

Summary of analysis for survival model meta-analysis

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1 Summary

This is a document that outlines analysis using survival models and meta-analyzing hazard ratios in the DataSHIELD platform.

2 Survival analysis in DataSHIELD

All code is available here:

- https://github.com/neelsoumya/dsBaseClient/tree/absolute_newbie_client
- https://github.com/neelsoumya/dsBase/tree/absolute_newbie
- https://github.com/neelsoumya/datashield_testing_basic/blob/master/development_plan.rmd
- https://github.com/neelsoumya/datashield_testing_basic/blob/master/development_plan.pdf
- https://github.com/neelsoumya/datashield_testing_basic/tree/master/gui/survival_models_gui

3 Model parameters

This report and the model has been run according to the following parameters.

Model	Exposure
Survival model	poultry

4 Meta-analysis model summary

A summary of the meta-analyzed model is shown below.

```
##
## Random-Effects Model (k = 7; tau^2 estimator: REML)
##
## tau^2 (estimated amount of total heterogeneity): 0.0000 (SE = 0.0000)
## tau (square root of estimated tau^2 value):      0.0026
## I^2 (total heterogeneity / total variability):   76.31%
## H^2 (total variability / sampling variability):   4.22
##
## Test for Heterogeneity:
## Q(df = 6) = 20.9055, p-val = 0.0019
##
## Model Results:
##
## estimate      se      zval      pval      ci.lb      ci.ub
##    1.0030    0.0012   845.6114   <.0001    1.0007    1.0053   ***
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5 Cox model summary

A summary of the fitted Cox model for each study is shown below.

```
## Summary of Cox model .....

## $study1
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
##      ties = ties, singular.ok = singular.ok, model = model, x = x,
##      y = y)
##
##      n= 814, number of events= 263
##
##              coef exp(coef)  se(coef)      z Pr(>|z|)
## POULTRY      0.008259   1.008293  0.002697   3.062 0.002200 **
## AGEBASE      0.036657   1.037338  0.009654   3.797 0.000146 ***
## GENDER0             NA             NA  0.000000      NA      NA
## PA2      -0.139645   0.869667  0.162268  -0.861 0.389469
## PA3      -0.132103   0.876251  0.176617  -0.748 0.454482
## PA4      -0.626155   0.534643  0.309900  -2.021 0.043331 *
## SMOKING2  0.186458   1.204974  0.149540   1.247 0.212443
## SMOKING3 -0.192741   0.824696  0.248343  -0.776 0.437687
```

```

## SMOKING4 0.165784 1.180318 0.263561 0.629 0.529338
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##      exp(coef) exp(-coef) lower .95 upper .95
## POULTRY      1.0083      0.9918      1.0030      1.0136
## AGEBASE      1.0373      0.9640      1.0179      1.0572
## GENDER0      NA          NA          NA          NA
## PA2          0.8697      1.1499      0.6327      1.1953
## PA3          0.8763      1.1412      0.6199      1.2387
## PA4          0.5346      1.8704      0.2913      0.9814
## SMOKING2     1.2050      0.8299      0.8989      1.6153
## SMOKING3     0.8247      1.2126      0.5069      1.3418
## SMOKING4     1.1803      0.8472      0.7041      1.9785
##
## Concordance= 0.623 (se = 0.02 )
## Likelihood ratio test= 33.32 on 8 df,  p=5e-05
## Wald test              = 33.99 on 8 df,  p=4e-05
## Score (logrank) test = 34.41 on 8 df,  p=3e-05
##
##
## $study2
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
##      ties = ties, singular.ok = singular.ok, model = model, x = x,
##      y = y)
##
##      n= 3045, number of events= 1246
##      (4 observations deleted due to missingness)
##
##      coef exp(coef) se(coef)      z Pr(>|z|)
## POULTRY  0.006312  1.006331  0.001353  4.664 3.10e-06 ***
## AGEBASE  0.037132  1.037830  0.003827  9.703 < 2e-16 ***
## GENDER0  0.284419  1.328989  0.065476  4.344 1.40e-05 ***
## PA2     -0.351082  0.703926  0.067933 -5.168 2.37e-07 ***
## PA3     -0.387865  0.678504  0.091371 -4.245 2.19e-05 ***
## PA4     -0.395204  0.673543  0.098311 -4.020 5.82e-05 ***
## SMOKING2 -0.044044  0.956912  0.073785 -0.597 0.5506
## SMOKING3  0.140839  1.151239  0.070064  2.010 0.0444 *
## SMOKING4 -0.783791  0.456672  0.710538 -1.103 0.2700
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##      exp(coef) exp(-coef) lower .95 upper .95
## POULTRY      1.0063      0.9937      1.0037      1.0090
## AGEBASE      1.0378      0.9635      1.0301      1.0456
## GENDER0      1.3290      0.7525      1.1689      1.5110
## PA2          0.7039      1.4206      0.6162      0.8042
## PA3          0.6785      1.4738      0.5673      0.8116
## PA4          0.6735      1.4847      0.5555      0.8167
## SMOKING2     0.9569      1.0450      0.8281      1.1058
## SMOKING3     1.1512      0.8686      1.0035      1.3207
## SMOKING4     0.4567      2.1898      0.1134      1.8383
##

```

```

## Concordance= 0.643 (se = 0.01 )
## Likelihood ratio test= 183.3 on 9 df, p=<2e-16
## Wald test = 182 on 9 df, p=<2e-16
## Score (logrank) test = 183.9 on 9 df, p=<2e-16
##
##
## $study3
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
## ties = ties, singular.ok = singular.ok, model = model, x = x,
## y = y)
##
## n= 5605, number of events= 2360
##
##          coef exp(coef) se(coef)      z Pr(>|z|)
## POULTRY    0.0019543  1.0019562  0.0006908  2.829  0.00467 **
## AGEBASE    0.0388380  1.0396020  0.0027714 14.014 < 2e-16 ***
## GENDER0    0.4063890  1.5013865  0.0517118  7.859 3.88e-15 ***
## PA2        -0.0584568  0.9432190  0.0495506 -1.180  0.23810
## PA3        -0.1269046  0.8808177  0.0614389 -2.066  0.03887 *
## PA4        -0.2077808  0.8123851  0.0747256 -2.781  0.00543 **
## SMOKING2   -0.0143287  0.9857735  0.0628746 -0.228  0.81973
## SMOKING3    0.1160177  1.1230158  0.0535209  2.168  0.03018 *
## SMOKING4    0.5286285  1.6966037  0.7084468  0.746  0.45556
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## POULTRY          1.0020      0.9980      1.0006      1.0033
## AGEBASE          1.0396      0.9619      1.0340      1.0453
## GENDER0          1.5014      0.6661      1.3567      1.6615
## PA2              0.9432      1.0602      0.8559      1.0394
## PA3              0.8808      1.1353      0.7809      0.9935
## PA4              0.8124      1.2309      0.7017      0.9405
## SMOKING2         0.9858      1.0144      0.8715      1.1151
## SMOKING3         1.1230      0.8905      1.0112      1.2472
## SMOKING4         1.6966      0.5894      0.4232      6.8016
##
## Concordance= 0.64 (se = 0.007 )
## Likelihood ratio test= 363.2 on 9 df, p=<2e-16
## Wald test = 360.3 on 9 df, p=<2e-16
## Score (logrank) test = 366 on 9 df, p=<2e-16
##
##
## $study4
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
## ties = ties, singular.ok = singular.ok, model = model, x = x,
## y = y)
##
## n= 2107, number of events= 728
## (113 observations deleted due to missingness)
##
##          coef exp(coef) se(coef)      z Pr(>|z|)

```

```

## POULTRY -0.0009743 0.9990261 0.0018951 -0.514 0.607147
## AGEBASE 0.0216436 1.0218795 0.0041491 5.216 1.82e-07 ***
## GENDER0 0.2244742 1.2516645 0.0774700 2.898 0.003761 **
## PA2 -0.2905915 0.7478211 0.0935787 -3.105 0.001901 **
## PA3 -0.3918253 0.6758222 0.1136182 -3.449 0.000563 ***
## PA4 -0.3029240 0.7386553 0.1283061 -2.361 0.018228 *
## SMOKING2 0.1859179 1.2043234 0.0841615 2.209 0.027170 *
## SMOKING3 0.0898226 1.0939801 0.1180628 0.761 0.446775
## SMOKING4 0.2552638 1.2908021 0.2845787 0.897 0.369725
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## exp(coef) exp(-coef) lower .95 upper .95
## POULTRY 0.9990 1.0010 0.9953 1.0027
## AGEBASE 1.0219 0.9786 1.0136 1.0302
## GENDER0 1.2517 0.7989 1.0753 1.4569
## PA2 0.7478 1.3372 0.6225 0.8984
## PA3 0.6758 1.4797 0.5409 0.8444
## PA4 0.7387 1.3538 0.5744 0.9499
## SMOKING2 1.2043 0.8303 1.0212 1.4203
## SMOKING3 1.0940 0.9141 0.8680 1.3788
## SMOKING4 1.2908 0.7747 0.7390 2.2547
##
## Concordance= 0.629 (se = 0.012 )
## Likelihood ratio test= 98.91 on 9 df, p=<2e-16
## Wald test = 96.89 on 9 df, p=<2e-16
## Score (logrank) test = 98.55 on 9 df, p=<2e-16
##
##
## $study5
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
## ties = ties, singular.ok = singular.ok, model = model, x = x,
## y = y)
##
## n= 2069, number of events= 745
## (144 observations deleted due to missingness)
##
## coef exp(coef) se(coef) z Pr(>|z|)
## POULTRY 5.189e-03 1.005e+00 2.379e-03 2.181 0.029210 *
## AGEBASE 4.871e-02 1.050e+00 4.801e-03 10.146 < 2e-16 ***
## GENDER0 4.775e-01 1.612e+00 1.035e-01 4.614 3.95e-06 ***
## PA2 -3.852e-01 6.803e-01 1.162e-01 -3.315 0.000918 ***
## PA3 -3.489e-01 7.055e-01 1.228e-01 -2.841 0.004503 **
## PA4 -5.570e-01 5.729e-01 1.174e-01 -4.745 2.09e-06 ***
## SMOKING2 7.371e-02 1.076e+00 8.550e-02 0.862 0.388637
## SMOKING3 2.365e-02 1.024e+00 9.636e-02 0.245 0.806124
## SMOKING4 -1.315e+01 1.939e-06 7.212e+02 -0.018 0.985449
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## exp(coef) exp(-coef) lower .95 upper .95
## POULTRY 1.005e+00 9.948e-01 1.0005 1.0099
## AGEBASE 1.050e+00 9.525e-01 1.0401 1.0598

```

```

## GENDER0 1.612e+00 6.203e-01 1.3161 1.9745
## PA2 6.803e-01 1.470e+00 0.5417 0.8543
## PA3 7.055e-01 1.418e+00 0.5545 0.8975
## PA4 5.729e-01 1.745e+00 0.4552 0.7212
## SMOKING2 1.076e+00 9.289e-01 0.9104 1.2729
## SMOKING3 1.024e+00 9.766e-01 0.8477 1.2368
## SMOKING4 1.939e-06 5.157e+05 0.0000 Inf
##
## Concordance= 0.659 (se = 0.012 )
## Likelihood ratio test= 167.9 on 9 df, p=<2e-16
## Wald test = 154.9 on 9 df, p=<2e-16
## Score (logrank) test = 158.1 on 9 df, p=<2e-16
##
##
## $study7
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
## ties = ties, singular.ok = singular.ok, model = model, x = x,
## y = y)
##
## n= 3420, number of events= 1497
##
##      coef exp(coef) se(coef)      z Pr(>|z|)
## POULTRY  0.001944 1.001945 0.001821 1.068 0.285735
## AGEBASE  0.053138 1.054575 0.003537 15.025 < 2e-16 ***
## GENDER0  0.343834 1.410345 0.056900 6.043 1.51e-09 ***
## PA2     -0.195901 0.822094 0.067909 -2.885 0.003917 **
## PA3     -0.291246 0.747332 0.076398 -3.812 0.000138 ***
## PA4     -0.303448 0.738268 0.084239 -3.602 0.000316 ***
## SMOKING2 0.242791 1.274802 0.061597 3.942 8.09e-05 ***
## SMOKING3 0.264102 1.302261 0.072198 3.658 0.000254 ***
## SMOKING4 -0.495348 0.609359 1.001980 -0.494 0.621045
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##      exp(coef) exp(-coef) lower .95 upper .95
## POULTRY      1.0019      0.9981      0.9984      1.0055
## AGEBASE      1.0546      0.9482      1.0473      1.0619
## GENDER0      1.4103      0.7090      1.2615      1.5767
## PA2          0.8221      1.2164      0.7196      0.9391
## PA3          0.7473      1.3381      0.6434      0.8680
## PA4          0.7383      1.3545      0.6259      0.8708
## SMOKING2     1.2748      0.7844      1.1298      1.4384
## SMOKING3     1.3023      0.7679      1.1304      1.5002
## SMOKING4     0.6094      1.6411      0.0855      4.3427
##
## Concordance= 0.696 (se = 0.009 )
## Likelihood ratio test= 413.6 on 9 df, p=<2e-16
## Wald test = 384.5 on 9 df, p=<2e-16
## Score (logrank) test = 397.2 on 9 df, p=<2e-16
##
##
## $study8
## Call:

```

```

## survival::coxph(formula = formula, data = dataTable, weights = weights,
##   ties = ties, singular.ok = singular.ok, model = model, x = x,
##   y = y)
##
##   n= 5167, number of events= 2363
##   (19 observations deleted due to missingness)
##
##               coef exp(coef)   se(coef)      z Pr(>|z|)
## POULTRY      0.0002034 1.0002034 0.0013437 0.151 0.879697
## AGEBASE      0.0176385 1.0177950 0.0022050 7.999 1.25e-15 ***
## GENDER0      0.2582253 1.2946305 0.0420403 6.142 8.13e-10 ***
## PA2          -0.2179843 0.8041381 0.0515820 -4.226 2.38e-05 ***
## PA3          -0.1970206 0.8211737 0.0567991 -3.469 0.000523 ***
## PA4          -0.2922857 0.7465552 0.0686133 -4.260 2.05e-05 ***
## SMOKING2     0.1347059 1.1442002 0.0496762 2.712 0.006694 **
## SMOKING3     0.0895323 1.0936626 0.0513898 1.742 0.081470 .
## SMOKING4    -0.0459120 0.9551260 0.2908950 -0.158 0.874591
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##               exp(coef) exp(-coef) lower .95 upper .95
## POULTRY          1.0002      0.9998   0.9976   1.0028
## AGEBASE          1.0178      0.9825   1.0134   1.0222
## GENDER0          1.2946      0.7724   1.1922   1.4058
## PA2              0.8041      1.2436   0.7268   0.8897
## PA3              0.8212      1.2178   0.7347   0.9179
## PA4              0.7466      1.3395   0.6526   0.8540
## SMOKING2         1.1442      0.8740   1.0380   1.2612
## SMOKING3         1.0937      0.9144   0.9889   1.2096
## SMOKING4         0.9551      1.0470   0.5401   1.6892
##
## Concordance= 0.598 (se = 0.008 )
## Likelihood ratio test= 165.5 on 9 df,  p=<2e-16
## Wald test              = 163.6 on 9 df,  p=<2e-16
## Score (logrank) test = 164.6 on 9 df,  p=<2e-16
##
##
## $study9
## Call:
## survival::coxph(formula = formula, data = dataTable, weights = weights,
##   ties = ties, singular.ok = singular.ok, model = model, x = x,
##   y = y)
##
##   n= 5167, number of events= 2363
##   (19 observations deleted due to missingness)
##
##               coef exp(coef)   se(coef)      z Pr(>|z|)
## POULTRY      0.0002034 1.0002034 0.0013437 0.151 0.879697
## AGEBASE      0.0176385 1.0177950 0.0022050 7.999 1.25e-15 ***
## GENDER0      0.2582253 1.2946305 0.0420403 6.142 8.13e-10 ***
## PA2          -0.2179843 0.8041381 0.0515820 -4.226 2.38e-05 ***
## PA3          -0.1970206 0.8211737 0.0567991 -3.469 0.000523 ***
## PA4          -0.2922857 0.7465552 0.0686133 -4.260 2.05e-05 ***
## SMOKING2     0.1347059 1.1442002 0.0496762 2.712 0.006694 **

```



```
## SMOKING3 0.0895323 1.0936626 0.0513898 1.742 0.081470 .
## SMOKING4 -0.0459120 0.9551260 0.2908950 -0.158 0.874591
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##      exp(coef) exp(-coef) lower .95 upper .95
## POULTRY      1.0002      0.9998      0.9976      1.0028
## AGEBASE      1.0178      0.9825      1.0134      1.0222
## GENDER0      1.2946      0.7724      1.1922      1.4058
## PA2          0.8041      1.2436      0.7268      0.8897
## PA3          0.8212      1.2178      0.7347      0.9179
## PA4          0.7466      1.3395      0.6526      0.8540
## SMOKING2     1.1442      0.8740      1.0380      1.2612
## SMOKING3     1.0937      0.9144      0.9889      1.2096
## SMOKING4     0.9551      1.0470      0.5401      1.6892
##
## Concordance= 0.598 (se = 0.008 )
## Likelihood ratio test= 165.5 on 9 df,  p=<2e-16
## Wald test              = 163.6 on 9 df,  p=<2e-16
## Score (logrank) test = 164.6 on 9 df,  p=<2e-16
```

6 Forest plot of meta-analyzed hazard ratios

We now outline the hazard ratios from the survival models which are meta-analyzed. We use the *metafor* package for meta-analysis. We show a forest plot below.

7 References

- <https://github.com/datashield>
- <http://www.metafor-project.org>
- https://github.com/neelsoumya/datashield_testing_basic/tree/master/gui/survival_models_gui

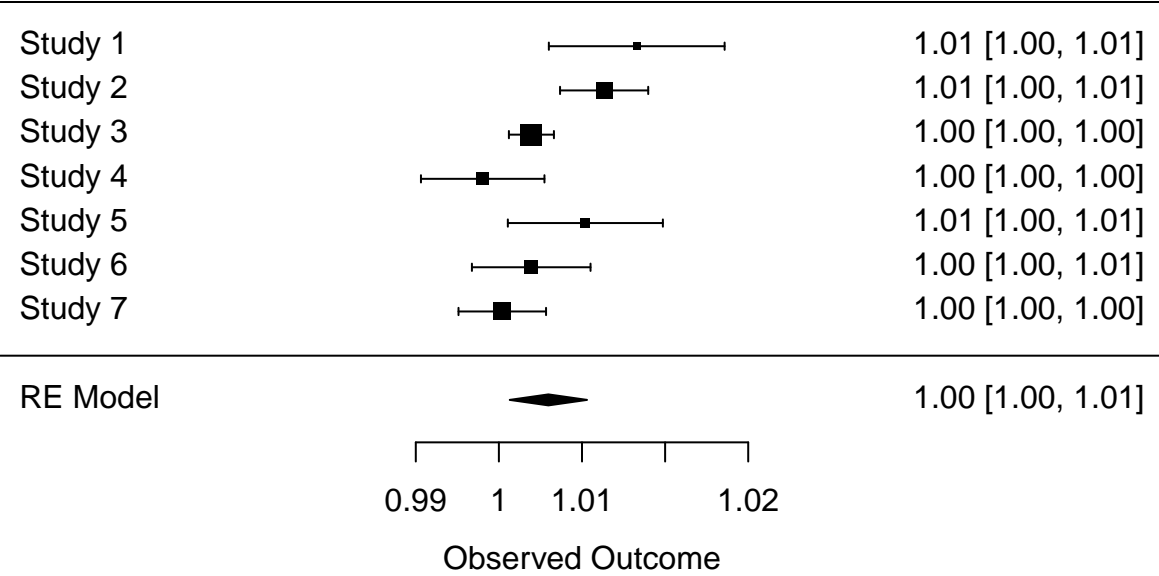


Figure 1: Forest plot of meta-analyzed hazard ratios.