Final Report

randy

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Table of Contents

[Goal of the analysis 2](#_Toc169695828)

[Final Table1 3](#_Toc169695829)

[Contingency Table 6](#_Toc169695830)

[Training 6](#_Toc169695831)

[1 Year Interval 6](#_Toc169695832)

[2 Year Interval 6](#_Toc169695833)

[3 Year Interval 7](#_Toc169695834)

[4 Year Interval 7](#_Toc169695835)

[5 Year Interval 7](#_Toc169695836)

[Testing 8](#_Toc169695837)

[1 Year Interval 8](#_Toc169695838)

[2 Year Interval 8](#_Toc169695839)

[3 Year Interval 8](#_Toc169695840)

[4 Year Interval 9](#_Toc169695841)

[5 Year Interval 9](#_Toc169695842)

[Final Model 10](#_Toc169695843)

[Value + Rate model 10](#_Toc169695844)

[Summarization 11](#_Toc169695845)

[SD Calculation for slope term 13](#_Toc169695846)

[Prediction Performance 14](#_Toc169695847)

[Training set 14](#_Toc169695848)

[Testing set 15](#_Toc169695849)

## Goal of the analysis

* ☒ Fit the final joint model with rate with JMbayes2 based on model selection results
* ☒ Table1
* ☒ Life Tables for Training and Testing datasets
* ☒ Dynamic prediction for the joint model
* ☒ Training dataset
  + ☒ Calculate the AUC for the joint model for (year)
  + ☒ Calculate the Brier score for the joint model for (year)
* ☒ Testing dataset
  + ☒ Calculate the AUC for the joint model for (year)
  + ☒ Calculate the Brier score for the joint model for (year)

## Final Table1

For testing dataset there are missings for amh and the visit numbers are different from the training.

| **Characteristics** | **Overall**, N = 9011 | **0Training**, N = 6001 | **1Testing**, N = 3011 |
| --- | --- | --- | --- |
| ***Baseline Age (years)*** |  |  |  |
| Mean (SD) | 46.38 (2.41) | 46.42 (2.41) | 46.29 (2.42) |
| Median | 46.00 | 46.00 | 46.00 |
| [Range] | [42.00, 53.00] | [42.00, 53.00] | [42.00, 53.00] |
| ***Ethnicity / Race*** |  |  |  |
| BLACK | 242 / 901 (27%) | 170 / 600 (28%) | 72 / 301 (24%) |
| CAUCA | 418 / 901 (46%) | 265 / 600 (44%) | 153 / 301 (51%) |
| CHINE | 99 / 901 (11%) | 62 / 600 (10%) | 37 / 301 (12%) |
| HISPA | 24 / 901 (2.7%) | 18 / 600 (3.0%) | 6 / 301 (2.0%) |
| JAPAN | 118 / 901 (13%) | 85 / 600 (14%) | 33 / 301 (11%) |
| ***Marital Status*** |  |  |  |
| Not Married/Partnered | 285 / 899 (32%) | 191 / 600 (32%) | 94 / 299 (31%) |
| Married/Partnered | 614 / 899 (68%) | 409 / 600 (68%) | 205 / 299 (69%) |
| Unknown | 2 | 0 | 2 |
| ***Alcohol Use*** |  |  |  |
| None | 467 / 901 (52%) | 308 / 600 (51%) | 159 / 301 (53%) |
| <1/wk | 111 / 901 (12%) | 71 / 600 (12%) | 40 / 301 (13%) |
| 1-7/wk | 222 / 901 (25%) | 161 / 600 (27%) | 61 / 301 (20%) |
| >7/wk | 101 / 901 (11%) | 60 / 600 (10%) | 41 / 301 (14%) |
| ***Smoking History*** |  |  |  |
| Never Smoked | 562 / 901 (62%) | 373 / 600 (62%) | 189 / 301 (63%) |
| Past Only | 220 / 901 (24%) | 149 / 600 (25%) | 71 / 301 (24%) |
| Current Smoker | 119 / 901 (13%) | 78 / 600 (13%) | 41 / 301 (14%) |
| ***Ever use of BC Pills*** |  |  |  |
| Never | 235 / 897 (26%) | 155 / 600 (26%) | 80 / 297 (27%) |
| Ever use BC pills | 662 / 897 (74%) | 445 / 600 (74%) | 217 / 297 (73%) |
| Unknown | 4 | 0 | 4 |
| ***BMI*** |  |  |  |
| Mean (SD) | 28 (7) | 28 (7) | 28 (7) |
| Median | 26 | 26 | 26 |
| [Range] | [16, 57] | [16, 56] | [16, 57] |
| ***Overall Health*** |  |  |  |
| Excellent | 224 / 901 (25%) | 147 / 600 (25%) | 77 / 301 (26%) |
| Very Good | 353 / 901 (39%) | 233 / 600 (39%) | 120 / 301 (40%) |
| Good | 224 / 901 (25%) | 151 / 600 (25%) | 73 / 301 (24%) |
| Fair/Poor | 100 / 901 (11%) | 69 / 600 (12%) | 31 / 301 (10%) |
| ***Physical Activity Score*** |  |  |  |
| Mean (SD) | 7.81 (1.75) | 7.75 (1.77) | 7.93 (1.70) |
| Median | 7.70 | 7.60 | 7.90 |
| [Range] | [3.40, 12.80] | [3.40, 12.80] | [3.80, 12.30] |
| ***Baseline AMH*** |  |  |  |
| Mean (SD) | 538 (687) | 540 (702) | 534 (658) |
| Median | 271 | 273 | 266 |
| [Range] | [1, 4,652] | [1, 4,652] | [1, 3,621] |
| ***Menopausal Status*** |  |  |  |
| Pre | 333 / 901 (37%) | 222 / 600 (37%) | 111 / 301 (37%) |
| Early Peri | 568 / 901 (63%) | 378 / 600 (63%) | 190 / 301 (63%) |
| Late Peri | 0 / 901 (0%) | 0 / 600 (0%) | 0 / 301 (0%) |
| Post | 0 / 901 (0%) | 0 / 600 (0%) | 0 / 301 (0%) |
| ***Event Time*** |  |  |  |
| Mean (SD) | 10.97 (2.48) | 10.98 (2.51) | 10.94 (2.42) |
| Median | 10.96 | 11.05 | 10.82 |
| [Range] | [3.59, 20.10] | [3.59, 20.10] | [4.42, 17.69] |
| ***Employment Status*** |  |  |  |
| Unemployed | 158 / 901 (18%) | 104 / 600 (17%) | 54 / 301 (18%) |
| Employed | 743 / 901 (82%) | 496 / 600 (83%) | 247 / 301 (82%) |
| ***Educational Attainment*** |  |  |  |
| High School or Less | 186 / 900 (21%) | 125 / 600 (21%) | 61 / 300 (20%) |
| Some College | 272 / 900 (30%) | 190 / 600 (32%) | 82 / 300 (27%) |
| College degree or higher | 442 / 900 (49%) | 285 / 600 (48%) | 157 / 300 (52%) |
| Unknown | 1 | 0 | 1 |
| ***Study Site*** |  |  |  |
| B | 146 / 901 (16%) | 96 / 600 (16%) | 50 / 301 (17%) |
| C | 125 / 901 (14%) | 76 / 600 (13%) | 49 / 301 (16%) |
| M | 144 / 901 (16%) | 103 / 600 (17%) | 41 / 301 (14%) |
| NJ | 35 / 901 (3.9%) | 27 / 600 (4.5%) | 8 / 301 (2.7%) |
| P | 124 / 901 (14%) | 74 / 600 (12%) | 50 / 301 (17%) |
| UCD | 159 / 901 (18%) | 102 / 600 (17%) | 57 / 301 (19%) |
| UCLA | 168 / 901 (19%) | 122 / 600 (20%) | 46 / 301 (15%) |
| ***Visiting Numbers*** |  |  |  |
| Mean (SD) | 5.54 (2.10) | 5.54 (2.14) | 5.54 (2.02) |
| Median | 5.00 | 5.00 | 5.00 |
| [Range] | [3.00, 11.00] | [3.00, 11.00] | [3.00, 10.00] |
| 1n / N (%) | | | |

## Contingency Table

### Training

### 1 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 1 | 0 | 601 |
| 1 | 2 | 0 | 601 |
| 2 | 3 | 0 | 601 |
| 3 | 4 | 2 | 600 |
| 4 | 5 | 4 | 598 |
| 5 | 6 | 6 | 594 |
| 6 | 7 | 22 | 588 |
| 7 | 8 | 35 | 566 |
| 8 | 9 | 58 | 531 |
| 9 | 10 | 81 | 473 |
| 10 | 11 | 90 | 392 |
| 11 | 12 | 93 | 302 |
| 12 | 13 | 84 | 209 |
| 13 | 14 | 59 | 125 |
| 14 | 15 | 32 | 66 |
| 15 | 16 | 16 | 34 |
| 16 | 17 | 11 | 18 |
| 17 | 18 | 6 | 7 |
| 20 | 21 | 1 | 1 |

### 2 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 2 | 0 | 601 |
| 2 | 4 | 2 | 601 |
| 4 | 6 | 10 | 598 |
| 6 | 8 | 57 | 588 |
| 8 | 10 | 139 | 531 |
| 10 | 12 | 183 | 392 |
| 12 | 14 | 143 | 209 |
| 14 | 16 | 48 | 66 |
| 16 | 18 | 17 | 18 |
| 20 | 22 | 1 | 1 |

### 3 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 3 | 0 | 601 |
| 3 | 6 | 12 | 600 |
| 6 | 9 | 115 | 588 |
| 9 | 12 | 264 | 473 |
| 12 | 15 | 175 | 209 |
| 15 | 18 | 33 | 34 |
| 18 | 21 | 1 | 1 |

### 4 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 4 | 2 | 601 |
| 4 | 8 | 67 | 598 |
| 8 | 12 | 322 | 531 |
| 12 | 16 | 191 | 209 |
| 16 | 20 | 17 | 18 |

### 5 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 5 | 6 | 601 |
| 5 | 10 | 202 | 594 |
| 10 | 15 | 358 | 392 |
| 15 | 20 | 33 | 34 |

### Testing

### 1 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 1 | 0 | 302 |
| 1 | 2 | 0 | 302 |
| 2 | 3 | 0 | 302 |
| 4 | 5 | 1 | 301 |
| 5 | 6 | 2 | 300 |
| 6 | 7 | 12 | 298 |
| 7 | 8 | 21 | 286 |
| 8 | 9 | 34 | 265 |
| 9 | 10 | 33 | 231 |
| 10 | 11 | 59 | 198 |
| 11 | 12 | 49 | 139 |
| 12 | 13 | 29 | 90 |
| 13 | 14 | 29 | 61 |
| 14 | 15 | 15 | 32 |
| 15 | 16 | 12 | 17 |
| 16 | 17 | 2 | 5 |
| 17 | 18 | 3 | 3 |

### 2 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 2 | 0 | 302 |
| 2 | 4 | 0 | 302 |
| 4 | 6 | 3 | 301 |
| 6 | 8 | 33 | 298 |
| 8 | 10 | 67 | 265 |
| 10 | 12 | 108 | 198 |
| 12 | 14 | 58 | 90 |
| 14 | 16 | 27 | 32 |
| 16 | 18 | 5 | 5 |

### 3 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 3 | 0 | 302 |
| 3 | 6 | 3 | 301 |
| 6 | 9 | 67 | 298 |
| 9 | 12 | 141 | 231 |
| 12 | 15 | 73 | 90 |
| 15 | 18 | 17 | 17 |

### 4 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 4 | 0 | 302 |
| 4 | 8 | 36 | 301 |
| 8 | 12 | 175 | 265 |
| 12 | 16 | 85 | 90 |
| 16 | 20 | 5 | 5 |

### 5 Year Interval

| Tstart | Tend | Events | AtRisks |
| --- | --- | --- | --- |
| 0 | 5 | 1 | 302 |
| 5 | 10 | 102 | 300 |
| 10 | 15 | 181 | 198 |
| 15 | 20 | 17 | 17 |

## Final Model

### Value + Rate model

Fitting the model with:

* Chain 5
* Iteration 500k
* Thinning 50
* Total iterations of 50k

### Summarization

#>   
#> Call:  
#> Data Descriptives:  
#> Number of Groups: 600 Number of events: 600 (100%)  
#> Number of Observations:  
#> lamh: 3326  
#>   
#> DIC WAIC LPML  
#> marginal 1582856.93 3.098274e+14 -1.972734e+09  
#> conditional 12568.56 1.243650e+04 -7.035887e+03  
#>   
#> Random-effects covariance matrix:  
#>   
#> StdDev Corr  
#> (Intr) 1.4337 (Intr)  
#> time 0.0554 0.5626  
#>   
#> Survival Outcome:  
#> Mean StDev 2.5% 97.5% P Rhat  
#> as.factor(bmi\_cat)2 -1.7653 0.9776 -3.8803 -0.0204 0.0478 1.0915  
#> as.factor(bmi\_cat)3 -4.1637 1.2015 -6.7940 -2.1801 0.0000 1.3149  
#> ethnic\_black -1.8183 0.9090 -3.8019 -0.2063 0.0270 1.1094  
#> ethnic\_chine -0.5666 1.4562 -3.5373 2.2573 0.6963 1.0191  
#> ethnic\_hispa -2.9555 3.0372 -9.2317 2.8380 0.3164 1.0236  
#> ethnic\_japan -0.0405 1.3552 -2.7209 2.6614 0.9690 1.0154  
#> site\_c 0.8305 1.1303 -1.3235 3.1756 0.4524 1.0208  
#> site\_m 1.4957 1.0779 -0.5081 3.7606 0.1423 1.0487  
#> site\_nj 3.1132 2.5748 -1.7007 8.5777 0.2066 1.0306  
#> site\_p 2.1477 1.2220 -0.0466 4.7813 0.0557 1.0724  
#> site\_ucd 0.2790 1.3536 -2.3839 3.0123 0.8378 1.0141  
#> site\_ucla 2.1235 1.4331 -0.5253 5.0853 0.1219 1.0680  
#> smoke\_current\_smoker 1.9266 1.0421 0.0660 4.1468 0.0430 1.1092  
#> smoke\_past\_only -0.1978 0.7382 -1.6563 1.2888 0.7808 1.0199  
#> value(lamh) -1.5168 0.6703 -2.7496 -0.1883 0.0226 1.0634  
#> slope(lamh) -168.5483 36.0005 -249.3613 -108.8513 0.0000 1.5492  
#>   
#> Longitudinal Outcome: lamh (family = gaussian, link = identity)  
#> Mean StDev 2.5% 97.5% P Rhat  
#> (Intercept) 7.8514 0.0981 7.6627 8.0449 0 1.0480  
#> time -0.5953 0.0116 -0.6184 -0.5728 0 1.1215  
#> sigma 1.3194 0.0179 1.2848 1.3551 0 1.0000  
#>   
#> MCMC summary:  
#> chains: 5   
#> iterations per chain: 7e+05   
#> burn-in per chain: 2e+05   
#> thinning: 50   
#> time: 14.4 hours

### SD Calculation for slope term

Hence, we have the final results for the variability of the slope term.

* The random effect slope term based on MCMC is = 0.0146757;
* The fixed effect slope term = 0.0116406;
* We have the pooled = 0.0187318.
* The 95% CI for the slope term is -0.5984049 (-0.6320562, -0.5586275)

## Prediction Performance

### Training set

#### AUC

|  | Dt1 | Dt2 | Dt3 | Dt4 | Dt5 |
| --- | --- | --- | --- | --- | --- |
| Tstart2 | NA | 0.4739 | 0.7701 | 0.7270 | 0.7272 |
| Tstart3 | 0.7062 | 0.8250 | 0.7565 | 0.7925 | 0.7755 |
| Tstart4 | 0.8227 | 0.7686 | 0.7975 | 0.7682 | 0.7576 |
| Tstart5 | 0.7517 | 0.7693 | 0.7524 | 0.7580 | 0.8016 |
| Tstart6 | 0.7840 | 0.8101 | 0.7918 | 0.8030 | 0.7935 |
| Tstart8 | 0.7892 | 0.8028 | 0.7814 | 0.7746 | 0.8105 |

#### Brier Scores

|  | Dt1 | Dt2 | Dt3 | Dt4 | Dt5 |
| --- | --- | --- | --- | --- | --- |
| Tstart2 | NA | 0.0138 | 0.0324 | 0.0630 | 0.1196 |
| Tstart3 | 0.0091 | 0.0284 | 0.0574 | 0.1116 | 0.1543 |
| Tstart4 | 0.0118 | 0.0296 | 0.0837 | 0.1307 | 0.1847 |
| Tstart5 | 0.0234 | 0.0685 | 0.1208 | 0.1716 | 0.1851 |
| Tstart6 | 0.0542 | 0.0964 | 0.1491 | 0.1784 | 0.1871 |
| Tstart8 | 0.1151 | 0.1606 | 0.1922 | 0.1853 | 0.1315 |

### Testing set

#### AUC

|  | Dt1 | Dt2 | Dt3 | Dt4 | Dt5 |
| --- | --- | --- | --- | --- | --- |
| Tstart2 | NA | NA | 0.9615 | 0.6820 | 0.7512 |
| Tstart3 | NA | 0.9714 | 0.9432 | 0.9238 | 0.7250 |
| Tstart4 | 0.9953 | 0.9163 | 0.8876 | 0.7834 | 0.7842 |
| Tstart5 | 0.9321 | 0.8661 | 0.8346 | 0.7905 | 0.7184 |
| Tstart6 | 0.8628 | 0.8537 | 0.7837 | 0.7113 | 0.7067 |
| Tstart8 | 0.7681 | 0.6955 | 0.7328 | 0.7485 | 0.7717 |

#### Brier Scores

|  | Dt1 | Dt2 | Dt3 | Dt4 | Dt5 |
| --- | --- | --- | --- | --- | --- |
| Tstart2 | NA | NA | 0.0078 | 0.0290 | 0.0897 |
| Tstart3 | NA | 0.0057 | 0.0186 | 0.0521 | 0.1401 |
| Tstart4 | 0.0041 | 0.0154 | 0.0562 | 0.1182 | 0.1685 |
| Tstart5 | 0.0174 | 0.0512 | 0.0921 | 0.1541 | 0.2102 |
| Tstart6 | 0.0444 | 0.0839 | 0.1433 | 0.2062 | 0.2282 |
| Tstart8 | 0.1073 | 0.1903 | 0.2156 | 0.1974 | 0.1469 |