789 & 0,614393 & 0 & 0 \\ 0,5454 & 0,213185 & 0,810612 & 0 \\ 0,4545 & 0,258303 & -0,0777815 & 0,848917 \end{pmatrix}$$

Teprve vynásobením matice A a pomocných vektorů $\bar{\epsilon}_t$ získám vektory

$$\epsilon_t = (\epsilon_t^{VO}, \epsilon_t^{VS}, \epsilon_t^{E1}, \epsilon_t^{E2}),$$

jejichž vzájemná závislost je daná korelační maticí C .

Střední hodnoty měs. stornovostí dle stáří pojistné smlouvy

| k | ϑ_k (v %) |
|---------|---------------------|
| 1 | 2,4 |
| 2 | 3,6 |
| 3 | 2,4 |
| 4 | 1,2 |
| 5 | 1,2 |
| 6 | 1,2 |
| 7 | 6,0 |
| 8 | 1,2 |
| 9 | 1,2 |
| 10 | 1,2 |
| 11 | 1,2 |
| 12 | 1,2 |
| 13 – 24 | 1,08 |
| 25 – 36 | 0,84 |
| 37 – 48 | 0,60 |
| 49 – 60 | 0,48 |
| 61 – 72 | 0,36 |
| 73 – 84 | 0,24 |
| 85+ | 0,12 |

Tabulka B.3: Střední hodnoty měsíčních stornovostí v závislosti na stáří pojistné smlouvy.