

# PERSUADE BC\_OS\_output

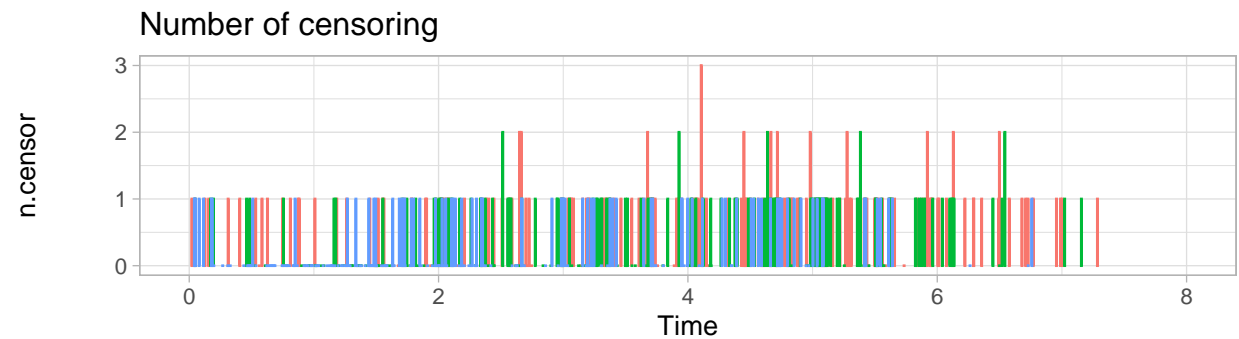
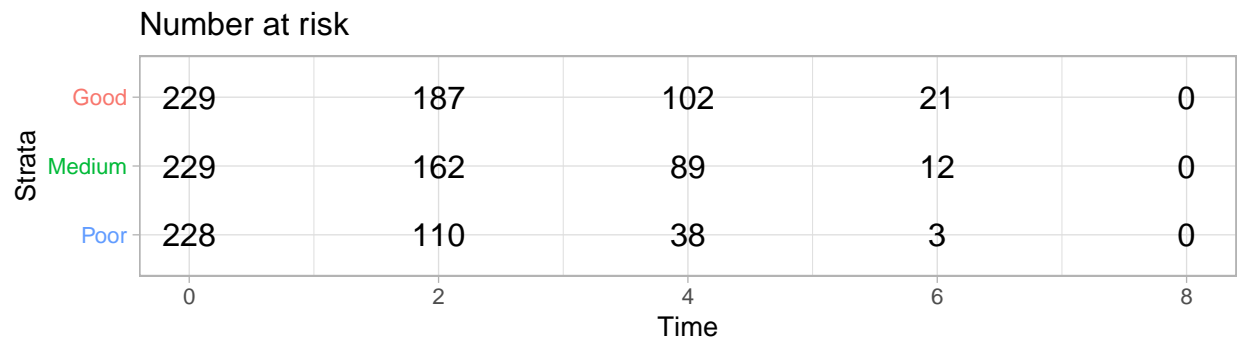
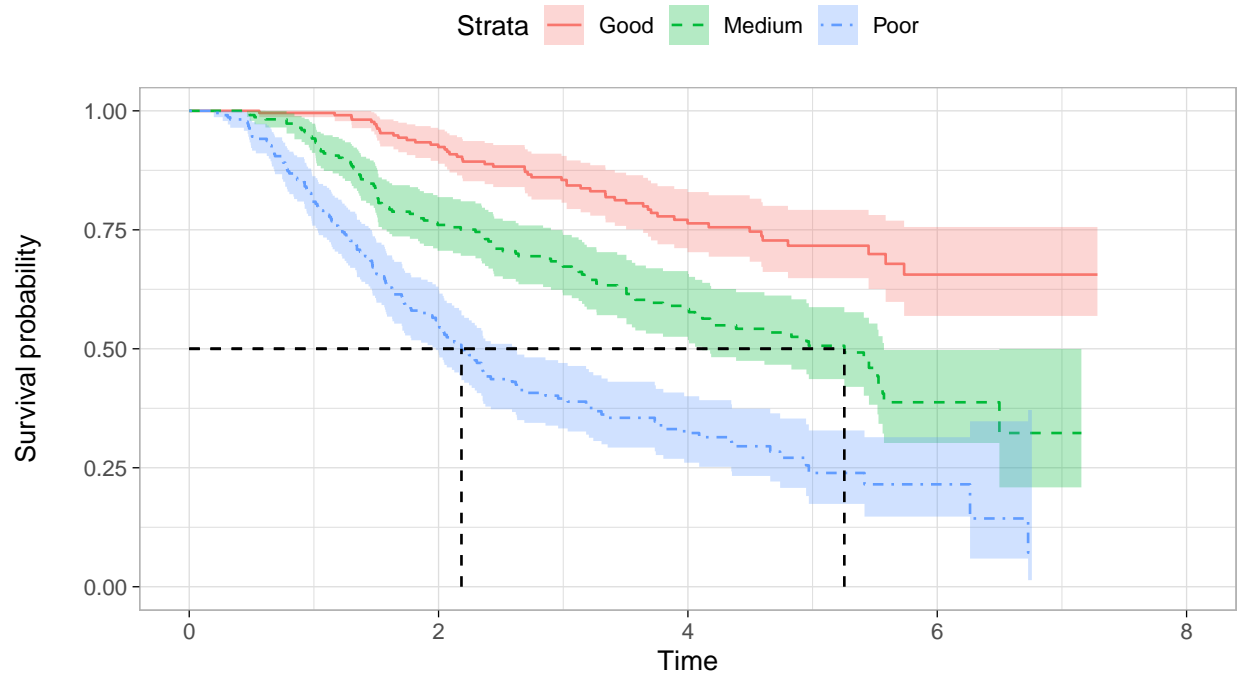
2021-01-29

## Contents

|   |           |
|---|-----------|
| <b>Kaplan-Meier</b>                                   | <b>2</b>  |
| <b>Stratified models?</b>                             | <b>3</b>  |
| <b>Shape of the observed smoothed hazard function</b> | <b>4</b>  |
| <b>Shape of the predicted hazard function</b>         | <b>5</b>  |
| <b>Standard parametric models?</b>                    | <b>7</b>  |
| Exponential . . . . .                                 | 8         |
| Weibull . . . . .                                     | 9         |
| Gompertz . . . . .                                    | 10        |
| Log-normal . . . . .                                  | 11        |
| Log-logistic . . . . .                                | 12        |
| Gamma . . . . .                                       | 13        |
| Generalised Gamma . . . . .                           | 14        |
| <b>Parametric spline models?</b>                      | <b>15</b> |
| Spline hazard 1 knot . . . . .                        | 16        |
| Spline hazard 2 knots . . . . .                       | 17        |
| Spline odds 1 knot . . . . .                          | 18        |
| Spline odds 2 knots . . . . .                         | 19        |
| Spline normal 1 knot . . . . .                        | 20        |
| Spline normal 2 knots . . . . .                       | 21        |
| <b>Validity of long-term extrapolation?</b>           | <b>22</b> |
| Group Good . . . . .                                  | 22        |
| Group Medium . . . . .                                | 25        |
| Group Poor . . . . .                                  | 28        |
| <b>Session information</b>                            | <b>31</b> |

[Link to PERSUADE GitHub page](#)

# Kaplan-Meier

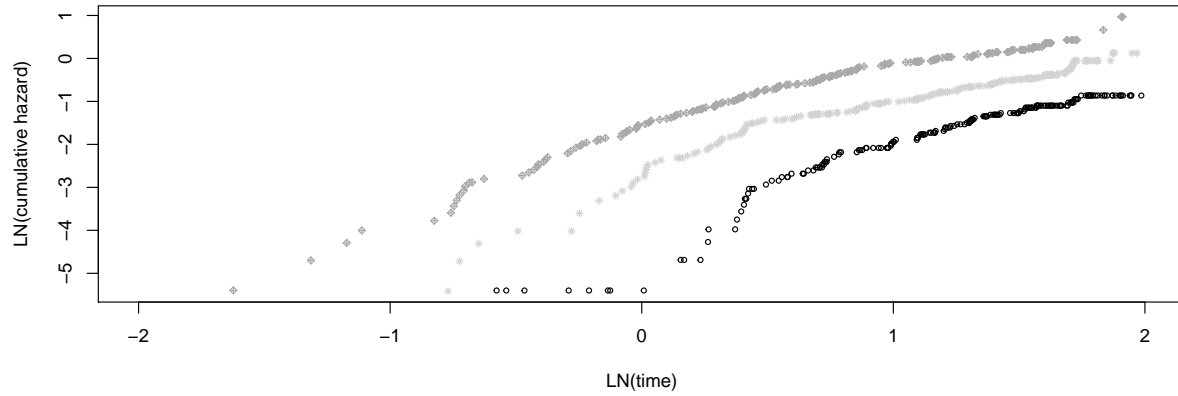


|              | records | n.max | n.start | events | *rmean   | *se(rmean) | median   | 0.95LCL  | 0.95UCL  |
|--------------|---------|-------|---------|--------|----------|------------|----------|----------|----------|
| group=Good   | 229     | 229   | 229     | 51     | 5.934330 | 0.1616003  | NA       | NA       | NA       |
| group=Medium | 229     | 229   | 229     | 103    | 4.600852 | 0.1856699  | 5.254795 | 4.115068 | 5.572603 |
| group=Poor   | 228     | 228   | 228     | 145    | 3.101736 | 0.1772520  | 2.183562 | 1.978082 | 2.619178 |

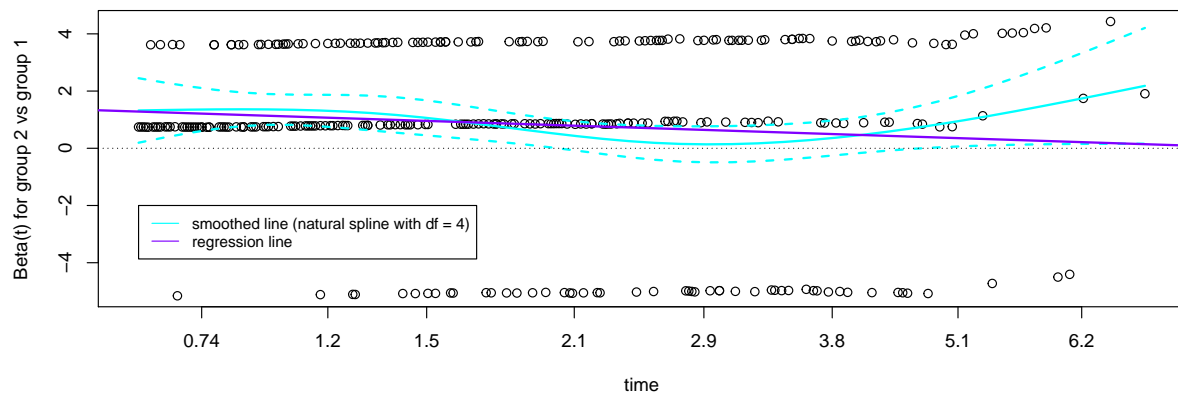
# Stratified models?

Should stratified parametric survival models be used?

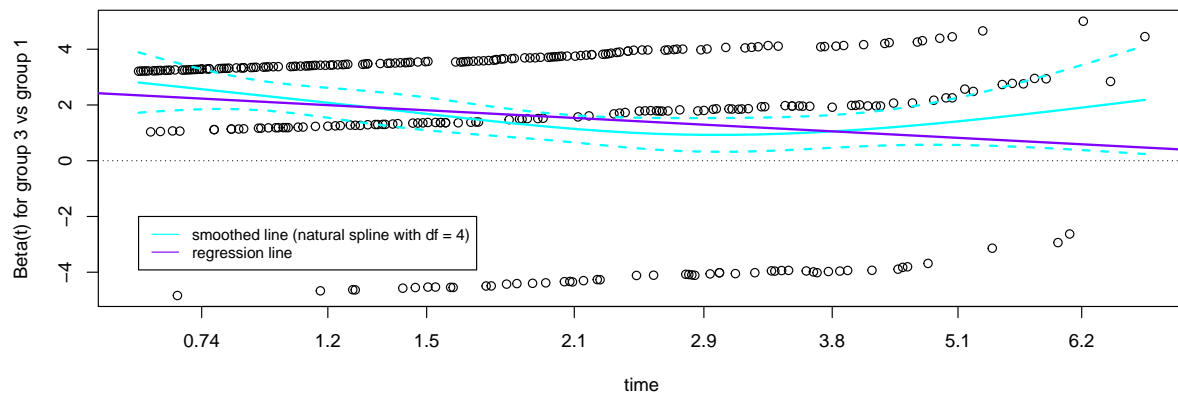
**A: LN(cumulative hazard)**



**B: Scaled Schoenfeld residuals**

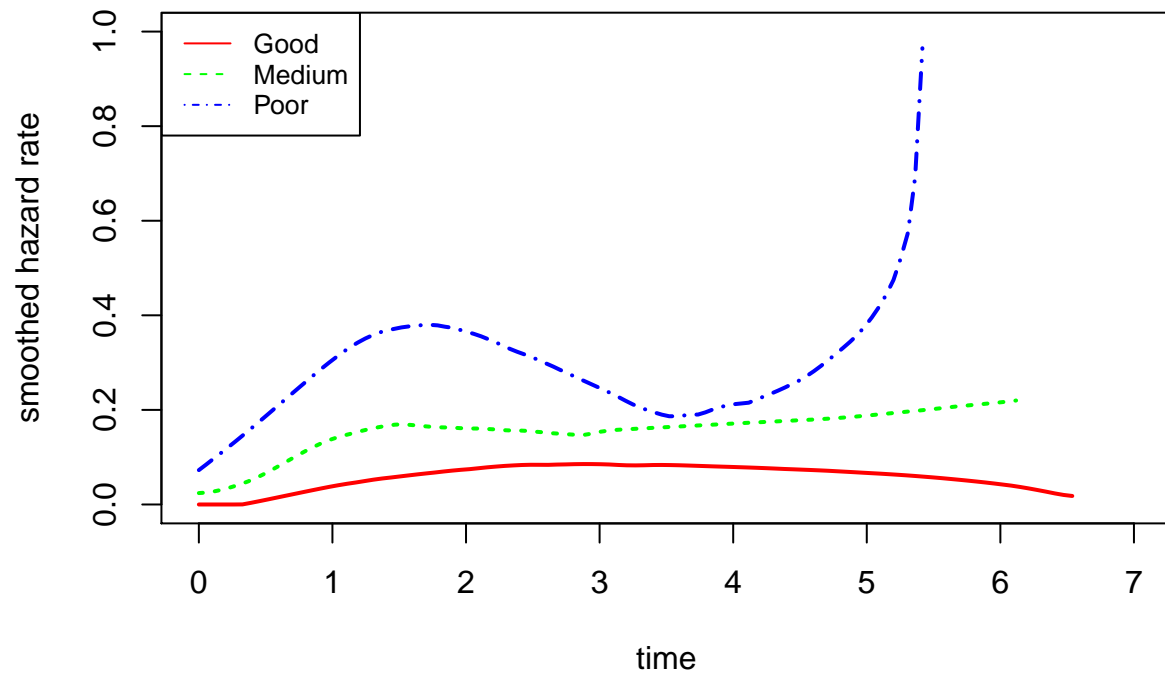


**C: Scaled Schoenfeld residuals**

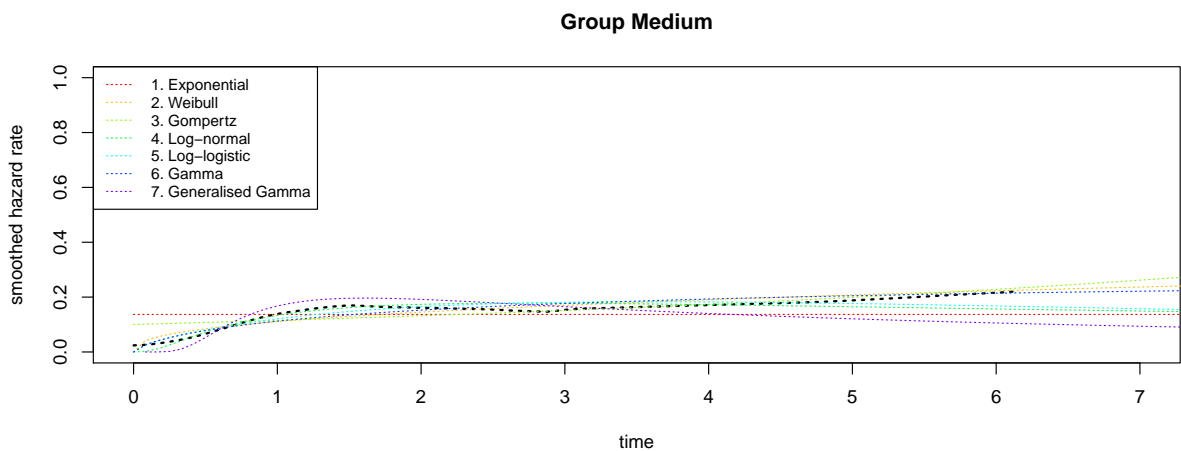
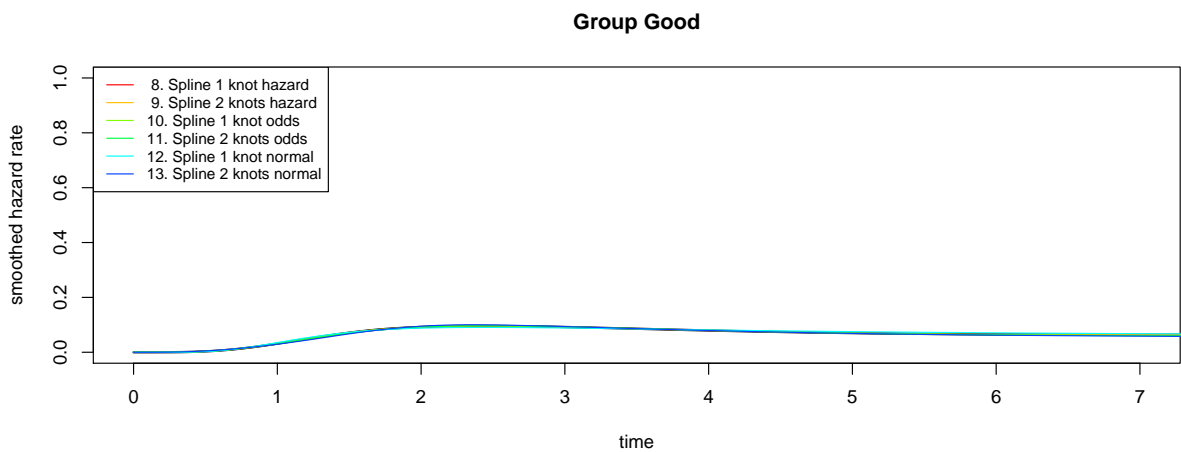
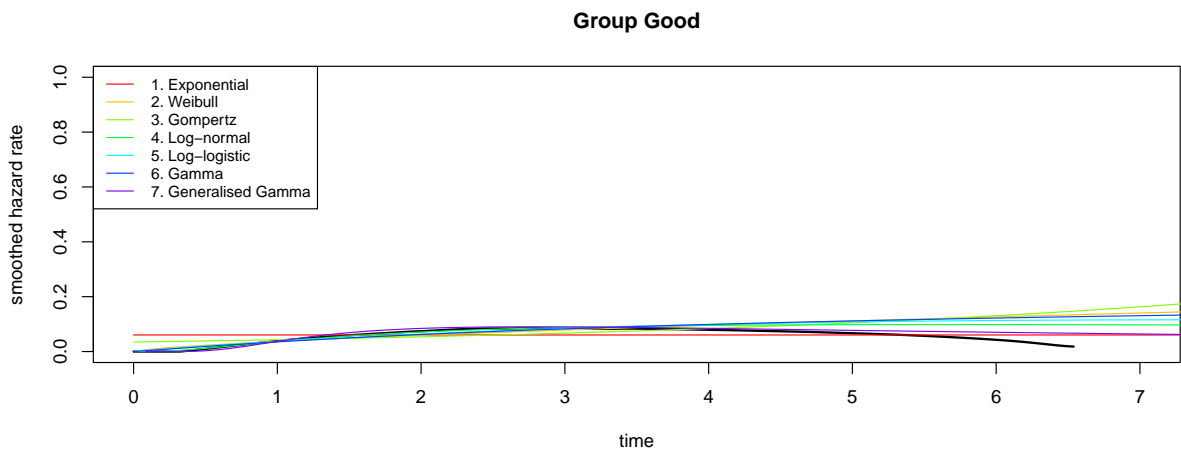


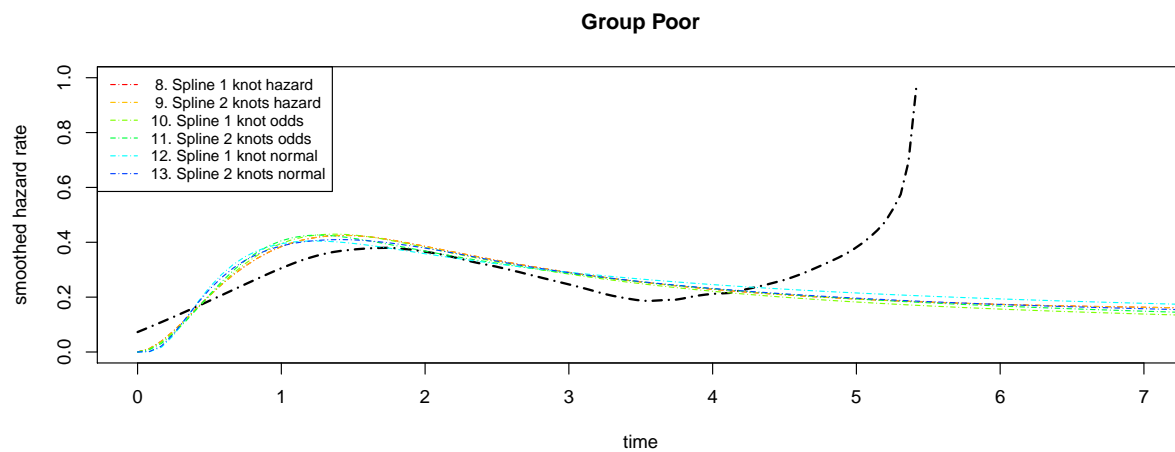
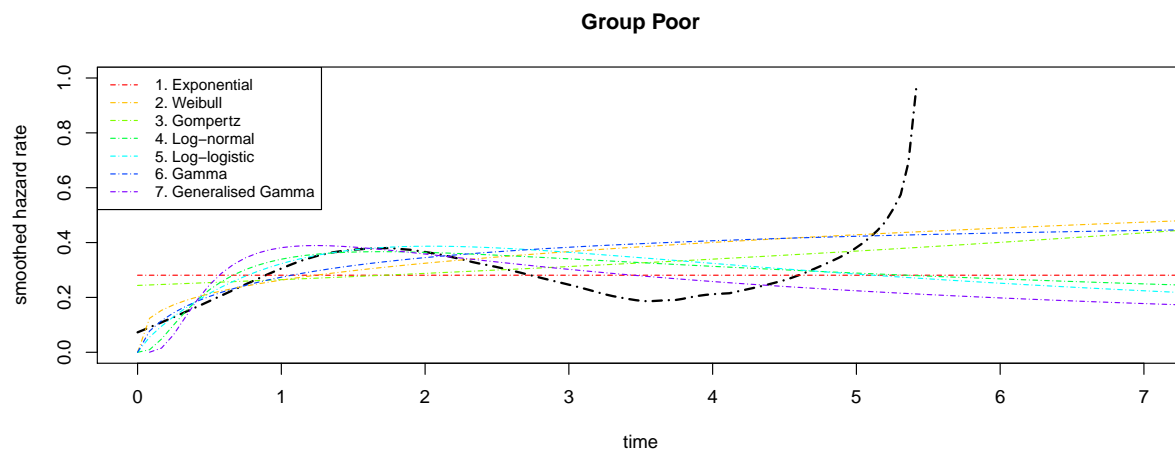
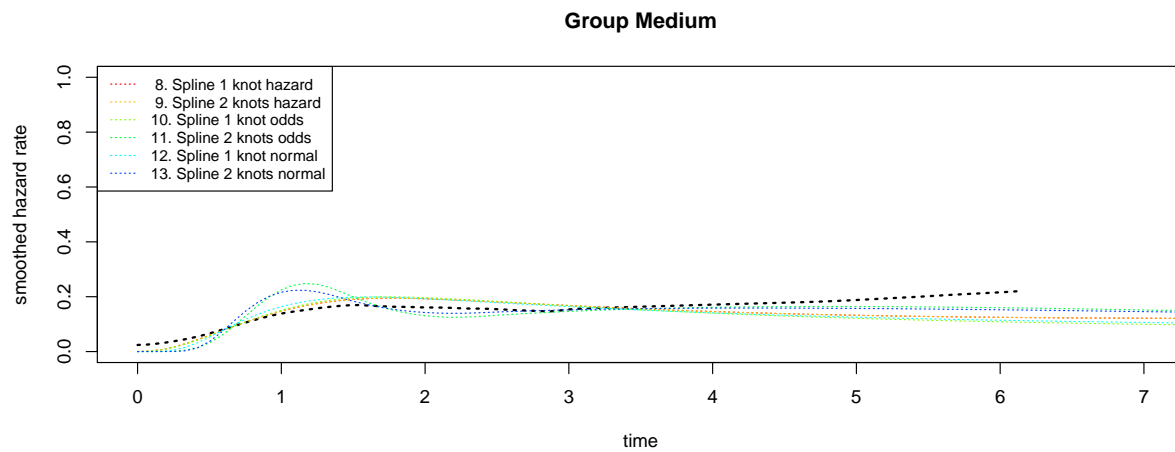
## Shape of the observed smoothed hazard function

Should parametric survival models assuming a monotonic hazard rate (i.e. exponential, Weibull, Gompertz) be used?



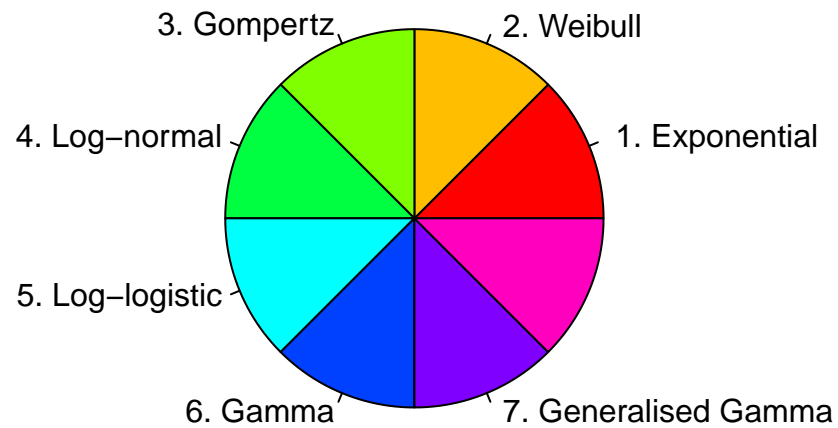
# Shape of the predicted hazard function





## Standard parametric models?

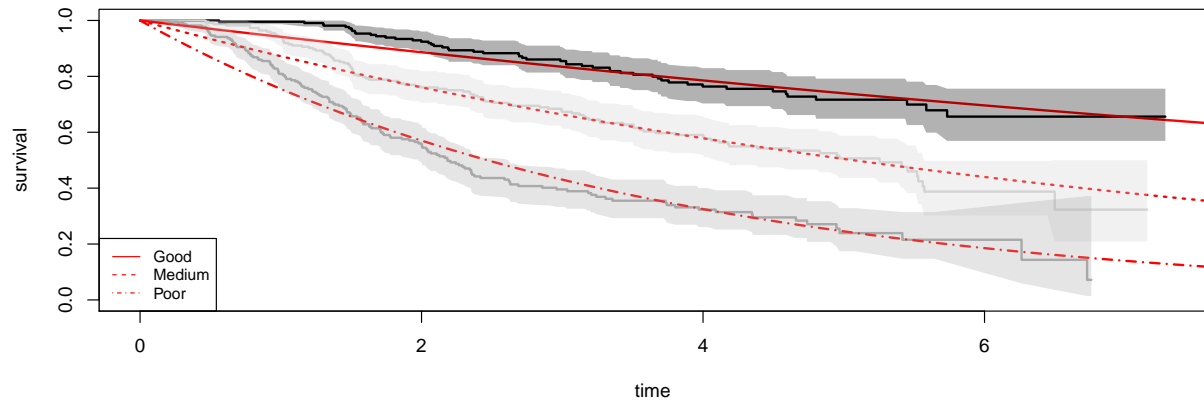
Do standard parametric models provide an appropriate fit to the data?



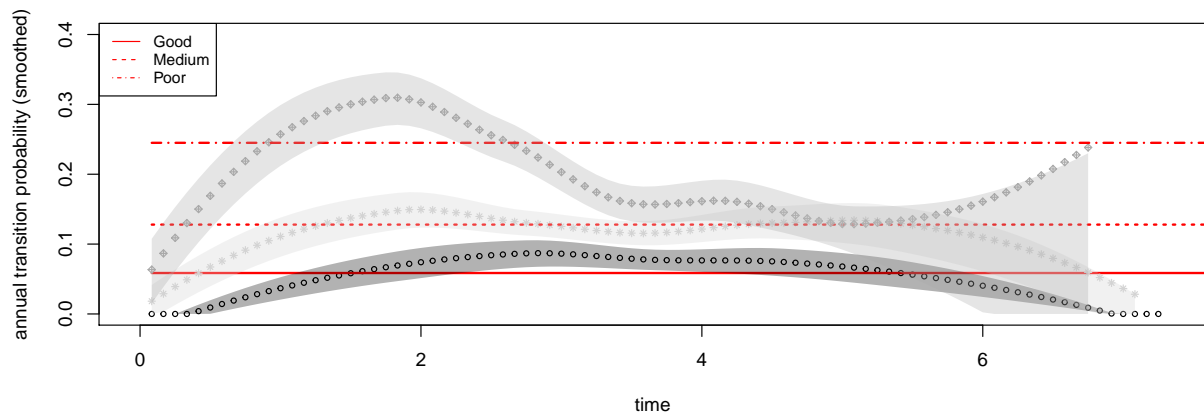
| Model                | AIC      | BIC      |
|----------------------|----------|----------|
| 7. Generalised Gamma | 1589.049 | 1629.826 |
| 4. Log-normal        | 1592.880 | 1620.066 |
| 5. Log-logistic      | 1609.294 | 1636.479 |
| 6. Gamma             | 1621.982 | 1649.167 |
| 2. Weibull           | 1632.618 | 1659.803 |
| 3. Gompertz          | 1660.954 | 1688.140 |
| 1. Exponential       | 1668.212 | 1681.805 |

# Exponential

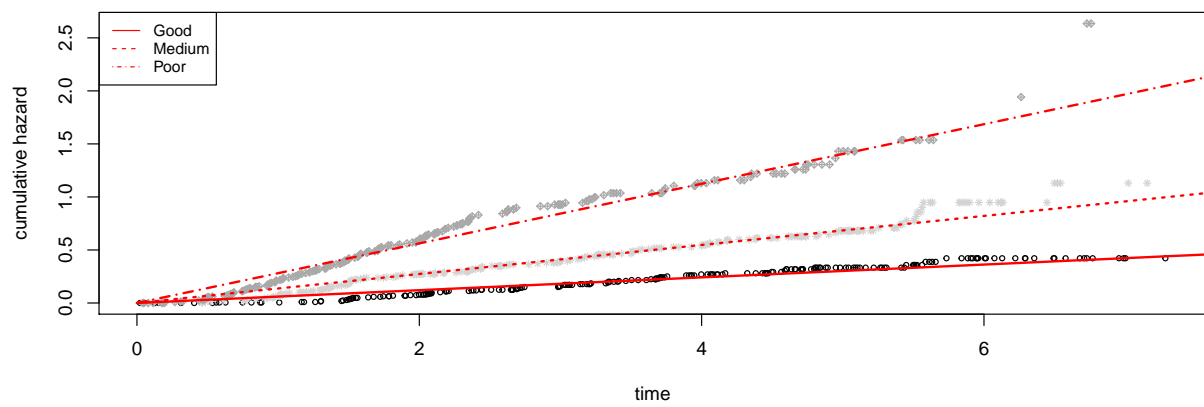
**A: Kaplan-Meier (Exponential)**



**B: Annual transition probability (Exponential)**



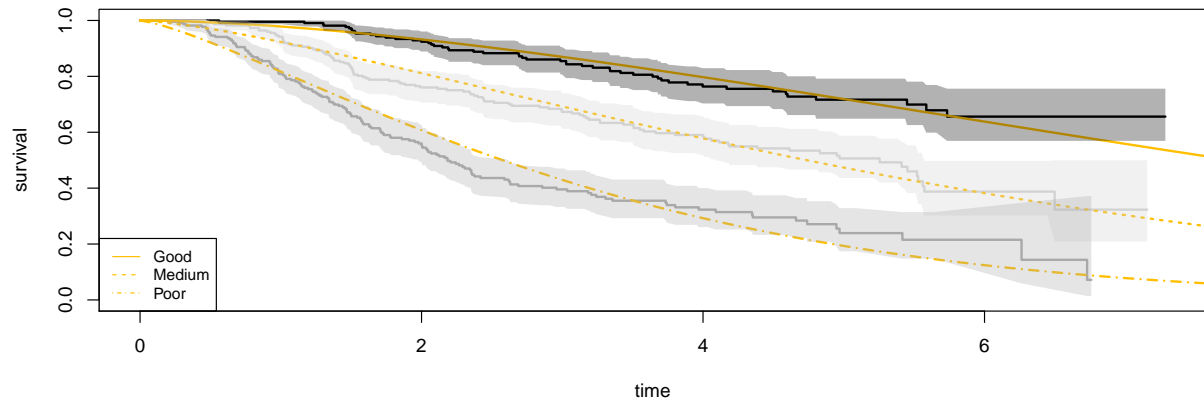
**C: Diagnostic plot (Exponential)**



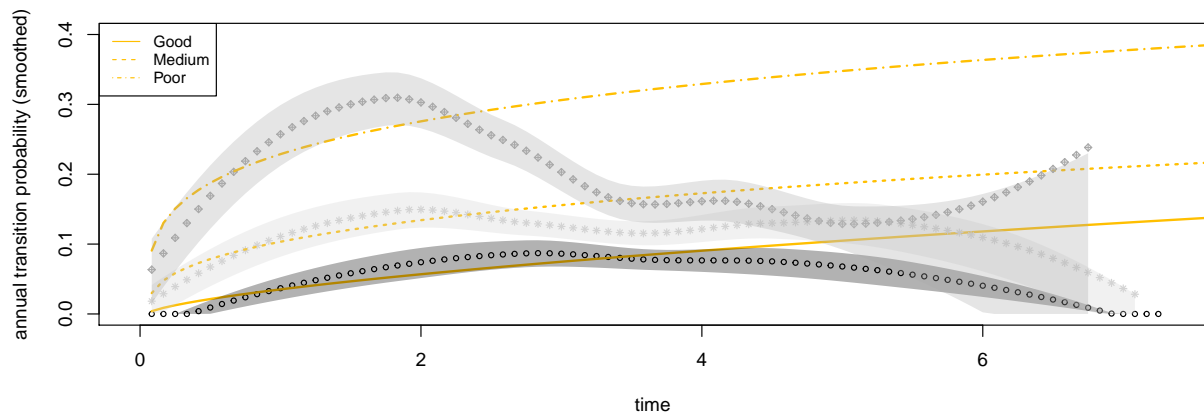


# Weibull

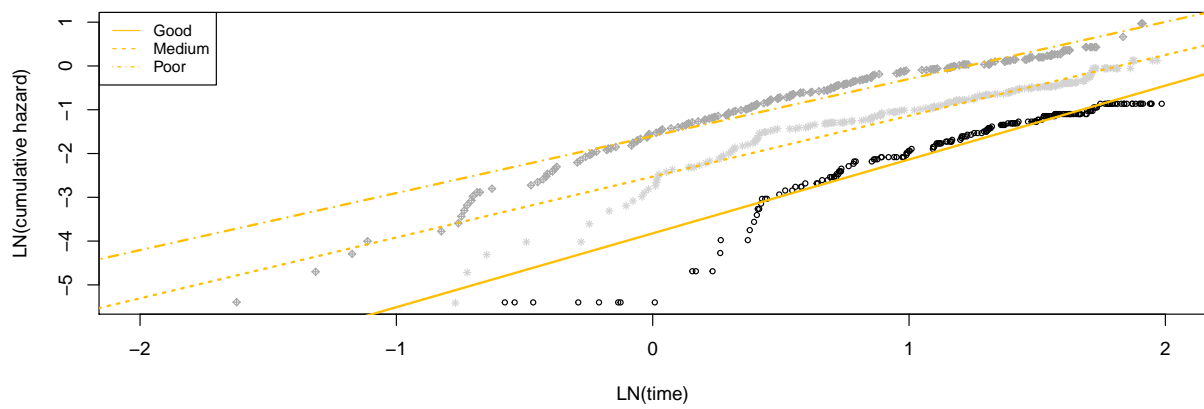
**A: Kaplan–Meier (Weibull)**



**B: Annual transition probability (Weibull)**

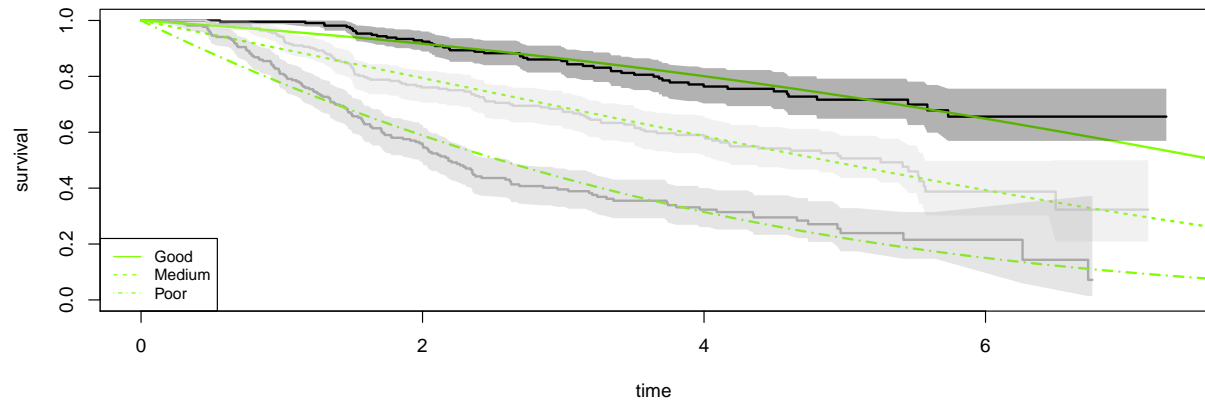


**C: Diagnostic plot (Weibull)**

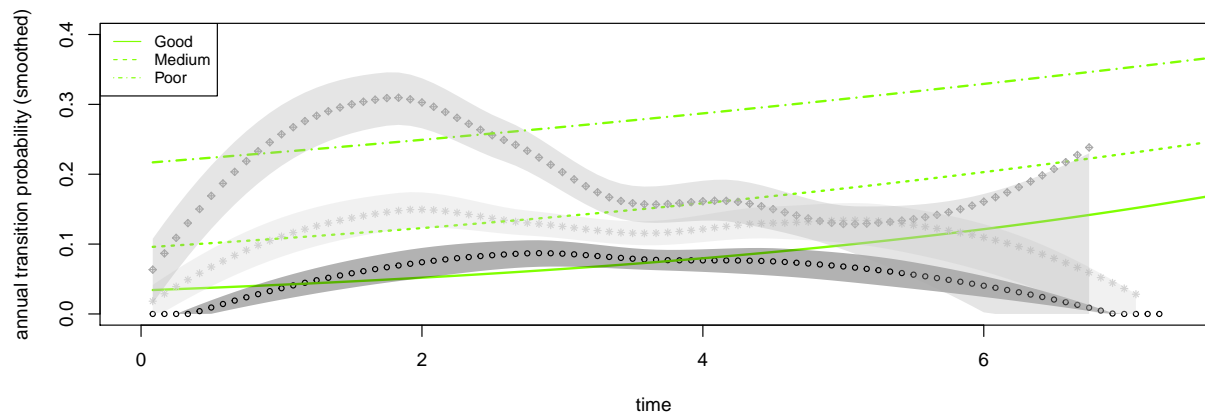


# Gompertz

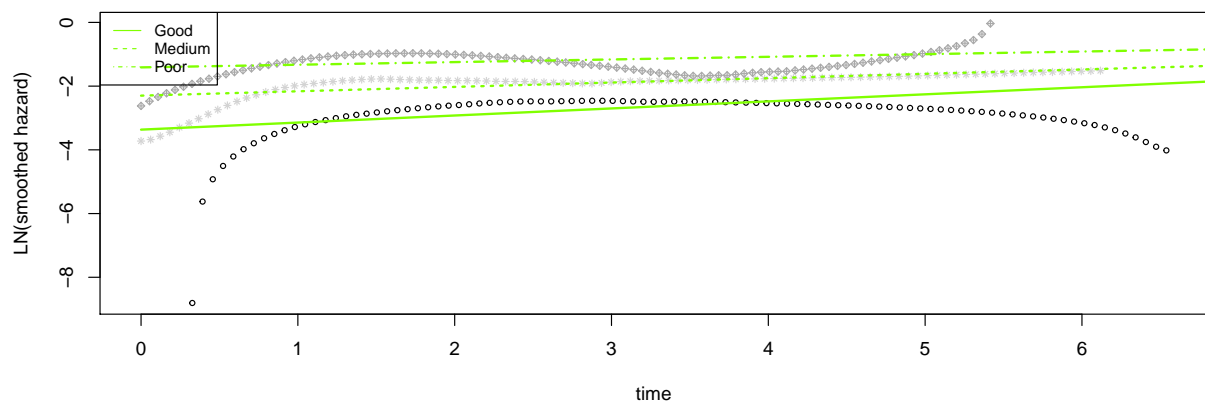
**A: Kaplan-Meier (Gompertz)**



**B: Annual transition probability (Gompertz)**

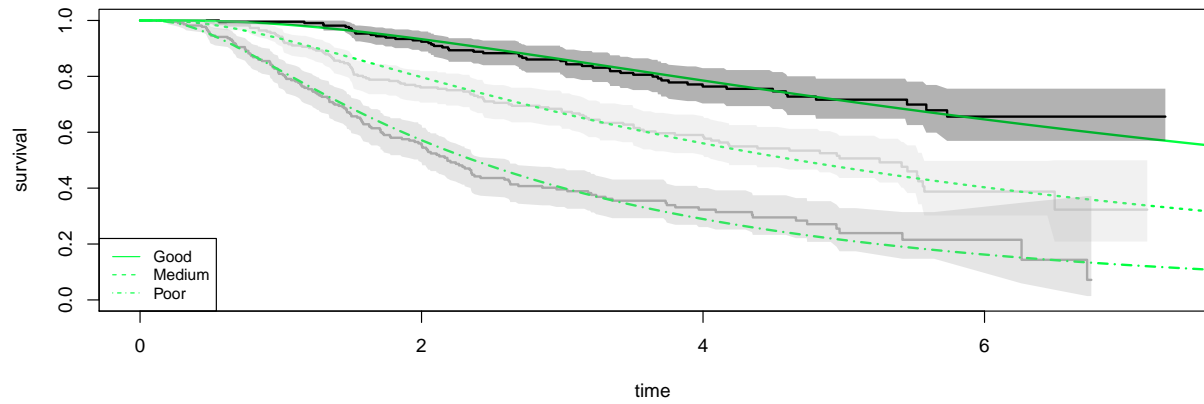


**C: Diagnostic plot (Gompertz)**

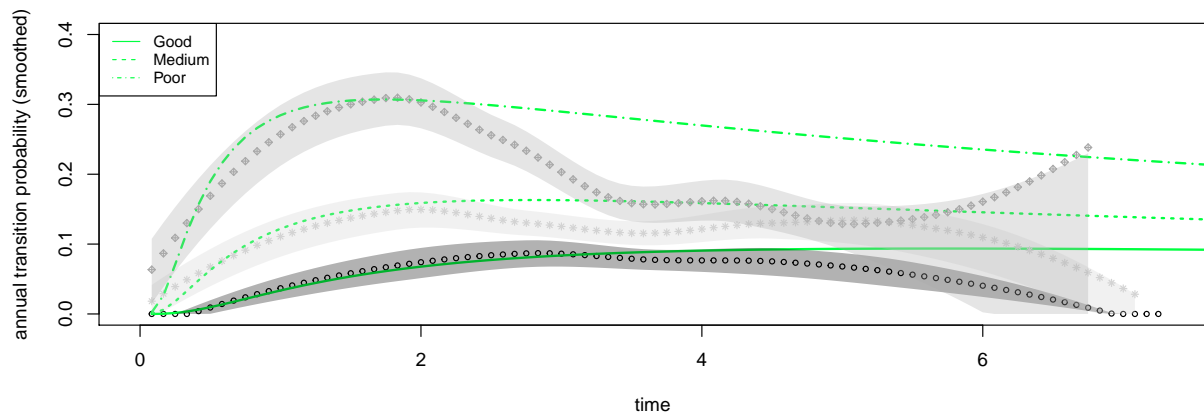


## Log-normal

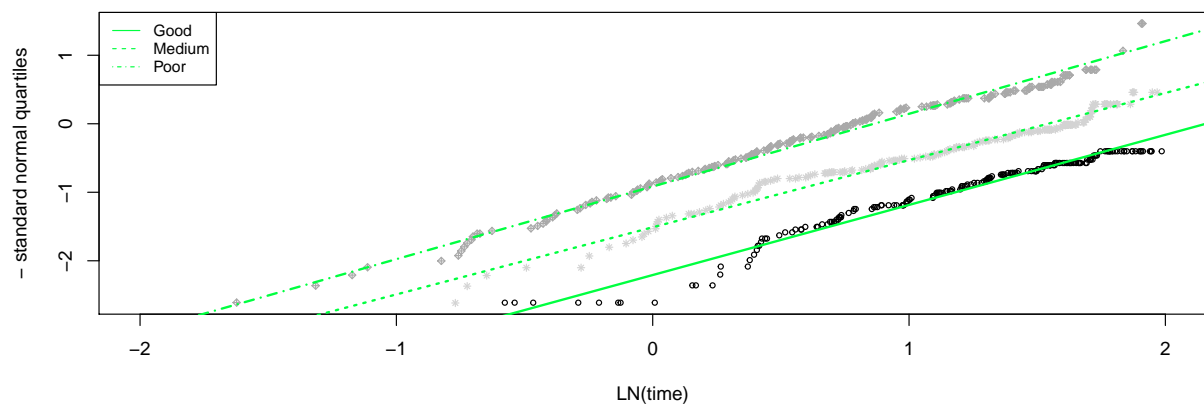
**A: Kaplan-Meier (Log-normal)**



**B: Annual transition probability (Log-normal)**

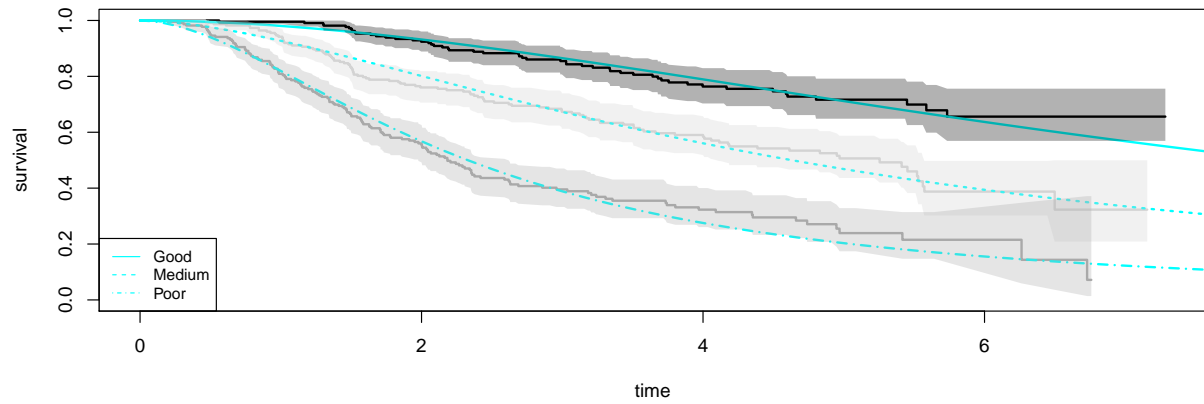


**C: Diagnostic plot (Log-normal)**

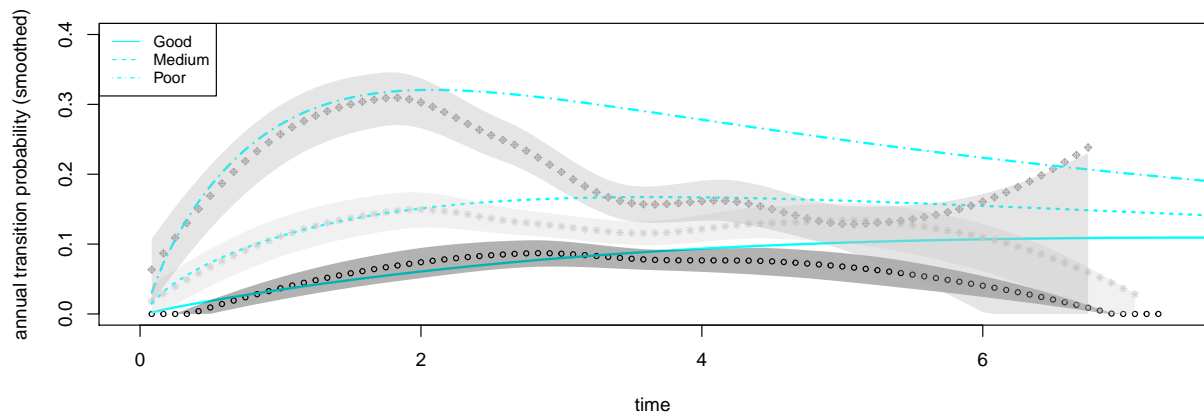


## Log-logistic

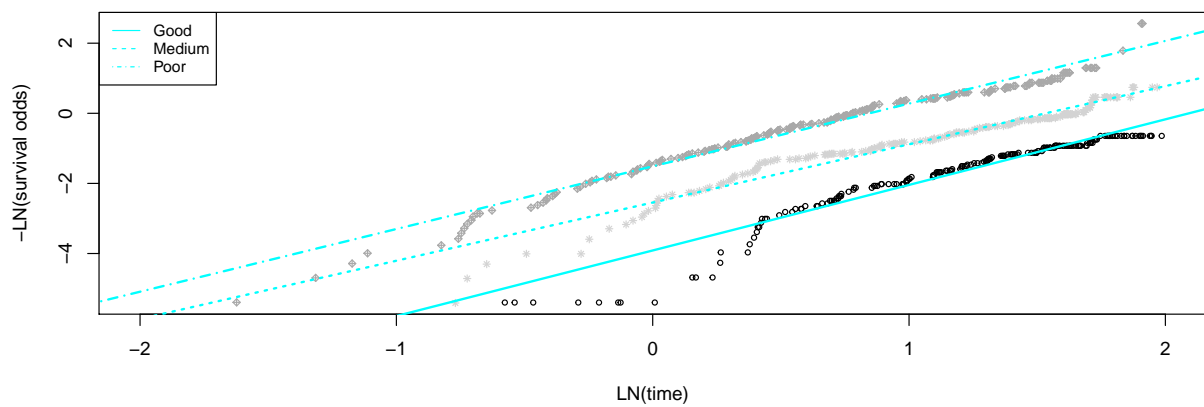
**A: Kaplan-Meier (Log-logistic)**



**B: Annual transition probability (Log-logistic)**

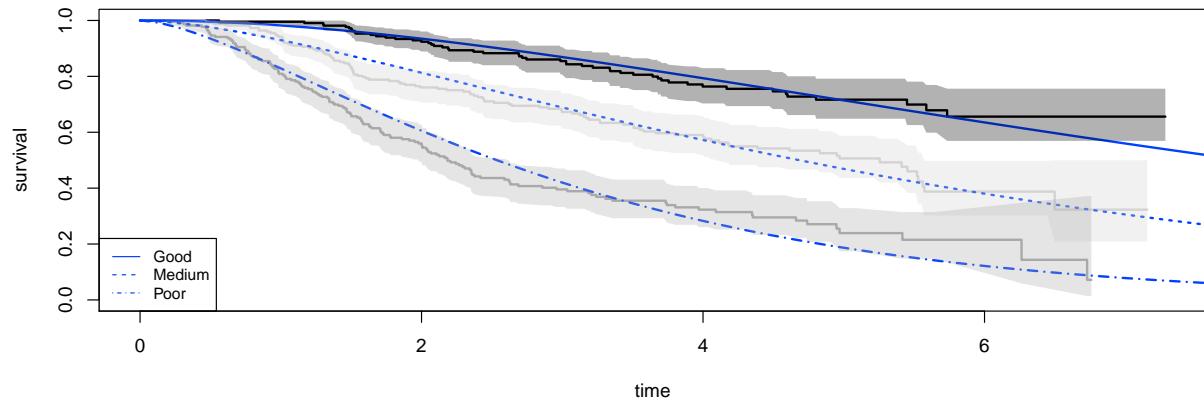


**C: Diagnostic plot (Log-logistic)**

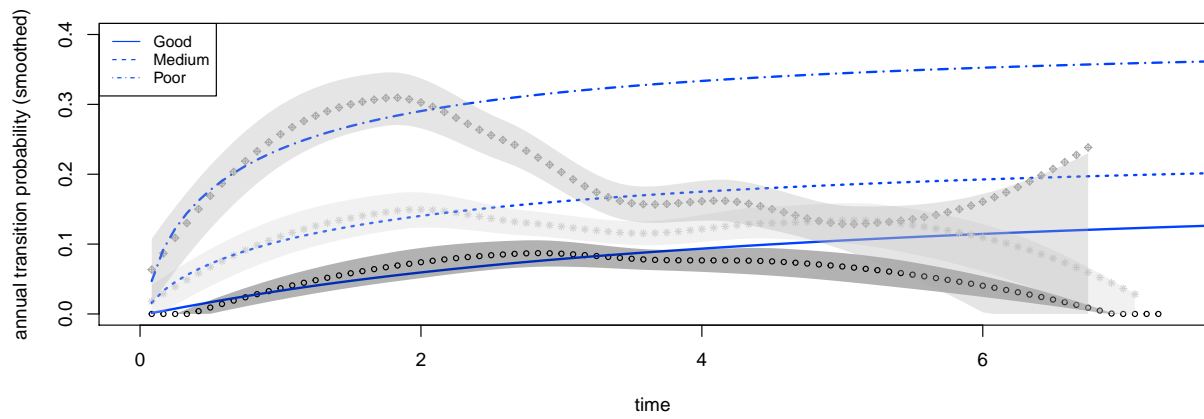


## Gamma

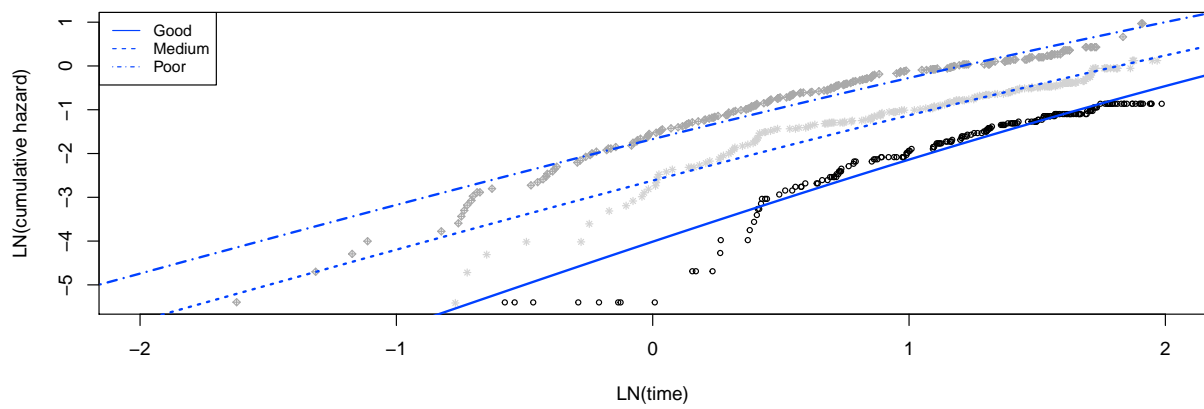
**A: Kaplan–Meier (Gamma)**



**B: Annual transition probability (Gamma)**

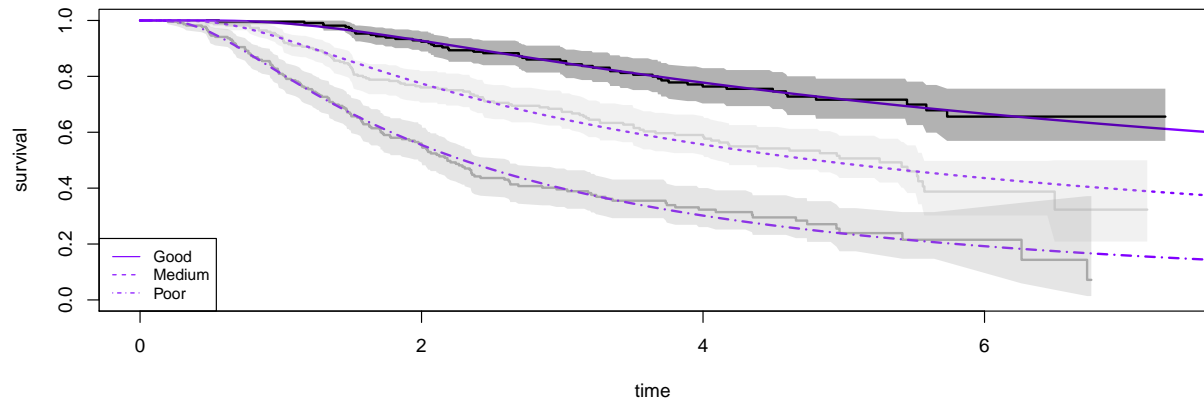


**C: Diagnostic plot (Gamma)**

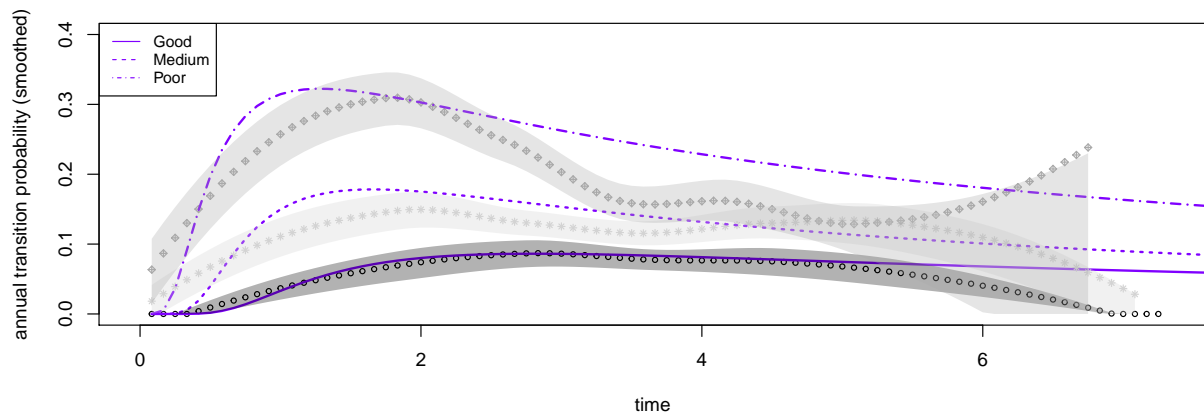


## Generalised Gamma

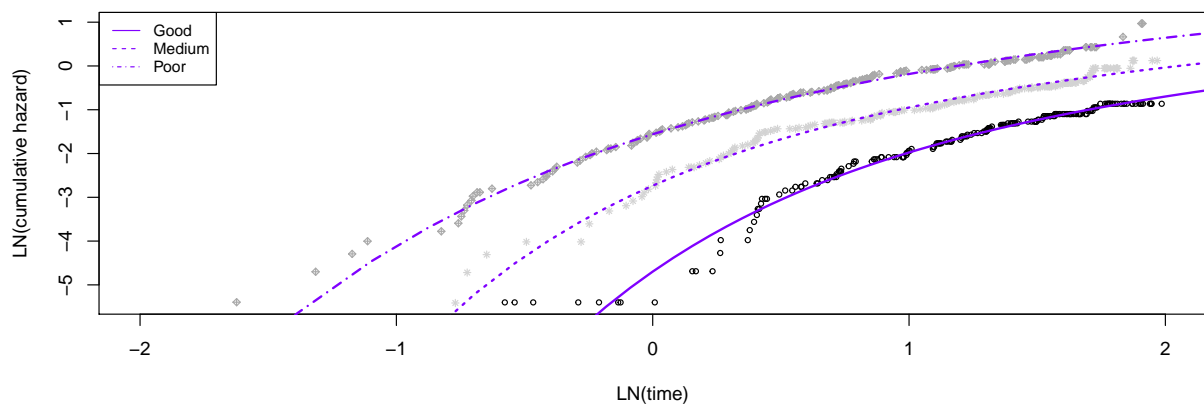
**A: Kaplan–Meier (Generalised gamma)**



**B: Annual transition probability (Generalised Gamma)**

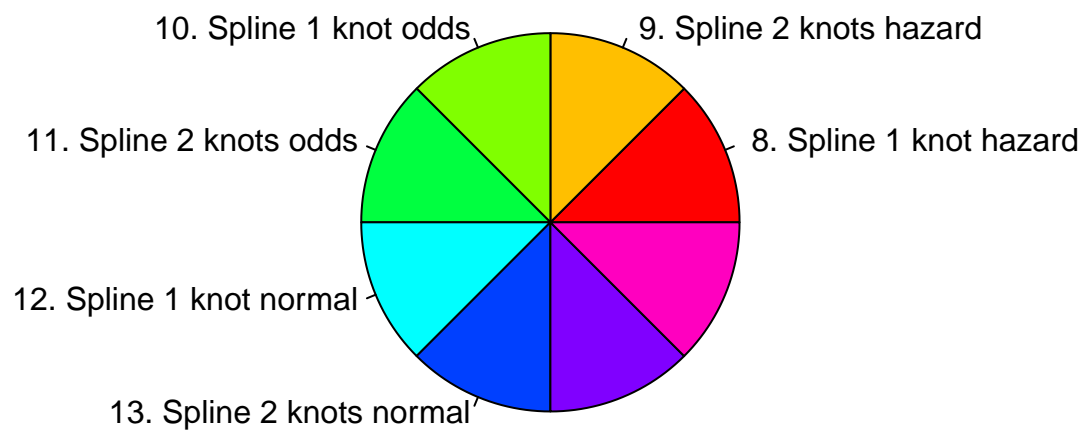


**C: Diagnostic plot (Generalised gamma)**



## Parametric spline models?

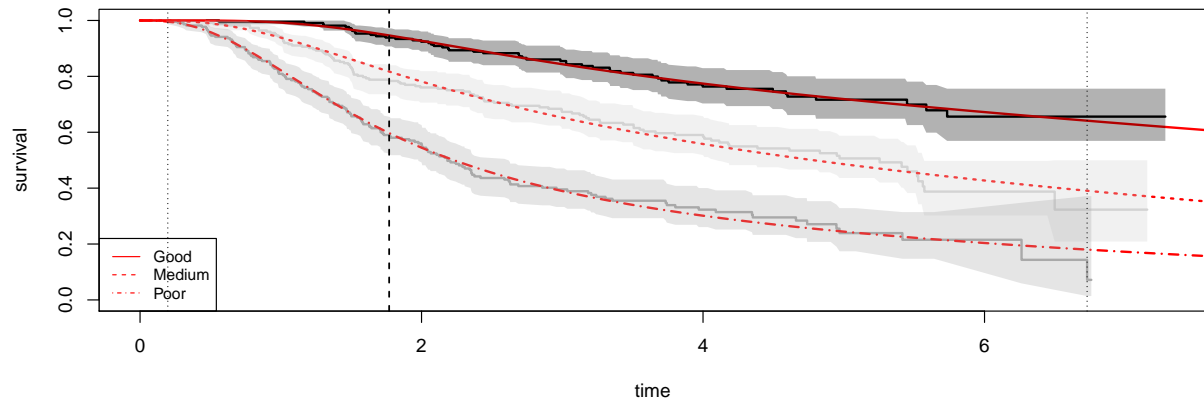
If standard parametric models are not appropriate, are spline models a more appropriate fit to the data?



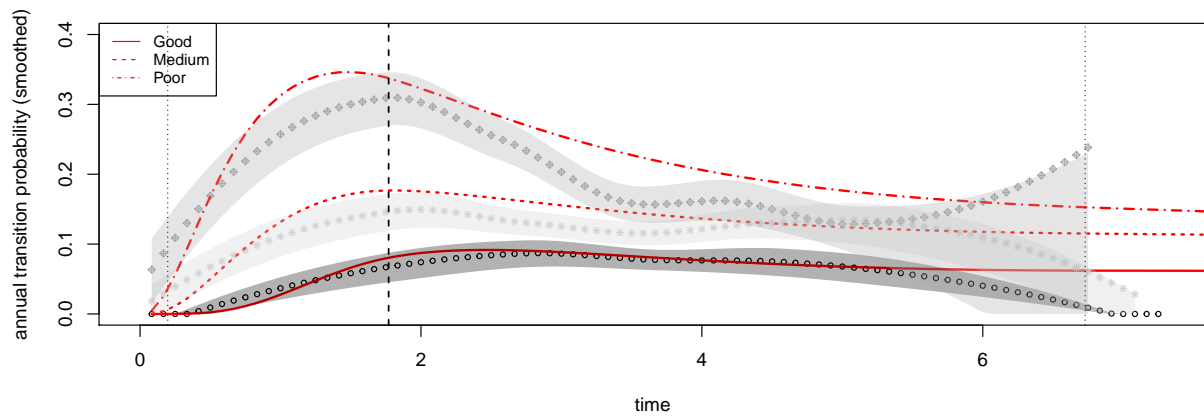
| Model                     | AIC      | BIC      |
|---------------------------|----------|----------|
| 9. Spline 2 knots hazard  | 1585.894 | 1640.264 |
| 11. Spline 2 knots odds   | 1587.289 | 1641.659 |
| 12. Spline 1 knot normal  | 1587.682 | 1628.460 |
| 13. Spline 2 knots normal | 1588.343 | 1642.714 |
| 7. Generalised Gamma      | 1589.049 | 1629.826 |
| 8. Spline 1 knot hazard   | 1589.327 | 1630.105 |
| 10. Spline 1 knot odds    | 1590.221 | 1630.999 |
| 4. Log-normal             | 1592.880 | 1620.066 |
| 5. Log-logistic           | 1609.294 | 1636.479 |
| 6. Gamma                  | 1621.982 | 1649.167 |
| 2. Weibull                | 1632.618 | 1659.803 |
| 3. Gompertz               | 1660.954 | 1688.140 |
| 1. Exponential            | 1668.212 | 1681.805 |

## Spline hazard 1 knot

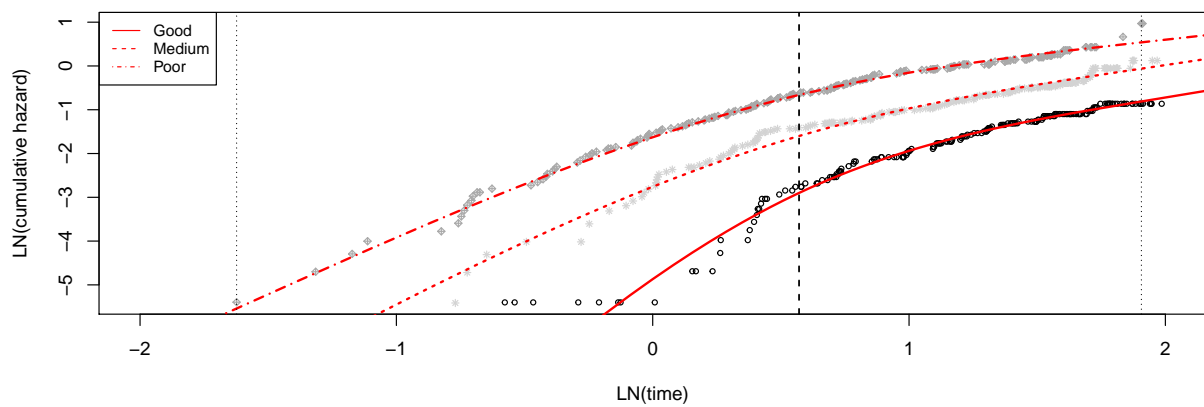
**A: Kaplan–Meier (Spline, 1 knot, hazard scale)**



**B: Annual transition probability (Spline, 1 knot, hazard scale)**



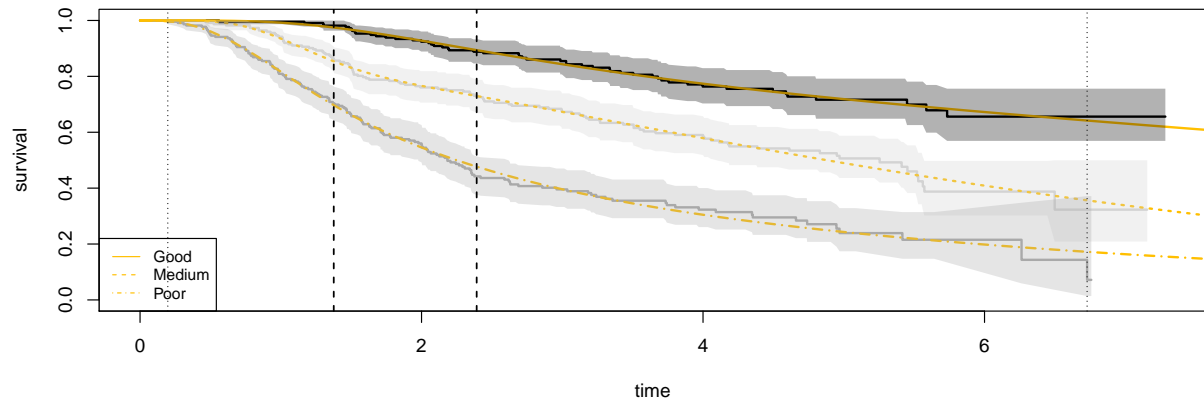
**C: Diagnostic plot (Spline, 1 knot, hazard scale)**



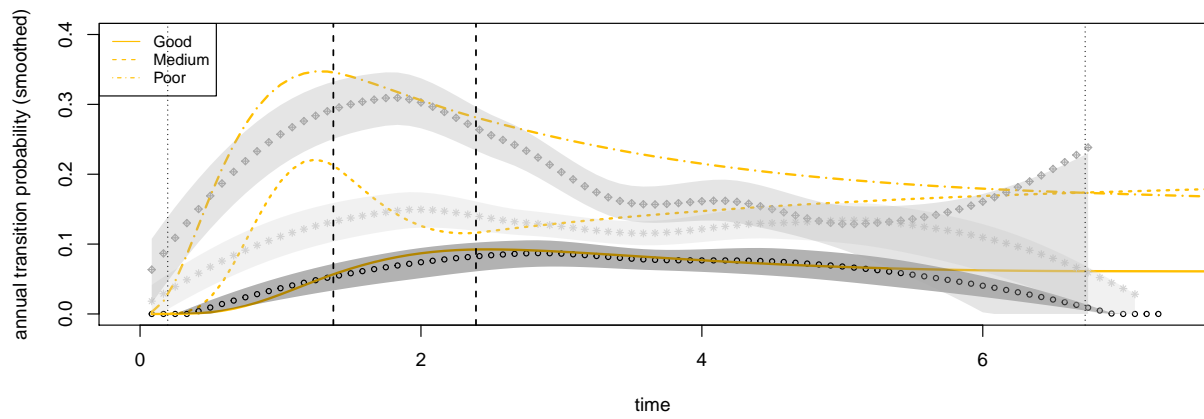


## Spline hazard 2 knots

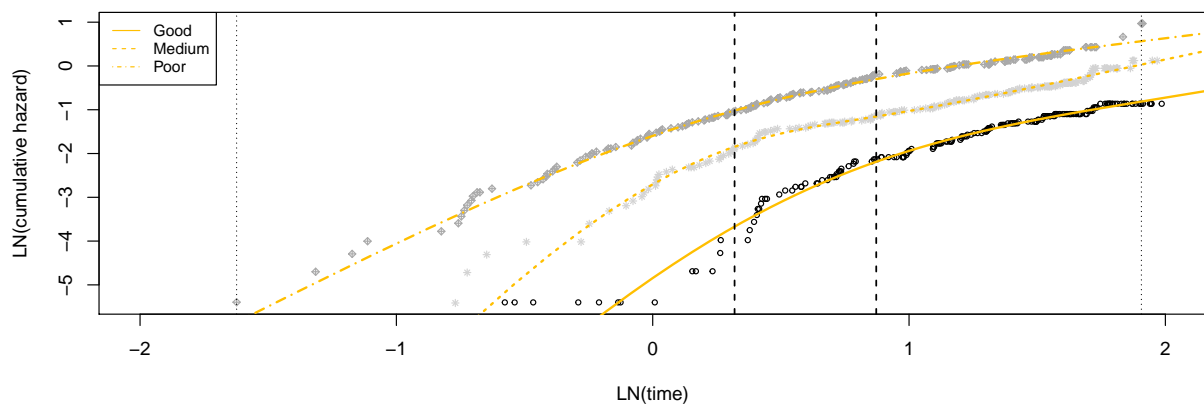
**A: Kaplan–Meier (Spline, 2 knots, hazard scale)**



**B: Annual transition probability (Spline, 2 knots, hazard scale)**

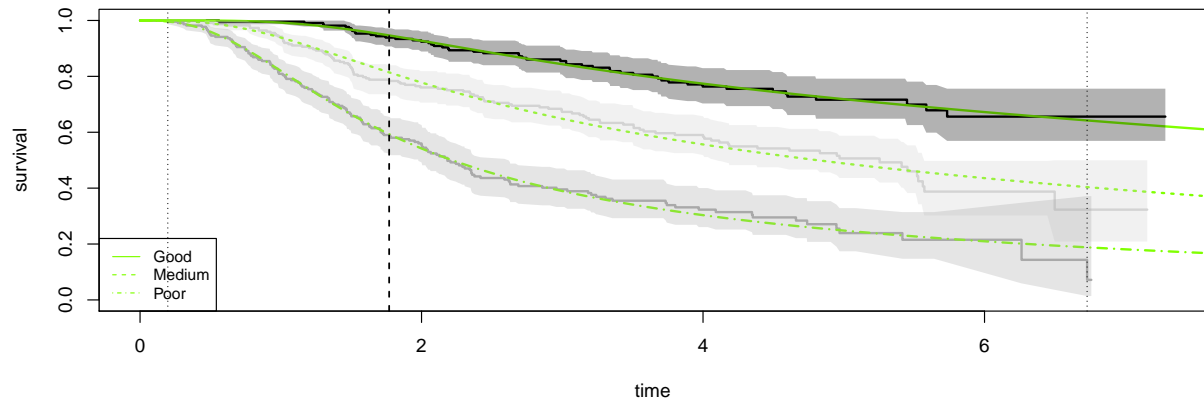


**C: Diagnostic plot (Spline, 2 knots, hazard scale)**

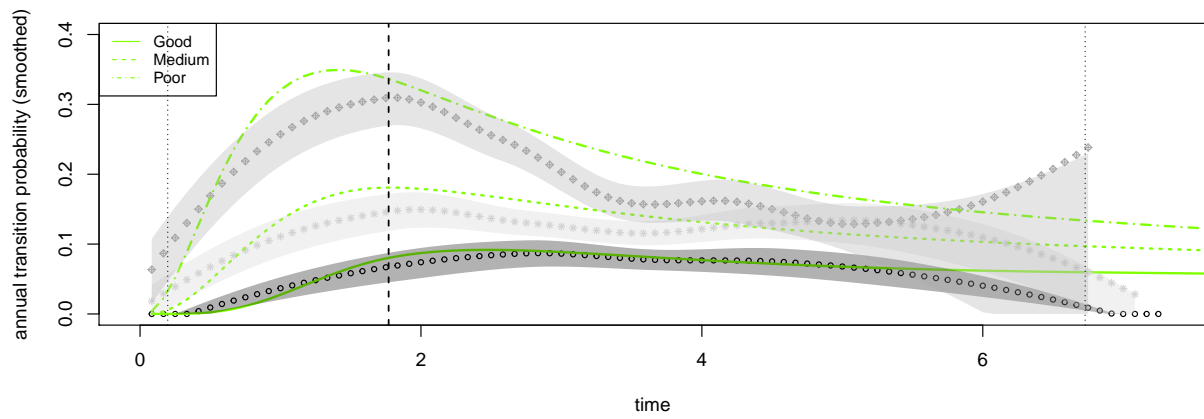


## Spline odds 1 knot

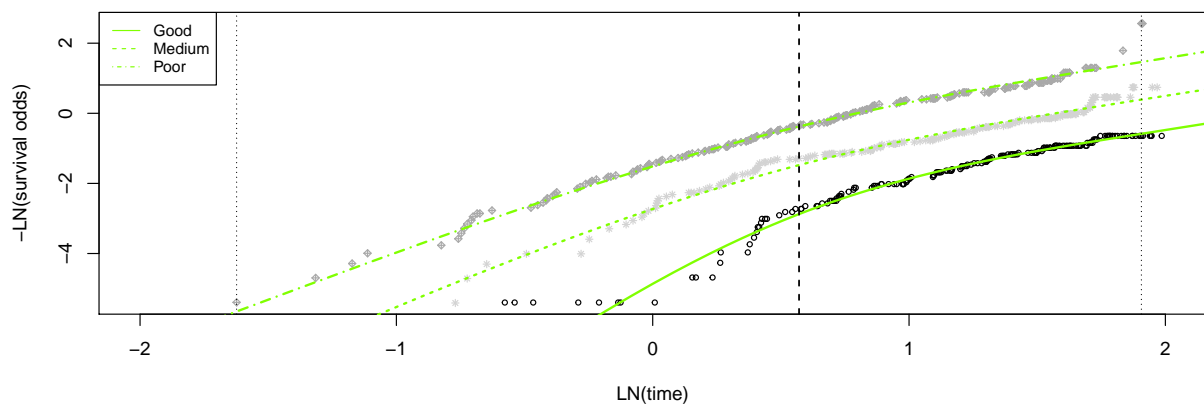
**A: Kaplan–Meier (Spline, 1 knot, odds scale)**



**B: Annual transition probability (Spline, 1 knot, odds scale)**

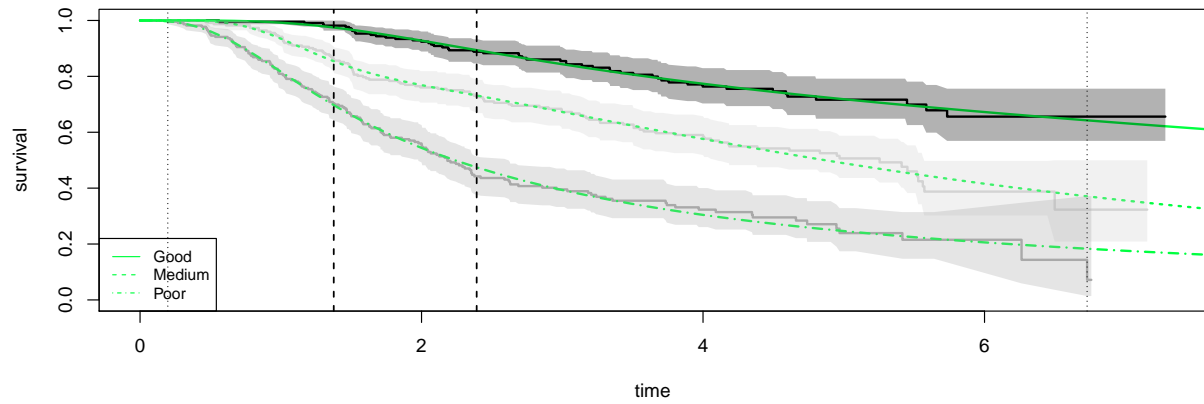


**C: Diagnostic plot (Spline, 1 knot, odds scale)**

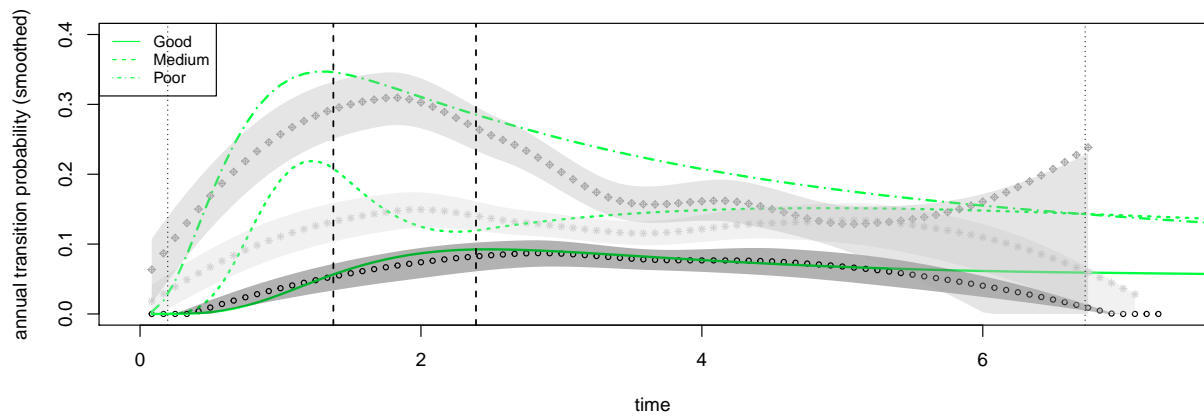


## Spline odds 2 knots

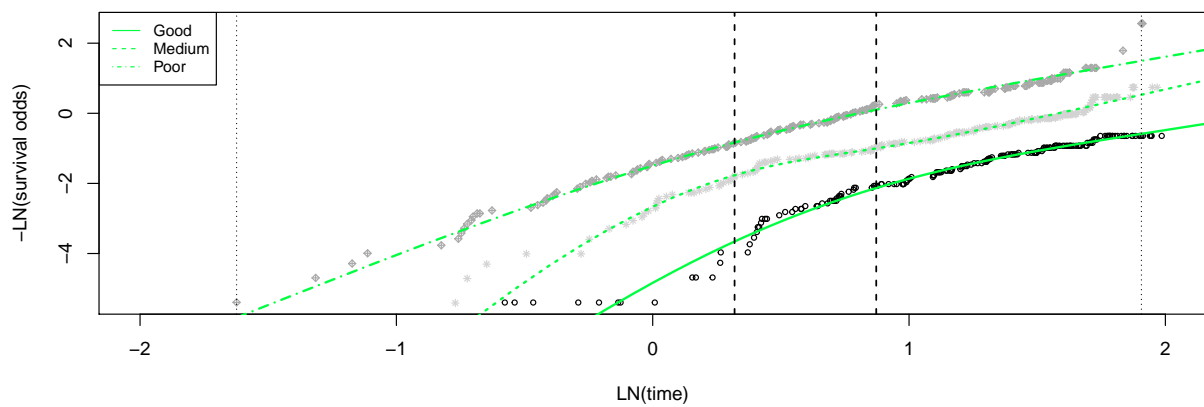
**A: Kaplan–Meier (Spline, 2 knots, odds scale)**



**B: Annual transition probability (Spline, 2 knots, odds scale)**

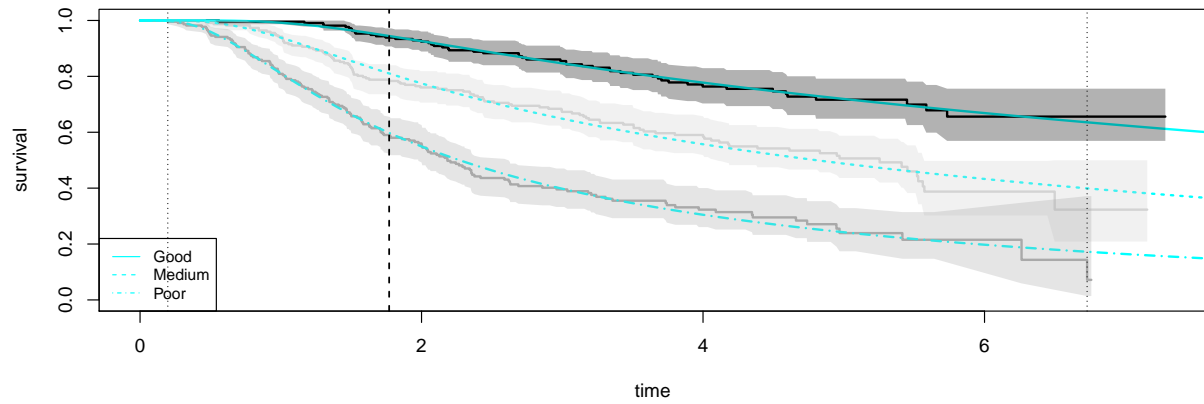


**C: Diagnostic plot (Spline, 2 knots, odds scale)**

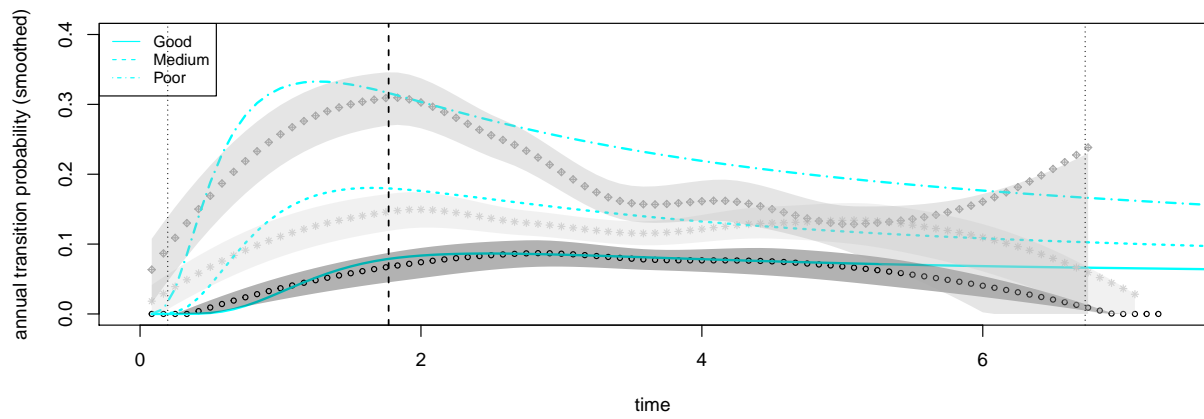


## Spline normal 1 knot

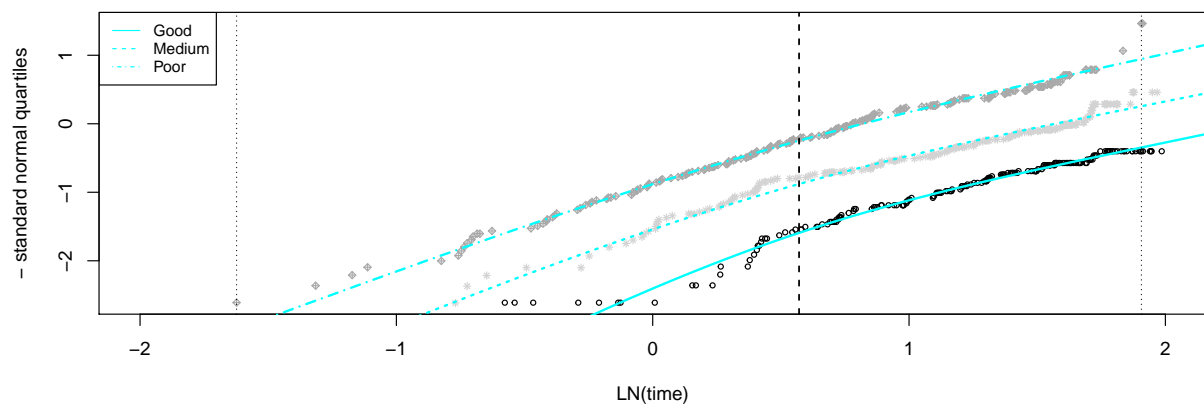
**A: Kaplan-Meier (Spline, 1 knot, normal scale)**



**B: Annual transition probability (Spline, 1 knot, normal scale)**

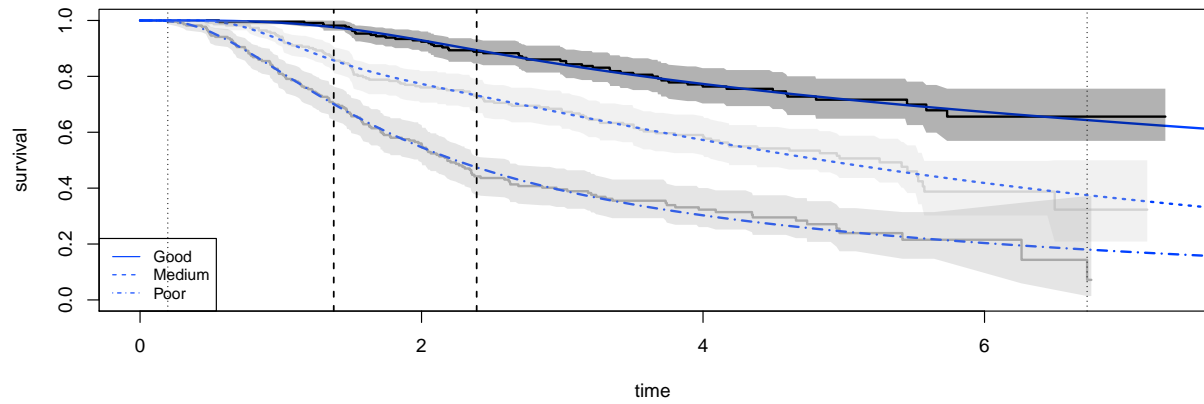


**C: Diagnostic plot (Spline, 1 knot, normal scale)**

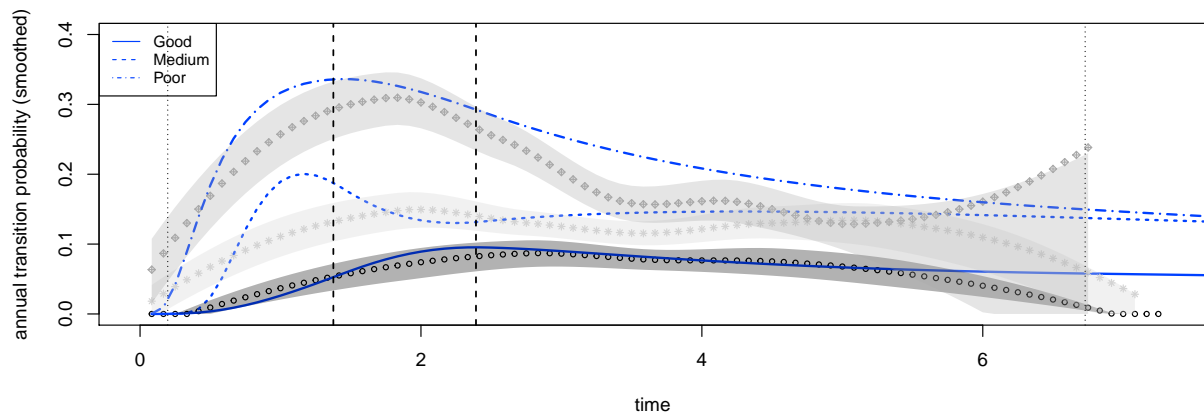


## Spline normal 2 knots

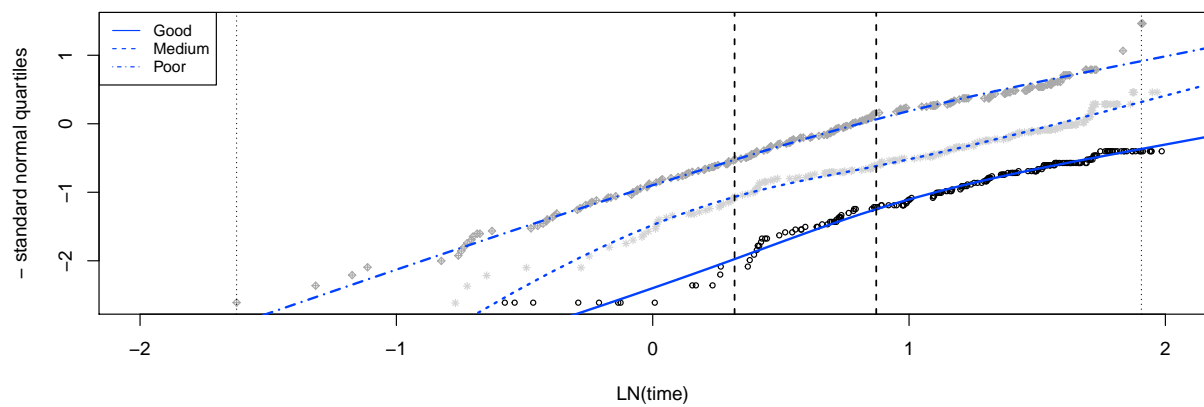
**A: Kaplan–Meier (Spline, 2 knots, normal scale)**



**B: Annual transition probability (Spline, 2 knots, normal scale)**



**C: Diagnostic plot (Spline, 2 knots, normal scale)**

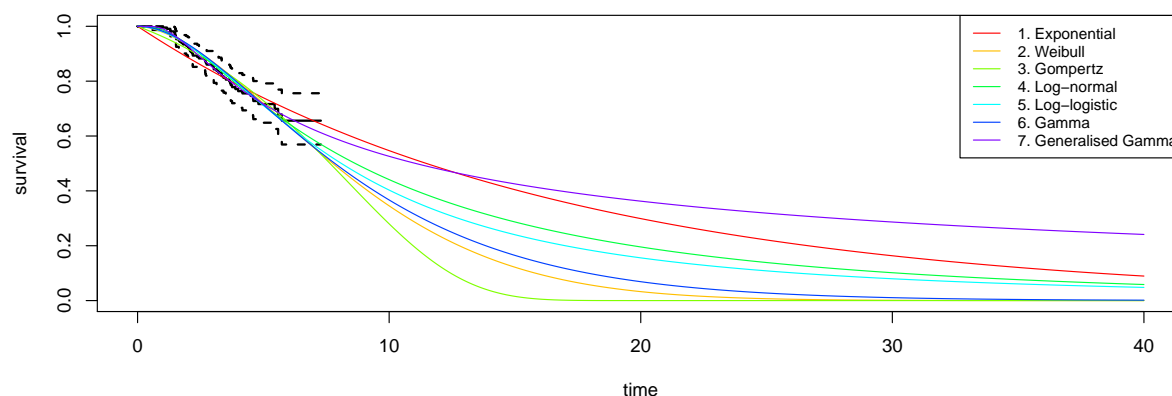


# Validity of long-term extrapolation?

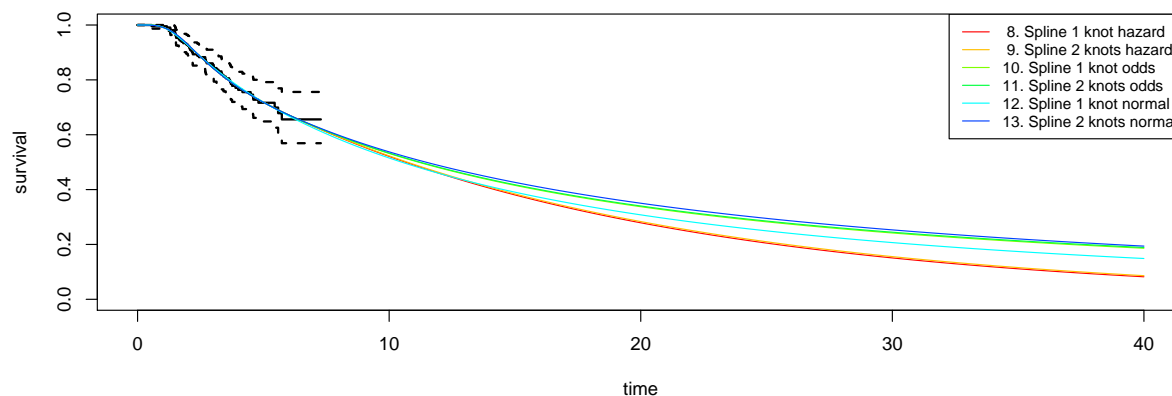
What model(s) is/are more appropriate for long-term extrapolation? Are/is the selected model(s) plausible in comparison with general population mortality?

## Group Good

**A: Kaplan–Meier (parametric curves)**

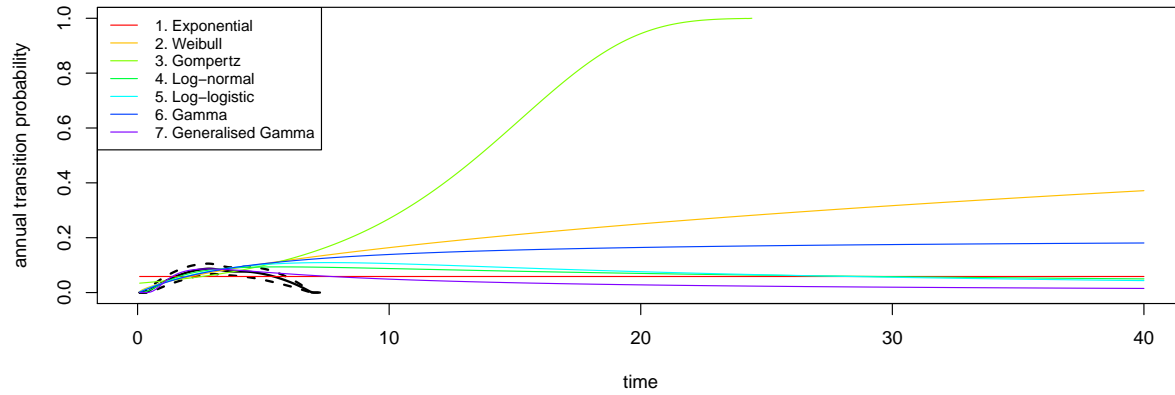


**B: Kaplan–Meier (spline curves)**

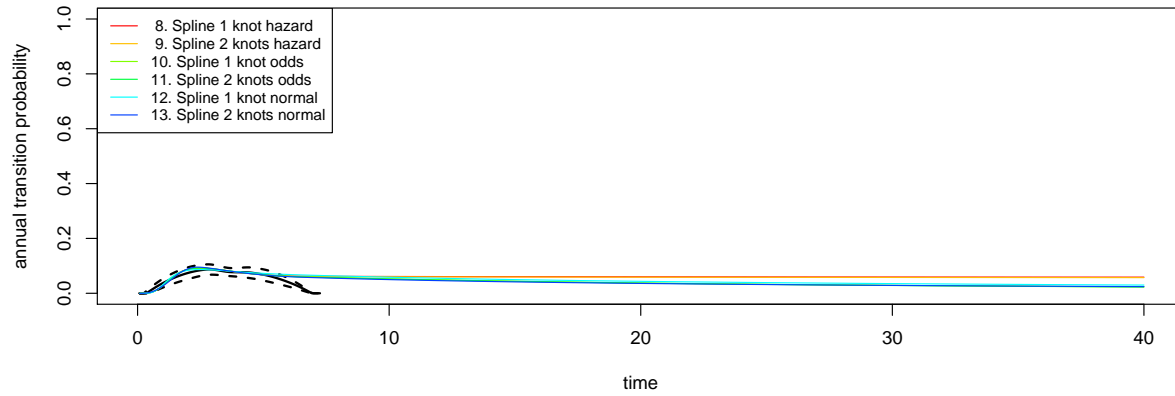


|                           | T= 0 | T= 1  | T= 2  | T= 3  | T= 4  | T= 5  | T= 10 | T= 15 | T= 20 | T= 25 | T= 30 | T= 35 |
|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Exponential            | 1    | 0.941 | 0.886 | 0.834 | 0.785 | 0.739 | 0.547 | 0.404 | 0.299 | 0.221 | 0.163 | 0.121 |
| 2. Weibull                | 1    | 0.978 | 0.932 | 0.870 | 0.797 | 0.719 | 0.345 | 0.122 | 0.033 | 0.007 | 0.001 | 0.000 |
| 3. Gompertz               | 1    | 0.962 | 0.917 | 0.863 | 0.801 | 0.729 | 0.280 | 0.015 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4. Log-normal             | 1    | 0.986 | 0.933 | 0.861 | 0.785 | 0.713 | 0.441 | 0.287 | 0.196 | 0.139 | 0.102 | 0.076 |
| 5. Log-logistic           | 1    | 0.980 | 0.932 | 0.865 | 0.789 | 0.712 | 0.403 | 0.240 | 0.156 | 0.108 | 0.080 | 0.061 |
| 6. Gamma                  | 1    | 0.982 | 0.935 | 0.869 | 0.793 | 0.714 | 0.367 | 0.165 | 0.069 | 0.027 | 0.011 | 0.004 |
| 7. Generalised Gamma      | 1    | 0.991 | 0.928 | 0.849 | 0.778 | 0.717 | 0.526 | 0.425 | 0.362 | 0.319 | 0.286 | 0.261 |
| 8. Spline 1 knot hazard   | 1    | 0.992 | 0.927 | 0.843 | 0.774 | 0.719 | 0.521 | 0.381 | 0.279 | 0.205 | 0.151 | 0.111 |
| 9. Spline 2 knots hazard  | 1    | 0.992 | 0.928 | 0.843 | 0.774 | 0.719 | 0.523 | 0.384 | 0.283 | 0.210 | 0.156 | 0.116 |
| 10. Spline 1 knot odds    | 1    | 0.992 | 0.927 | 0.843 | 0.774 | 0.718 | 0.532 | 0.415 | 0.338 | 0.283 | 0.242 | 0.211 |
| 11. Spline 2 knots odds   | 1    | 0.992 | 0.928 | 0.843 | 0.774 | 0.718 | 0.533 | 0.418 | 0.340 | 0.285 | 0.245 | 0.213 |
| 12. Spline 1 knot normal  | 1    | 0.992 | 0.926 | 0.847 | 0.778 | 0.719 | 0.515 | 0.391 | 0.308 | 0.250 | 0.207 | 0.174 |
| 13. Spline 2 knots normal | 1    | 0.992 | 0.929 | 0.842 | 0.773 | 0.718 | 0.538 | 0.426 | 0.350 | 0.295 | 0.253 | 0.220 |

**C: Annual transition probability (parametric curves)**

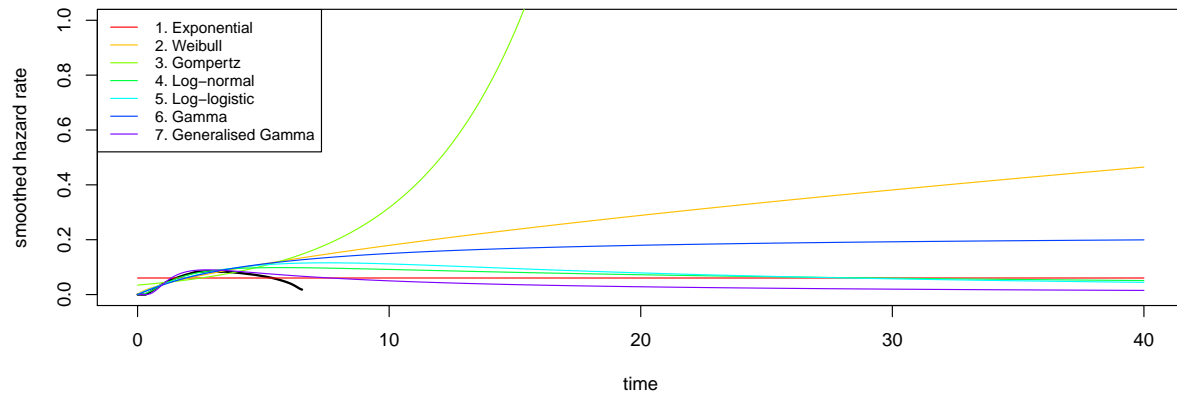


**D: Annual transition probability (spline curves)**

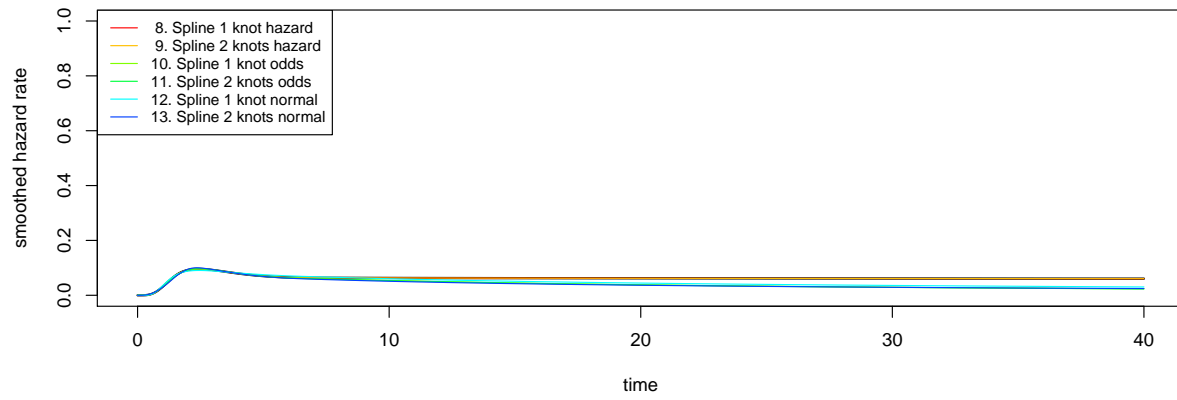


|                           | Min       | Q1        | Median    | Q3        | Max       |
|---------------------------|-----------|-----------|-----------|-----------|-----------|
| 1. Exponential            | 0.0585969 | 0.0585969 | 0.0585969 | 0.0585969 | 0.0585969 |
| 2. Weibull                | 0.0039603 | 0.1641779 | 0.2507544 | 0.3170901 | 0.3714738 |
| 3. Gompertz               | 0.0342601 | 0.1256322 | 0.4037134 | 0.8634656 | 1.0000000 |
| 4. Log-normal             | 0.0000121 | 0.0563972 | 0.0670524 | 0.0819079 | 0.0936091 |
| 5. Log-logistic           | 0.0022936 | 0.0533146 | 0.0700441 | 0.0935993 | 0.1092616 |
| 6. Gamma                  | 0.0014181 | 0.1390361 | 0.1644882 | 0.1750195 | 0.1807519 |
| 7. Generalised Gamma      | 0.0000000 | 0.0191123 | 0.0269247 | 0.0452063 | 0.0862100 |
| 8. Spline 1 knot hazard   | 0.0000002 | 0.0592140 | 0.0598953 | 0.0610195 | 0.0916043 |
| 9. Spline 2 knots hazard  | 0.0000002 | 0.0576502 | 0.0585313 | 0.0599923 | 0.0923962 |
| 10. Spline 1 knot odds    | 0.0000002 | 0.0281269 | 0.0363823 | 0.0502992 | 0.0917044 |
| 11. Spline 2 knots odds   | 0.0000002 | 0.0278516 | 0.0359503 | 0.0497462 | 0.0924439 |
| 12. Spline 1 knot normal  | 0.0000000 | 0.0345970 | 0.0424046 | 0.0560095 | 0.0865141 |
| 13. Spline 2 knots normal | 0.0000006 | 0.0281480 | 0.0348987 | 0.0473455 | 0.0953359 |

**E: Hazard function (parametric curves)**



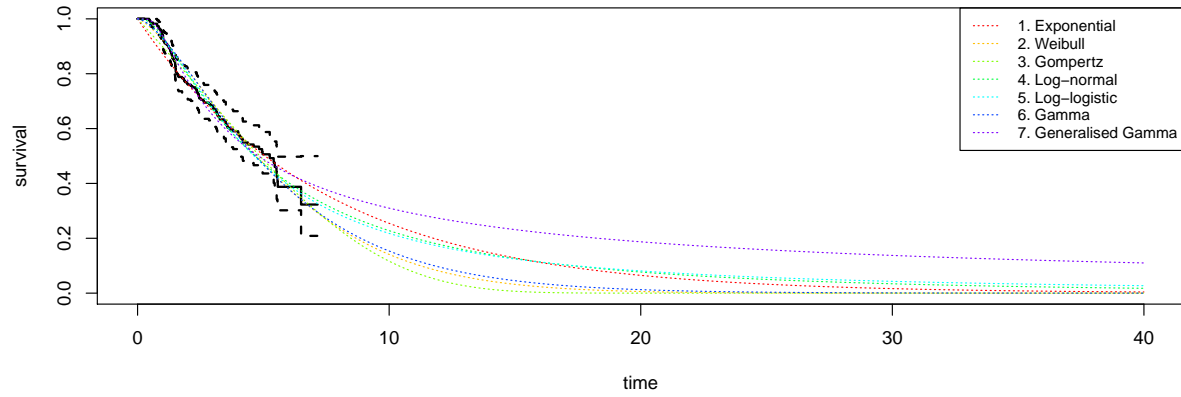
**F: Hazard function (spline curves)**



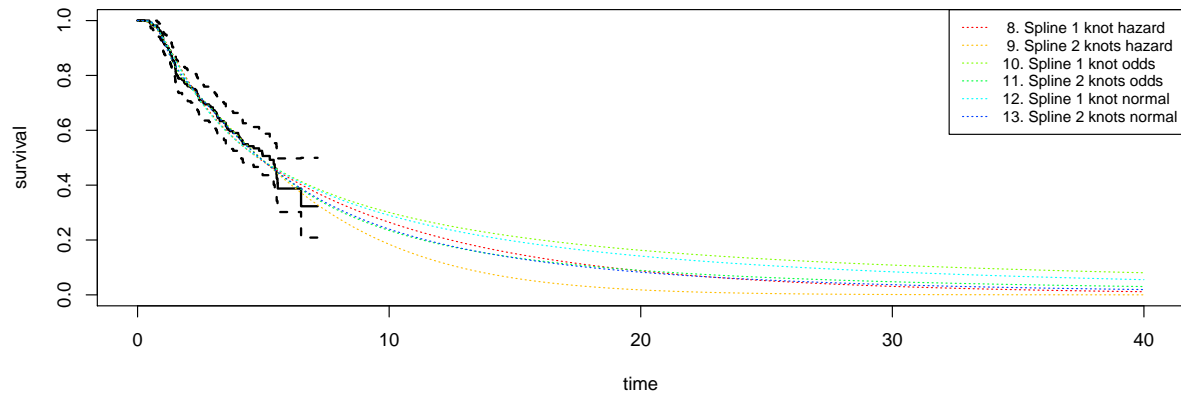


## Group Medium

**A: Kaplan–Meier (parametric curves)**

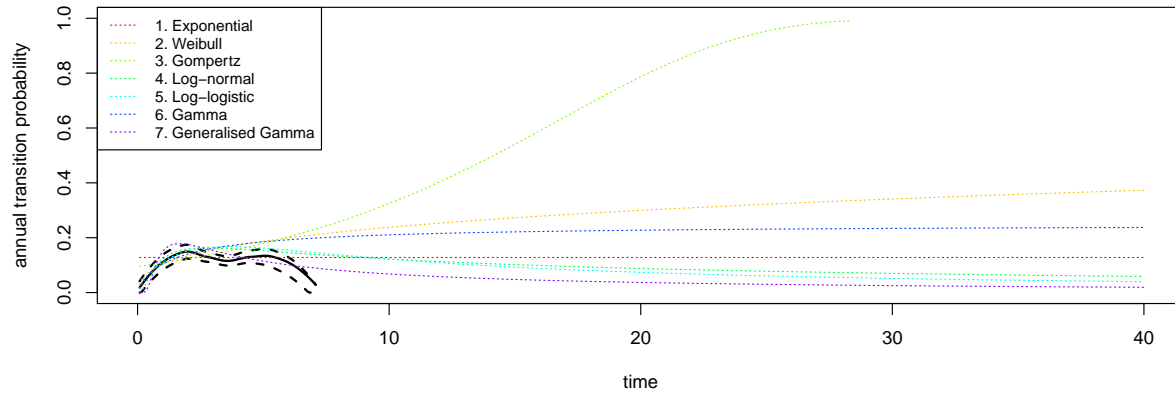


**B: Kaplan–Meier (spline curves)**

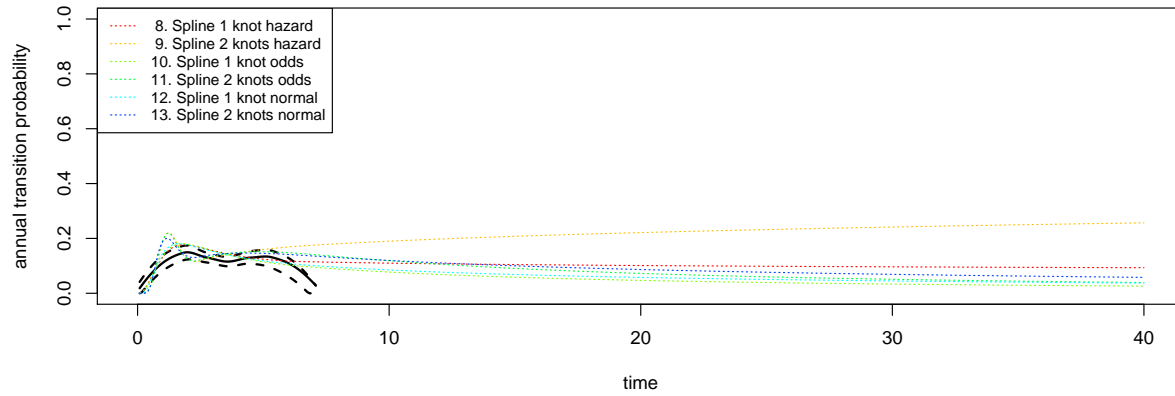


|                           | T= 0 | T= 1  | T= 2  | T= 3  | T= 4  | T= 5  | T= 10 | T= 15 | T= 20 | T= 25 | T= 30 | T= 35 |
|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Exponential            | 1    | 0.872 | 0.761 | 0.663 | 0.578 | 0.505 | 0.255 | 0.128 | 0.065 | 0.033 | 0.016 | 0.008 |
| 2. Weibull                | 1    | 0.923 | 0.811 | 0.693 | 0.578 | 0.474 | 0.141 | 0.032 | 0.006 | 0.001 | 0.000 | 0.000 |
| 3. Gompertz               | 1    | 0.898 | 0.794 | 0.689 | 0.586 | 0.486 | 0.117 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4. Log-normal             | 1    | 0.935 | 0.797 | 0.668 | 0.560 | 0.473 | 0.228 | 0.126 | 0.077 | 0.050 | 0.034 | 0.024 |
| 5. Log-logistic           | 1    | 0.927 | 0.801 | 0.673 | 0.561 | 0.468 | 0.218 | 0.124 | 0.081 | 0.057 | 0.043 | 0.034 |
| 6. Gamma                  | 1    | 0.930 | 0.813 | 0.689 | 0.572 | 0.469 | 0.154 | 0.045 | 0.013 | 0.003 | 0.001 | 0.000 |
| 7. Generalised Gamma      | 1    | 0.937 | 0.774 | 0.648 | 0.556 | 0.488 | 0.310 | 0.232 | 0.187 | 0.158 | 0.138 | 0.122 |
| 8. Spline 1 knot hazard   | 1    | 0.939 | 0.782 | 0.652 | 0.558 | 0.486 | 0.265 | 0.150 | 0.087 | 0.052 | 0.031 | 0.019 |
| 9. Spline 2 knots hazard  | 1    | 0.935 | 0.766 | 0.673 | 0.579 | 0.490 | 0.184 | 0.061 | 0.018 | 0.005 | 0.001 | 0.000 |
| 10. Spline 1 knot odds    | 1    | 0.939 | 0.778 | 0.648 | 0.556 | 0.489 | 0.301 | 0.213 | 0.162 | 0.131 | 0.109 | 0.093 |
| 11. Spline 2 knots odds   | 1    | 0.935 | 0.769 | 0.673 | 0.576 | 0.489 | 0.235 | 0.136 | 0.089 | 0.063 | 0.048 | 0.037 |
| 12. Spline 1 knot normal  | 1    | 0.938 | 0.775 | 0.648 | 0.557 | 0.488 | 0.290 | 0.195 | 0.141 | 0.107 | 0.084 | 0.067 |
| 13. Spline 2 knots normal | 1    | 0.930 | 0.773 | 0.669 | 0.572 | 0.489 | 0.240 | 0.135 | 0.083 | 0.054 | 0.037 | 0.026 |

**C: Annual transition probability (parametric curves)**

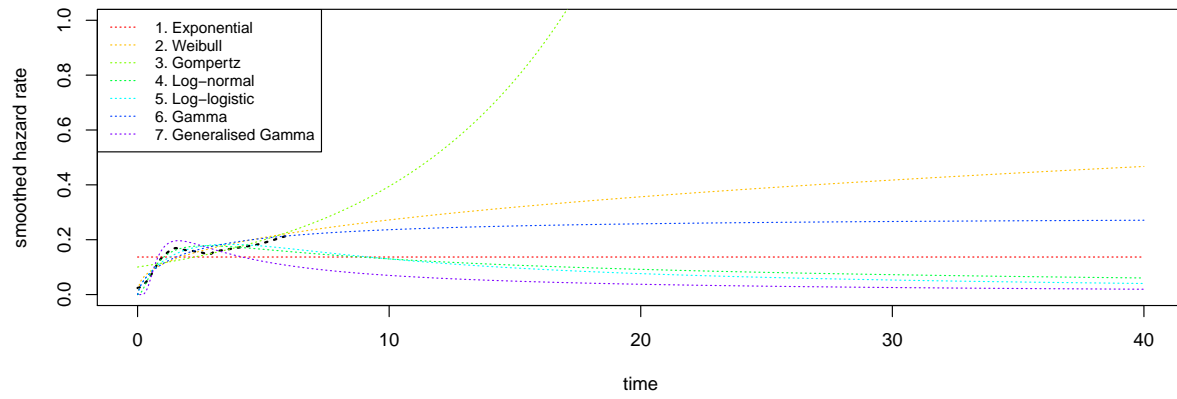


**D: Annual transition probability (spline curves)**

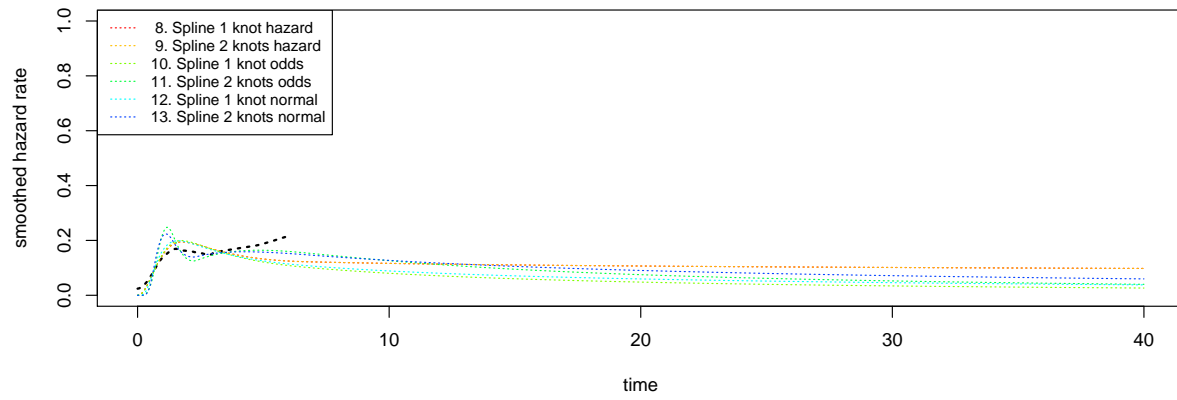


|                           | Min       | Q1        | Median    | Q3        | Max       |
|---------------------------|-----------|-----------|-----------|-----------|-----------|
| 1. Exponential            | 0.1278820 | 0.1278820 | 0.1278820 | 0.1278820 | 0.1278820 |
| 2. Weibull                | 0.0298491 | 0.2382194 | 0.2998675 | 0.3413164 | 0.3730304 |
| 3. Gompertz               | 0.0960264 | 0.2326209 | 0.5026105 | 0.8415103 | 1.0000000 |
| 4. Log-normal             | 0.0004751 | 0.0692201 | 0.0864990 | 0.1175437 | 0.1630482 |
| 5. Log-logistic           | 0.0150627 | 0.0512119 | 0.0722192 | 0.1148301 | 0.1673124 |
| 6. Gamma                  | 0.0159374 | 0.2105278 | 0.2273428 | 0.2338793 | 0.2373538 |
| 7. Generalised Gamma      | 0.0000000 | 0.0249765 | 0.0361491 | 0.0643696 | 0.1783037 |
| 8. Spline 1 knot hazard   | 0.0005533 | 0.0961200 | 0.1007177 | 0.1087714 | 0.1767370 |
| 9. Spline 2 knots hazard  | 0.0000006 | 0.1921569 | 0.2213494 | 0.2415978 | 0.2568265 |
| 10. Spline 1 knot odds    | 0.0004610 | 0.0331955 | 0.0461415 | 0.0743721 | 0.1809477 |
| 11. Spline 2 knots odds   | 0.0000004 | 0.0500917 | 0.0706148 | 0.1135216 | 0.2192447 |
| 12. Spline 1 knot normal  | 0.0000012 | 0.0444894 | 0.0569700 | 0.0823605 | 0.1804334 |
| 13. Spline 2 knots normal | 0.0000000 | 0.0682231 | 0.0852159 | 0.1164045 | 0.2005479 |

**E: Hazard function (parametric curves)**

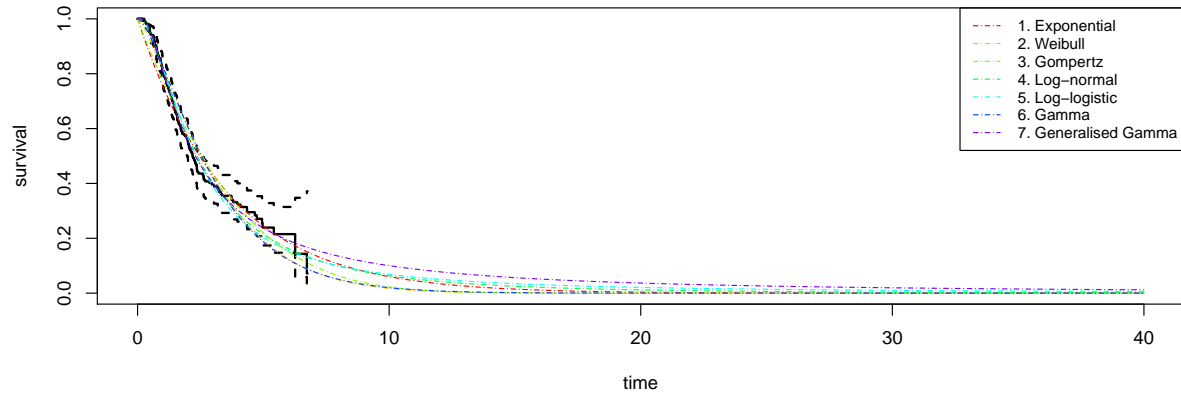


**F: Hazard function (spline curves)**

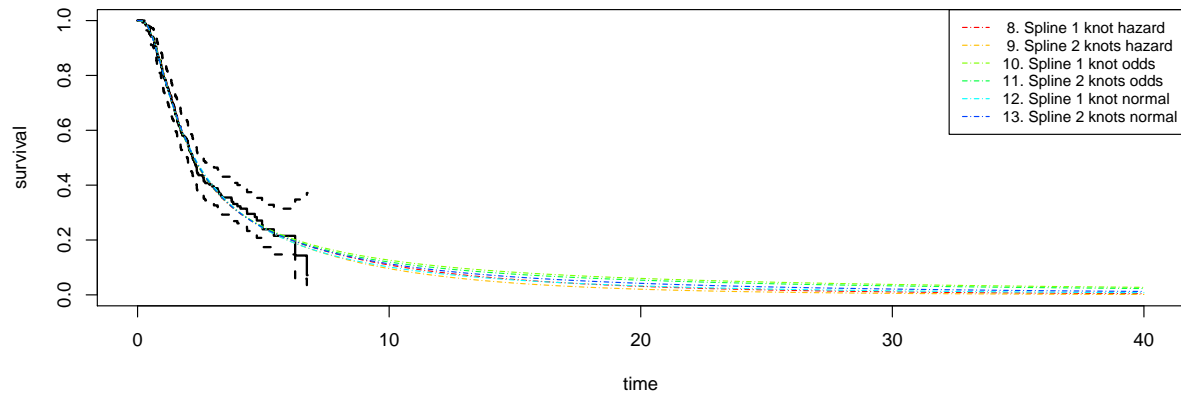


## Group Poor

**A: Kaplan–Meier (parametric curves)**

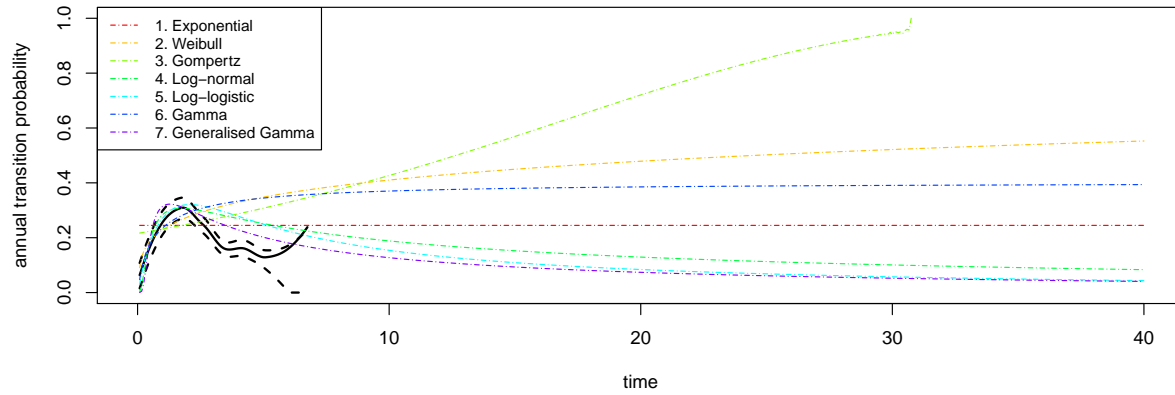


**B: Kaplan–Meier (spline curves)**

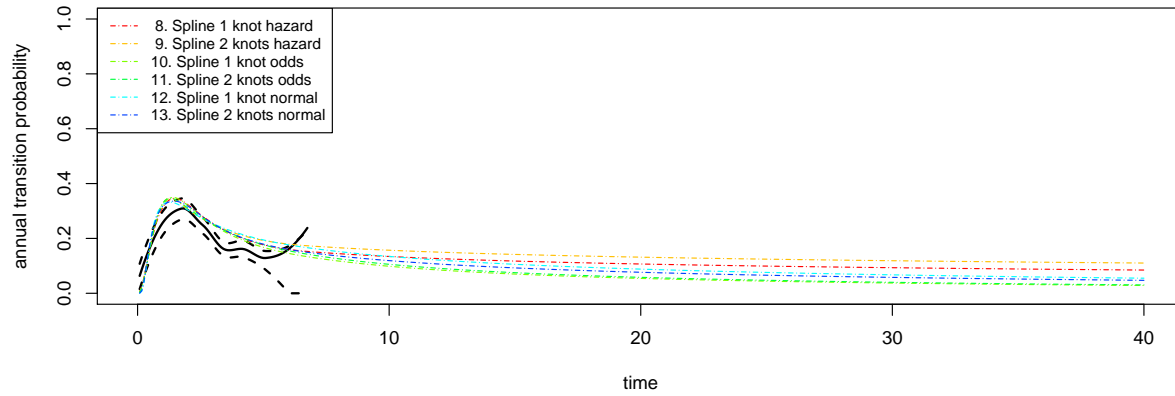


|                           | T= 0 | T= 1  | T= 2  | T= 3  | T= 4  | T= 5  | T= 10 | T= 15 | T= 20 | T= 25 | T= 30 | T= 35 |
|---------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Exponential            | 1    | 0.755 | 0.570 | 0.430 | 0.325 | 0.245 | 0.060 | 0.015 | 0.004 | 0.001 | 0.000 | 0.000 |
| 2. Weibull                | 1    | 0.817 | 0.608 | 0.430 | 0.292 | 0.193 | 0.017 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3. Gompertz               | 1    | 0.776 | 0.588 | 0.436 | 0.315 | 0.221 | 0.022 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4. Log-normal             | 1    | 0.820 | 0.572 | 0.401 | 0.289 | 0.214 | 0.063 | 0.025 | 0.012 | 0.006 | 0.004 | 0.002 |
| 5. Log-logistic           | 1    | 0.819 | 0.568 | 0.389 | 0.275 | 0.203 | 0.069 | 0.034 | 0.021 | 0.014 | 0.010 | 0.008 |
| 6. Gamma                  | 1    | 0.829 | 0.605 | 0.420 | 0.283 | 0.187 | 0.020 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7. Generalised Gamma      | 1    | 0.810 | 0.555 | 0.399 | 0.302 | 0.237 | 0.100 | 0.057 | 0.037 | 0.026 | 0.019 | 0.015 |
| 8. Spline 1 knot hazard   | 1    | 0.822 | 0.545 | 0.390 | 0.301 | 0.244 | 0.109 | 0.056 | 0.031 | 0.018 | 0.011 | 0.007 |
| 9. Spline 2 knots hazard  | 1    | 0.817 | 0.546 | 0.396 | 0.305 | 0.243 | 0.096 | 0.043 | 0.021 | 0.010 | 0.005 | 0.003 |
| 10. Spline 1 knot odds    | 1    | 0.820 | 0.542 | 0.390 | 0.303 | 0.248 | 0.127 | 0.082 | 0.060 | 0.047 | 0.038 | 0.032 |
| 11. Spline 2 knots odds   | 1    | 0.817 | 0.544 | 0.393 | 0.304 | 0.246 | 0.120 | 0.075 | 0.054 | 0.041 | 0.033 | 0.027 |
| 12. Spline 1 knot normal  | 1    | 0.811 | 0.549 | 0.398 | 0.305 | 0.242 | 0.102 | 0.054 | 0.033 | 0.021 | 0.015 | 0.011 |
| 13. Spline 2 knots normal | 1    | 0.815 | 0.546 | 0.392 | 0.303 | 0.245 | 0.113 | 0.065 | 0.042 | 0.029 | 0.021 | 0.016 |

**C: Annual transition probability (parametric curves)**

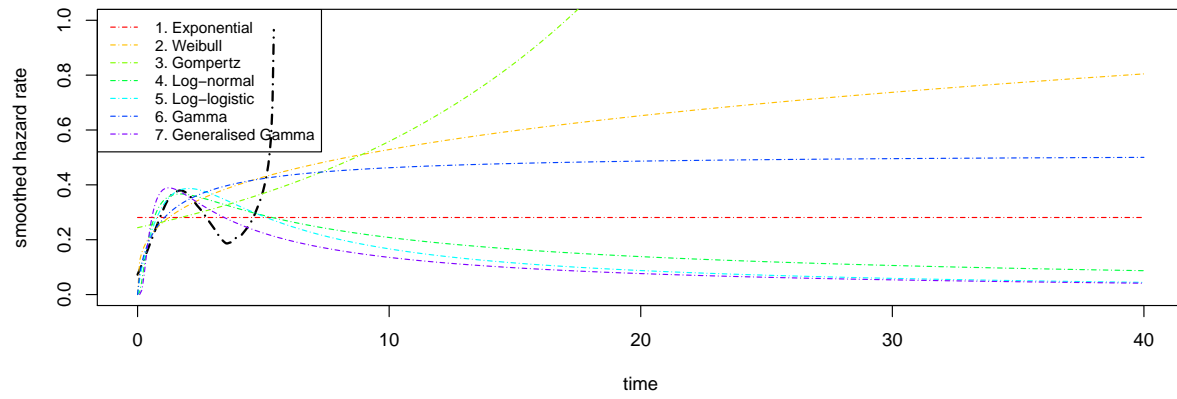


**D: Annual transition probability (spline curves)**

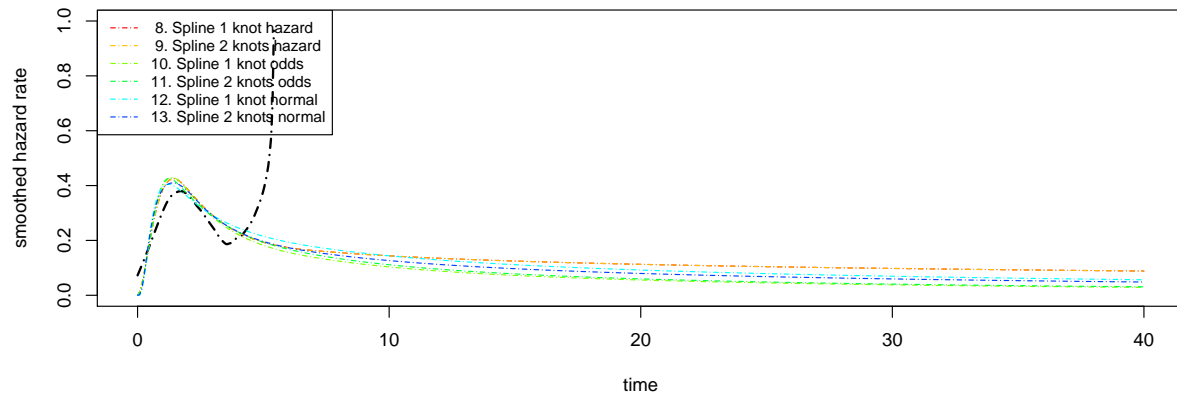


|                           | Min       | Q1        | Median    | Q3        | Max       |
|---------------------------|-----------|-----------|-----------|-----------|-----------|
| 1. Exponential            | 0.2449482 | 0.2449482 | 0.2449482 | 0.2449482 | 0.2449482 |
| 2. Weibull                | 0.0907442 | 0.4105709 | 0.4790585 | 0.5216195 | 0.5525972 |
| 3. Gompertz               | 0.2169796 | 0.3698466 | 0.5818235 | 0.8071868 | 1.0000000 |
| 4. Log-normal             | 0.0022958 | 0.1000774 | 0.1279068 | 0.1841659 | 0.3070152 |
| 5. Log-logistic           | 0.0305143 | 0.0571627 | 0.0832145 | 0.1494462 | 0.3207417 |
| 6. Gamma                  | 0.0471845 | 0.3701940 | 0.3852535 | 0.3907371 | 0.3935697 |
| 7. Generalised Gamma      | 0.0000317 | 0.0518395 | 0.0728961 | 0.1237607 | 0.3222943 |
| 8. Spline 1 knot hazard   | 0.0048605 | 0.0929348 | 0.1060806 | 0.1322263 | 0.3462113 |
| 9. Spline 2 knots hazard  | 0.0027621 | 0.1183362 | 0.1309295 | 0.1552006 | 0.3471134 |
| 10. Spline 1 knot odds    | 0.0040186 | 0.0370407 | 0.0534928 | 0.0956147 | 0.3493116 |
| 11. Spline 2 knots odds   | 0.0029239 | 0.0397013 | 0.0573770 | 0.1025038 | 0.3469030 |
| 12. Spline 1 knot normal  | 0.0001727 | 0.0667705 | 0.0870224 | 0.1315769 | 0.3327152 |
| 13. Spline 2 knots normal | 0.0003302 | 0.0575542 | 0.0758377 | 0.1164719 | 0.3361441 |

**E: Hazard function (parametric curves)**



**F: Hazard function (spline curves)**



## Session information

```
## R version 4.0.1 (2020-06-06)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19041)
##
## Matrix products: default
##
## Random number generation:
##  RNG:      Mersenne-Twister
##  Normal:   Inversion
##  Sample:   Rejection
##
## attached base packages:
## [1] splines      stats      graphics  grDevices  utils      datasets  methods
## [8] base
##
## other attached packages:
##  [1] sft_2.2-1          SuppDists_1.1-9.5  fda_5.1.7          fds_1.8
##  [5] RCurl_1.98-1.2     rainbow_3.6        pcaPP_1.9-73        MASS_7.3-51.6
##  [9] Matrix_1.2-18      kableExtra_1.3.1   knitr_1.30          summarytools_0.9.6
## [13] data.table_1.13.4  survminer_0.4.8    ggpubr_0.4.0        muhaz_1.2.6.1
## [17] flexsurv_1.1.1     rms_6.1-0          SparseM_1.78        Hmisc_4.4-2
## [21] ggplot2_3.3.2      Formula_1.2-4      survival_3.2-7      lattice_0.20-41
##
## loaded via a namespace (and not attached):
##  [1] TH.data_1.0-10      colorspace_2.0-0    ggsignif_0.6.0
##  [4] pryr_0.1.4          ellipsis_0.3.1      rio_0.5.16
##  [7] mclust_5.4.7        htmlTable_2.1.0     base64enc_0.1-3
## [10] rstudioapi_0.13     farver_2.0.3        MatrixModels_0.4-1
## [13] mvtnorm_1.1-1       lubridate_1.7.9.2   xml2_1.3.2
## [16] codetools_0.2-16    broom_0.7.2         km.ci_0.5-2
## [19] cluster_2.1.0       png_0.1-7           compiler_4.0.1
## [22] httr_1.4.2          backports_1.2.0     htmltools_0.5.0
## [25] quantreg_5.75       tools_4.0.1         gtable_0.3.0
## [28] glue_1.4.2          dplyr_1.0.2         Rcpp_1.0.5
## [31] carData_3.0-4       cellranger_1.1.0    vctrs_0.3.5
## [34] nlme_3.1-148        conquer_1.0.2       xfun_0.19
## [37] stringr_1.4.0       openxlsx_4.2.3      rvest_0.3.6
## [40] lifecycle_0.2.0     rstatix_0.6.0       polspline_1.1.19
## [43] zoo_1.8-8           scales_1.1.1        hms_0.5.3
## [46] sandwich_3.0-0      RColorBrewer_1.1-2  yaml_2.2.1
## [49] curl_4.3            gridExtra_2.3        KMsurv_0.1-5
## [52] pander_0.6.3        rpart_4.1-15        latticeExtra_0.6-29
## [55] stringi_1.5.3       checkmate_2.0.0     zip_2.1.1
## [58] hdrclde_3.3         bitops_1.0-6        rlang_0.4.9
## [61] pkgconfig_2.0.3     matrixStats_0.57.0  evaluate_0.14
## [64] purrr_0.3.4         labeling_0.4.2      ks_1.11.7
## [67] rapportools_1.0     htmlwidgets_1.5.2   tidyselect_1.1.0
## [70] deSolve_1.28        plyr_1.8.6          magrittr_2.0.1
## [73] R6_2.5.0            magick_2.5.2        generics_0.1.0
## [76] multcomp_1.4-15     pillar_1.4.7        haven_2.3.1
## [79] foreign_0.8-80      withr_2.3.0         abind_1.4-5
## [82] nnet_7.3-14         tibble_3.0.4        mstate_0.2.12
```

|    |       |                    |                |                   |
|----|-------|--------------------|----------------|-------------------|
| ## | [85]  | crayon_1.3.4       | car_3.0-10     | survMisc_0.5.5    |
| ## | [88]  | KernSmooth_2.23-17 | rmarkdown_2.5  | jpeg_0.1-8.1      |
| ## | [91]  | grid_4.0.1         | readxl_1.3.1   | forcats_0.5.0     |
| ## | [94]  | digest_0.6.27      | webshot_0.5.2  | xtable_1.8-4      |
| ## | [97]  | tidyr_1.1.2        | munsell_0.5.0  | viridisLite_0.3.0 |
| ## | [100] | tcltk_4.0.1        | quadprog_1.5-8 |                   |