

PERSUADE BC_OS_output

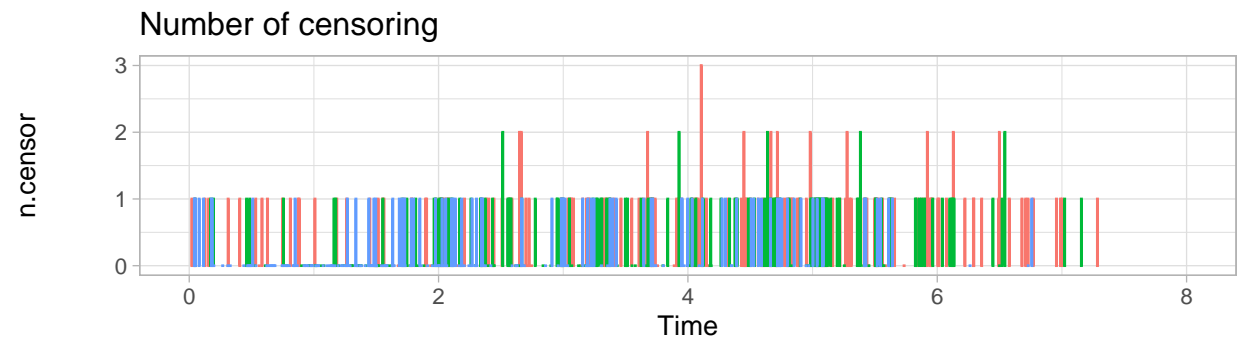
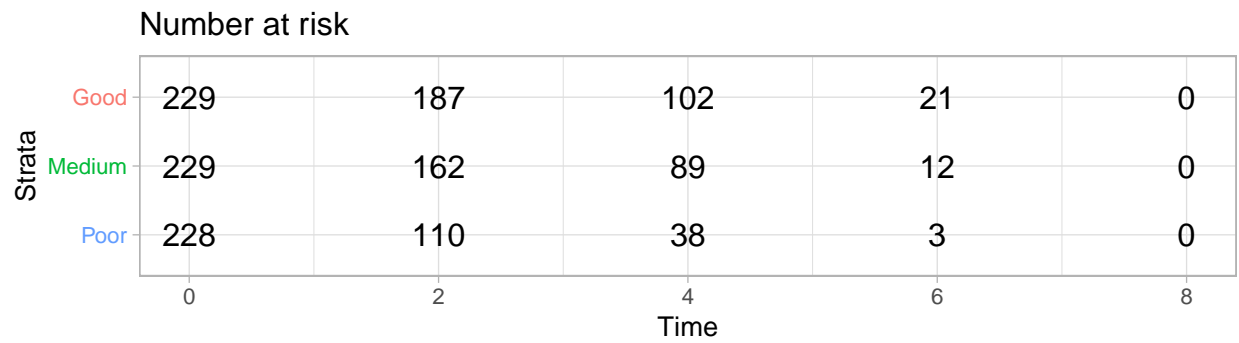
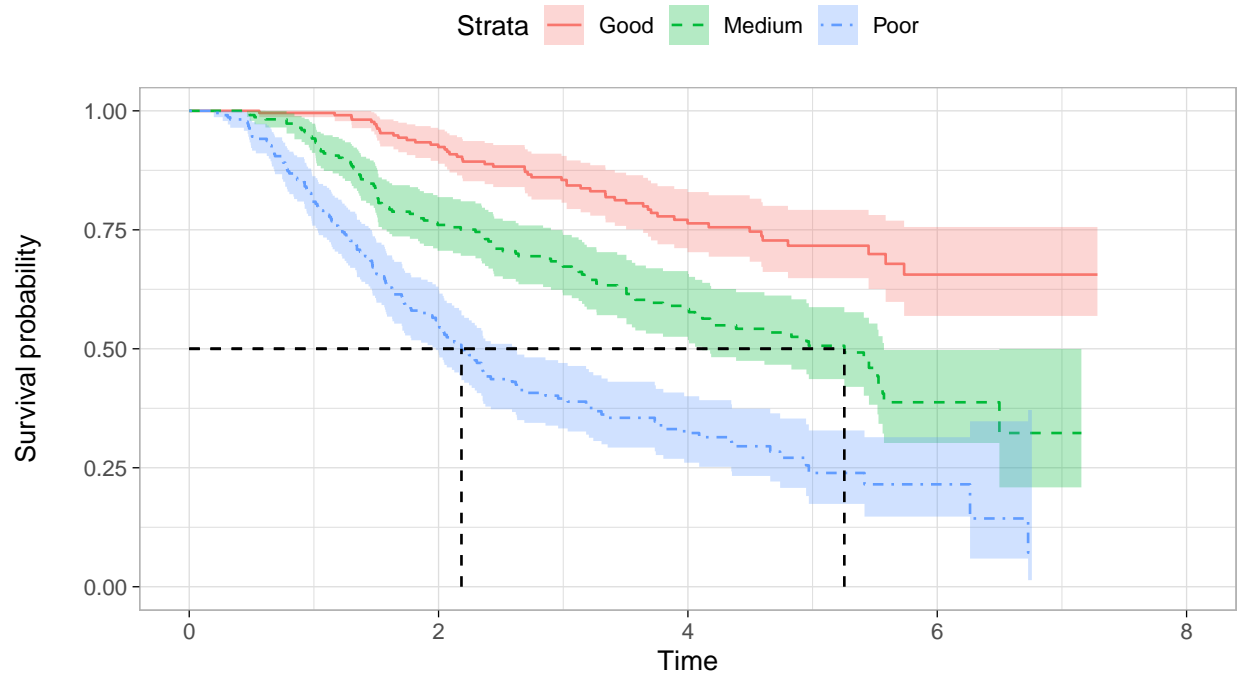
2020-11-16

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[Link to PERSUADE GitHub page](#)

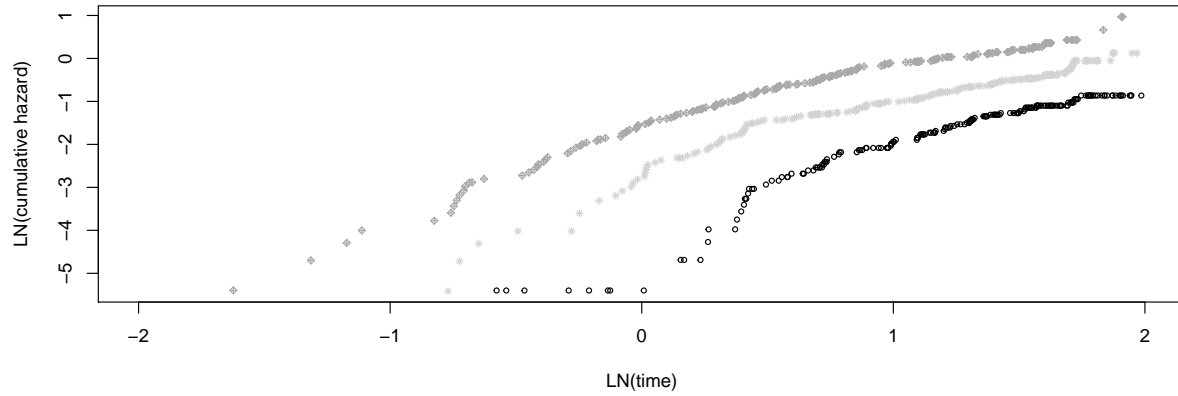
Kaplan-Meier



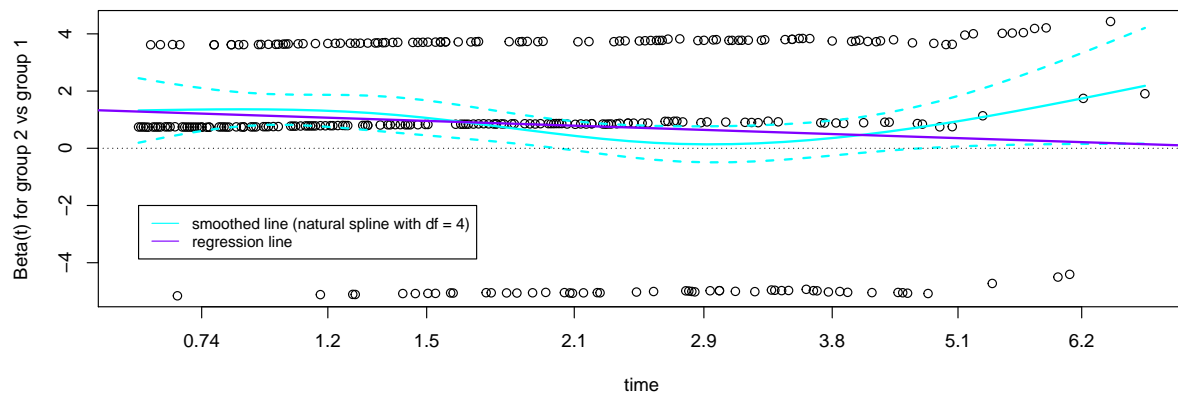
Stratified models?

Should stratified parametric survival models be used?

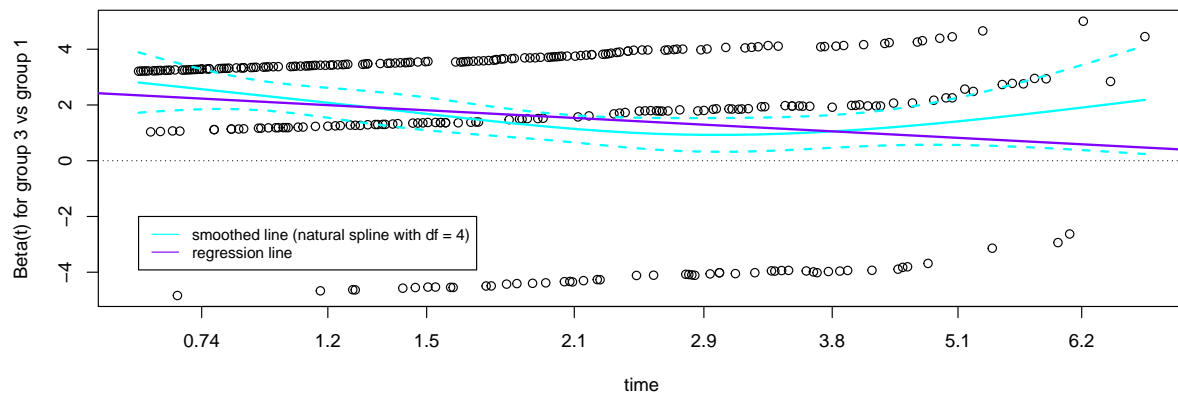
A: LN(cumulative hazard)



B: Scaled Schoenfeld residuals

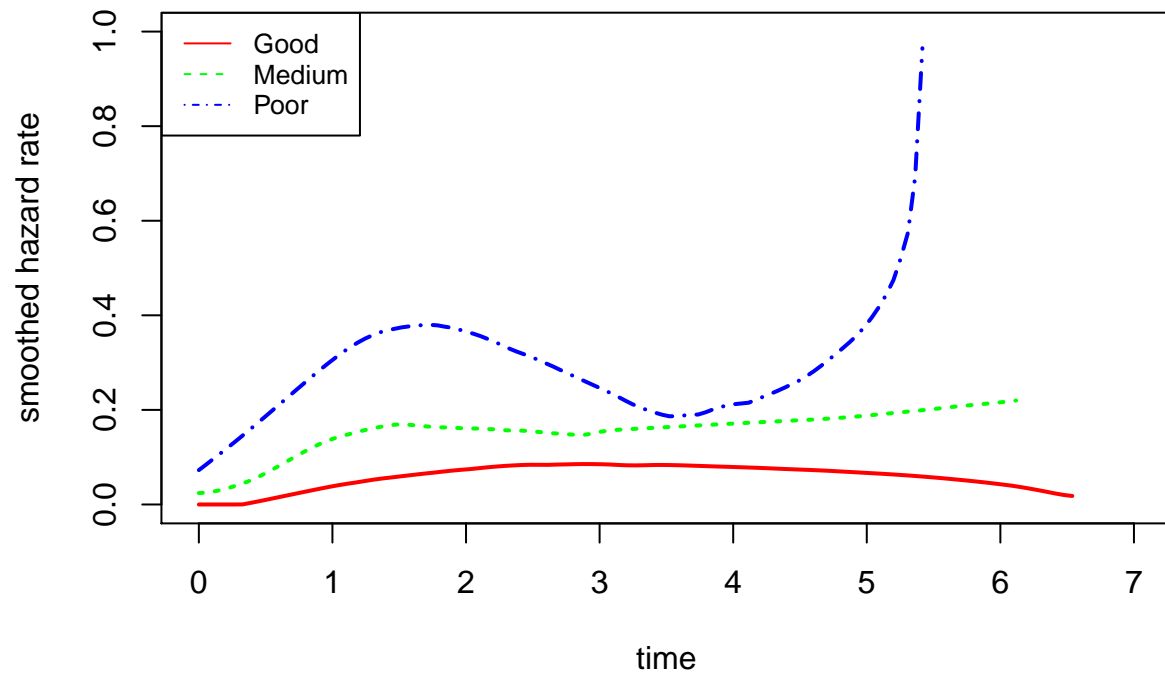


C: Scaled Schoenfeld residuals



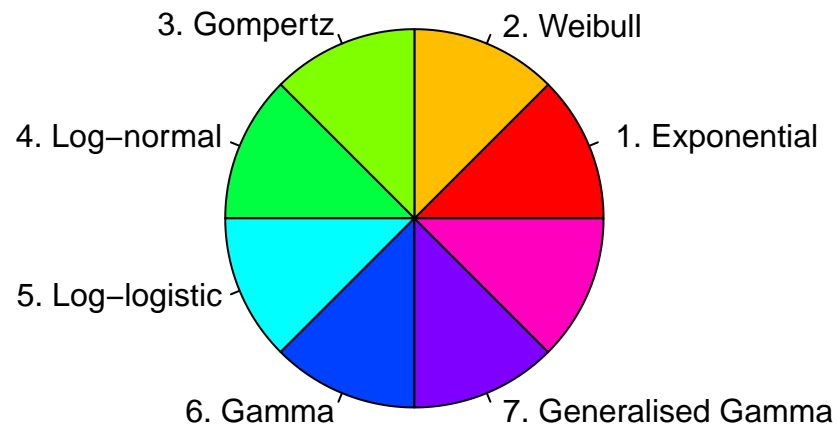
Monotonic hazard models?

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



Standard parametric models?

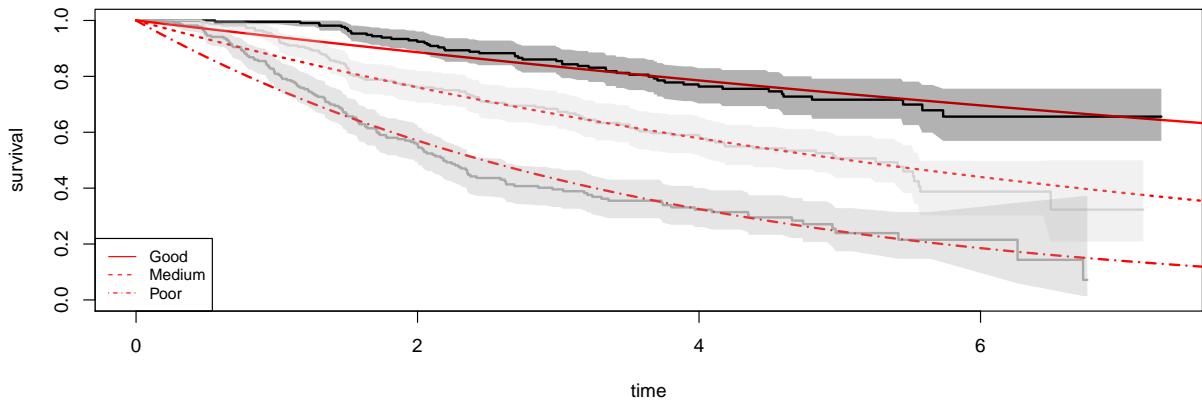
Do standard parametric models provide an appropriate fit to the data?



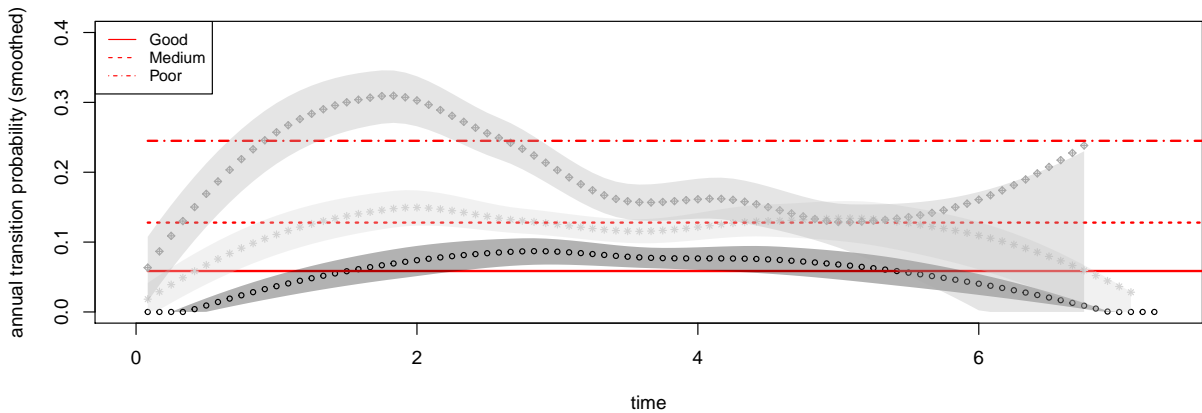
Model	AIC	BIC
7. Generalised Gamma	1589.049	1629.826
4. Log-normal	1592.880	1620.066
5. Log-logistic	1609.294	1636.479
6. Gamma	1621.982	1649.167
2. Weibull	1632.618	1659.803
3. Gompertz	1660.954	1688.140
1. Exponential	1668.212	1681.805

Exponential

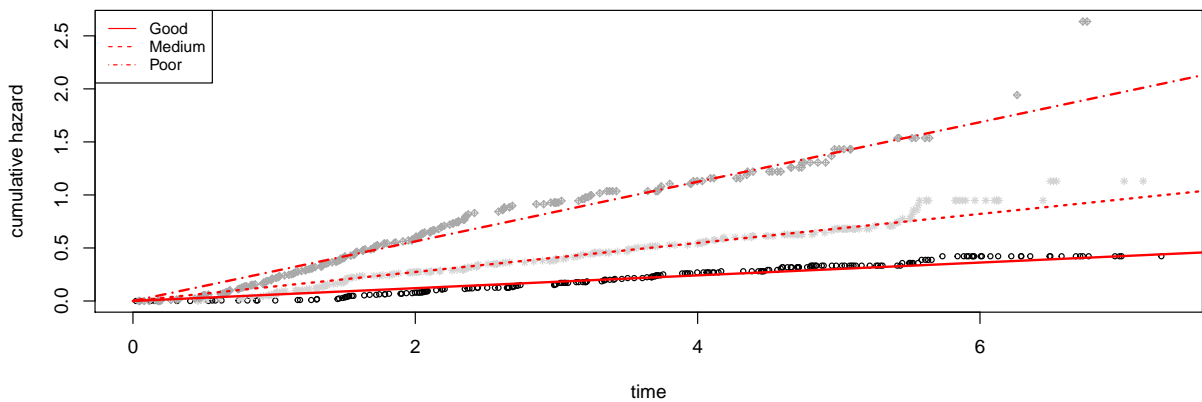
A: Kaplan–Meier (Exponential)



B: Annual transition probability (Exponential)

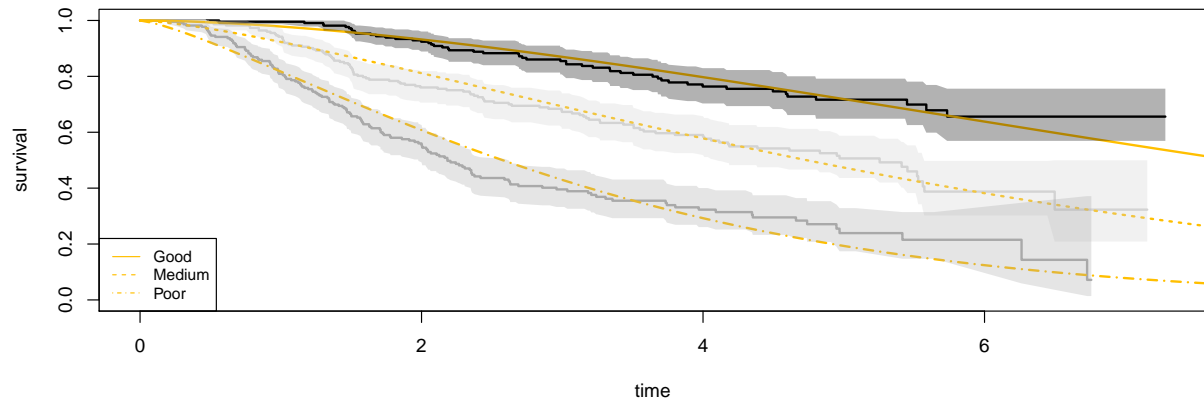


C: Diagnostic plot (Exponential)

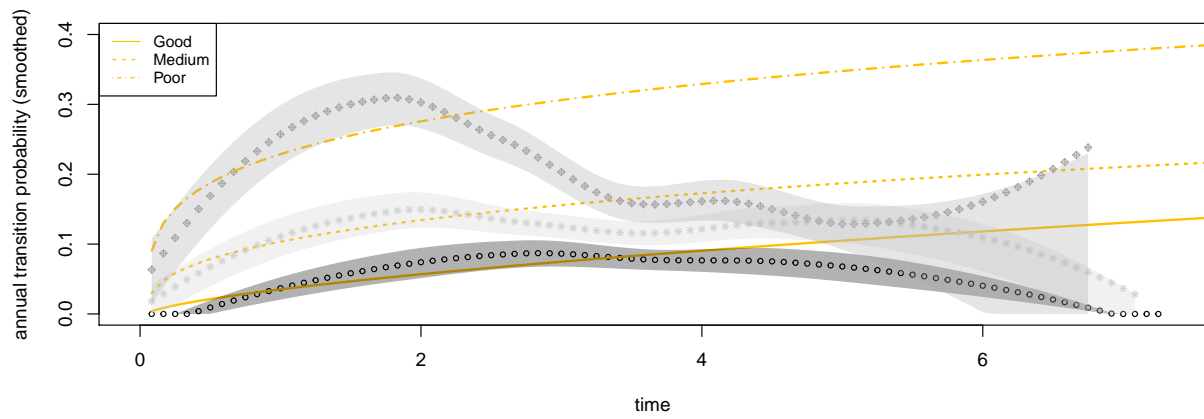


Weibull

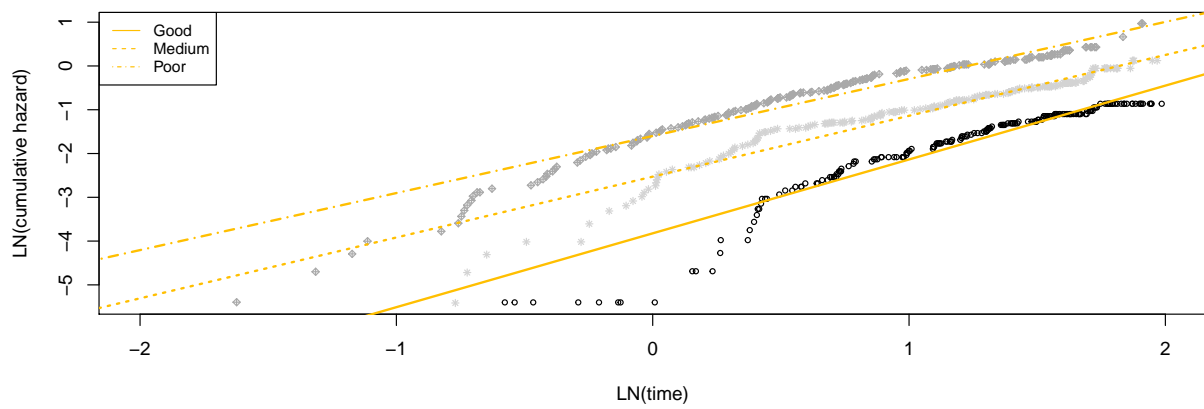
A: Kaplan–Meier (Weibull)



B: Annual transition probability (Weibull)

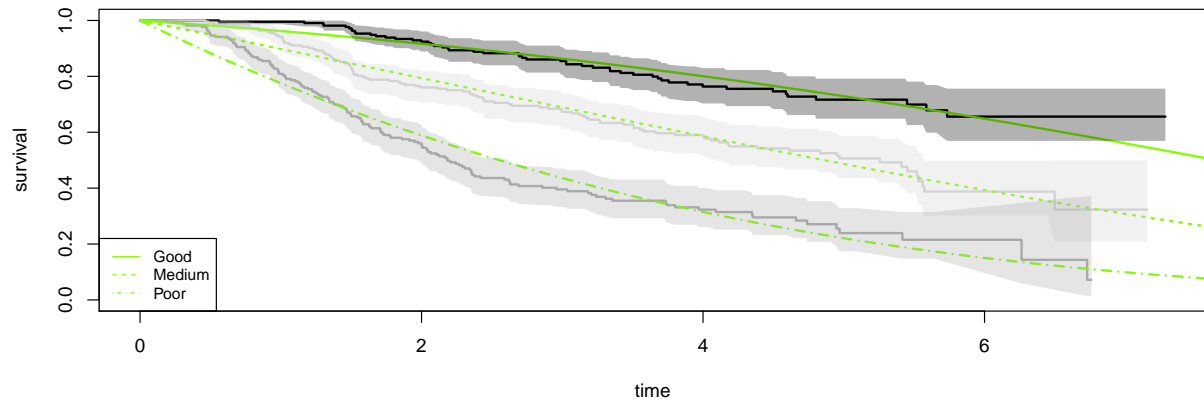


C: Diagnostic plot (Weibull)

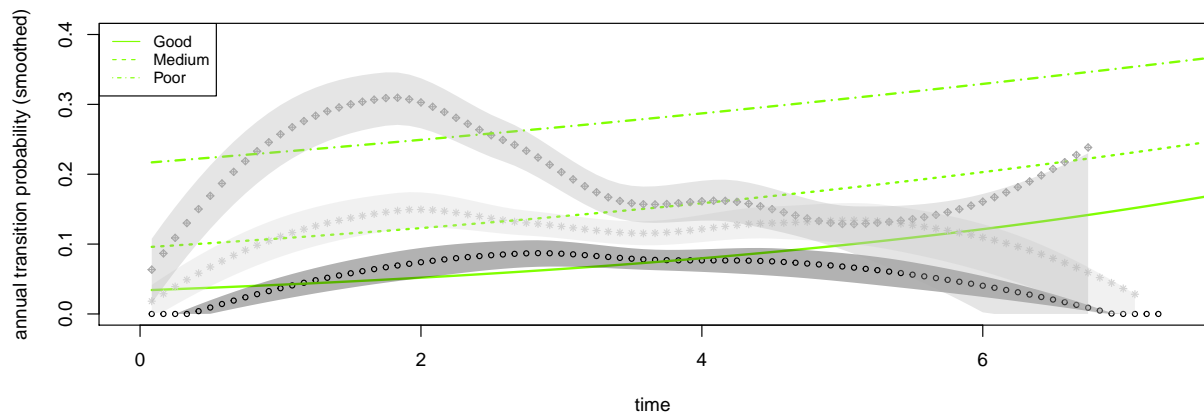


Gompertz

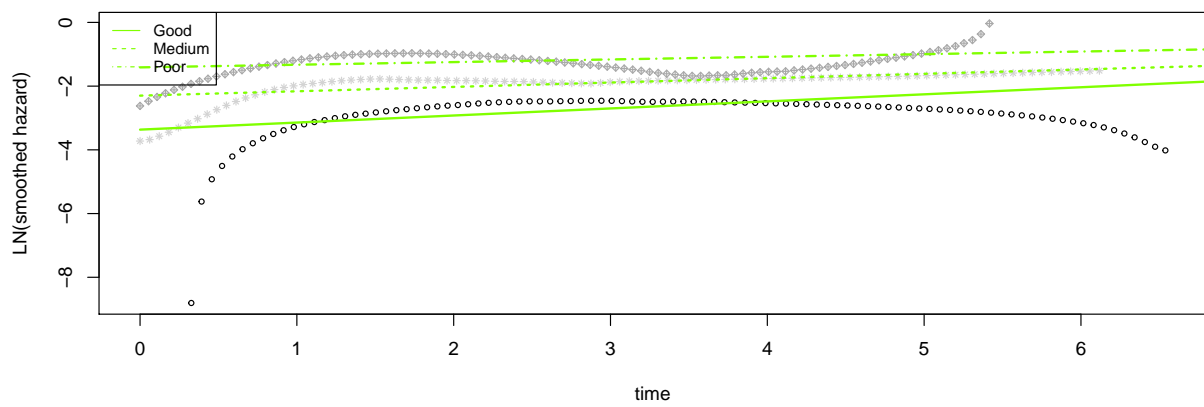
A: Kaplan-Meier (Gompertz)



B: Annual transition probability (Gompertz)

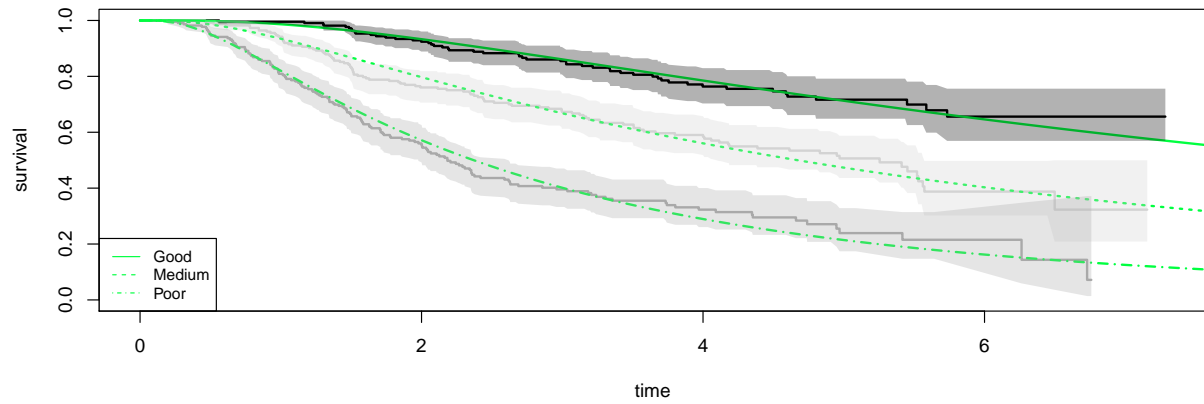


C: Diagnostic plot (Gompertz)

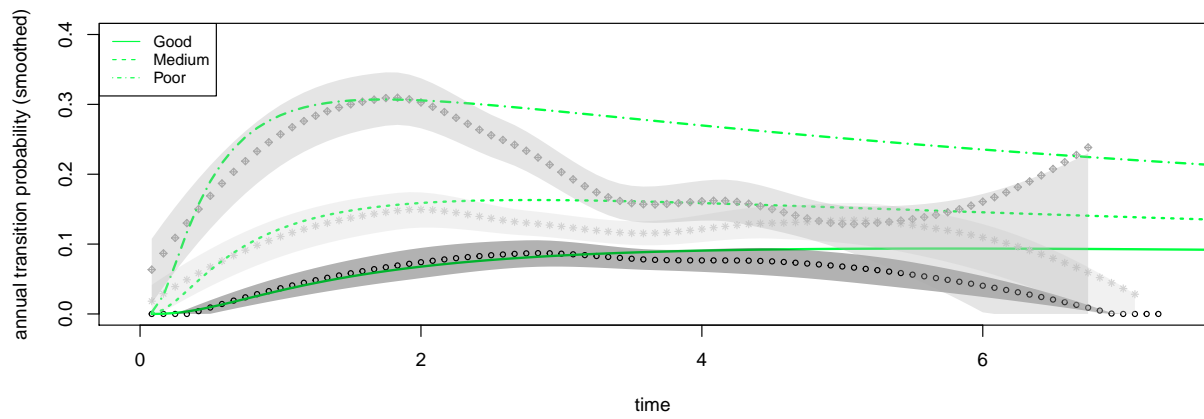


Log-normal

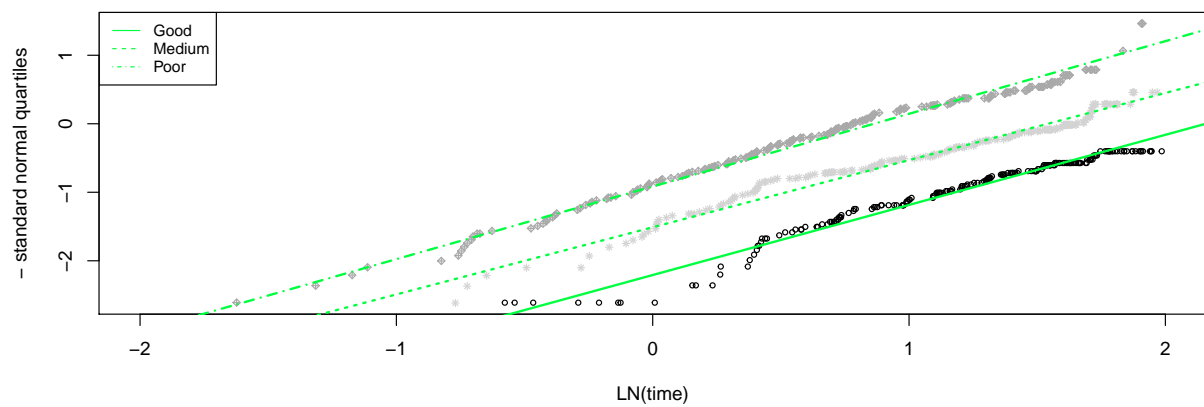
A: Kaplan-Meier (Log-normal)



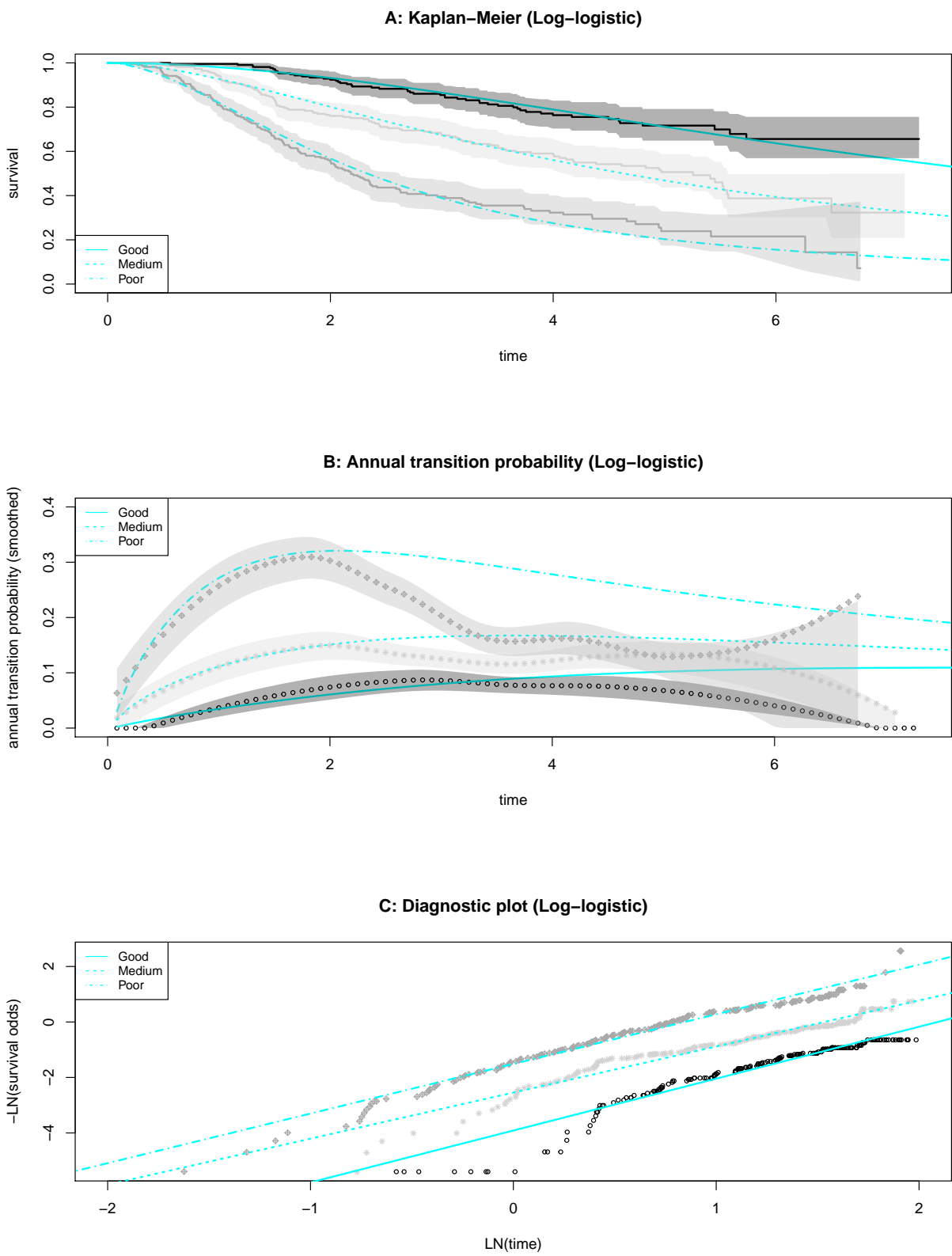
B: Annual transition probability (Log-normal)



C: Diagnostic plot (Log-normal)

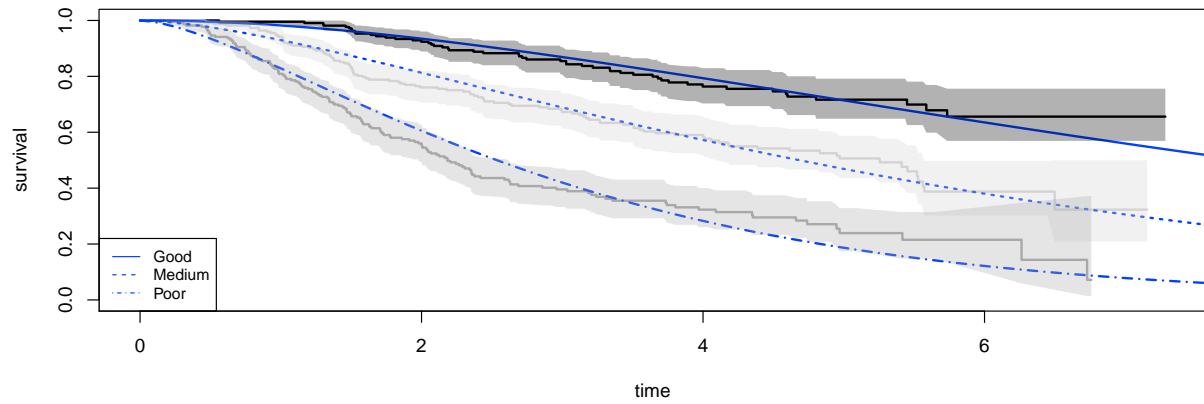


Log-logistic

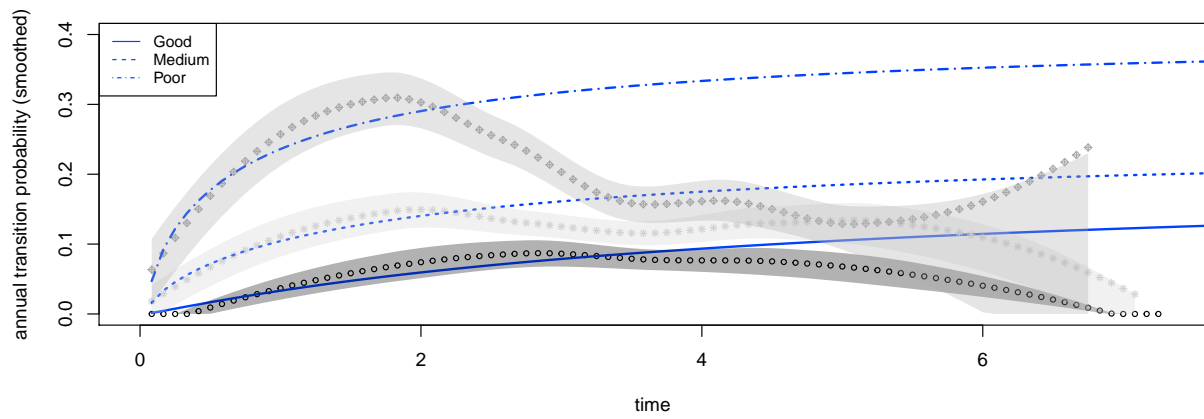


Gamma

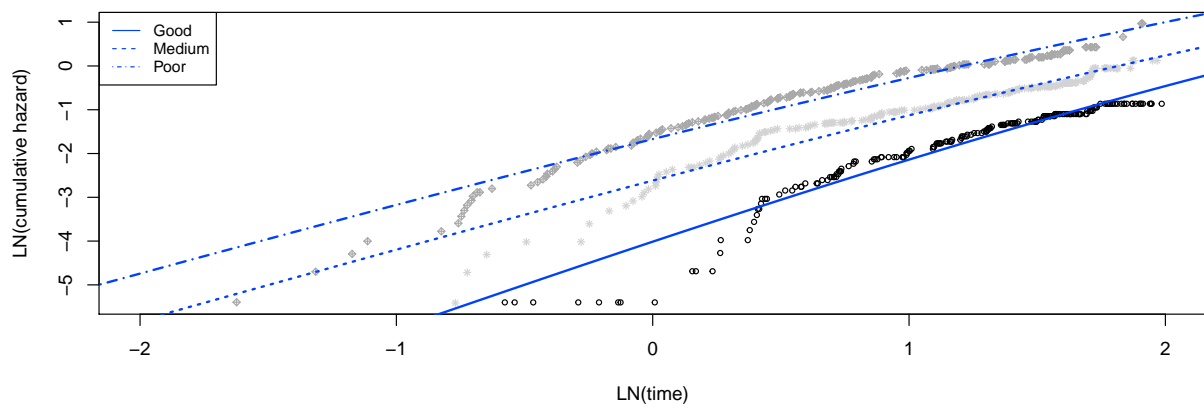
A: Kaplan–Meier (Gamma)



B: Annual transition probability (Gamma)

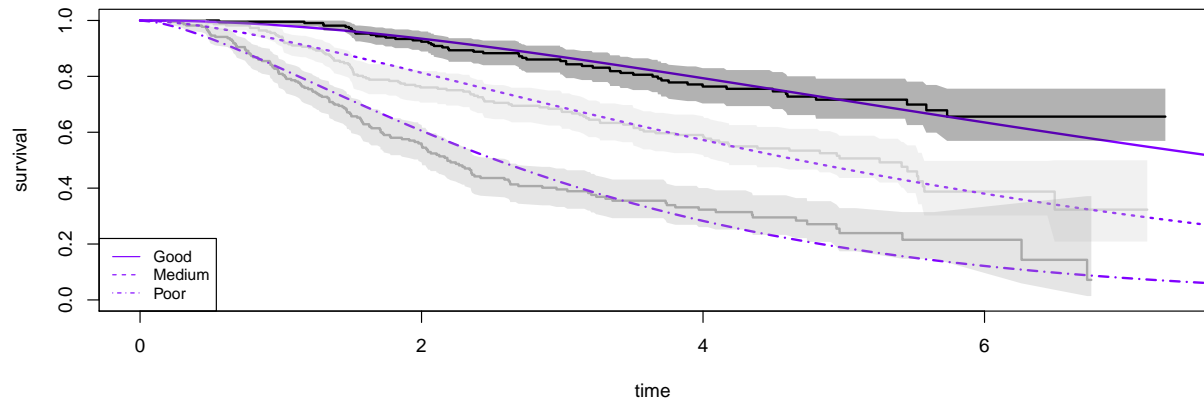


C: Diagnostic plot (Gamma)

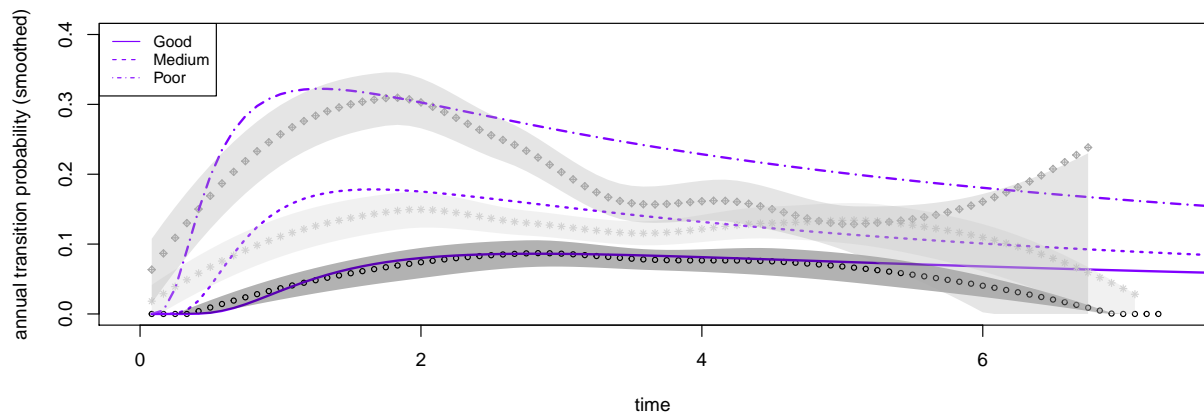


Generalised Gamma

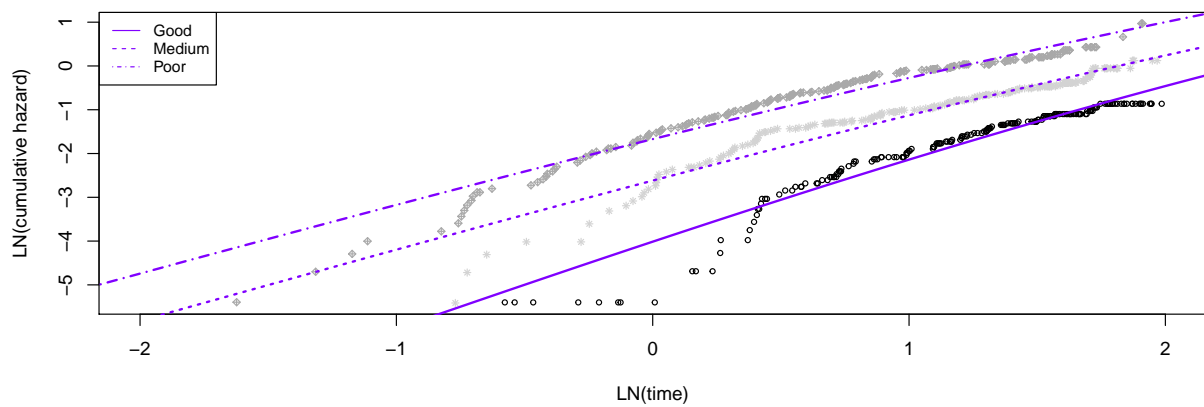
A: Kaplan–Meier (Generalised gamma)



B: Annual transition probability (Generalised Gamma)

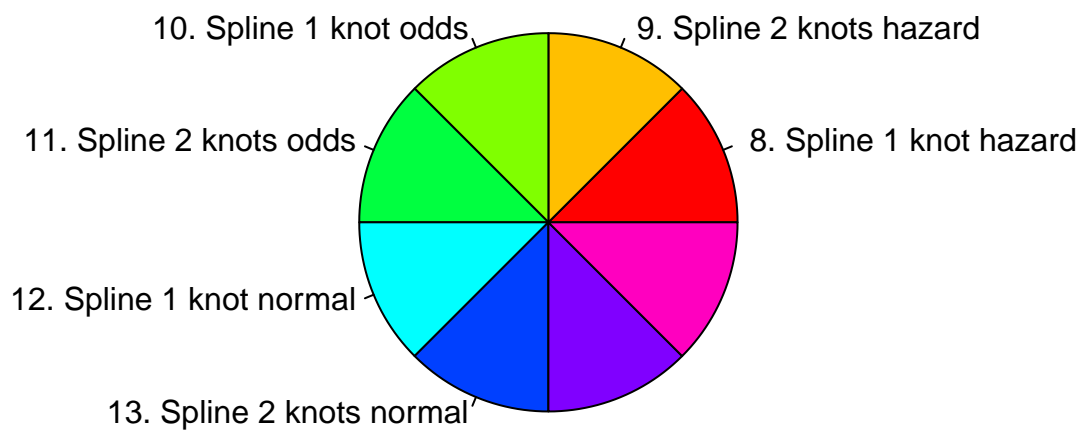


C: Diagnostic plot (Generalised gamma)



Parametric spline models?

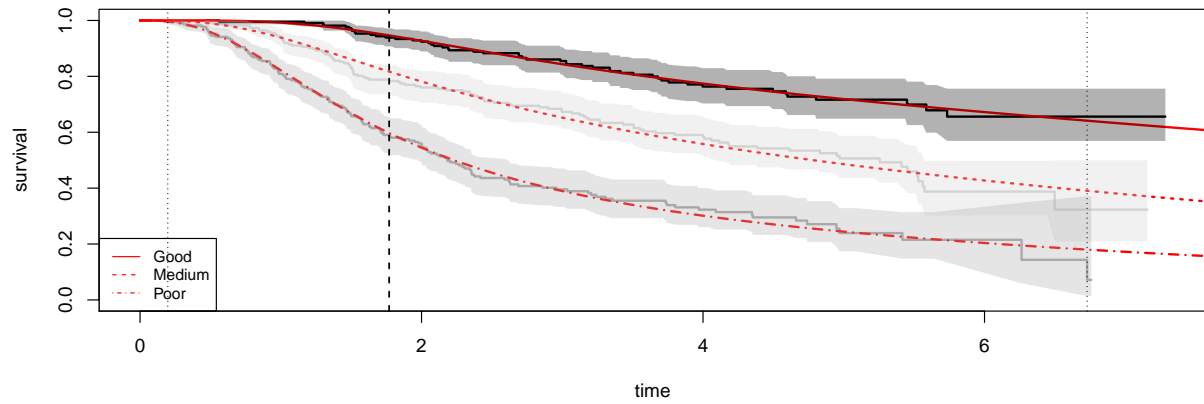
If standard parametric models are not appropriate, are spline models a more appropriate fit to the data?



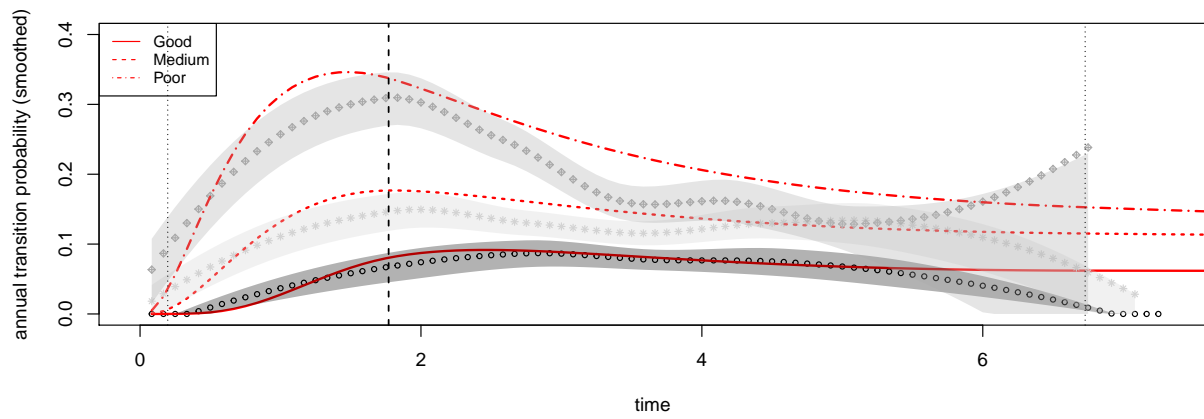
Model	AIC	BIC
9. Spline 2 knots hazard	1585.894	1640.264
11. Spline 2 knots odds	1587.289	1641.659
12. Spline 1 knot normal	1587.682	1628.460
13. Spline 2 knots normal	1588.343	1642.714
7. Generalised Gamma	1589.049	1629.826
8. Spline 1 knot hazard	1589.327	1630.105
10. Spline 1 knot odds	1590.221	1630.999
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

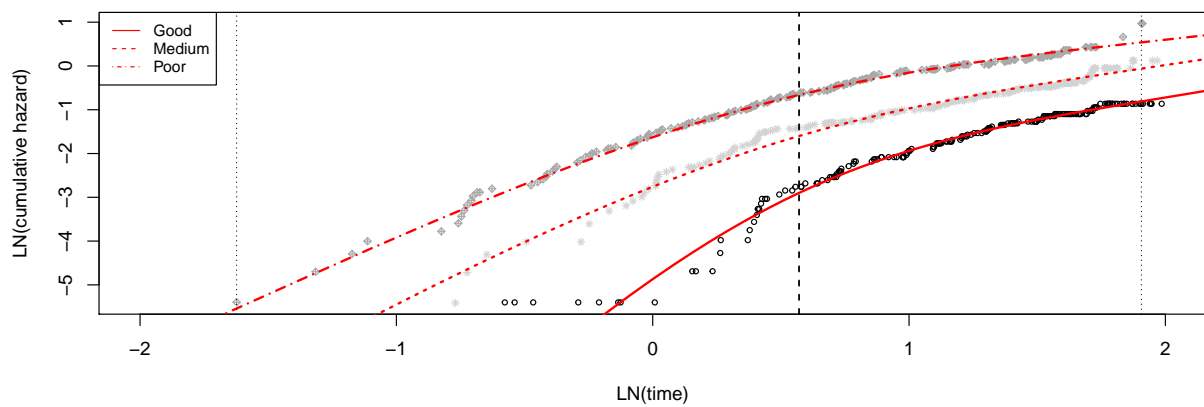
A: Kaplan-Meier (Spline, 1 knot, hazard scale)



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

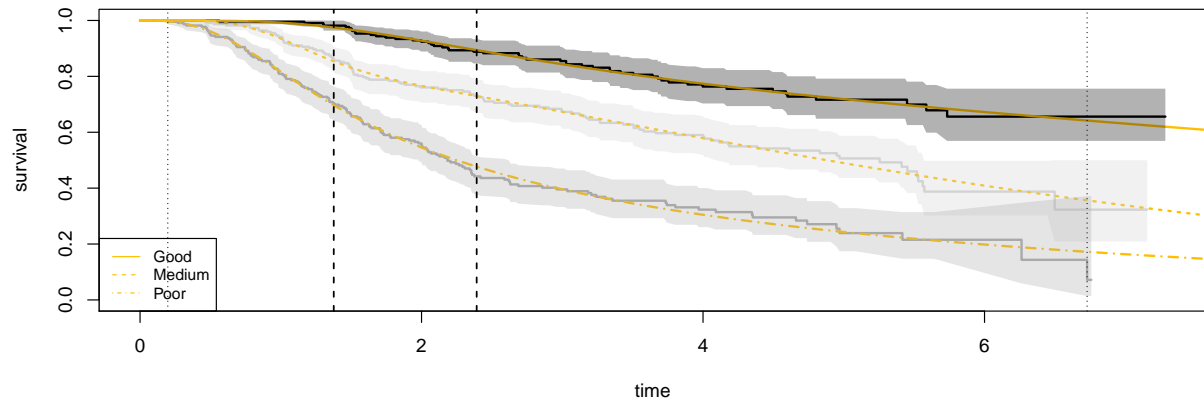


C: Diagnostic plot (Spline, 1 knot, hazard scale)

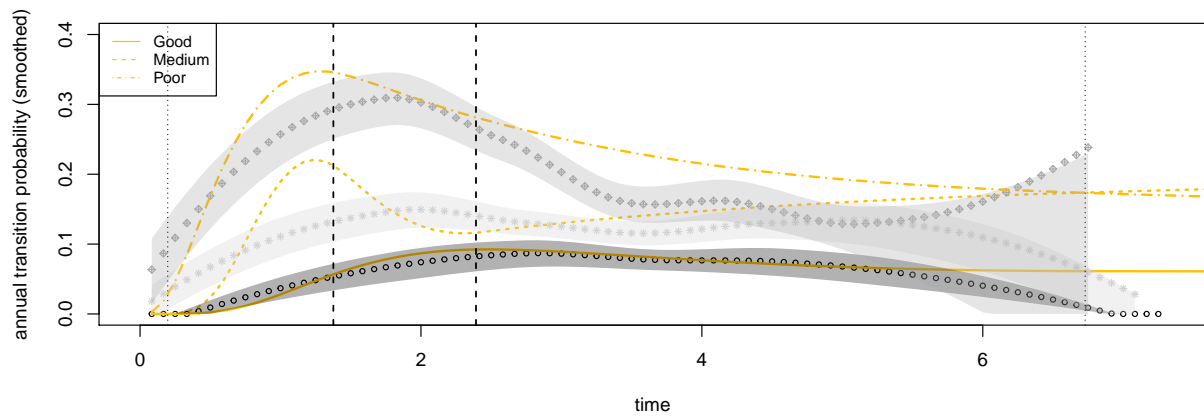


Spline hazard 2 knots

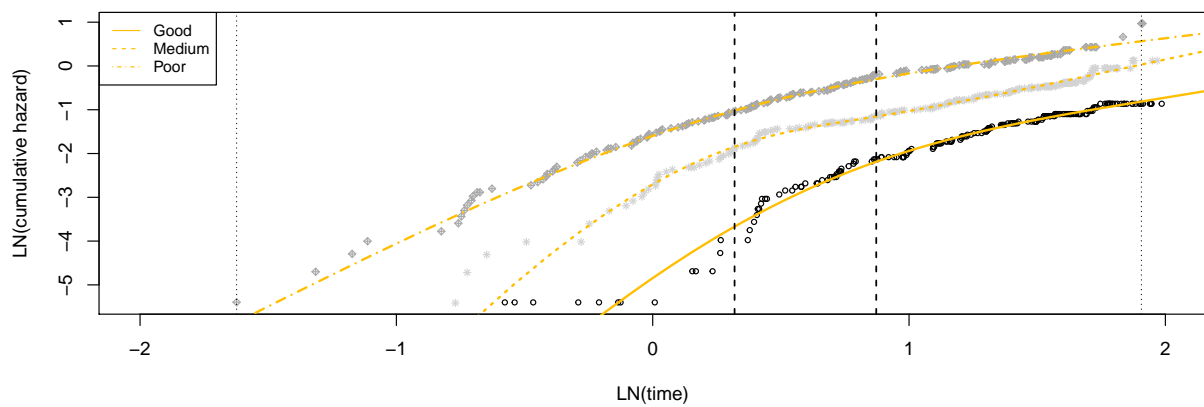
A: Kaplan–Meier (Spline, 2 knots, hazard scale)



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

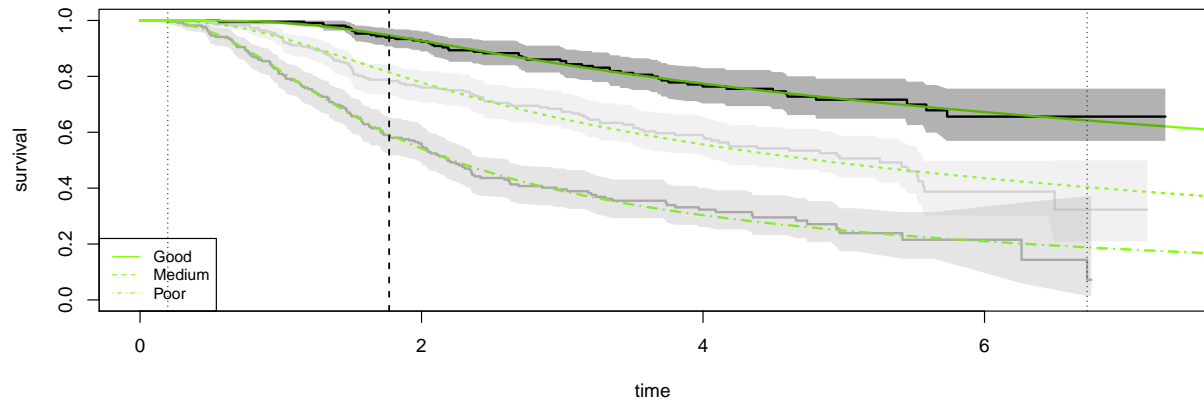


C: Diagnostic plot (Spline, 2 knots, hazard scale)

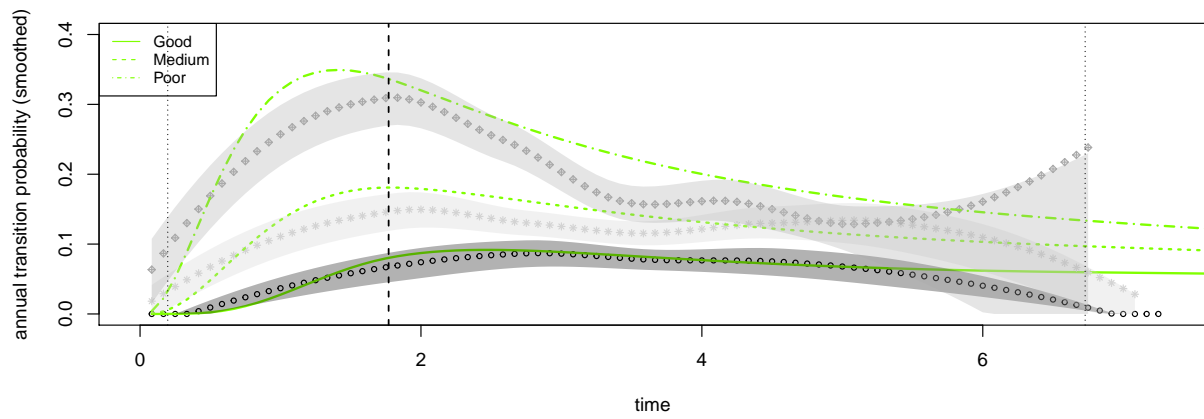


Spline odds 1 knot

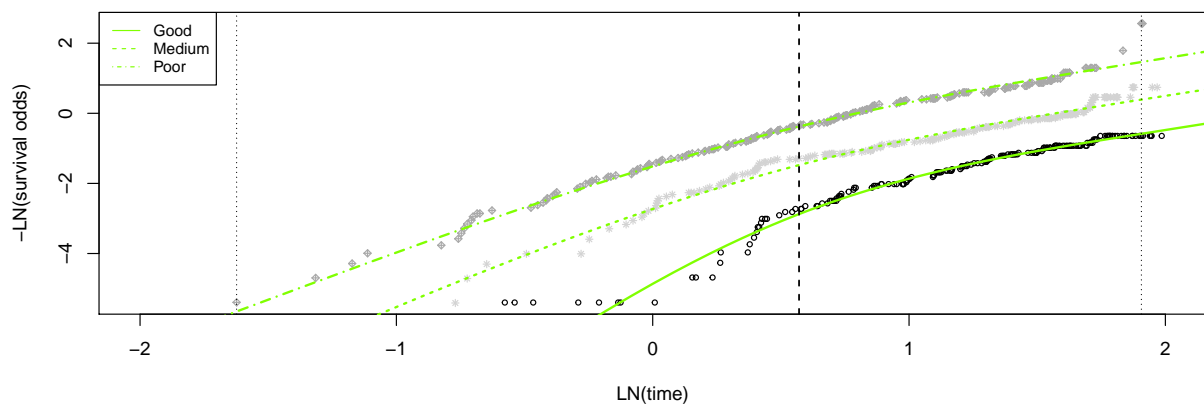
A: Kaplan–Meier (Spline, 1 knot, odds scale)



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

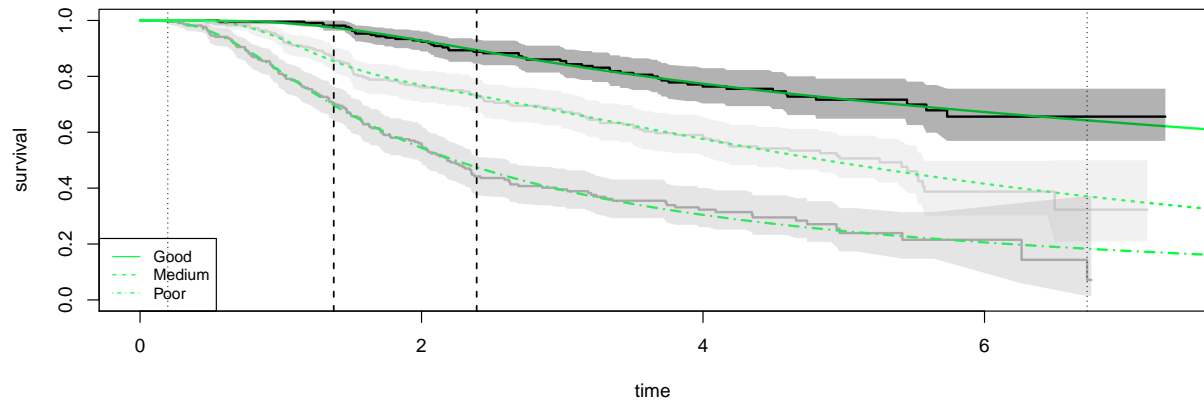


C: Diagnostic plot (Spline, 1 knot, odds scale)

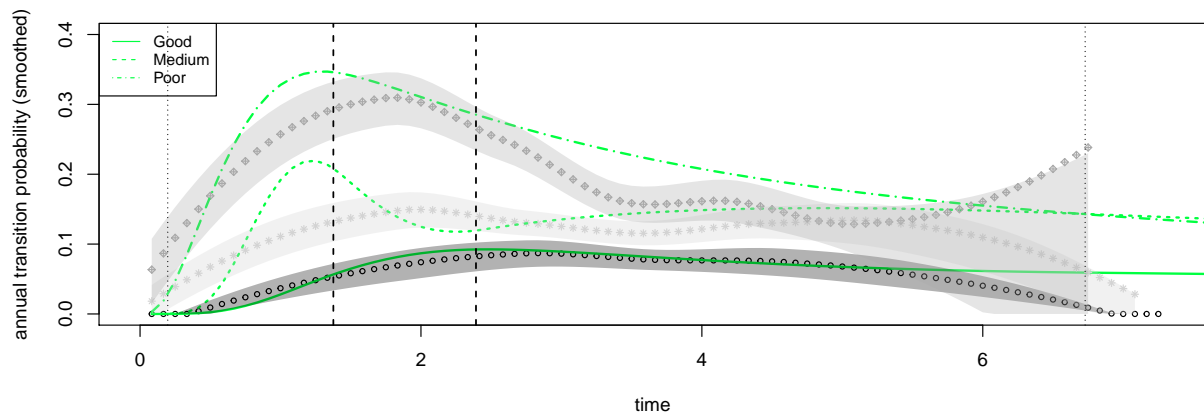


Spline odds 2 knots

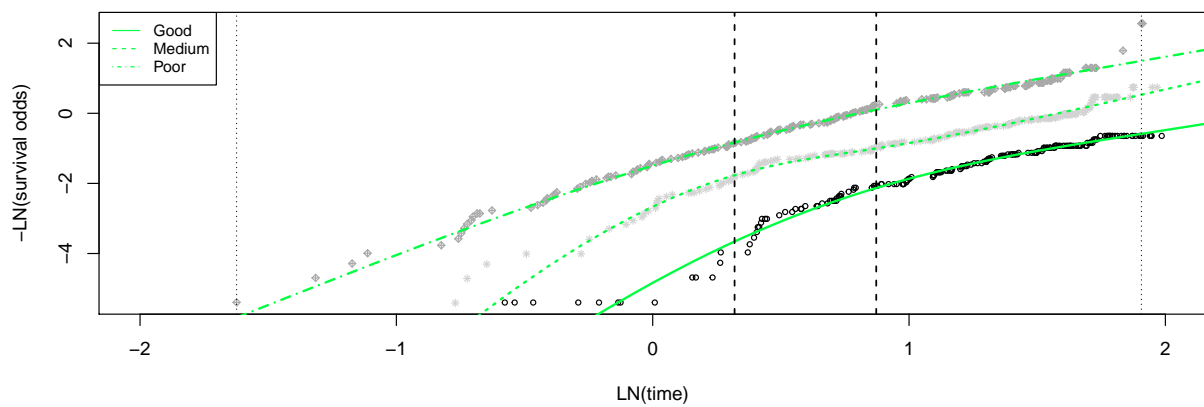
A: Kaplan–Meier (Spline, 2 knots, odds scale)



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

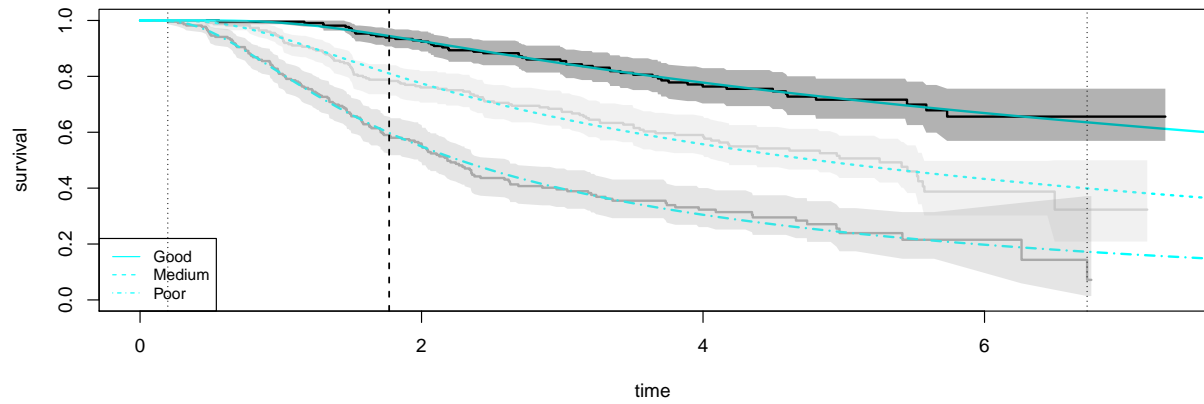


C: Diagnostic plot (Spline, 2 knots, odds scale)

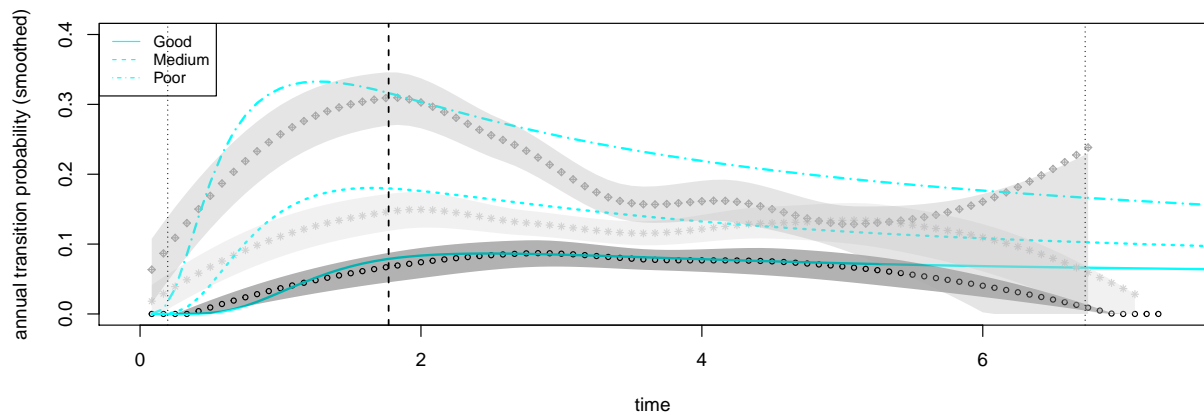


Spline normal 1 knot

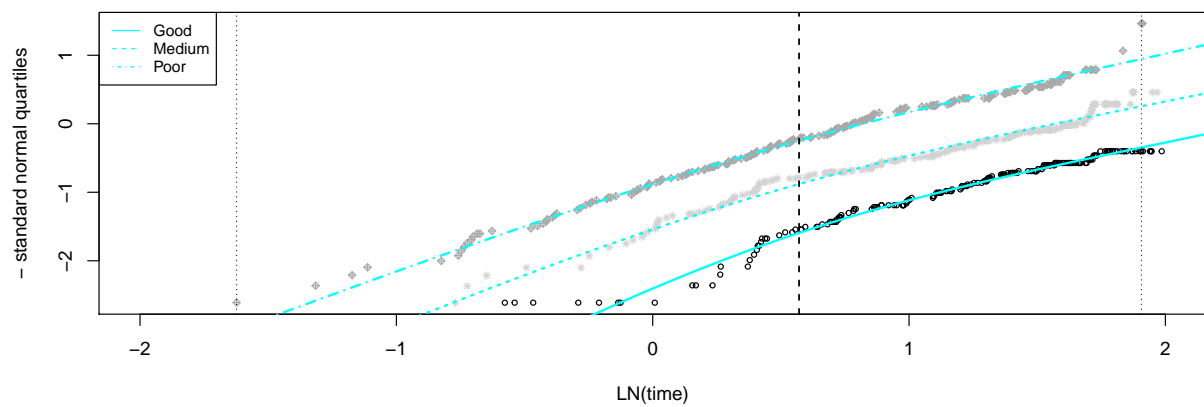
A: Kaplan-Meier (Spline, 1 knot, normal scale)



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

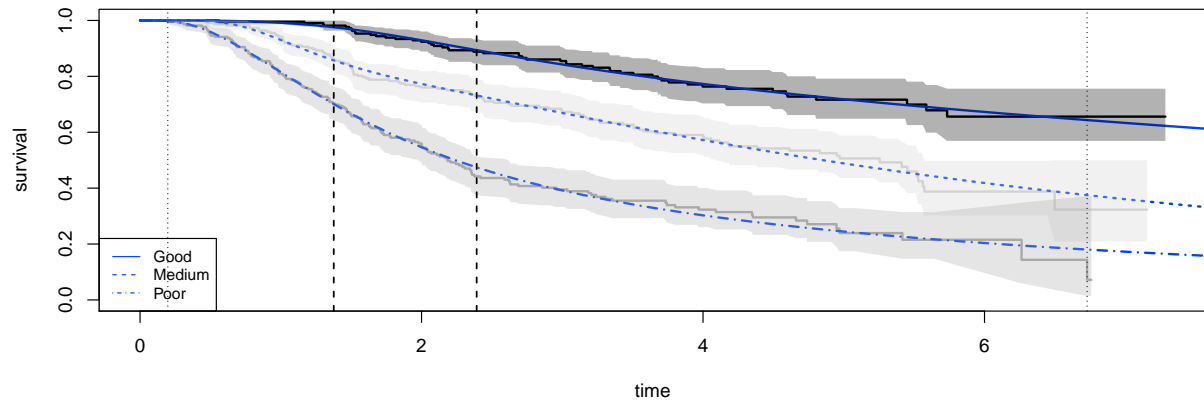


C: Diagnostic plot (Spline, 1 knot, normal scale)

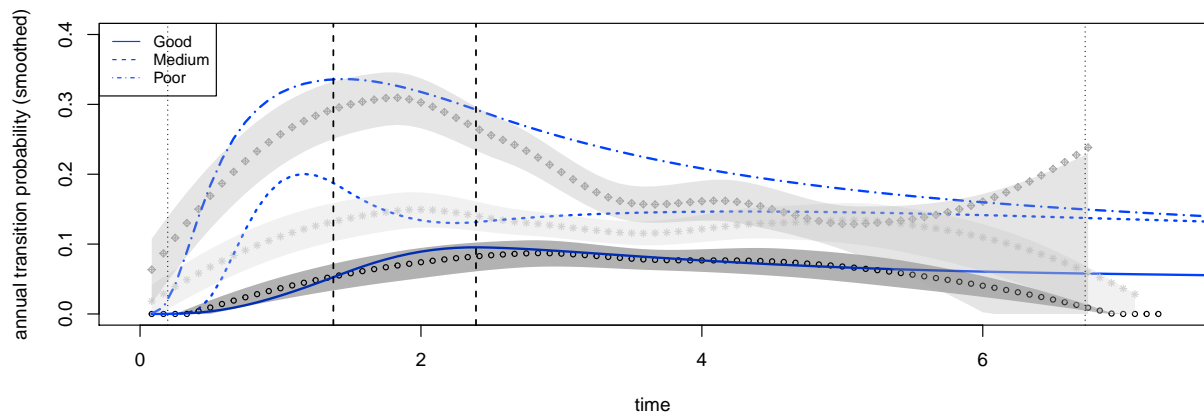


Spline normal 2 knots

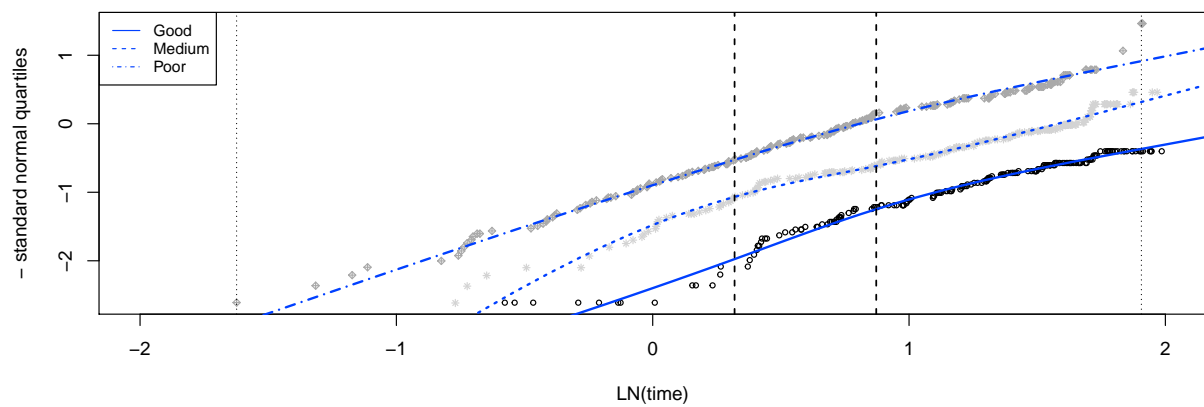
A: Kaplan–Meier (Spline, 2 knots, normal scale)



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



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

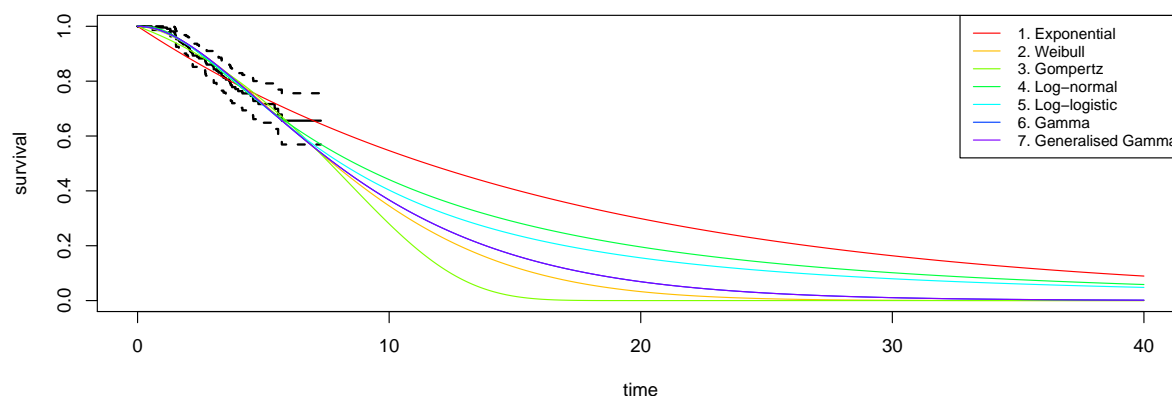


Validity of long-term extrapolation?

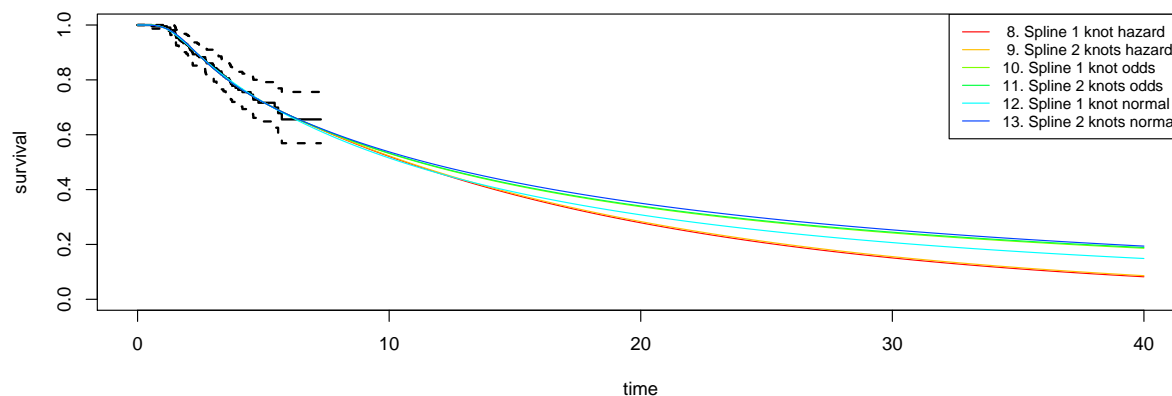
What model(s) is/are more appropriate for long-term extrapolation? Are/is the selected model(s) plausible in comparison with general population mortality?

Group Good

A: Kaplan–Meier (parametric curves)

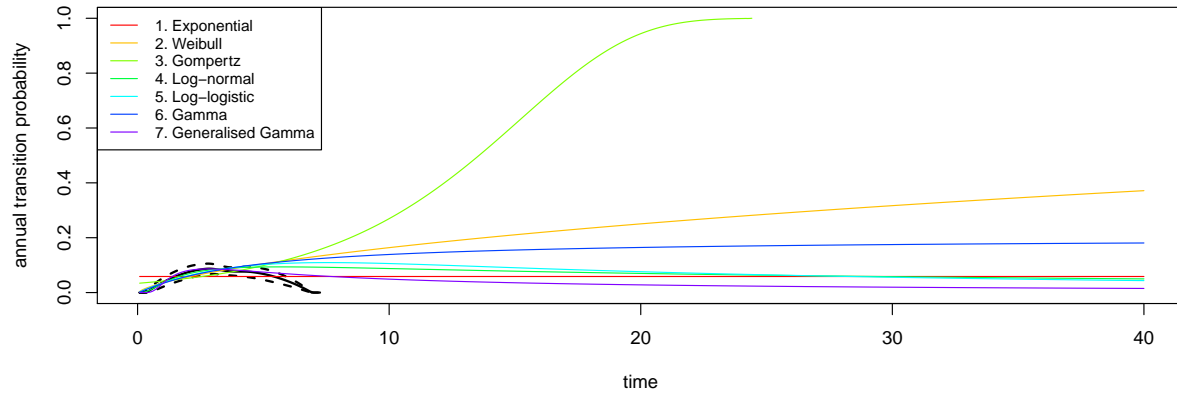


B: Kaplan–Meier (spline curves)

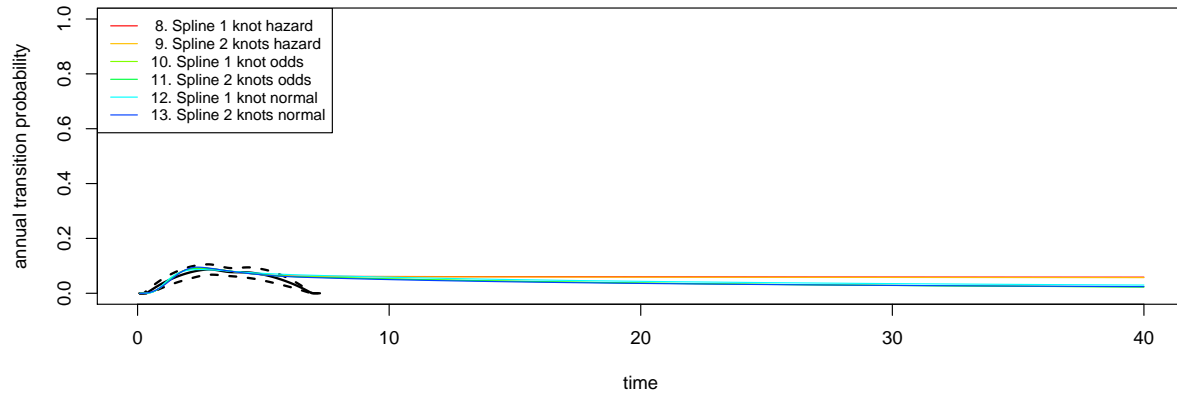


	T= 0	T= 1	T= 2	T= 3	T= 4	T= 5	T= 10	T= 15	T= 20	T= 25	T= 30	T= 35
1. Exponential	1	0.941	0.886	0.834	0.785	0.739	0.547	0.404	0.299	0.221	0.163	0.121
2. Weibull	1	0.978	0.932	0.870	0.797	0.719	0.345	0.122	0.033	0.007	0.001	0.000
3. Gompertz	1	0.962	0.917	0.863	0.801	0.729	0.280	0.015	0.000	0.000	0.000	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)



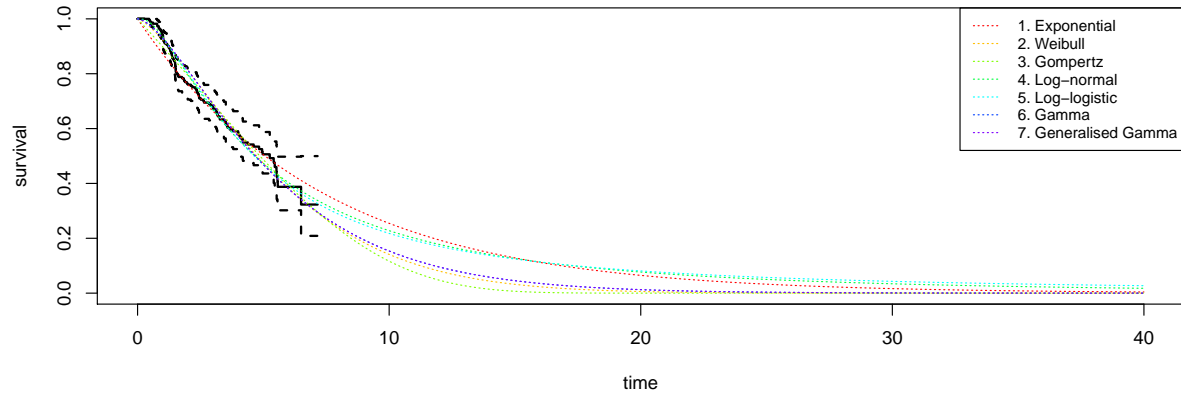
D: Annual transition probability (spline curves)



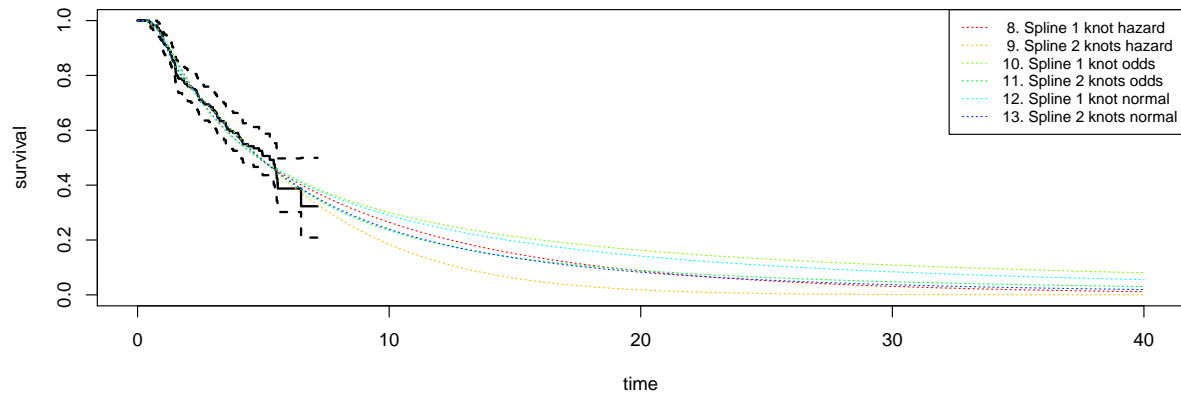
	Min	Q1	Median	Q3	Max
1. Exponential	0.0585969	0.0585969	0.0585969	0.0585969	0.0585969
2. Weibull	0.0039603	0.1641779	0.2507544	0.3170901	0.3714738
3. Gompertz	0.0342601	0.1256322	0.4037134	0.8634656	1.0000000
4. Log-normal	0.0000121	0.0563972	0.0670524	0.0819079	0.0936091
5. Log-logistic	0.0022936	0.0533146	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

Group Medium

A: Kaplan–Meier (parametric curves)

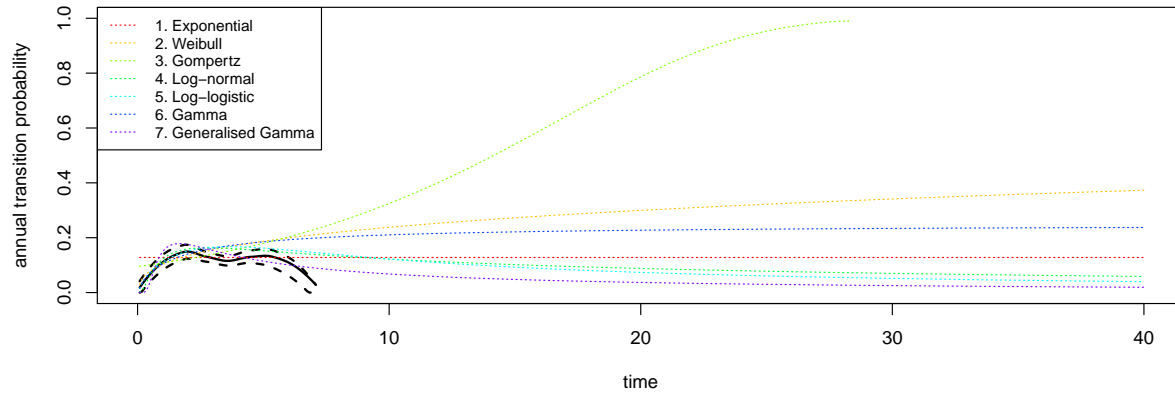


B: Kaplan–Meier (spline curves)

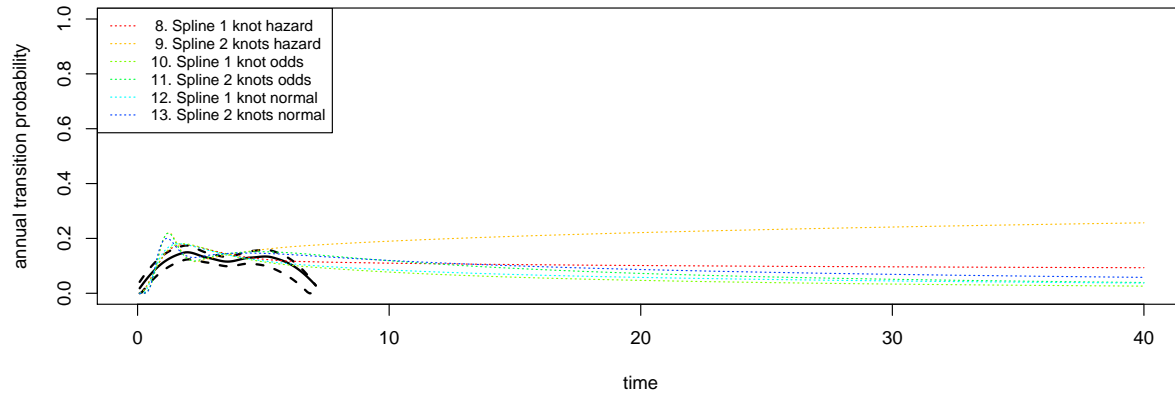


	T= 0	T= 1	T= 2	T= 3	T= 4	T= 5	T= 10	T= 15	T= 20	T= 25	T= 30	T= 35
1. Exponential	1	0.872	0.761	0.663	0.578	0.505	0.255	0.128	0.065	0.033	0.016	0.008
2. Weibull	1	0.923	0.811	0.693	0.578	0.474	0.141	0.032	0.006	0.001	0.000	0.000
3. Gompertz	1	0.898	0.794	0.689	0.586	0.486	0.117	0.007	0.000	0.000	0.000	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)



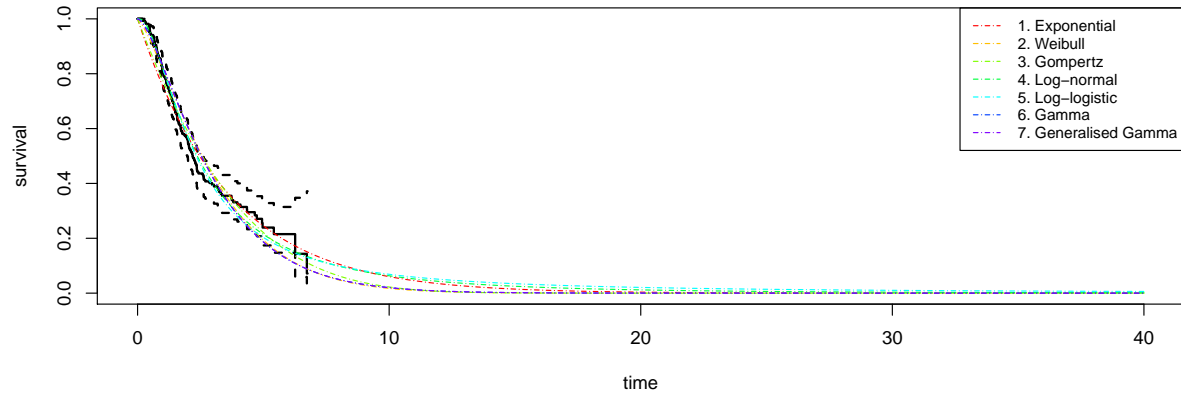
D: Annual transition probability (spline curves)



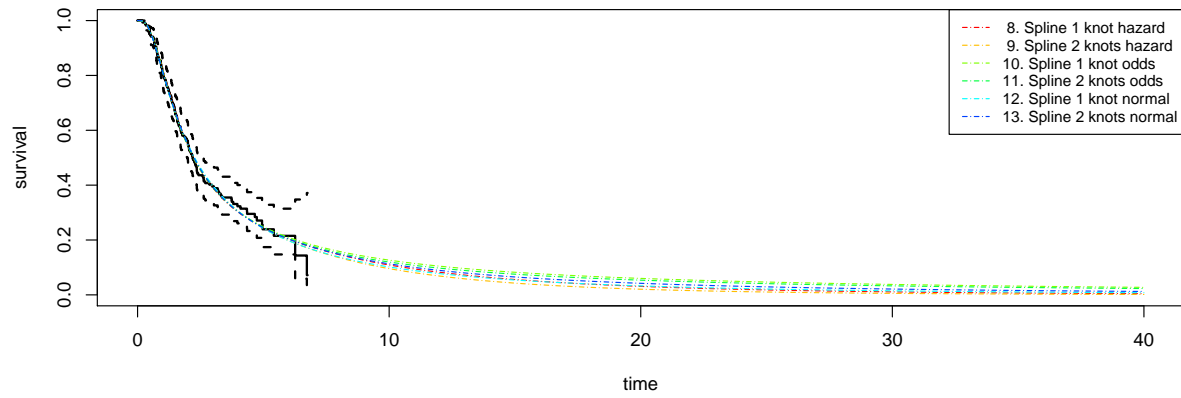
	Min	Q1	Median	Q3	Max
1. Exponential	0.1278820	0.1278820	0.1278820	0.1278820	0.1278820
2. Weibull	0.0298491	0.2382194	0.2998675	0.3413164	0.3730304
3. Gompertz	0.0960264	0.2326209	0.5026105	0.8415103	1.0000000
4. Log-normal	0.0004751	0.0692201	0.0864990	0.1175437	0.1630482
5. Log-logistic	0.0150627	0.0512119	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

Group Poor

A: Kaplan–Meier (parametric curves)

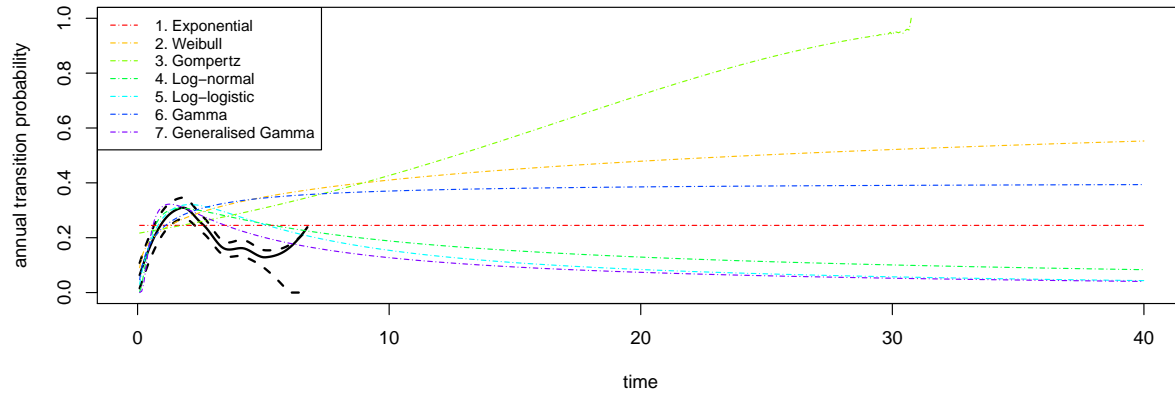


B: Kaplan–Meier (spline curves)

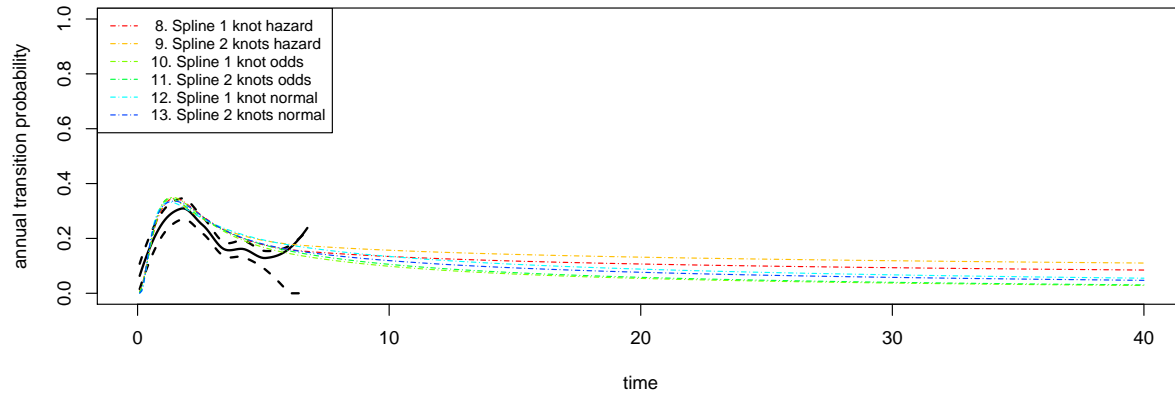


	T= 0	T= 1	T= 2	T= 3	T= 4	T= 5	T= 10	T= 15	T= 20	T= 25	T= 30	T= 35
1. Exponential	1	0.755	0.570	0.430	0.325	0.245	0.060	0.015	0.004	0.001	0.000	0.000
2. Weibull	1	0.817	0.608	0.430	0.292	0.193	0.017	0.001	0.000	0.000	0.000	0.000
3. Gompertz	1	0.776	0.588	0.436	0.315	0.221	0.022	0.001	0.000	0.000	0.000	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

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] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
##  [1] sft_2.2-1          SuppDists_1.1-9.5  fda_5.1.5.1       Matrix_1.2-18
##  [5] kableExtra_1.1.0   knitr_1.28         summarytools_0.9.6 data.table_1.12.8
##  [9] survminer_0.4.7    ggpubr_0.3.0       muhaz_1.2.6.1     flexsurv_1.1.1
## [13] rms_6.0-0          SparseM_1.78       Hmisc_4.4-0       ggplot2_3.3.2
## [17] Formula_1.2-3      survival_3.2-3     lattice_0.20-41
##
## loaded via a namespace (and not attached):
##  [1] TH.data_1.0-10     colorspace_1.4-1   ggsignif_0.6.0
##  [4] pryr_0.1.4         ellipsis_0.3.1     rio_0.5.16
##  [7] htmlTable_1.13.3   base64enc_0.1-3    rstudioapi_0.11
## [10] farver_2.0.3       MatrixModels_0.4-1 mvtnorm_1.1-1
## [13] lubridate_1.7.9    xml2_1.3.2         codetools_0.2-16
## [16] splines_4.0.1      broom_0.5.6        km.ci_0.5-2
## [19] cluster_2.1.0      png_0.1-7          readr_1.3.1
## [22] compiler_4.0.1     httr_1.4.1         backports_1.1.7
## [25] acepack_1.4.1      htmltools_0.5.0    quantreg_5.55
## [28] tools_4.0.1        gtable_0.3.0       glue_1.4.1
## [31] dplyr_1.0.0        Rcpp_1.0.4.6       carData_3.0-4
## [34] cellranger_1.1.0   vctrs_0.3.0        nlme_3.1-148
## [37] xfun_0.14          stringr_1.4.0      openxlsx_4.1.5
## [40] rvest_0.3.5        lifecycle_0.2.0    rstatix_0.5.0
## [43] polyspline_1.1.19  MASS_7.3-51.6      zoo_1.8-8
## [46] scales_1.1.1       hms_0.5.3          sandwich_2.5-1
## [49] RColorBrewer_1.1-2 yaml_2.2.1          curl_4.3
## [52] gridExtra_2.3      KMsurv_0.1-5       pander_0.6.3
## [55] rpart_4.1-15       latticeExtra_0.6-29 stringi_1.4.6
## [58] checkmate_2.0.0    zip_2.0.4          rlang_0.4.6
## [61] pkgconfig_2.0.3    matrixStats_0.56.0 evaluate_0.14
## [64] purrr_0.3.4        labeling_0.3        rapportools_1.0
## [67] htmlwidgets_1.5.1  tidyselect_1.1.0   deSolve_1.28
## [70] plyr_1.8.6         magrittr_1.5        R6_2.4.1
## [73] magick_2.3         generics_0.0.2     multcomp_1.4-13
## [76] pillar_1.4.4       haven_2.3.1        foreign_0.8-80
## [79] withr_2.2.0        abind_1.4-5        nnet_7.3-14
## [82] tibble_3.0.1       mstate_0.2.12      crayon_1.3.4
## [85] car_3.0-8          survMisc_0.5.5     rmarkdown_2.2
## [88] jpeg_0.1-8.1       grid_4.0.1         readxl_1.3.1
```

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## [91] forcats_0.5.0      digest_0.6.25      webshot_0.5.2
## [94] xtable_1.8-4        tidyr_1.1.0        munsell_0.5.0
## [97] viridisLite_0.3.0   tcltk_4.0.1        quadprog_1.5-8
```