PERSUADE BC_OS_output

2021-02-09

Contents

Link to PERSUADE GitHub page

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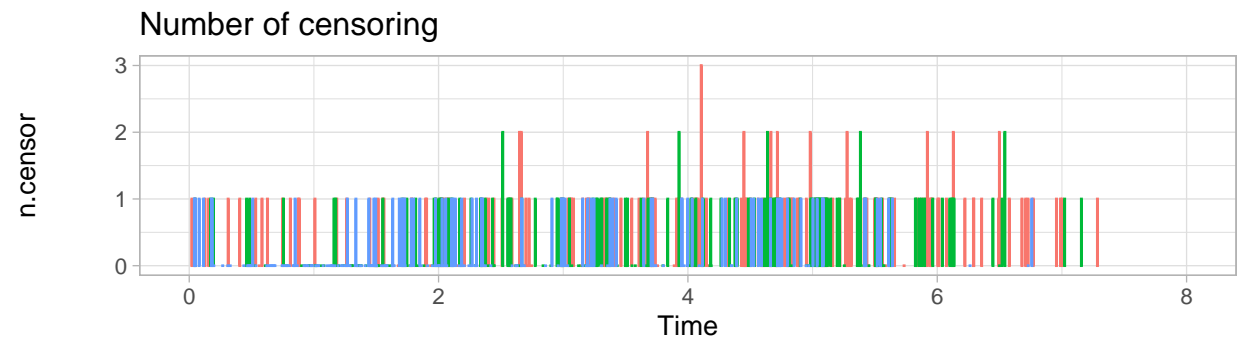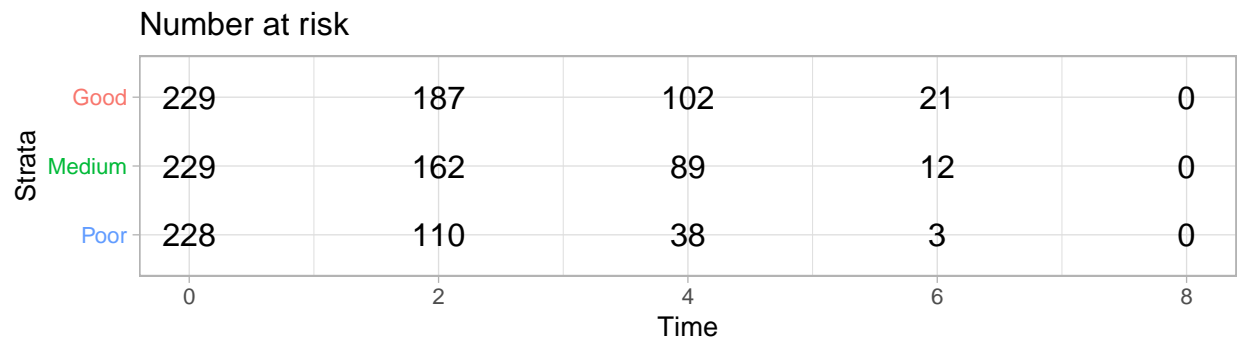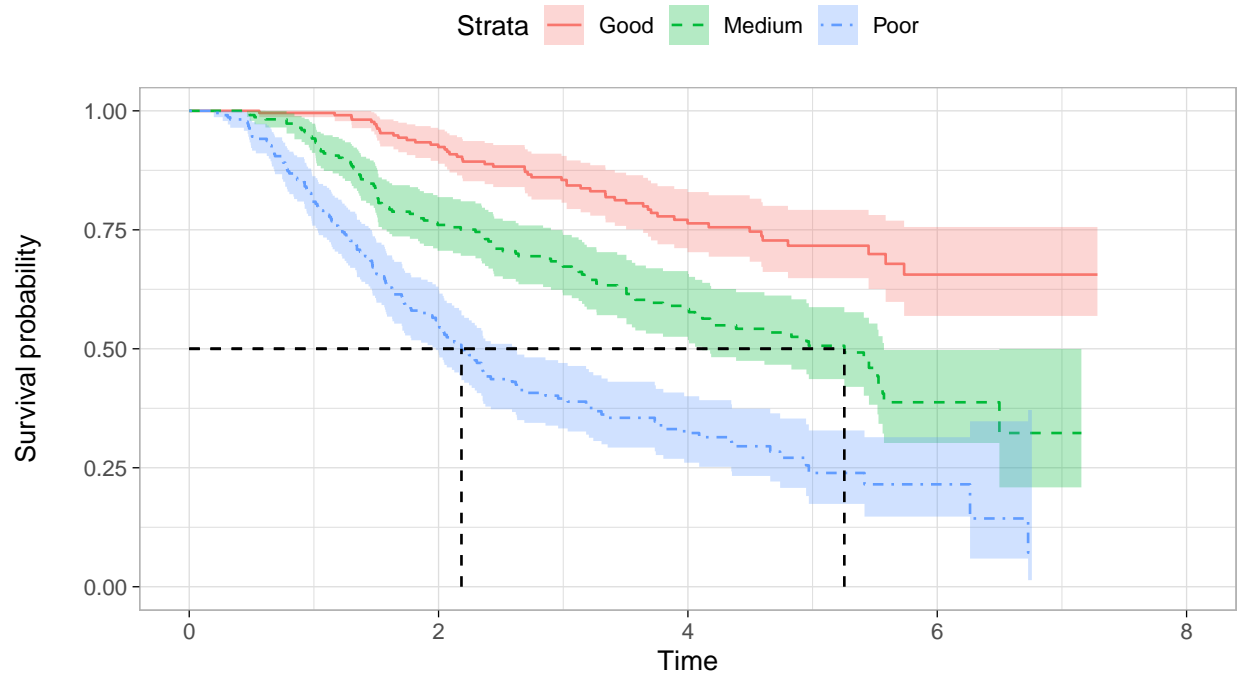
	records	n.max	n.start	events	*rmean	*se(rmean)	median	0.95LCL	0.95UCL
group=Good	229	229	229	51	5.934330	0.1616003	NA	NA	NA
group=Medium	229	229	229	103	4.600852	0.1856699	5.254795	4.115068	5.572603
group=Poor	228	228	228	145	3.101736	0.1772520	2.183562	1.978082	2.619178

Stratified models?

Should stratified parametric survival models be used?

A: LN(cumulative hazard)
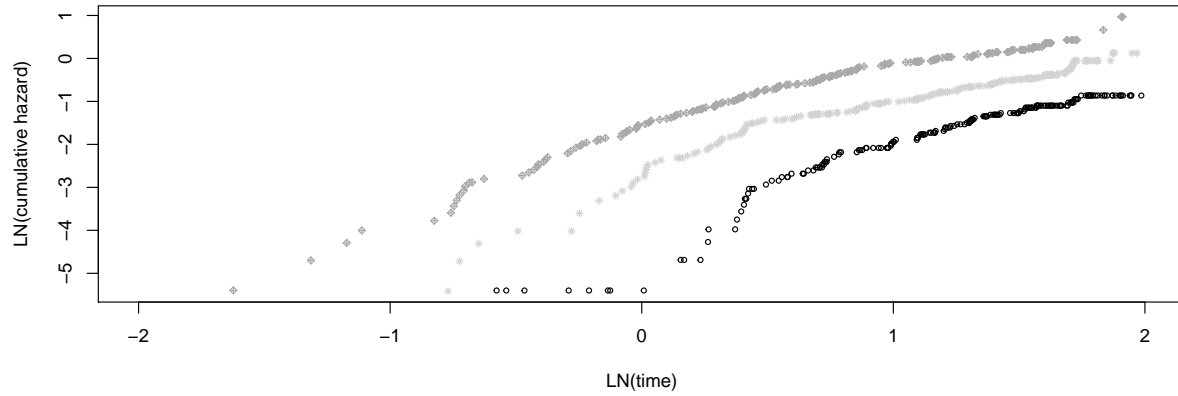
B: Scaled Schoenfeld residuals
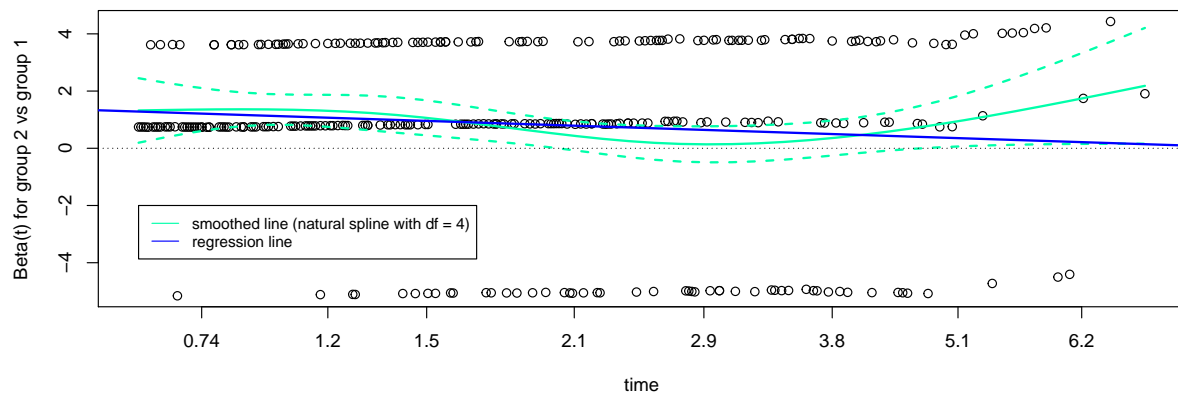
C: Scaled Schoenfeld residuals

Shape of the observed smoothed hazard function

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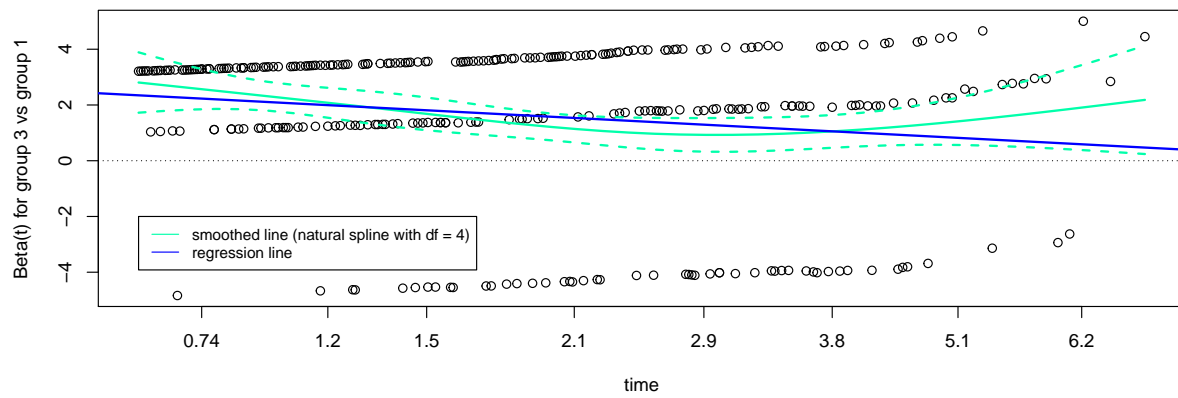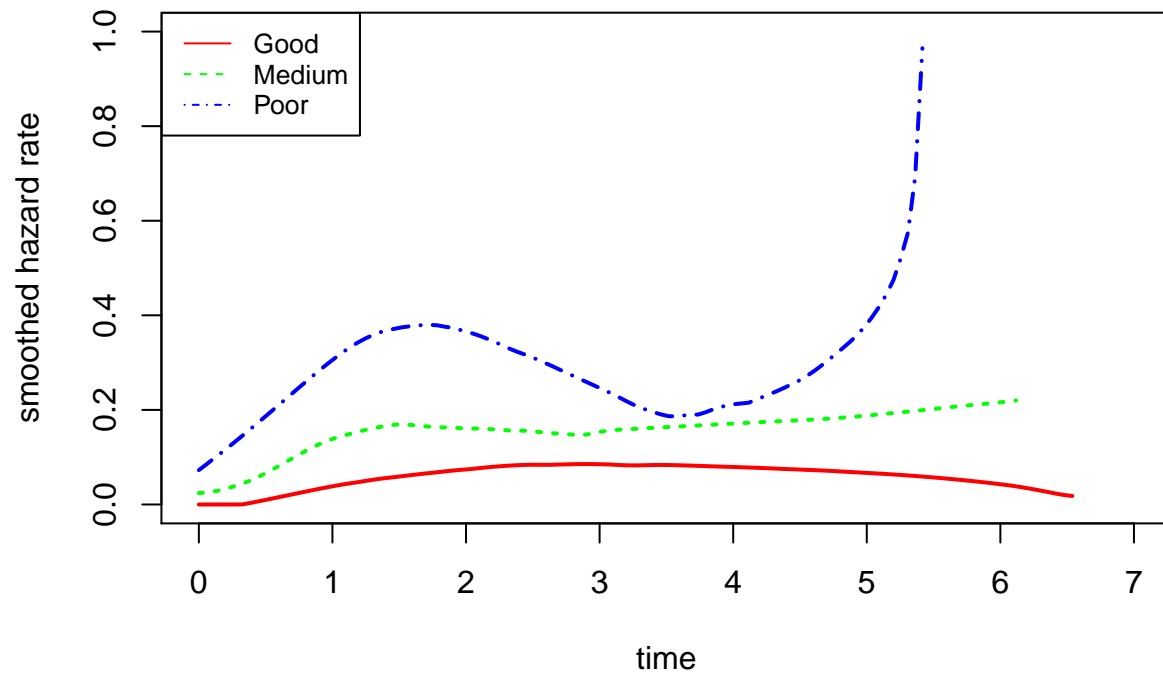
Shape of the predicted hazard function

Group Good

Group Good

Group Medium

Group Medium

Legend:
- 8. Spline 1 knot hazard
- 9. Spline 2 knots hazard
- 10. Spline 3 knots hazard
- 11. Spline 1 knot odds
- 12. Spline 2 knots odds
- 13. Spline 3 knots odds
- 14. Spline 1 knot normal
- 15. Spline 2 knots normal
- 16. Spline 3 knots normal

Group Poor

Legend:
- 1. Exponential
- 2. Weibull
- 3. Gompertz
- 4. Log–normal
- 5. Log–logistic
- 6. Gamma
- 7. Generalised Gamma

Group Poor

Legend:
- 8. Spline 1 knot hazard
- 9. Spline 2 knots hazard
- 10. Spline 3 knots hazard
- 11. Spline 1 knot odds
- 12. Spline 2 knots odds
- 13. Spline 3 knots odds
- 14. Spline 1 knot normal
- 15. Spline 2 knots normal
- 16. Spline 3 knots normal

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Standard parametric models?

Do standard parametric models provide an appropriate fit to the data?
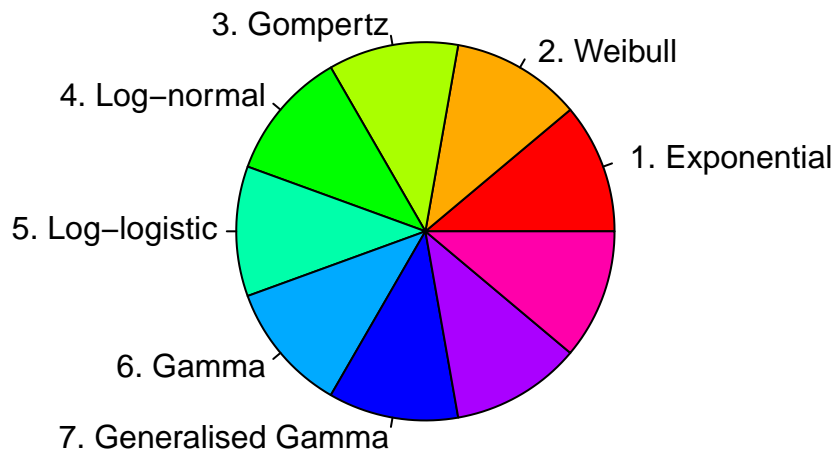
Model	AIC	BIC
7. Generalised Gamma	1589.049	1629.826
4. Log-normal	1592.880	1620.066
5. Log-logistic	1609.294	1636.479
6. Gamma	1621.982	1649.167
2. Weibull	1632.618	1659.803
3. Gompertz	1660.954	1688.140
1. Exponential	1668.212	1681.805

Exponential

A: Kaplan–Meier (Exponential)
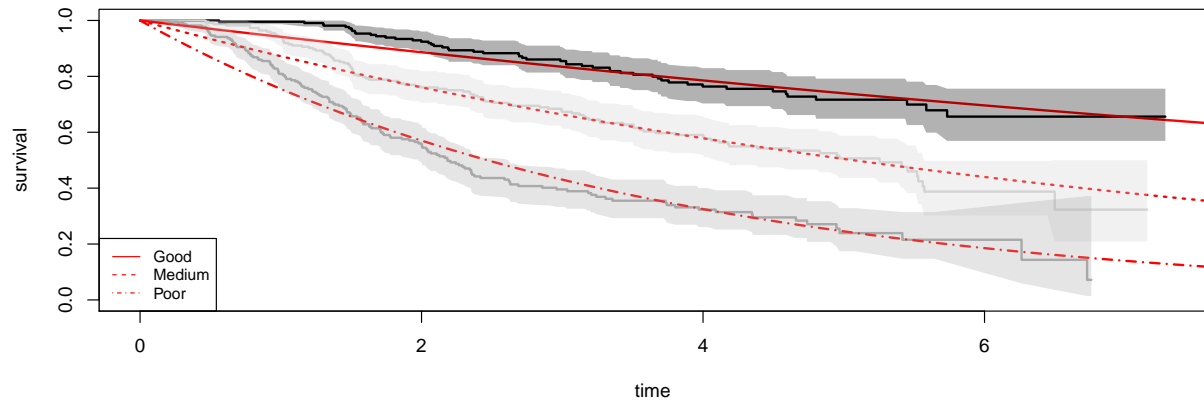
B: Annual transition probability (Exponential)
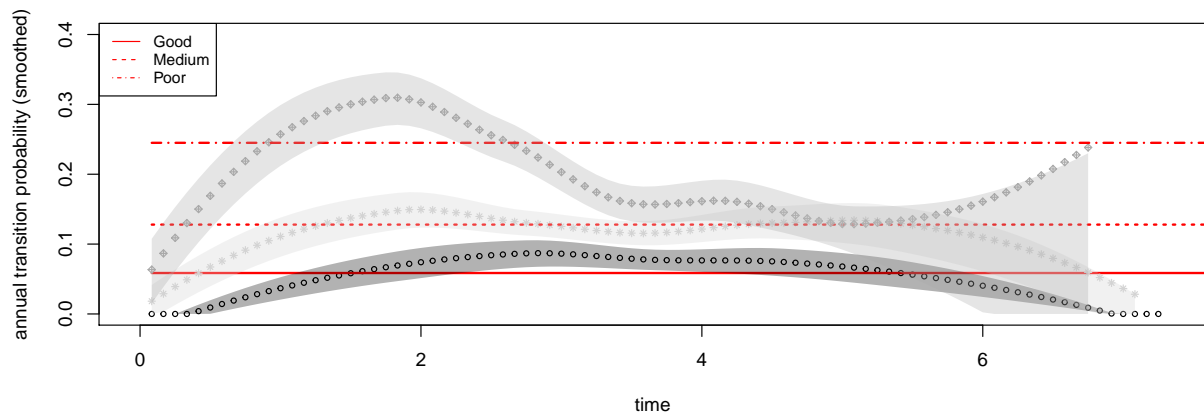
C: Diagnostic plot (Exponential)
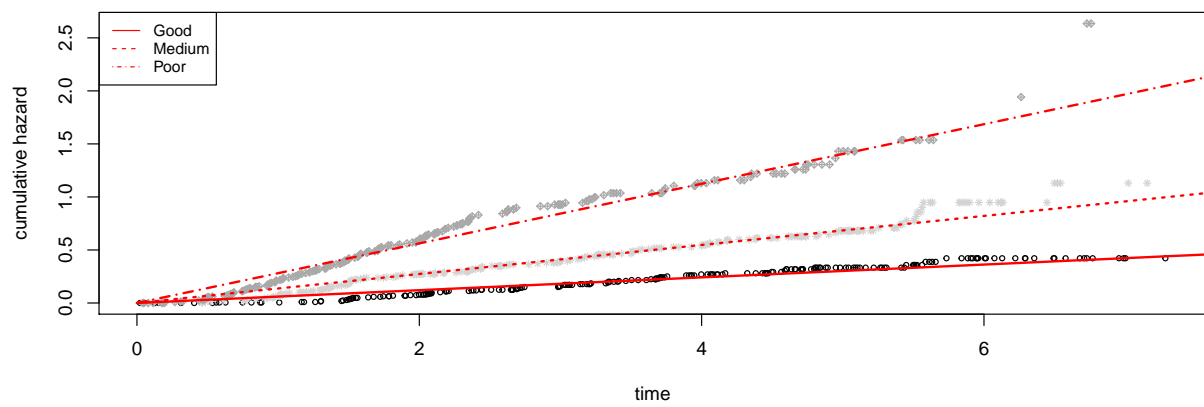
Weibull

A: Kaplan−Meier (Weibull)

Legend:
- Good
- Medium
- Poor
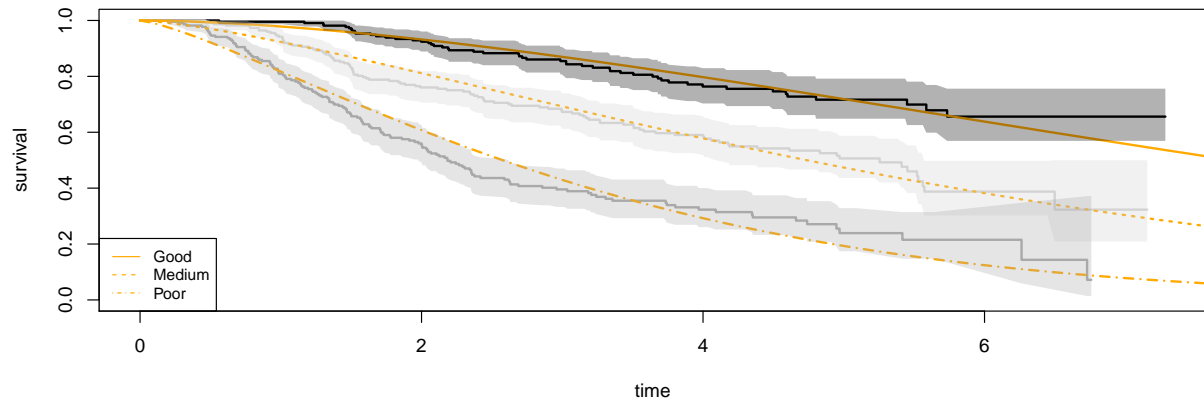
B: Annual transition probability (Weibull)

Legend:
- Good
- Medium
- Poor
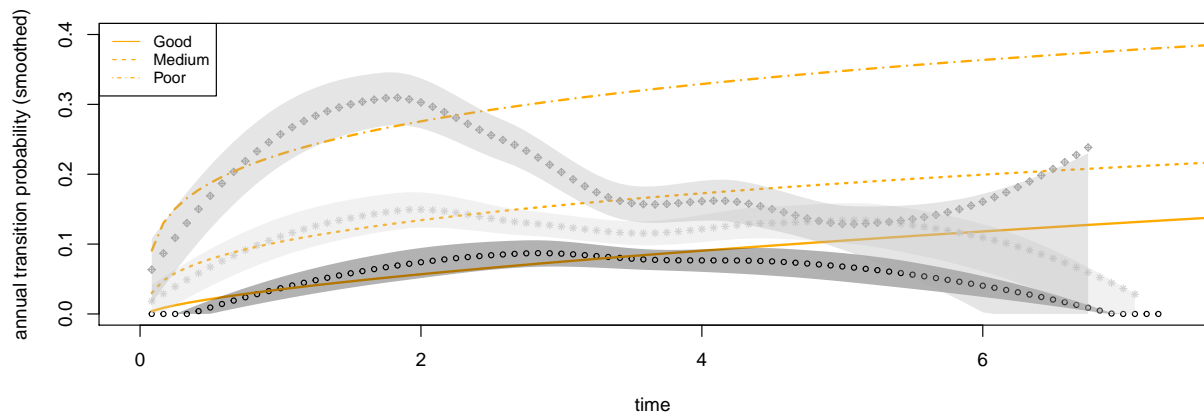
C: Diagnostic plot (Weibull)

Legend:
- Good
- Medium
- Poor
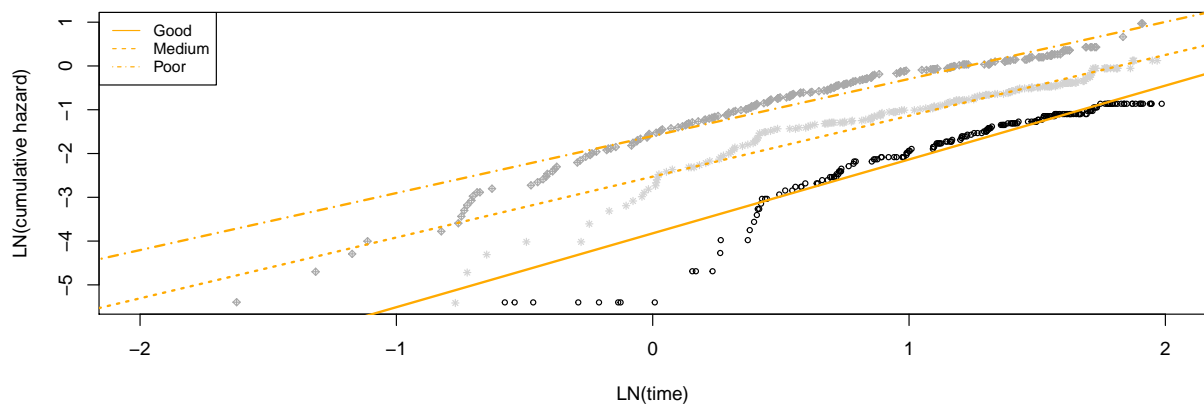
Gompertz

A: Kaplan−Meier (Gompertz)
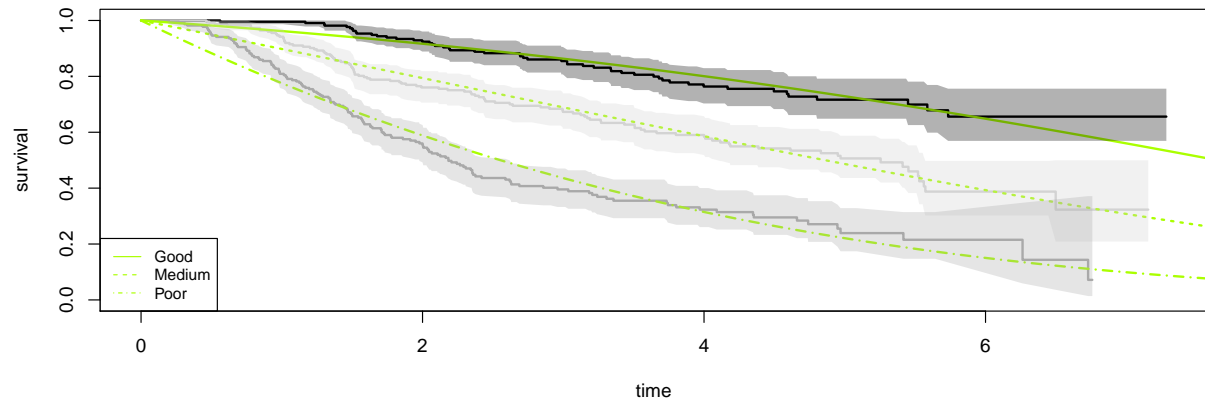
B: Annual transition probability (Gompertz)
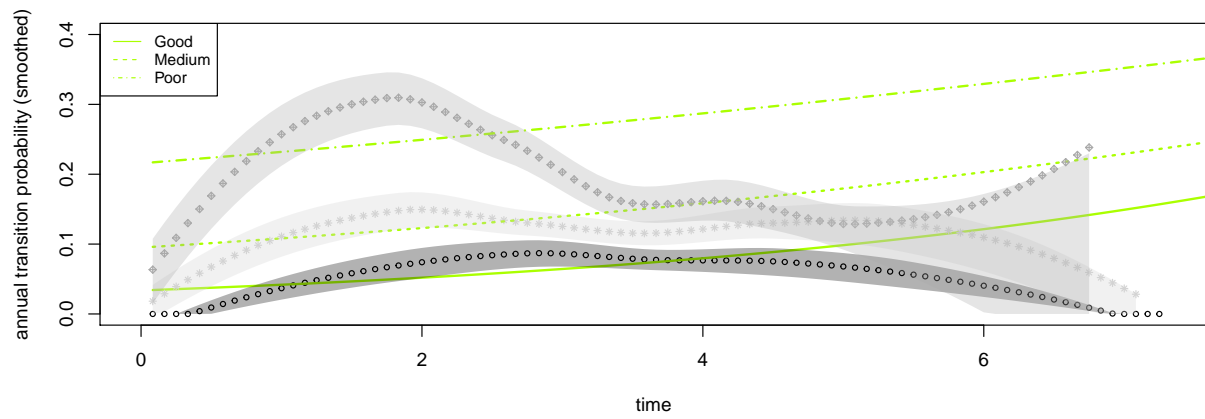
C: Diagnostic plot (Gompertz)
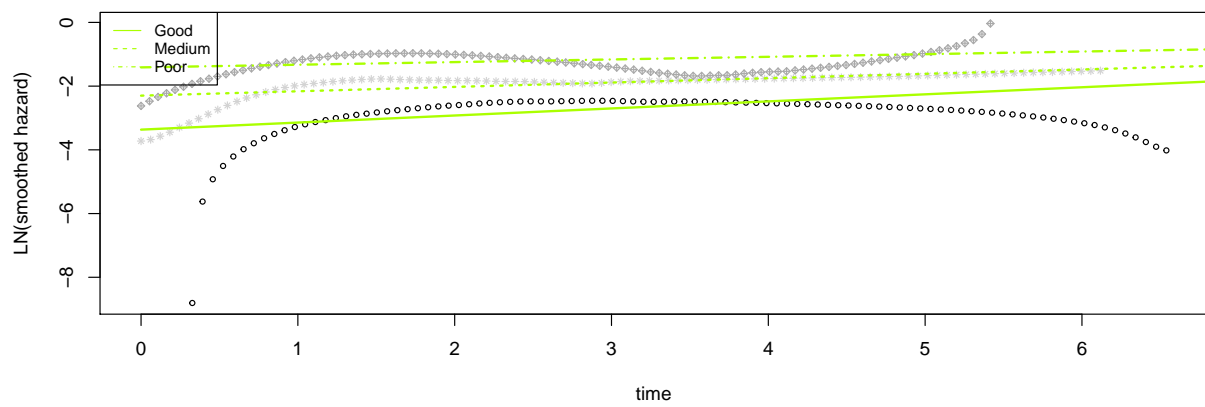
Log-normal

A: Kaplan–Meier (Log–normal)
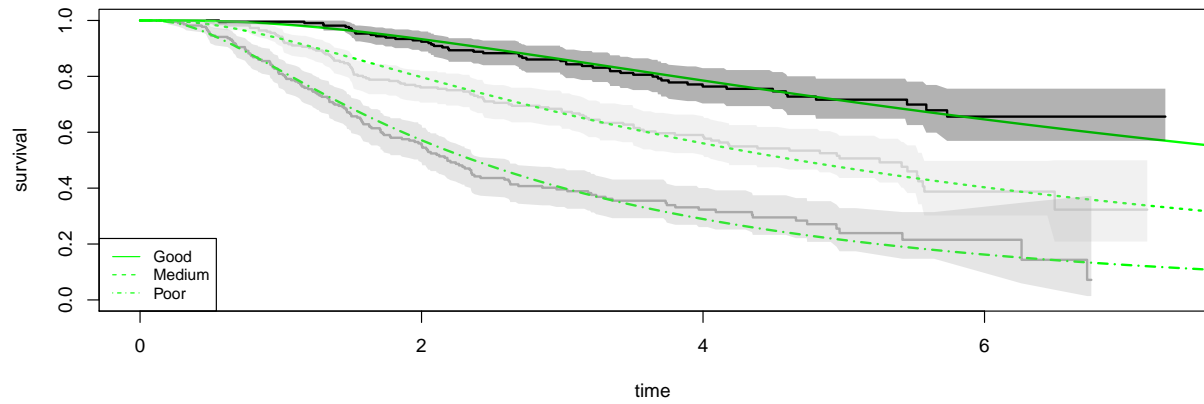
B: Annual transition probability (Log–normal)
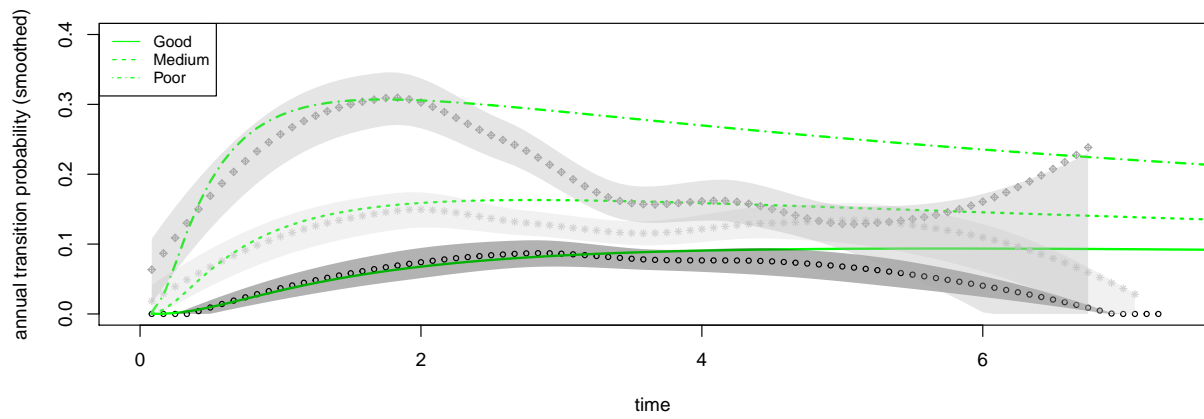
C: Diagnostic plot (Log–normal)
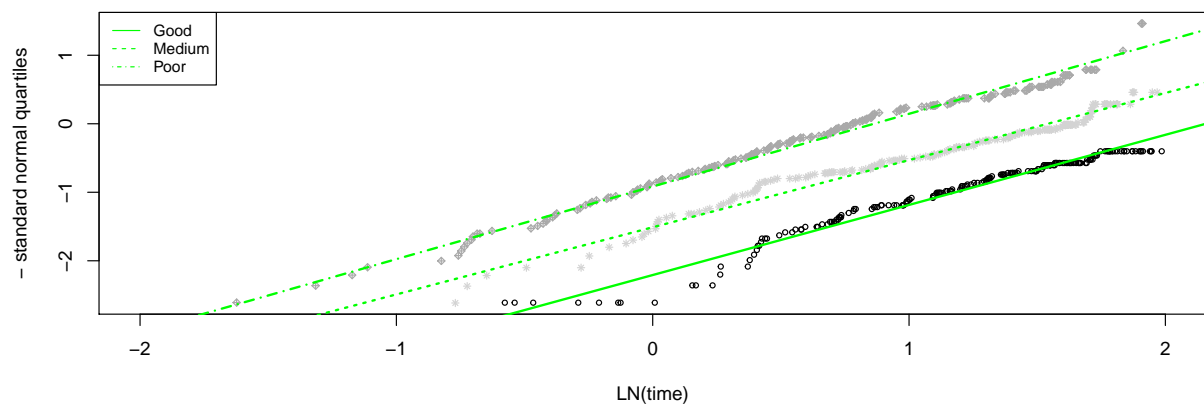
Log-logistic

A: Kaplan–Meier (Log–logistic)
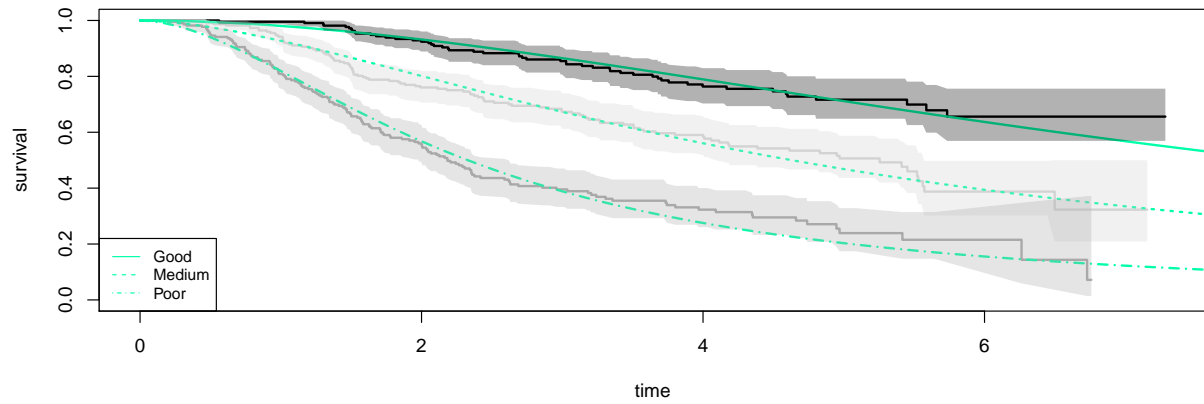
B: Annual transition probability (Log–logistic)
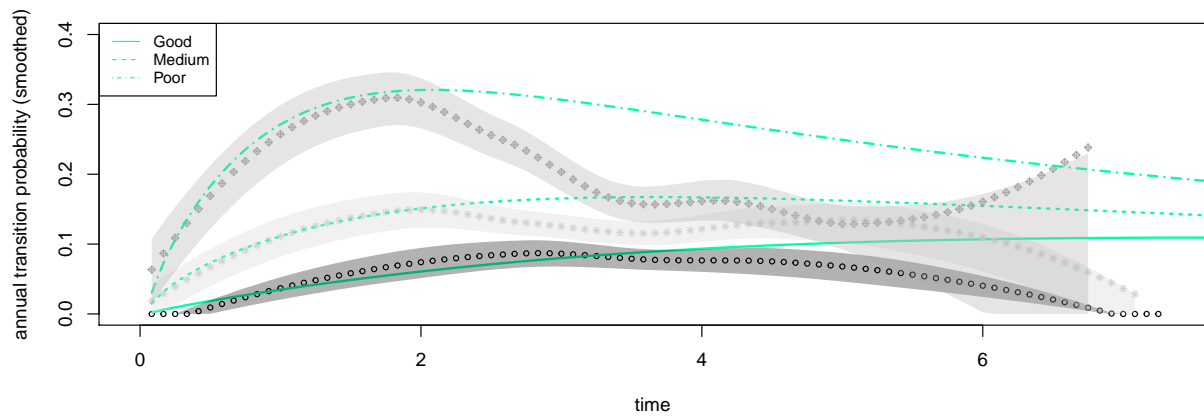
C: Diagnostic plot (Log–logistic)
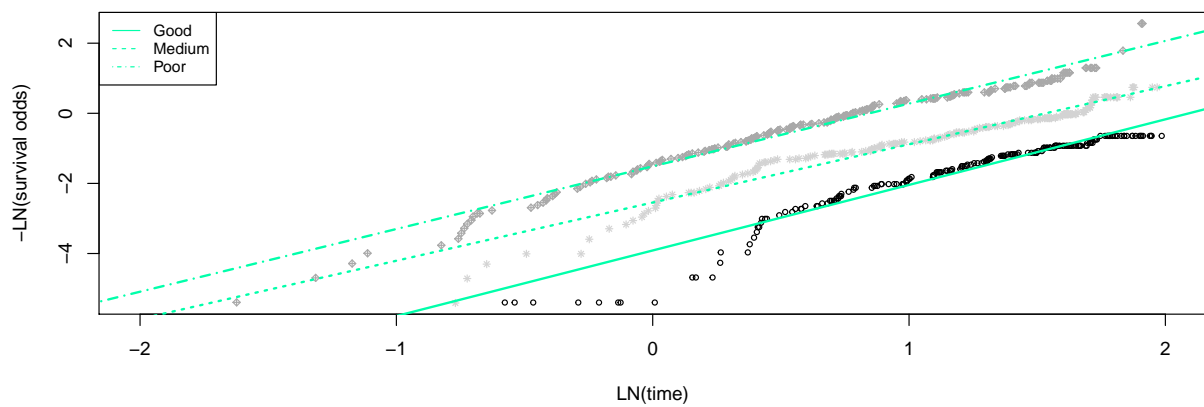
Gamma

A: Kaplan–Meier (Gamma)
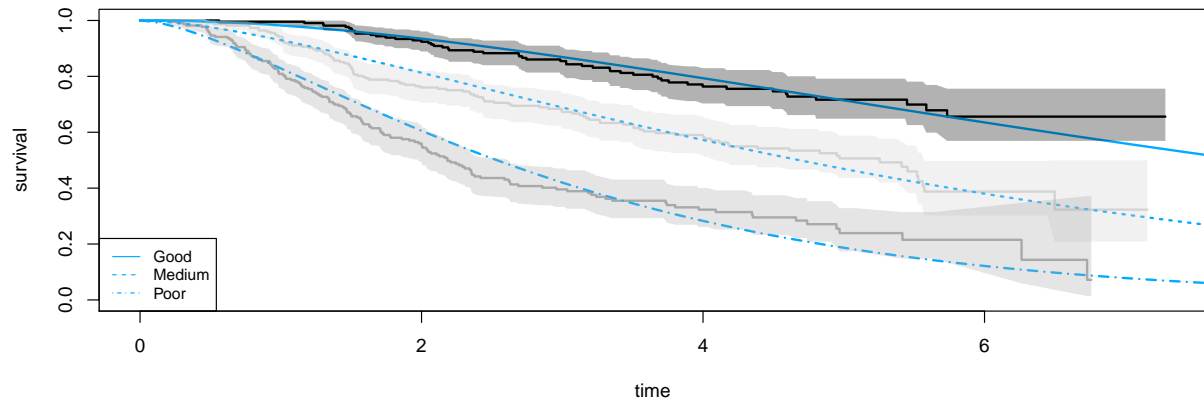
B: Annual transition probability (Gamma)
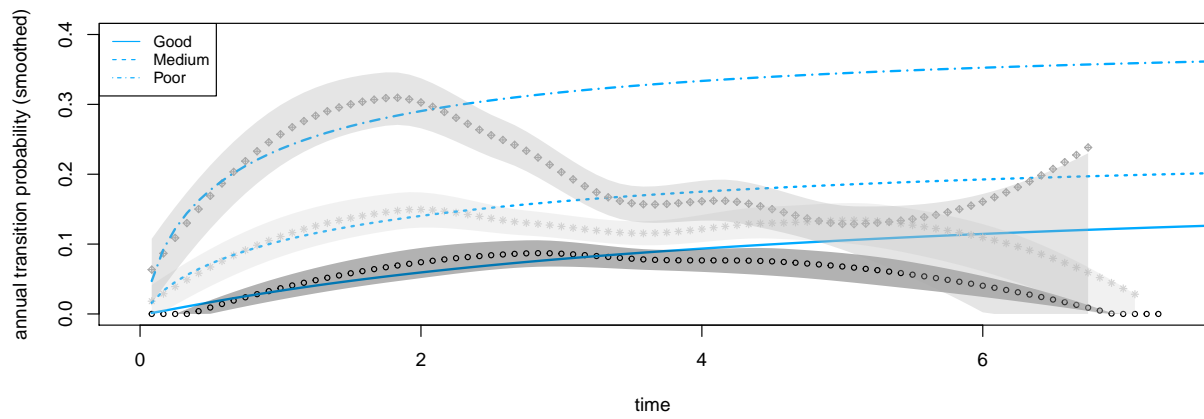
C: Diagnostic plot (Gamma)
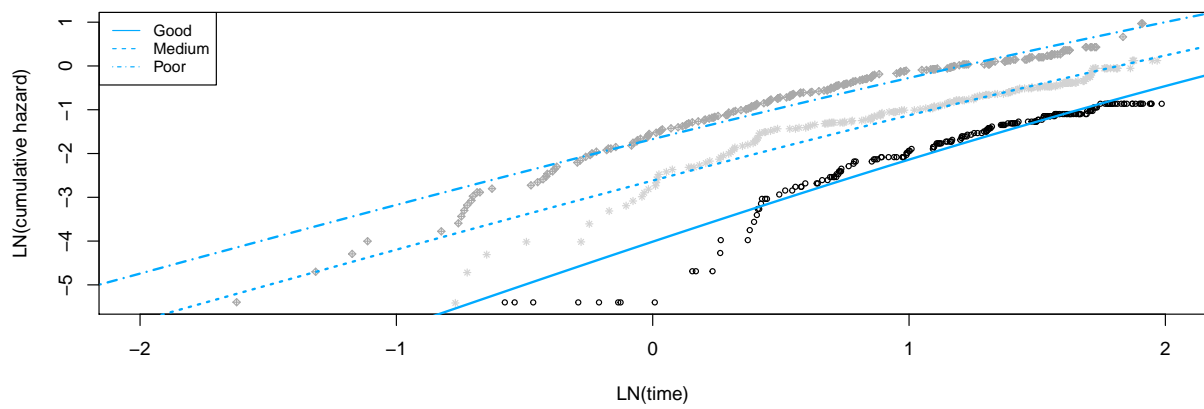
Generalised Gamma

A: Kaplan–Meier (Generalised gamma)

Legend: Good, Medium, Poor
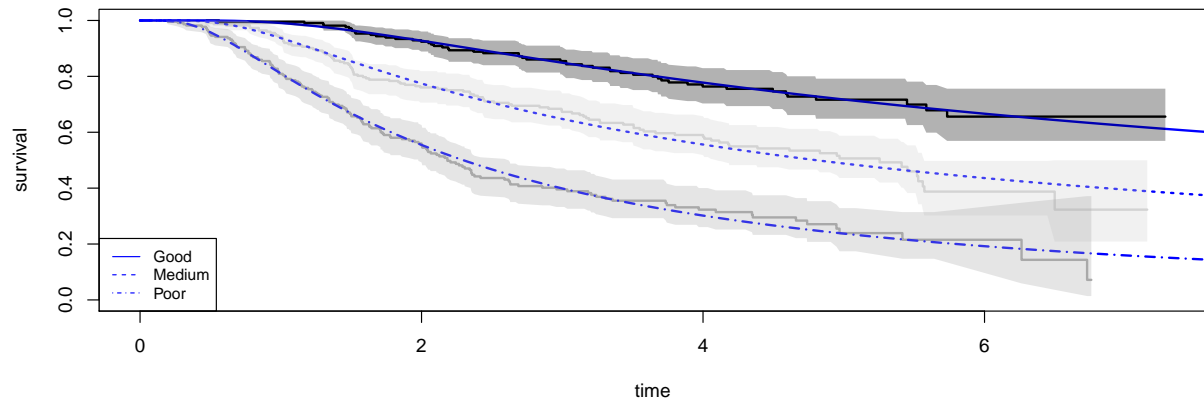
B: Annual transition probability (Generalised Gamma)

Legend: Good, Medium, Poor
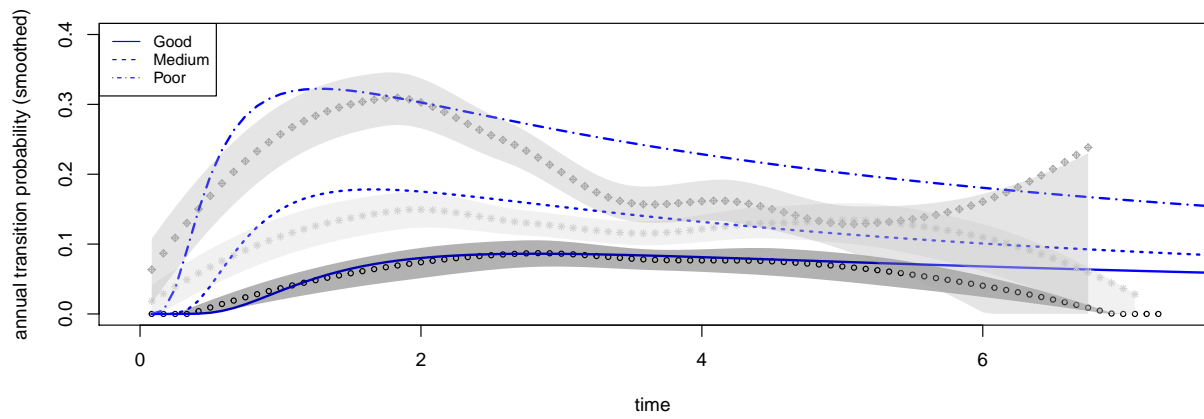
C: Diagnostic plot (Generalised gamma)

Legend: Good, Medium, Poor
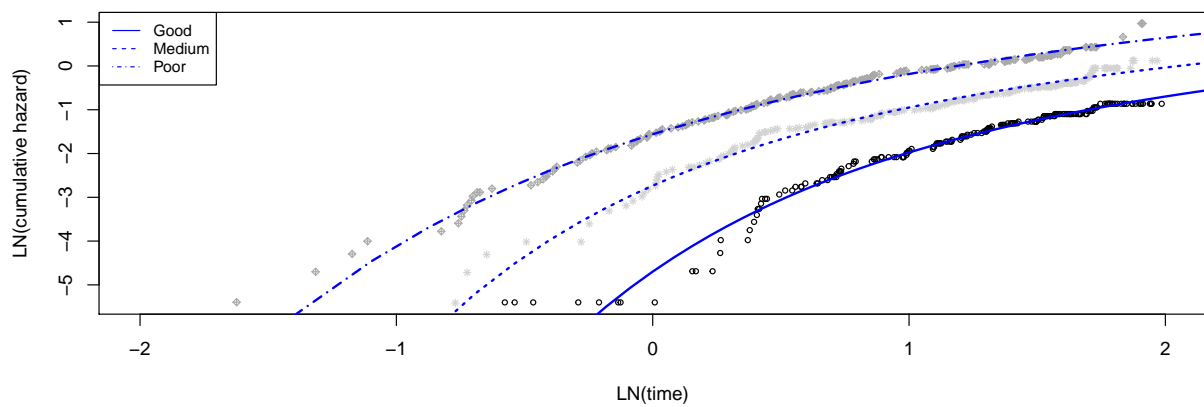
Parametric spline models?

If standard parametric models are not appropriate, are spline models a more appropriate fit to the data?
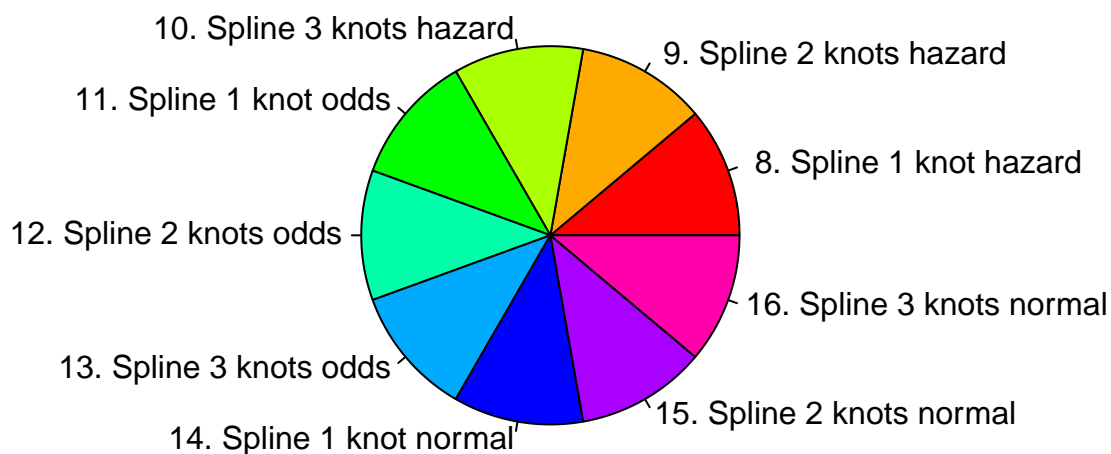
Model	AIC	BIC
9. Spline 2 knots hazard	1585.894	1640.264
12. Spline 2 knots odds	1587.289	1641.659
14. Spline 1 knot normal	1587.682	1628.460
15. Spline 2 knots normal	1588.343	1642.714
7. Generalised Gamma	1589.049	1629.826
8. Spline 1 knot hazard	1589.327	1630.105
16. Spline 3 knots normal	1589.832	1657.795
10. Spline 3 knots hazard	1589.875	1657.838
11. Spline 1 knot odds	1590.221	1630.999
13. Spline 3 knots odds	1590.720	1658.683
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)
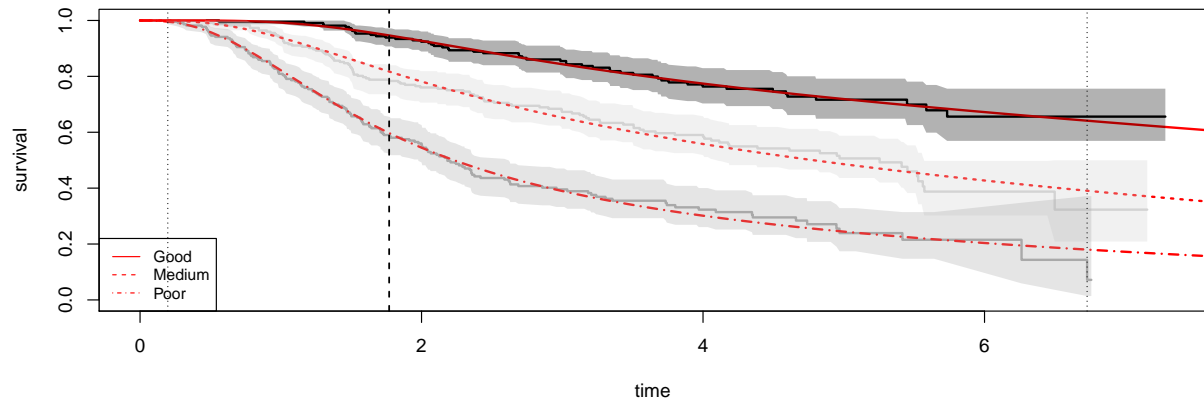
B: Annual transition probability (Spline, 1 knot, hazard scale)
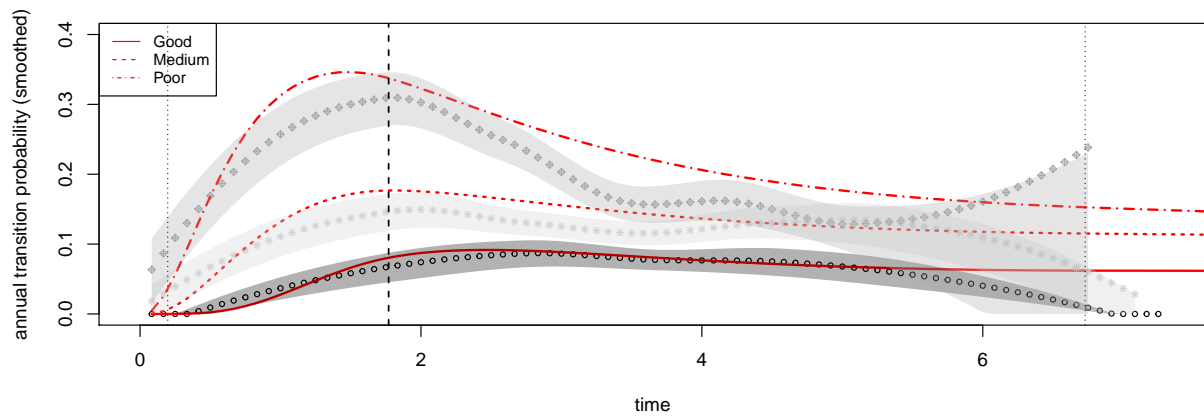
C: Diagnostic plot (Spline, 1 knot, hazard scale)
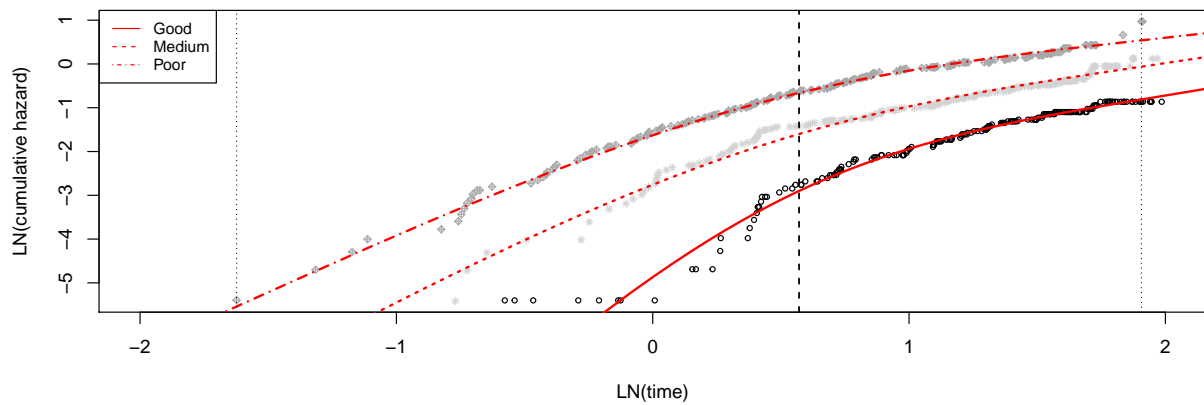
Spline hazard 2 knots

A: Kaplan–Meier (Spline, 2 knots, hazard scale)
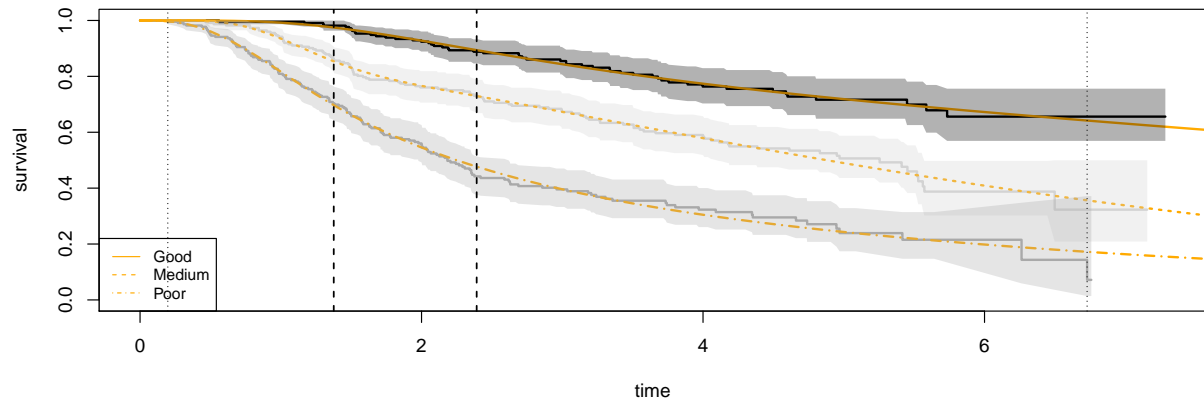
B: Annual transition probability (Spline, 2 knots, hazard scale)
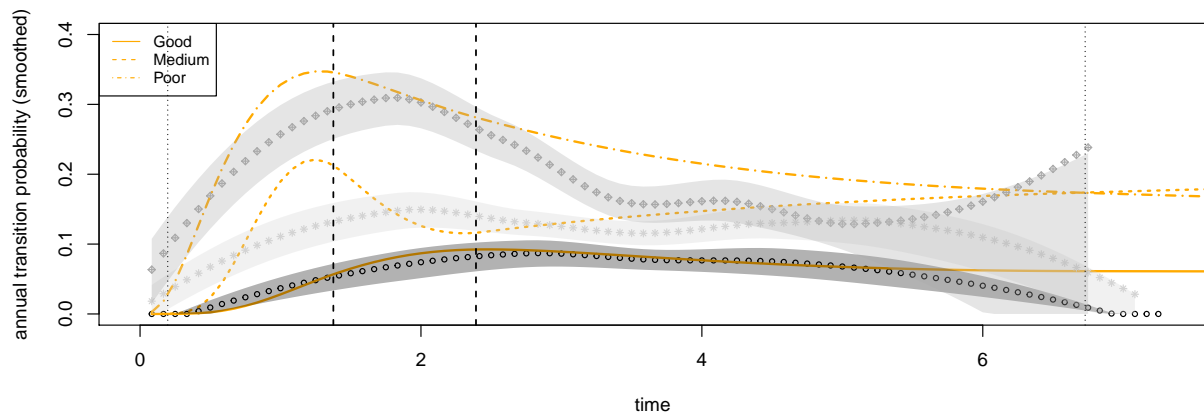
C: Diagnostic plot (Spline, 2 knots, hazard scale)
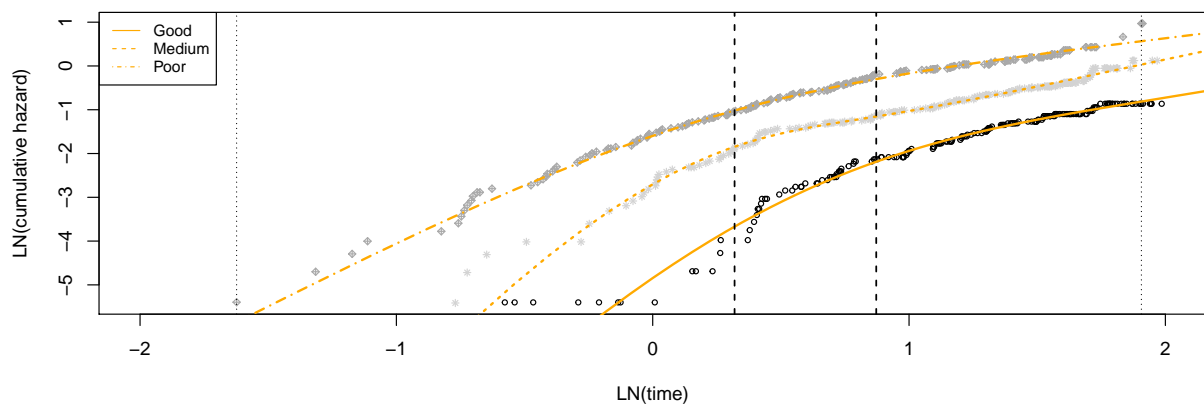
Spline hazard 3 knots

A: Kaplan–Meier (Spline, 3 knots, hazard scale)
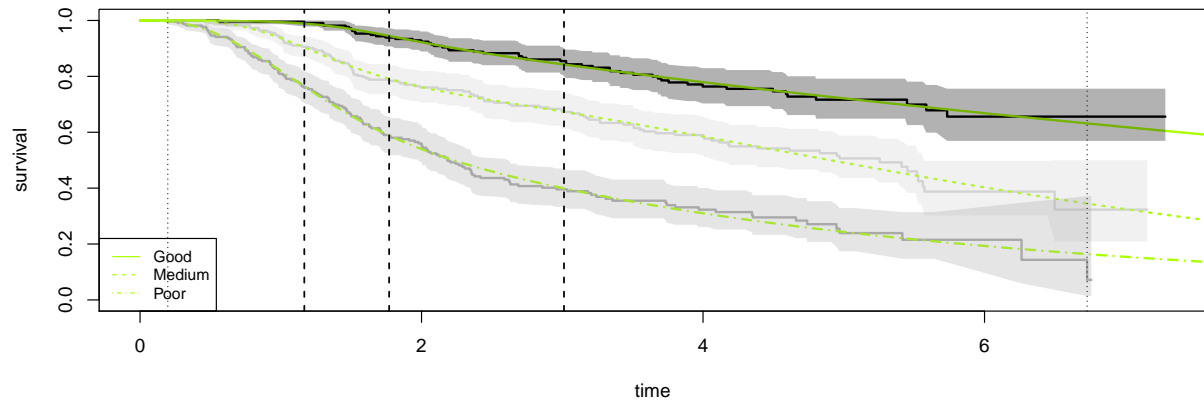
B: Annual transition probability (Spline, 3 knots, hazard scale)
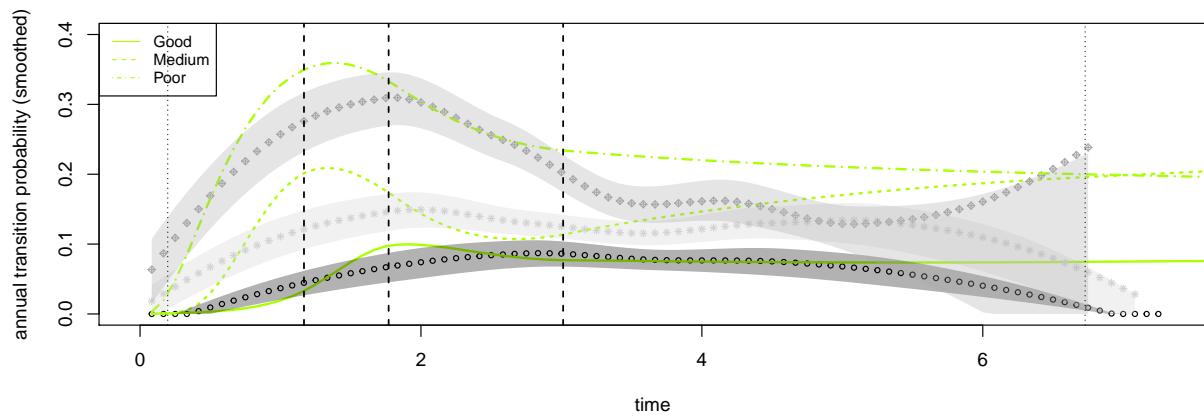
C: Diagnostic plot (Spline, 3 knots, hazard scale)

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)
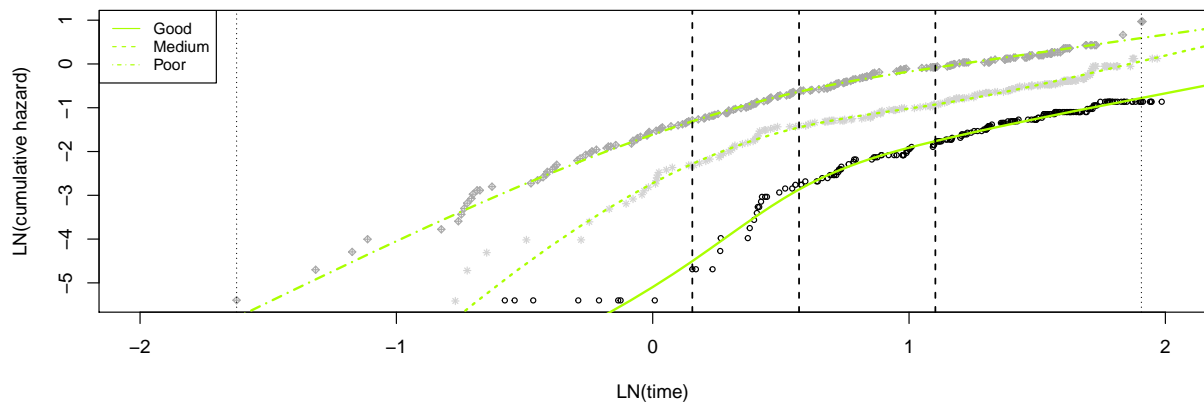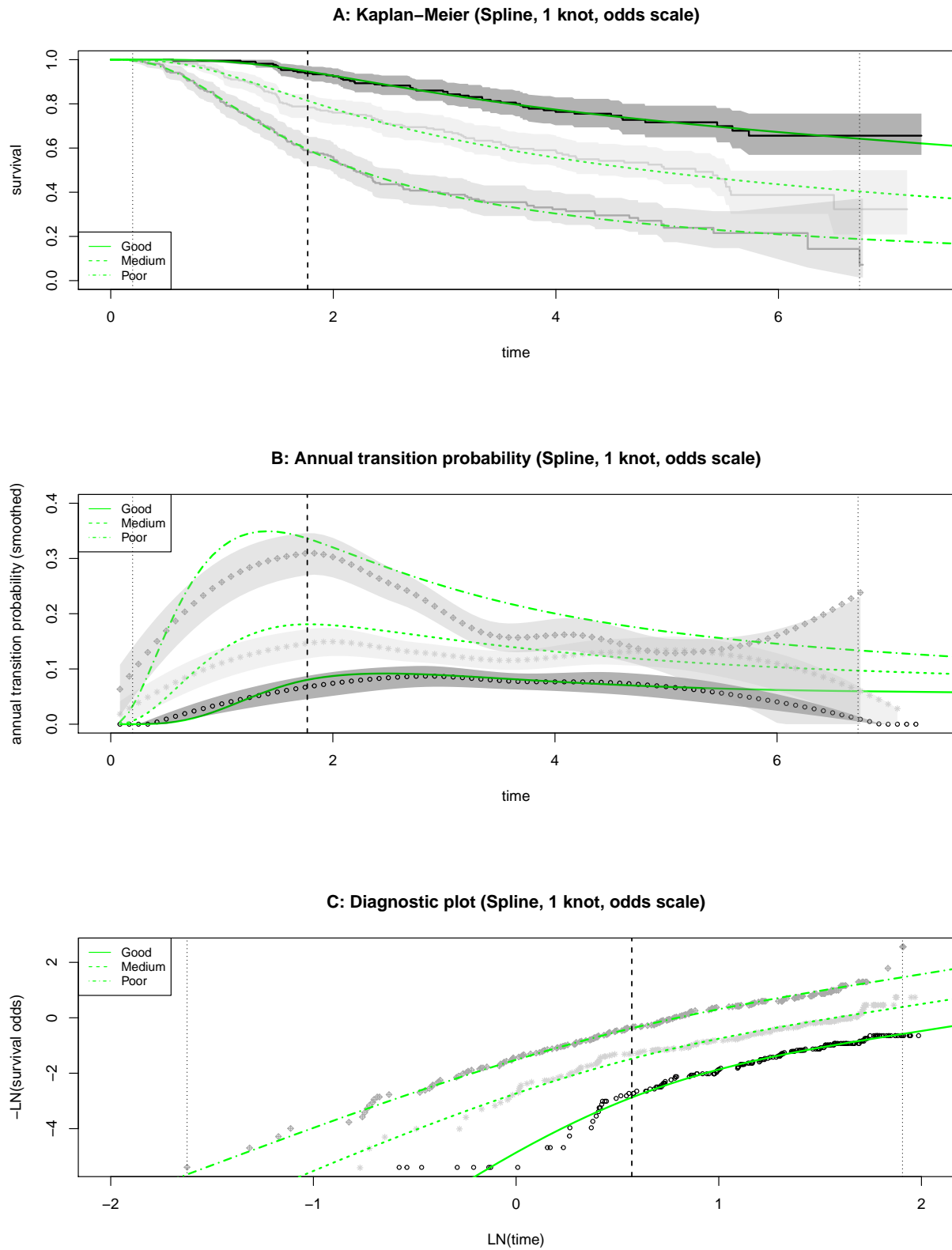
Spline odds 2 knots

A: Kaplan–Meier (Spline, 2 knots, odds scale)
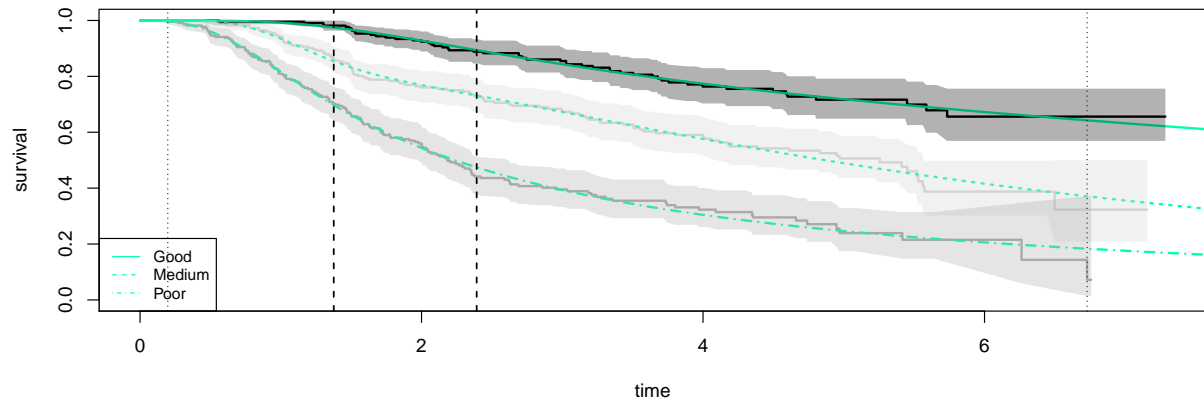
B: Annual transition probability (Spline, 2 knots, odds scale)
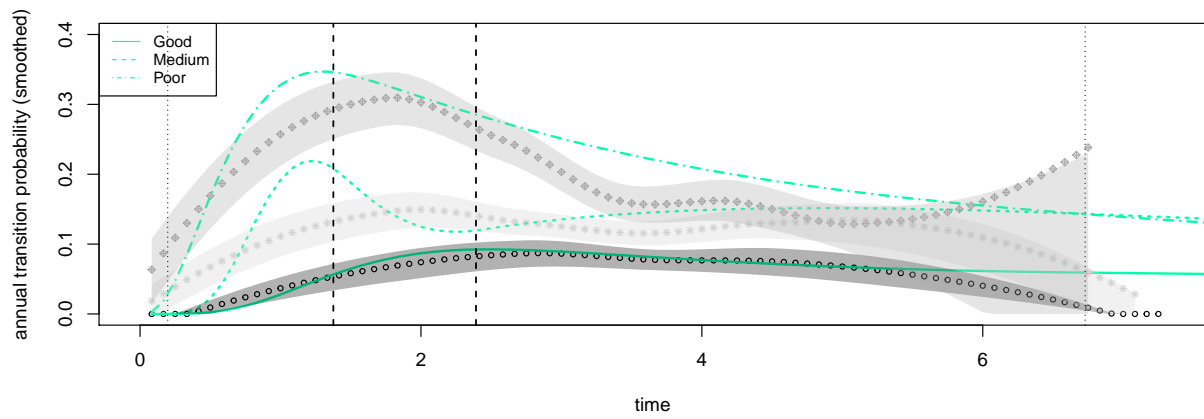
C: Diagnostic plot (Spline, 2 knots, odds scale)
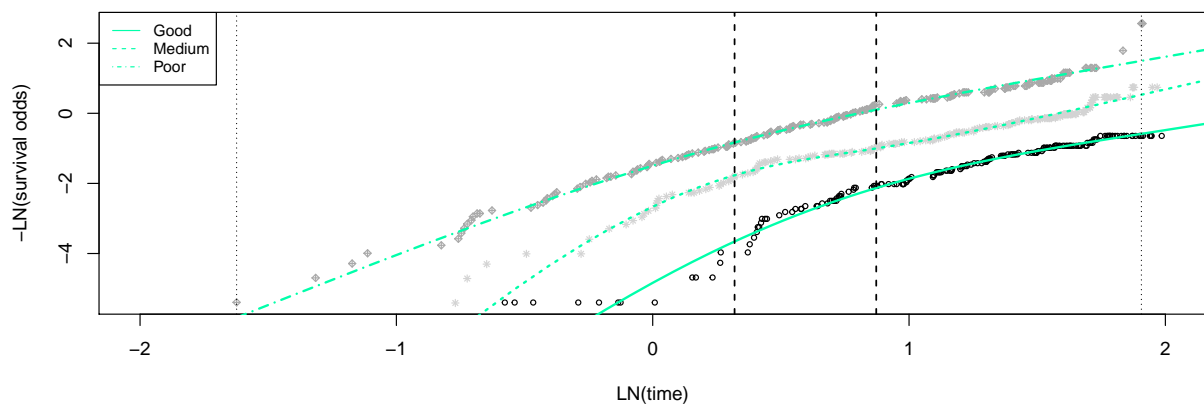
Spline odds 3 knots

A: Kaplan–Meier (Spline, 3 knots, odds scale)
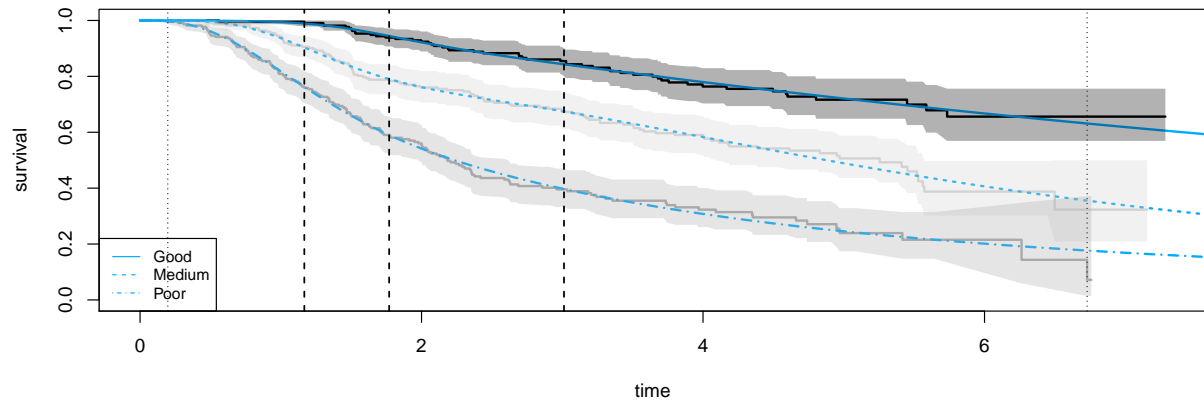
B: Annual transition probability (Spline, 3 knots, odds scale)
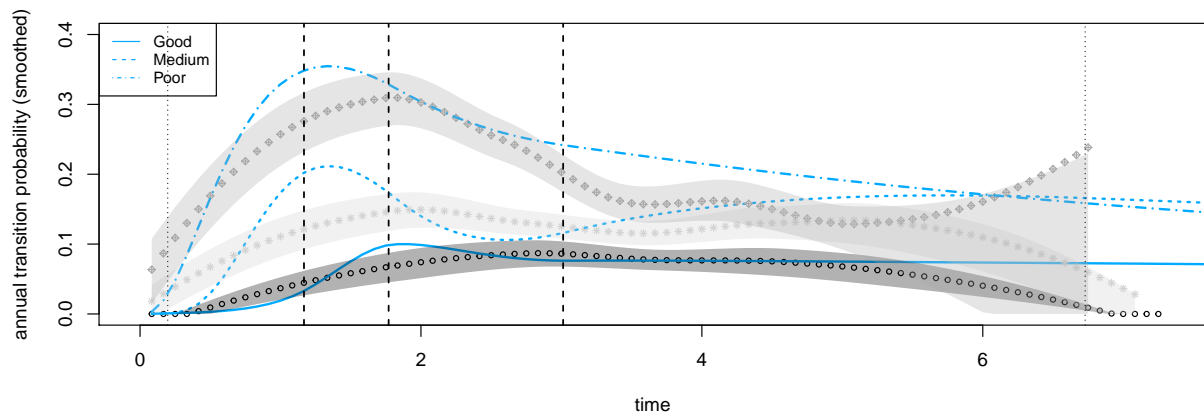
C: Diagnostic plot (Spline, 3 knots, odds scale)
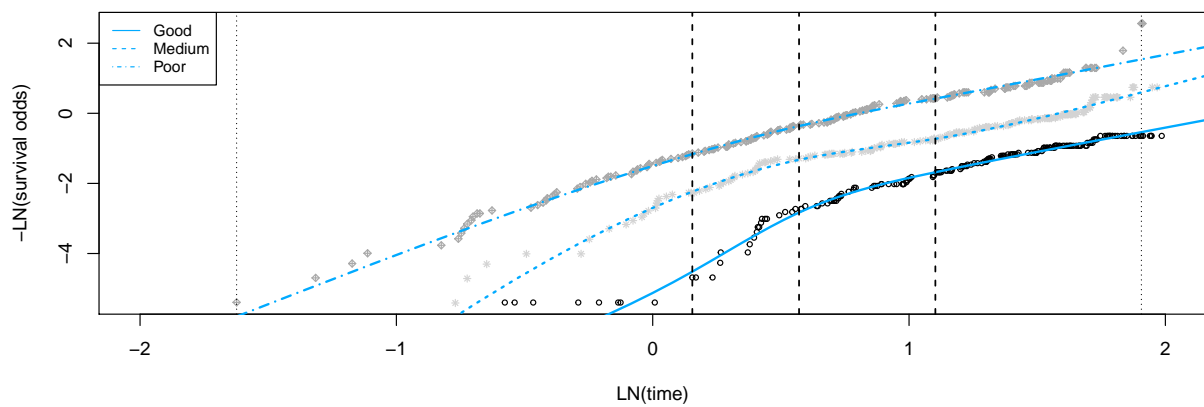
Spline normal 1 knot

A: Kaplan–Meier (Spline, 1 knot, normal scale)
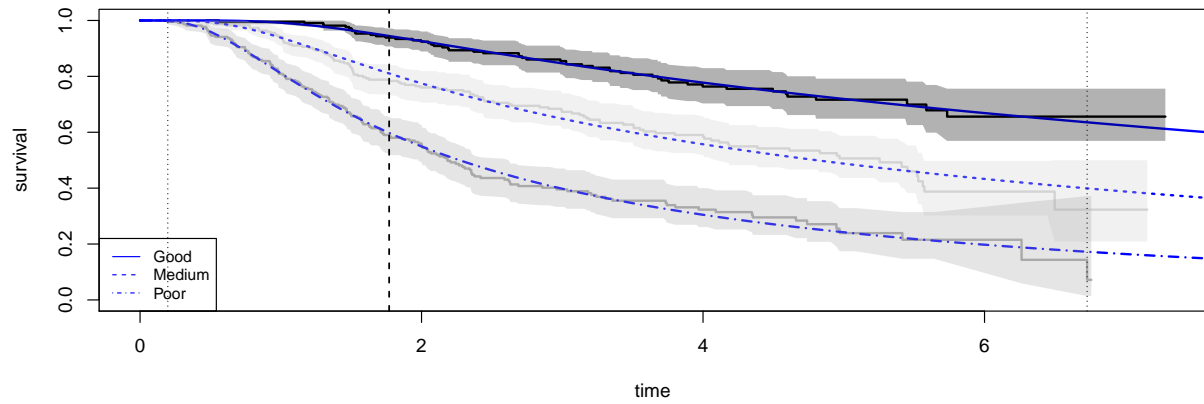
B: Annual transition probability (Spline, 1 knot, normal scale)
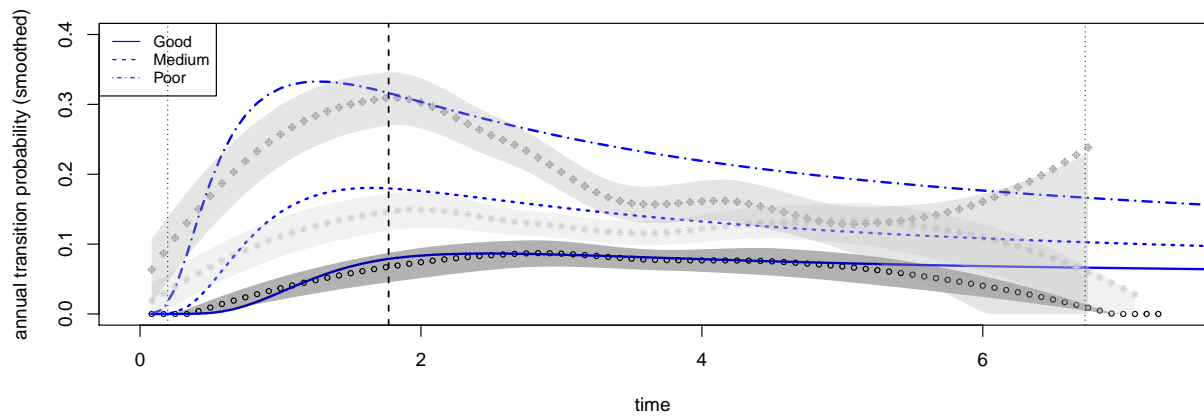
C: Diagnostic plot (Spline, 1 knot, normal scale)
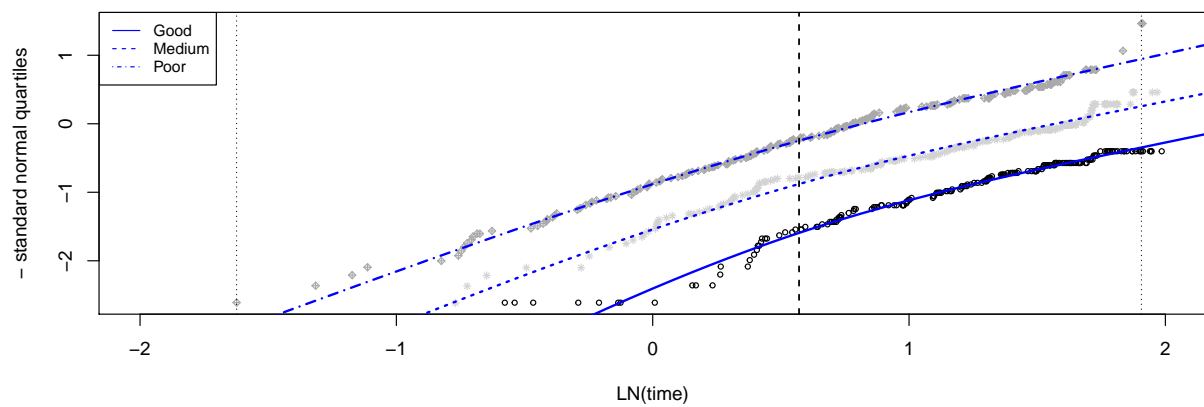
Spline normal 2 knots

A: Kaplan–Meier (Spline, 2 knots, normal scale)
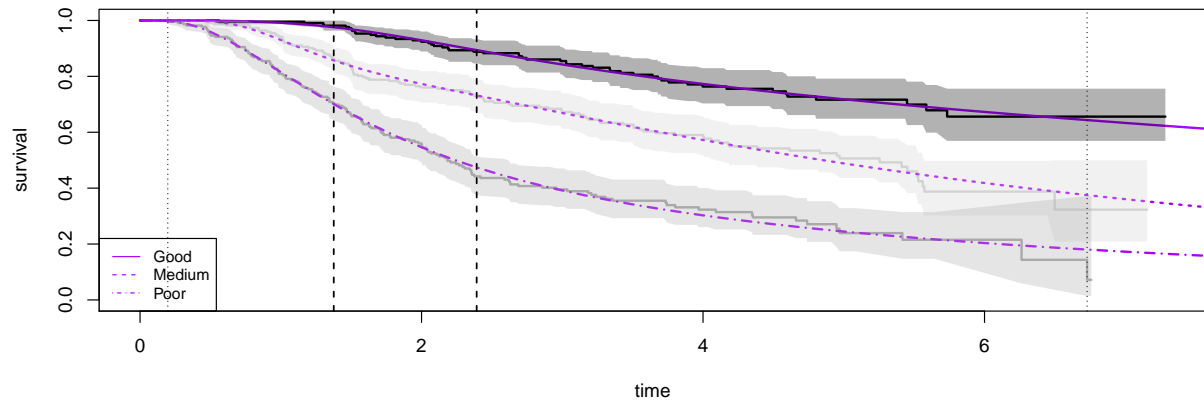
B: Annual transition probability (Spline, 2 knots, normal scale)
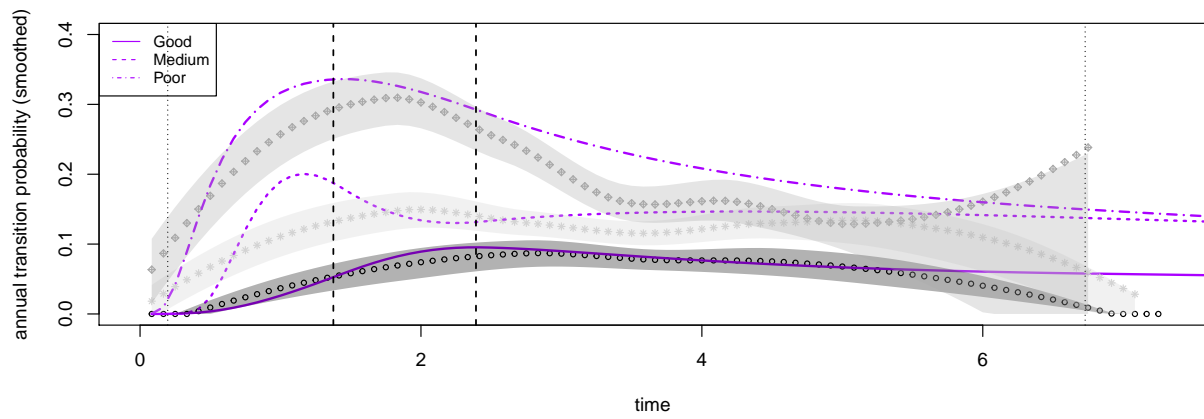
C: Diagnostic plot (Spline, 2 knots, normal scale)
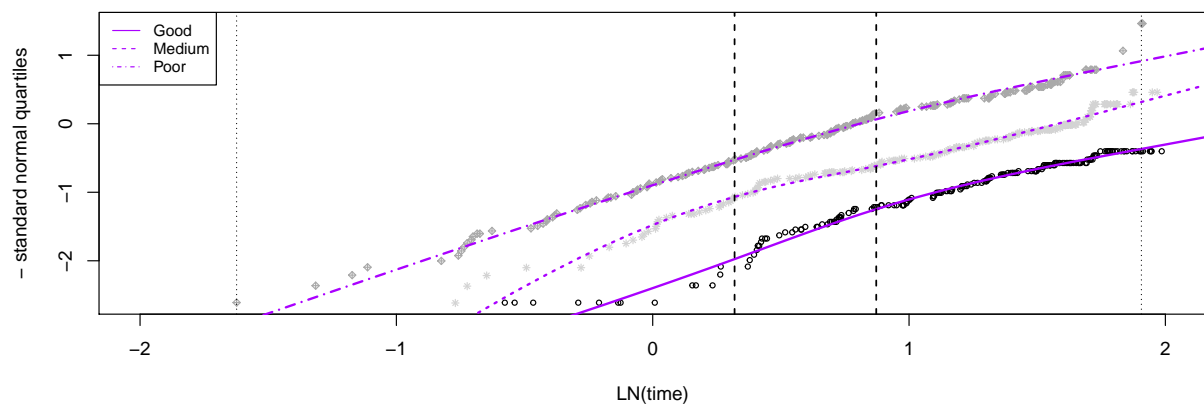
Spline normal 3 knots

A: Kaplan−Meier (Spline, 3 knots, normal scale)
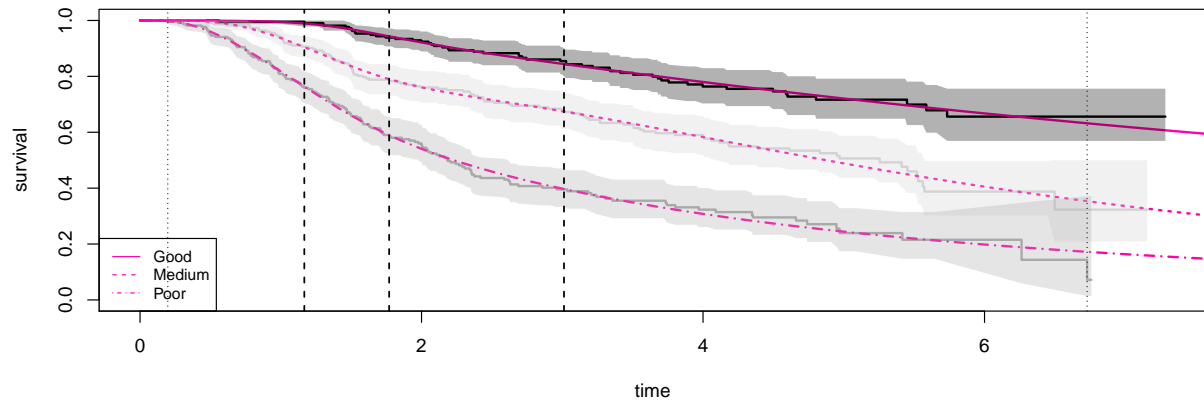
B: Annual transition probability (Spline, 3 knots, normal scale)
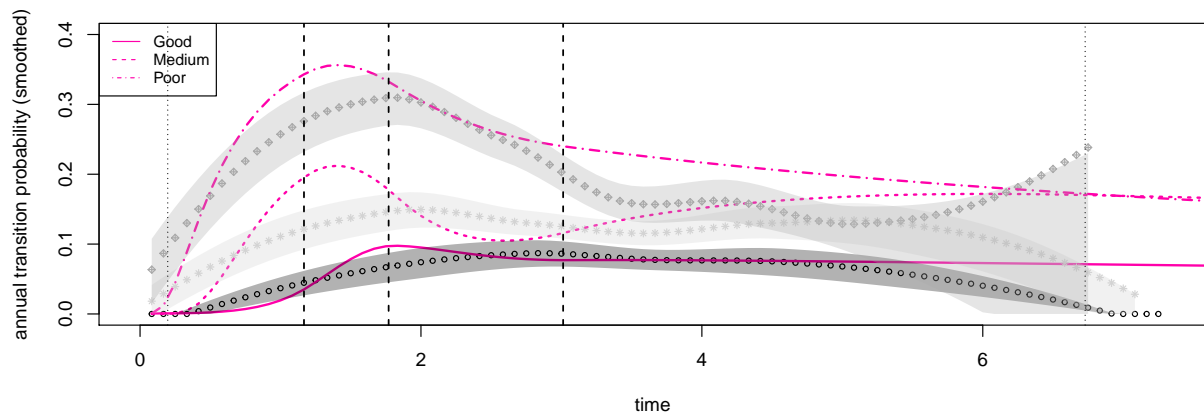
C: Diagnostic plot (Spline, 3 knots, normal scale)
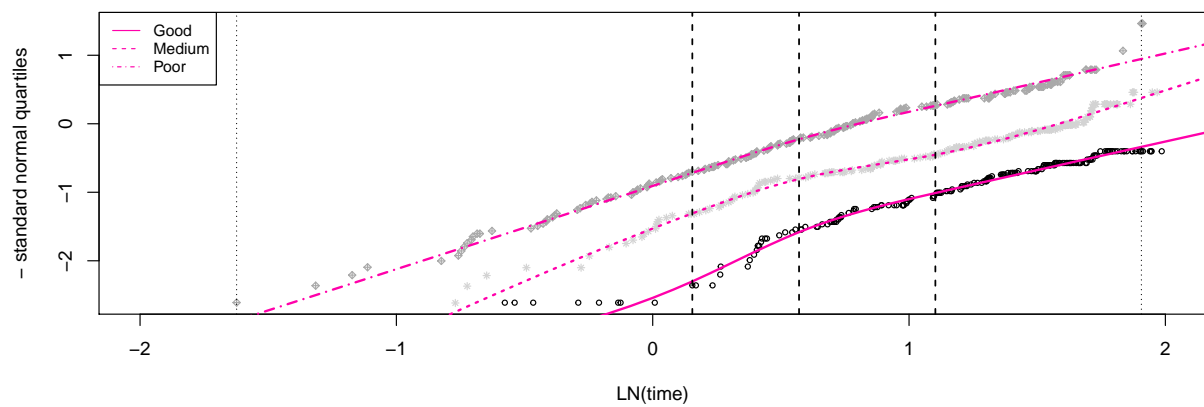
Validity of long-term extrapolation?

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)
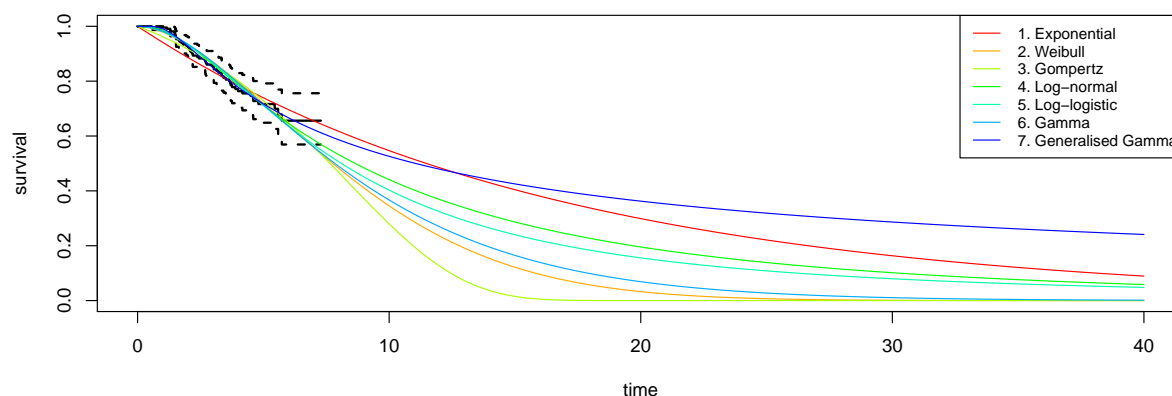
B: Kaplan–Meier (spline curves)
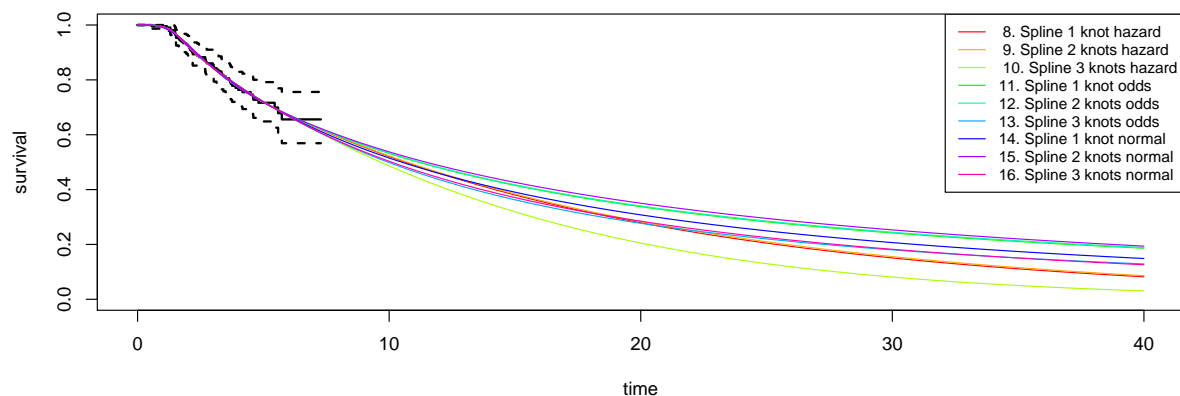
|	T= 0	T= 1	T= 2	T= 3	T= 4	T= 5	T= 10	T= 15	T= 20	T= 25	T= 30	T= 35
1. Exponential	1	0.941	0.886	0.834	0.785	0.739	0.547	0.404	0.299	0.221	0.163	0.121
2. Weibull	1	0.978	0.932	0.870	0.797	0.719	0.345	0.122	0.033	0.007	0.001	0.000
3. Gompertz	1	0.962	0.917	0.863	0.801	0.729	0.280	0.015	0.000	0.000	0.000	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 3 knots hazard	1	0.994	0.922	0.843	0.779	0.721	0.486	0.319	0.205	0.130	0.081	0.050
11. 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
12. 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
13. Spline 3 knots odds	1	0.994	0.922	0.844	0.780	0.721	0.498	0.363	0.277	0.220	0.180	0.151
14. 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
15. 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
16. Spline 3 knots normal	1	0.994	0.921	0.845	0.780	0.721	0.503	0.371	0.285	0.225	0.182	0.150

C: Annual transition probability (parametric curves)
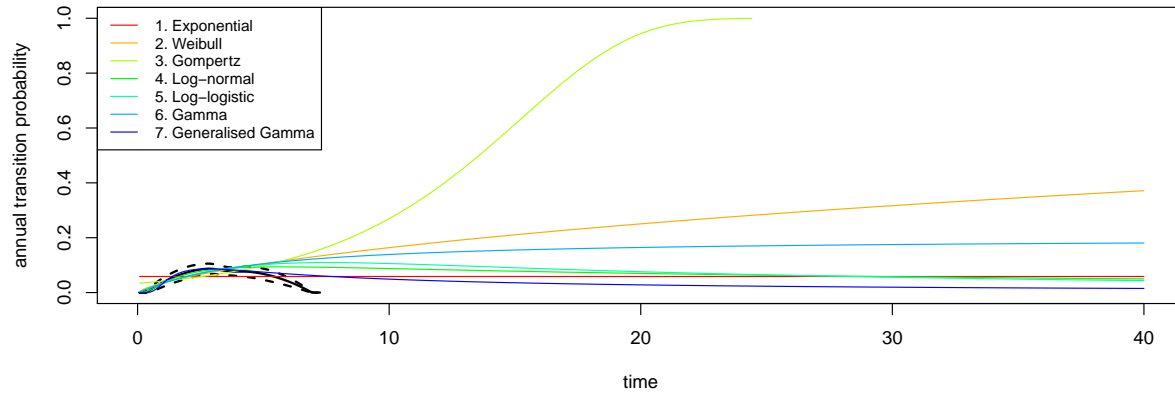
D: Annual transition probability (spline curves)
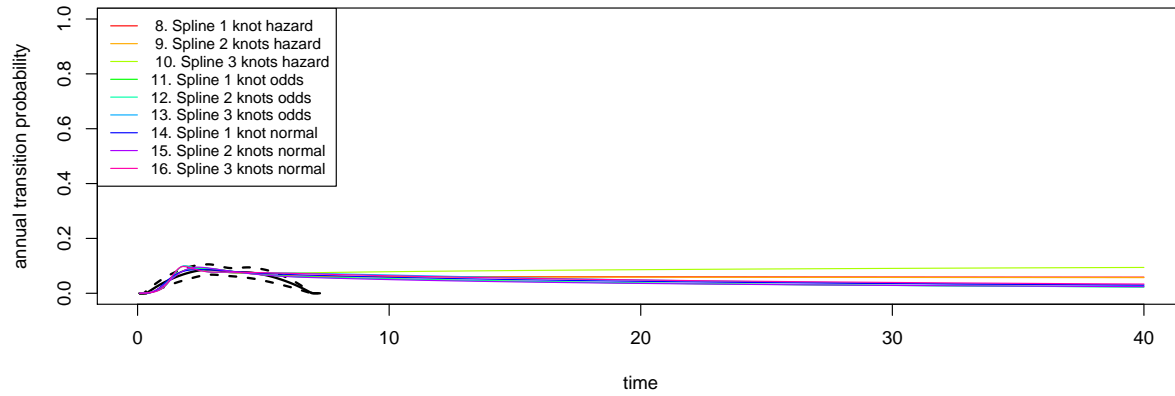
	Min	Q1	Median	Q3	Max
1. Exponential	0.0585969	0.0585969	0.0585969	0.0585969	0.0585969
10. Spline 3 knots hazard	0.0003310	0.0798260	0.0865334	0.0909988	0.0996328
2. Weibull	0.0039603	0.1641779	0.2507544	0.3170901	0.3714738
3. Gompertz	0.0342601	0.1256322	0.4037134	0.8634656	1.0000000
4. Log-normal	0.0000121	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
11. Spline 1 knot odds	0.0000002	0.0281269	0.0363823	0.0502992	0.0917044
12. Spline 2 knots odds	0.0000002	0.0278516	0.0359503	0.0497462	0.0924439
13. Spline 3 knots odds	0.0003253	0.0358147	0.0466608	0.0638606	0.0999099
14. Spline 1 knot normal	0.0000000	0.0345970	0.0424046	0.0560095	0.0865141
15. Spline 2 knots normal	0.0000006	0.0281480	0.0348987	0.0473455	0.0953359
16. Spline 3 knots normal	0.0007793	0.0386308	0.0470013	0.0611992	0.0975846

E: Hazard function (parametric curves)

smoothed hazard rate

1. Exponential
2. Weibull
3. Gompertz
4. Log–normal
5. Log–logistic
6. Gamma
7. Generalised Gamma

time

F: Hazard function (spline curves)

smoothed hazard rate

8. Spline 1 knot hazard
9. Spline 2 knots hazard
10. Spline 3 knots hazard
11. Spline 1 knot odds
12. Spline 2 knots odds
13. Spline 3 knots odds
14. Spline 1 knot normal
15. Spline 2 knots normal
16. Spline 3 knots normal

time
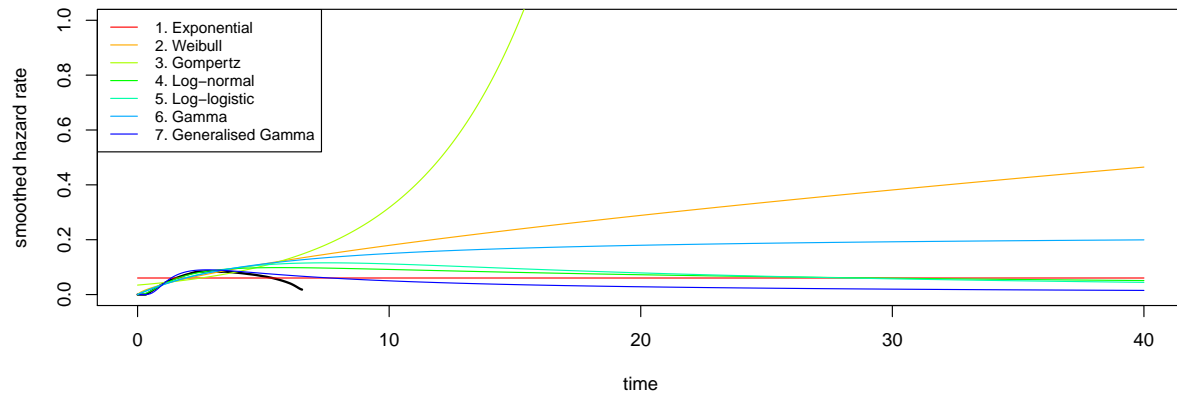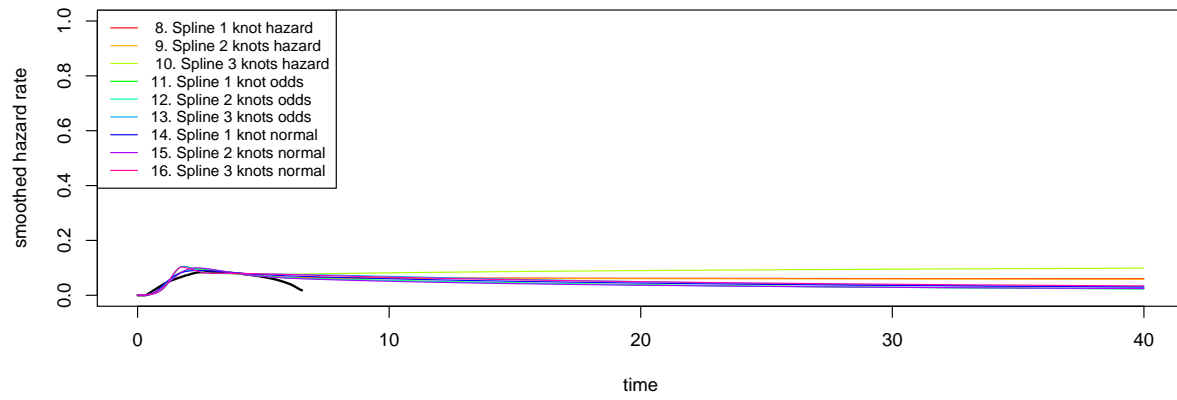
Group Medium

A: Kaplan–Meier (parametric curves)
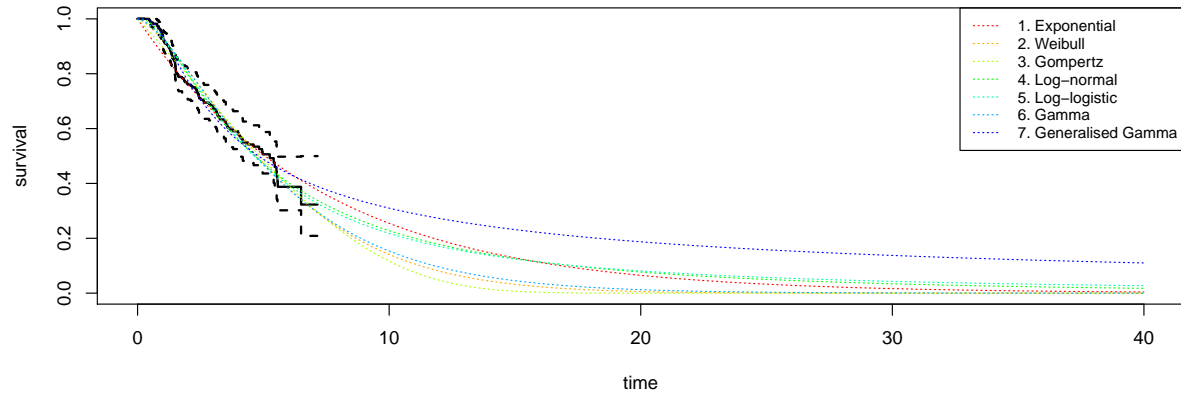
B: Kaplan–Meier (spline curves)
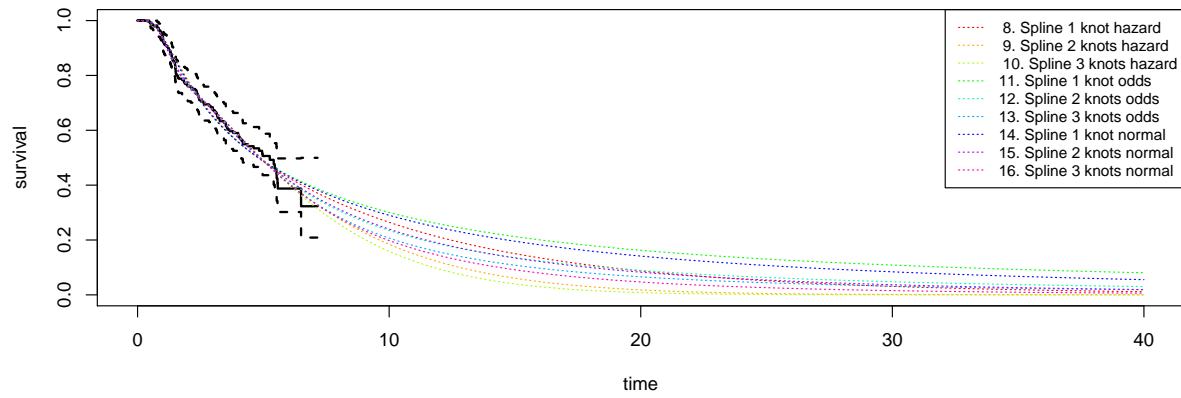
	T= 0	T= 1	T= 2	T= 3	T= 4	T= 5	T= 10	T= 15	T= 20	T= 25	T= 30	T= 35
1. Exponential	1	0.872	0.761	0.663	0.578	0.505	0.255	0.128	0.065	0.033	0.016	0.008
2. Weibull	1	0.923	0.811	0.693	0.578	0.474	0.141	0.032	0.006	0.001	0.000	0.000
3. Gompertz	1	0.898	0.794	0.689	0.586	0.486	0.117	0.007	0.000	0.000	0.000	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 3 knots hazard	1	0.936	0.761	0.674	0.585	0.491	0.159	0.040	0.008	0.001	0.000	0.000
11. 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
12. 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
13. Spline 3 knots odds	1	0.937	0.761	0.675	0.583	0.489	0.207	0.108	0.066	0.044	0.032	0.024
14. 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
15. 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
16. Spline 3 knots normal	1	0.937	0.761	0.675	0.583	0.489	0.198	0.091	0.047	0.026	0.015	0.010

C: Annual transition probability (parametric curves)
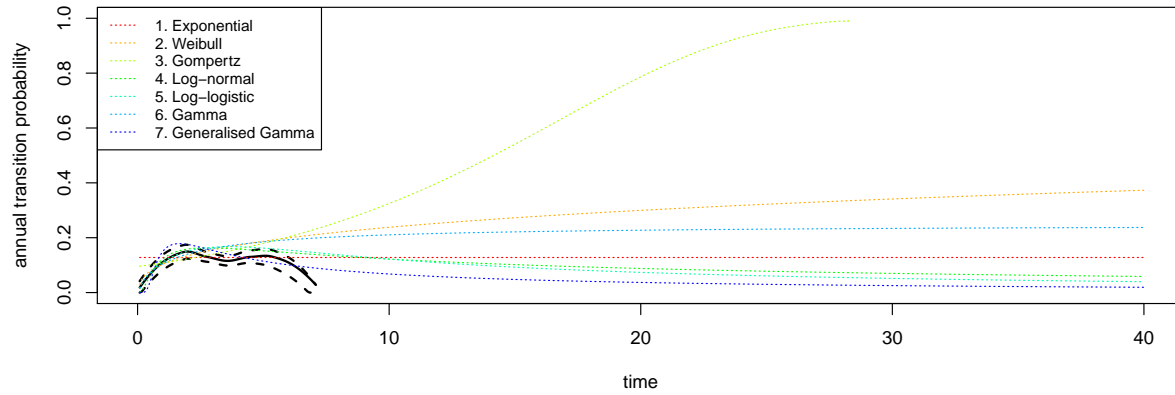
D: Annual transition probability (spline curves)
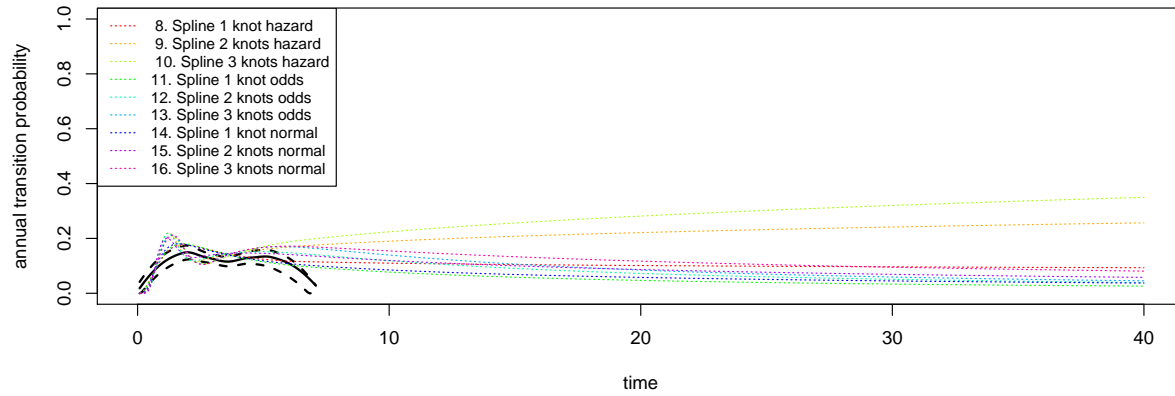
|	Min	Q1	Median	Q3	Max
1. Exponential	0.1278820	0.1278820	0.1278820	0.1278820	0.1278820
10. Spline 3 knots hazard	0.0000040	0.2243467	0.2816554	0.3202621	0.3498686
2. Weibull	0.0298491	0.2382194	0.2998675	0.3413164	0.3730304
3. Gompertz	0.0960264	0.2326209	0.5026105	0.8415103	1.0000000
4. Log-normal	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
11. Spline 1 knot odds	0.0004610	0.0331955	0.0461415	0.0743721	0.1809477
12. Spline 2 knots odds	0.0000004	0.0500917	0.0706148	0.1135216	0.2192447
13. Spline 3 knots odds	0.0000052	0.0581364	0.0821832	0.1255993	0.2117141
14. Spline 1 knot normal	0.0000012	0.0444894	0.0569700	0.0823605	0.1804334
15. Spline 2 knots normal	0.0000000	0.0682231	0.0852159	0.1164045	0.2005479
16. Spline 3 knots normal	0.0000001	0.0939627	0.1132858	0.1426801	0.2122248

E: Hazard function (parametric curves)
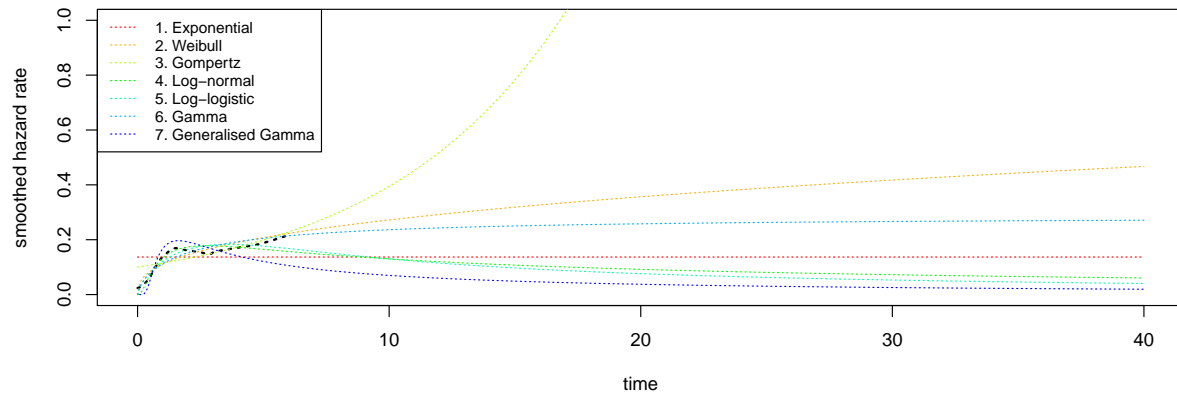
F: Hazard function (spline curves)
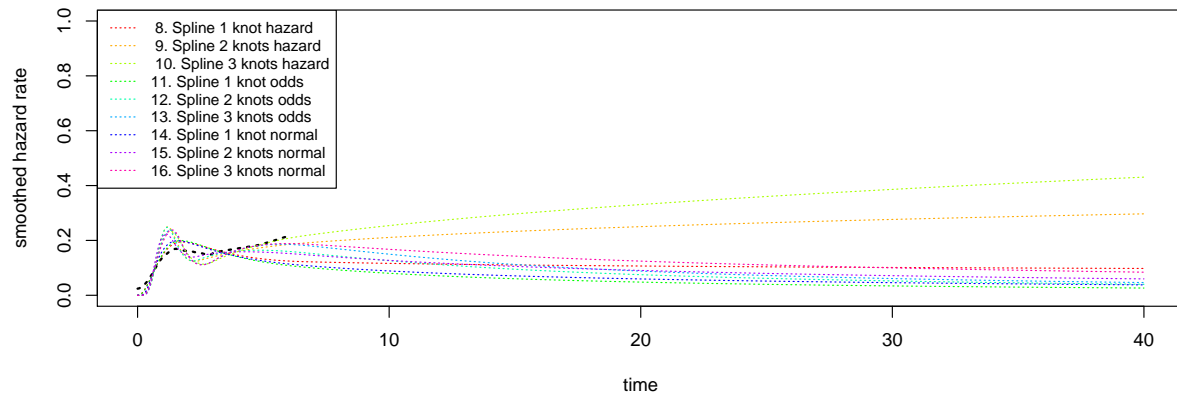
Group Poor

A: Kaplan–Meier (parametric curves)
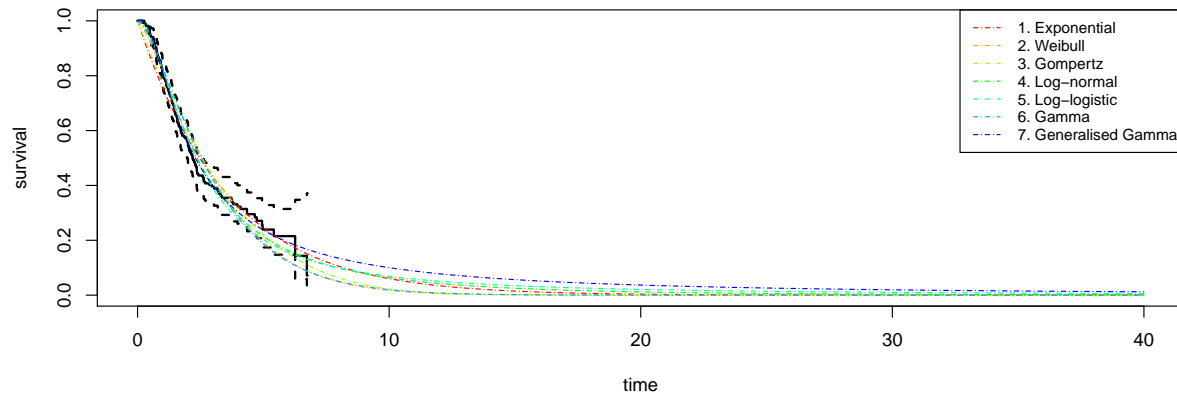
B: Kaplan–Meier (spline curves)
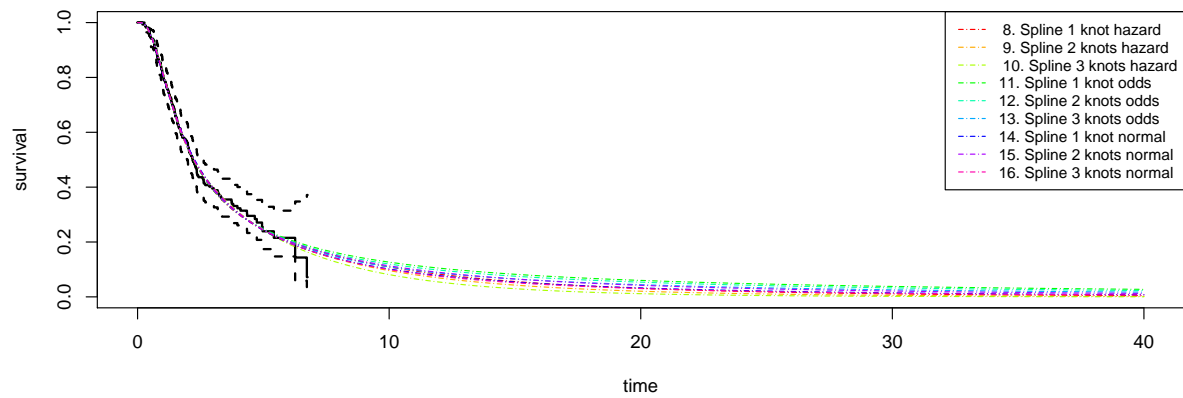
	T= 0	T= 1	T= 2	T= 3	T= 4	T= 5	T= 10	T= 15	T= 20	T= 25	T= 30	T= 35
1. Exponential	1	0.755	0.570	0.430	0.325	0.245	0.060	0.015	0.004	0.001	0.000	0.000
2. Weibull	1	0.817	0.608	0.430	0.292	0.193	0.017	0.001	0.000	0.000	0.000	0.000
3. Gompertz	1	0.776	0.588	0.436	0.315	0.221	0.022	0.001	0.000	0.000	0.000	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 3 knots hazard	1	0.819	0.540	0.400	0.310	0.243	0.081	0.030	0.012	0.005	0.002	0.001
11. 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
12. 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
13. Spline 3 knots odds	1	0.818	0.542	0.398	0.308	0.246	0.110	0.065	0.044	0.033	0.026	0.021
14. 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
15. 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
16. Spline 3 knots normal	1	0.818	0.541	0.398	0.308	0.244	0.100	0.051	0.030	0.019	0.013	0.009

C: Annual transition probability (parametric curves)
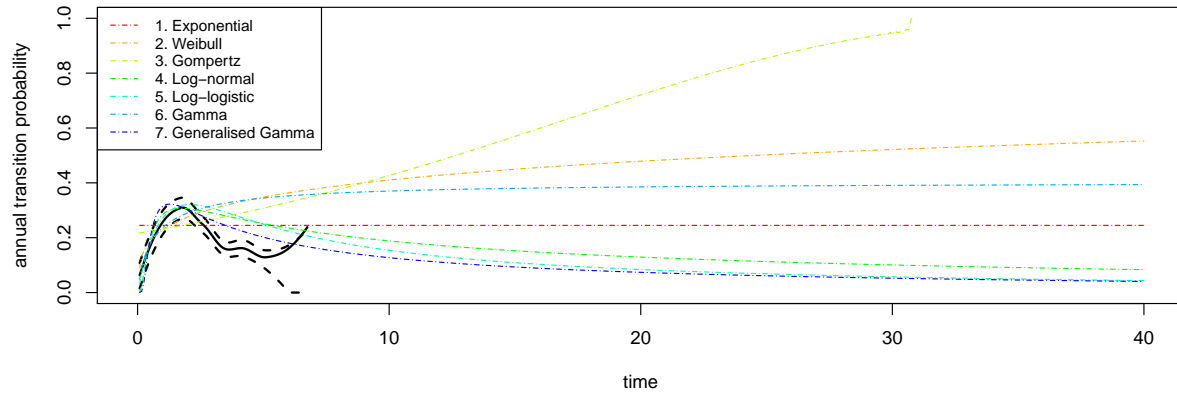

D: Annual transition probability (spline curves)
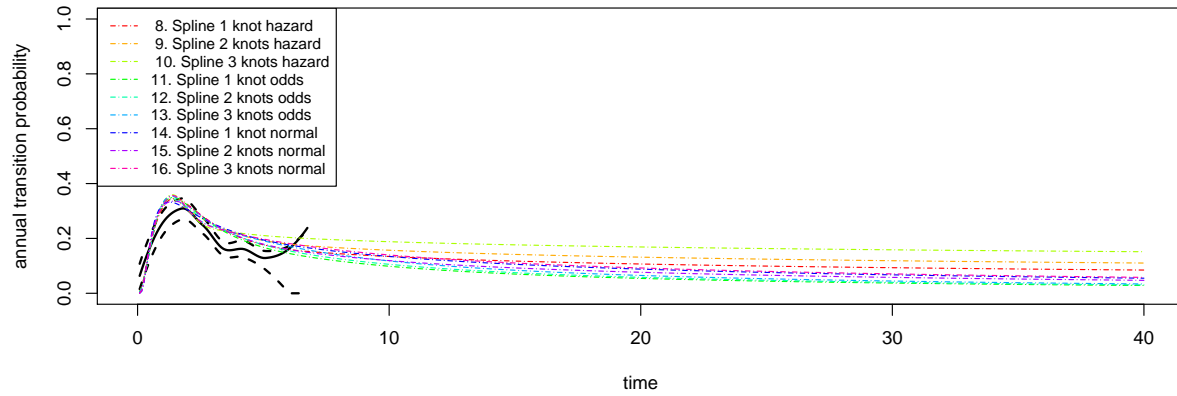
	Min	Q1	Median	Q3	Max
1. Exponential	0.2449482	0.2449482	0.2449482	0.2449482	0.2449482
10. Spline 3 knots hazard	0.0031604	0.1581132	0.1681704	0.1865373	0.3590229
2. Weibull	0.0907442	0.4105709	0.4790585	0.5216195	0.5525972
3. Gompertz	0.2169796	0.3698466	0.5818235	0.8071868	1.0000000
4. Log-normal	0.0022958	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
11. Spline 1 knot odds	0.0040186	0.0370407	0.0534928	0.0956147	0.3493116
12. Spline 2 knots odds	0.0029239	0.0397013	0.0573770	0.1025038	0.3469030
13. Spline 3 knots odds	0.0031346	0.0443526	0.0641665	0.1145082	0.3547245
14. Spline 1 knot normal	0.0001727	0.0667705	0.0870224	0.1315769	0.3327152
15. Spline 2 knots normal	0.0003302	0.0575542	0.0758377	0.1164719	0.3361441
16. Spline 3 knots normal	0.0005575	0.0702242	0.0912163	0.1362709	0.3562720

E: Hazard function (parametric curves)

smoothed hazard rate vs *time*

Legend:
1. Exponential
2. Weibull
3. Gompertz
4. Log–normal
5. Log–logistic
6. Gamma
7. Generalised Gamma

F: Hazard function (spline curves)

smoothed hazard rate vs *time*

Legend:
8. Spline 1 knot hazard
9. Spline 2 knots hazard
10. Spline 3 knots hazard
11. Spline 1 knot odds
12. Spline 2 knots odds
13. Spline 3 knots odds
14. Spline 1 knot normal
15. Spline 2 knots normal
16. Spline 3 knots normal
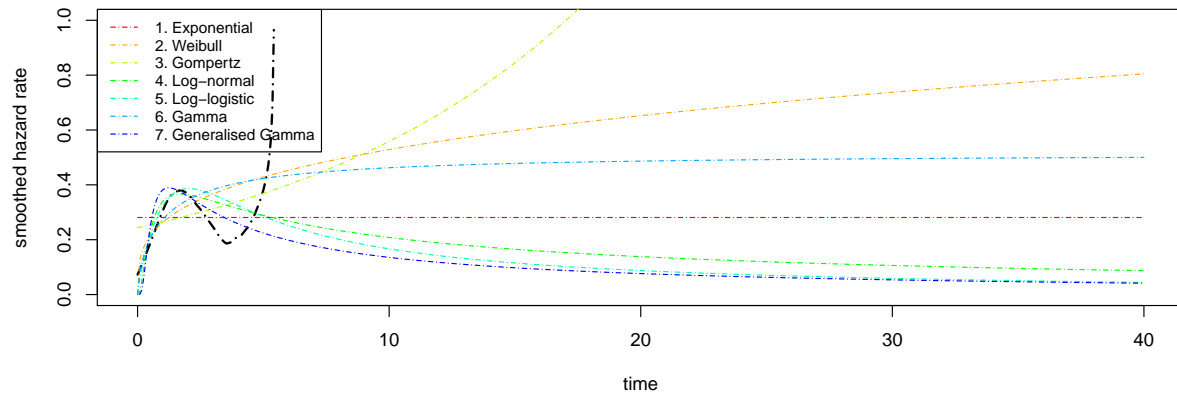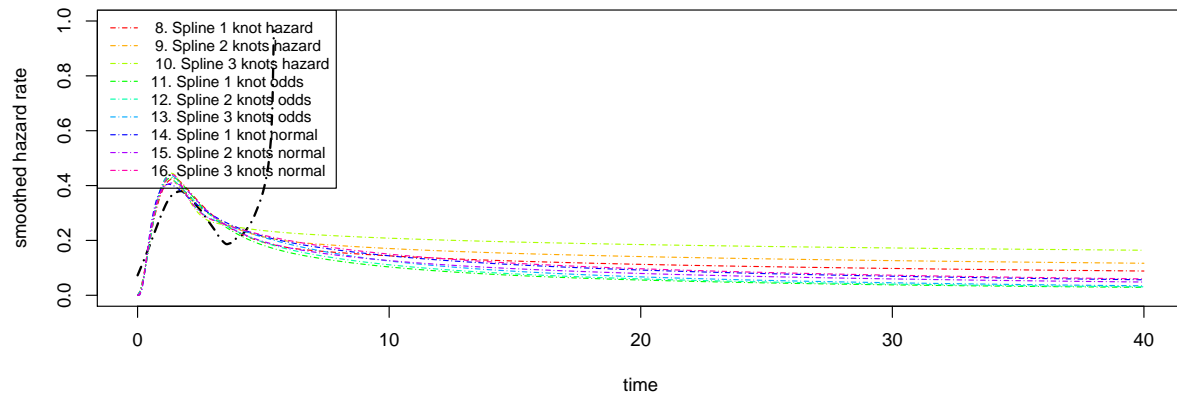
Session information

```
## 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] hdrcde_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
```