

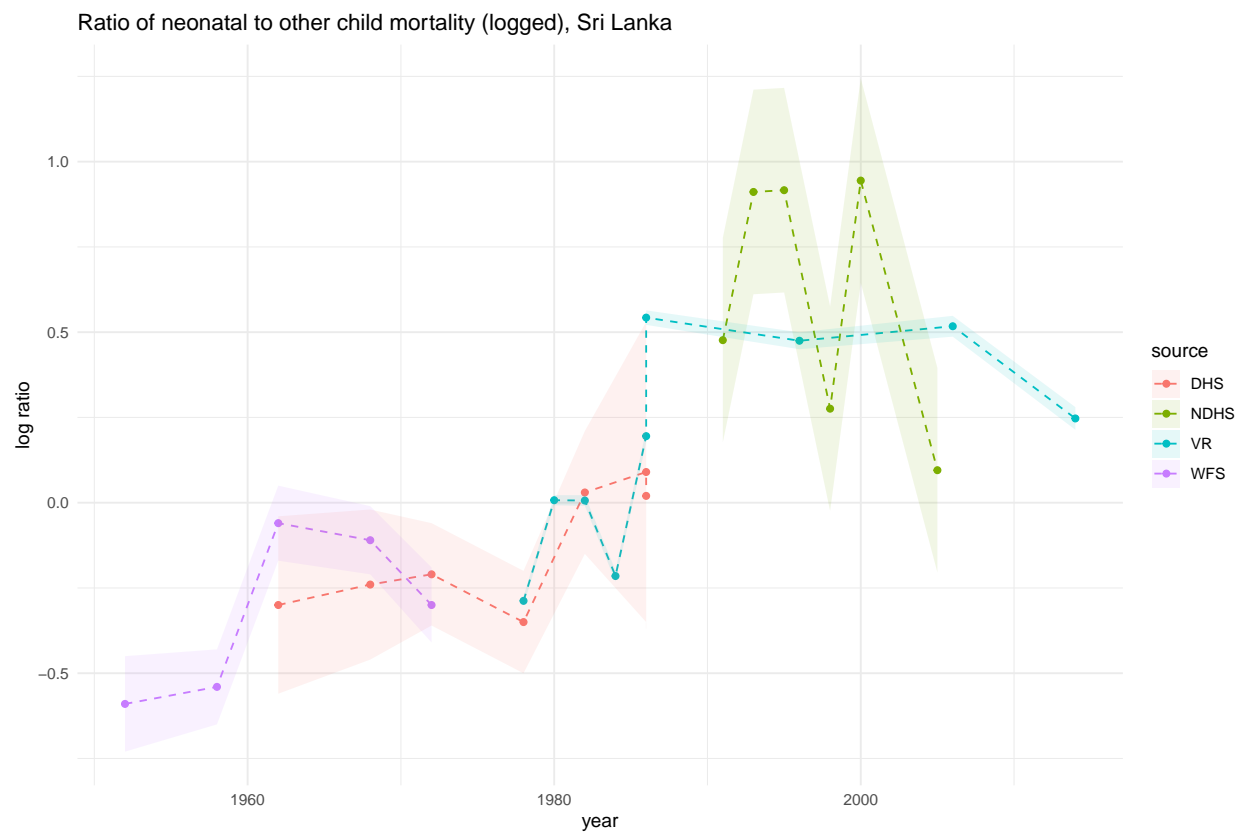
Week 10: Temporal data

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Child mortality in Sri Lanka

In this lab you will be fitting a couple of different models to the data about child mortality in Sri Lanka, which was used in the lecture. Here's the data and the plot from the lecture:



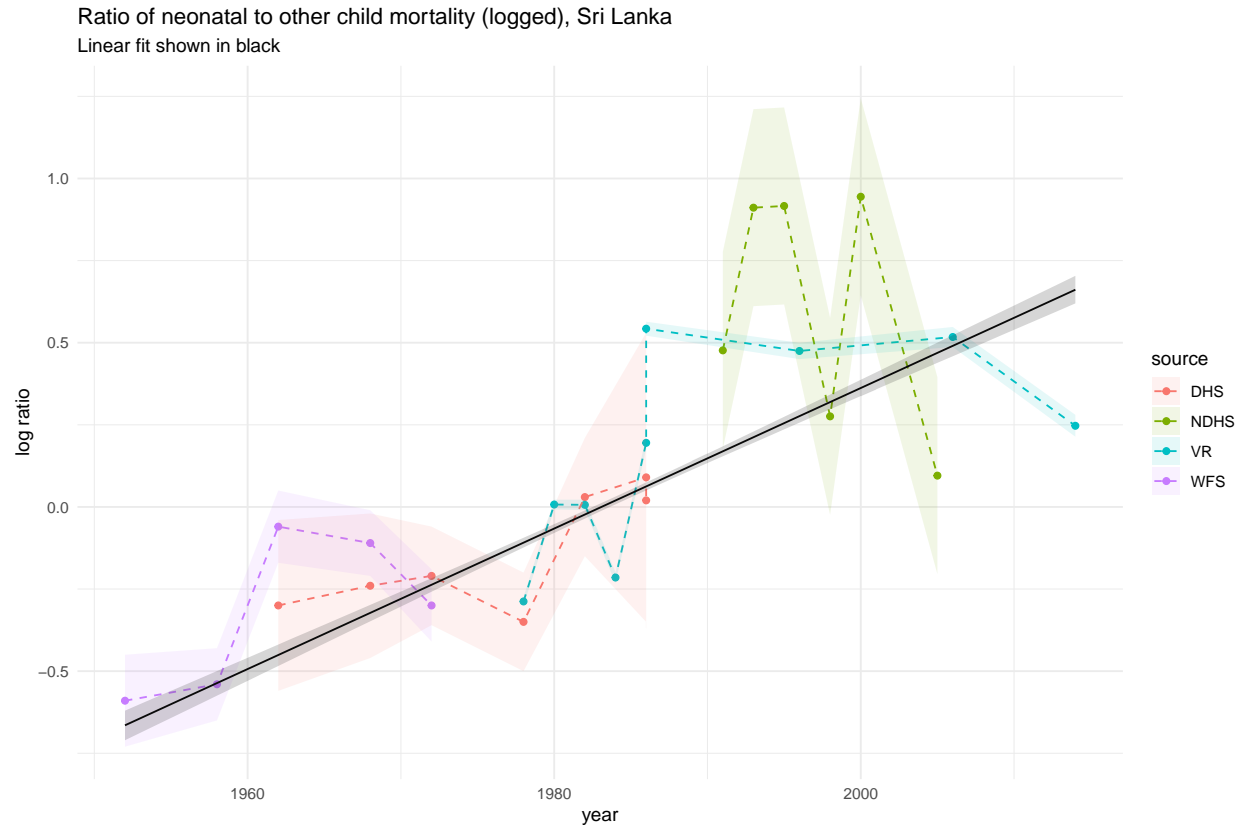
Fitting a linear model: Let's firstly fit a linear model in time to these data. Here's the code to do this:

Extract the results:

```
## # A tibble: 9 x 9
##       t .variable .value .lower .upper .width .point .interval year
##   <int> <chr>      <dbl> <dbl> <dbl> <dbl> <chr> <chr>    <int>
## 1     1 mu        -0.665 -0.710 -0.620  0.95 median qi      1952
## 2     2 mu        -0.643 -0.688 -0.600  0.95 median qi      1953
## 3     3 mu        -0.622 -0.665 -0.580  0.95 median qi      1954
```

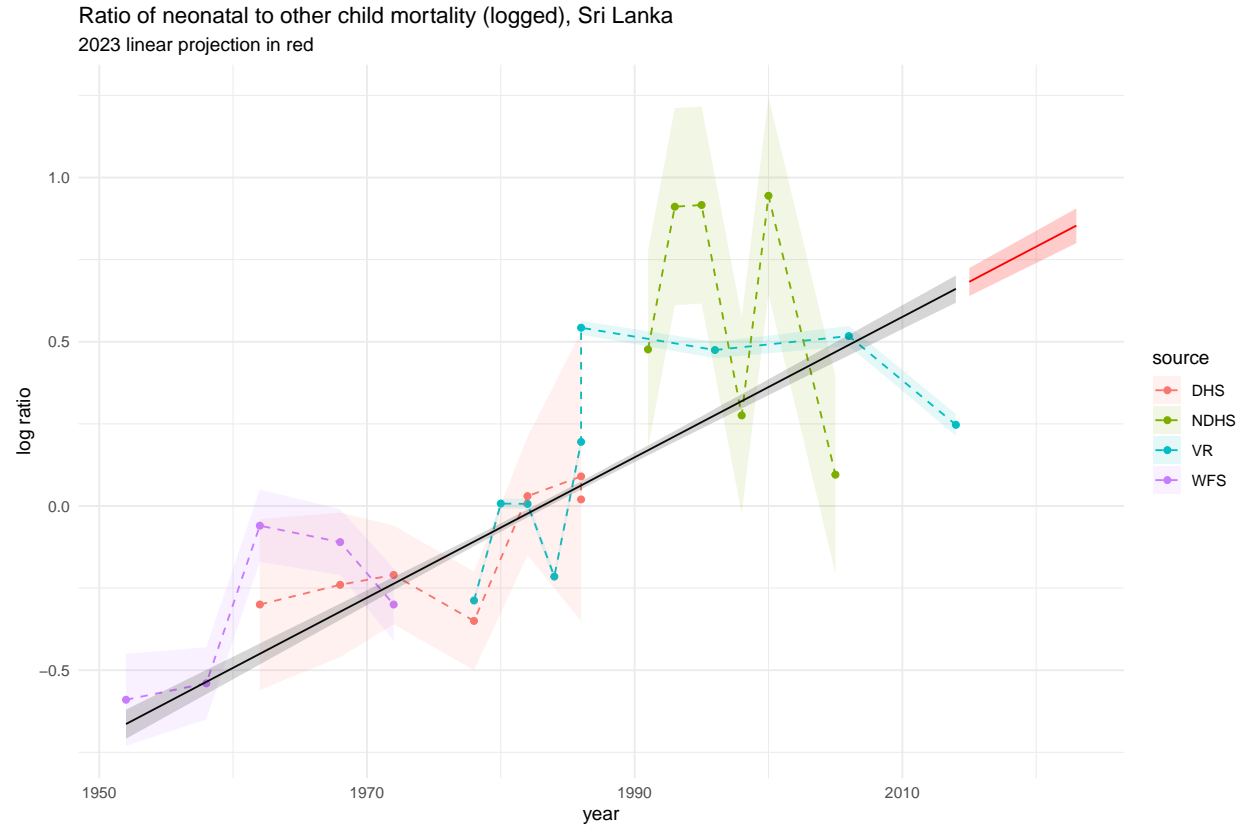
## 4	4 mu	-0.601	-0.643	-0.560	0.95	median	qi	1955
## 5	5 mu	-0.579	-0.620	-0.540	0.95	median	qi	1956
## 6	6 mu	-0.558	-0.597	-0.520	0.95	median	qi	1957
## 7	7 mu	-0.536	-0.575	-0.500	0.95	median	qi	1958
## 8	8 mu	-0.515	-0.552	-0.479	0.95	median	qi	1959
## 9	9 mu	-0.494	-0.530	-0.459	0.95	median	qi	1960

Plot the results:



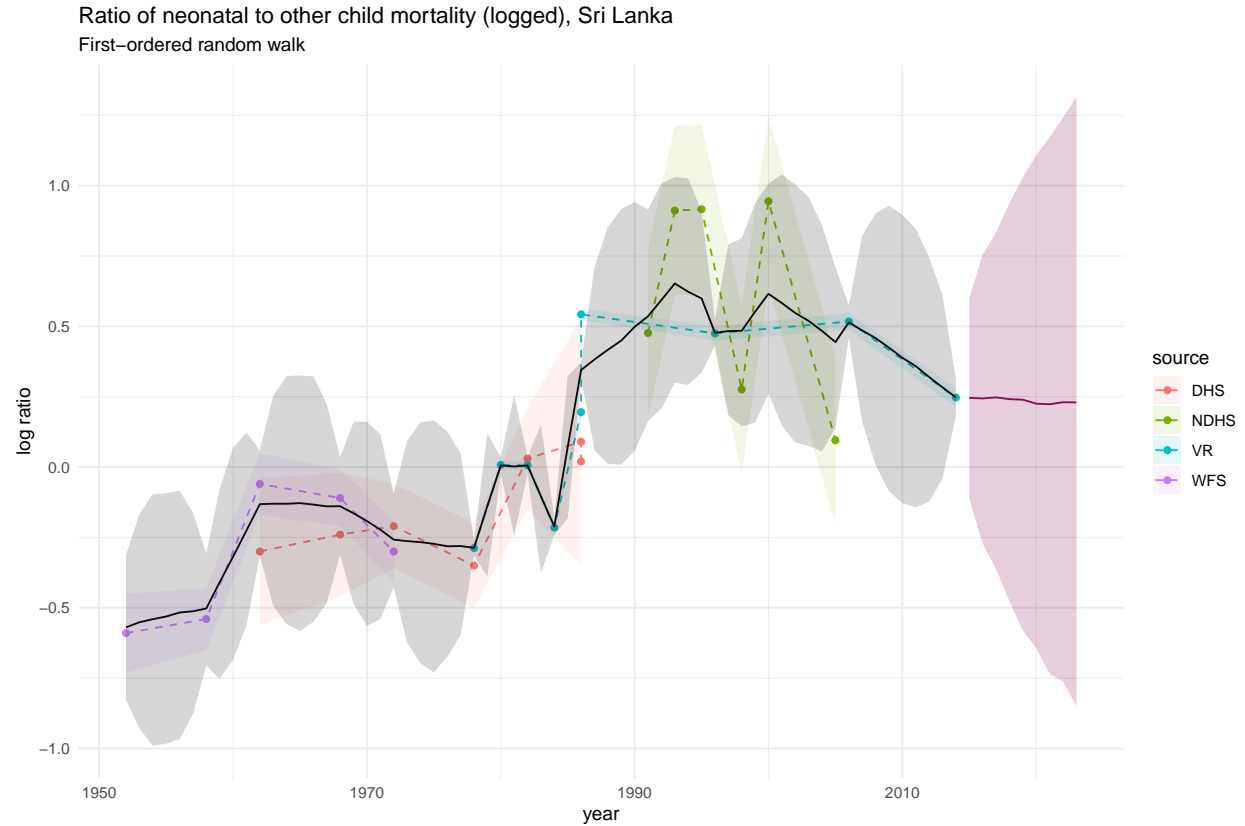
Question 1: Project the linear model above out to 2023 by adding a generated quantities block in Stan (do the projections based on the expected value μ). Plot the resulting projections on a graph similar to that above.

##	#	p	.variable	.value	.lower	.upper	.width	.point	.interval	year
##	<int>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>	<chr>	<int>	
## 1	1	mu_p	0.682	0.639	0.725	0.95	median	qi	2015	
## 2	2	mu_p	0.704	0.659	0.747	0.95	median	qi	2016	
## 3	3	mu_p	0.725	0.679	0.770	0.95	median	qi	2017	
## 4	4	mu_p	0.747	0.699	0.792	0.95	median	qi	2018	
## 5	5	mu_p	0.768	0.720	0.815	0.95	median	qi	2019	
## 6	6	mu_p	0.790	0.740	0.838	0.95	median	qi	2020	
## 7	7	mu_p	0.811	0.760	0.861	0.95	median	qi	2021	
## 8	8	mu_p	0.832	0.780	0.883	0.95	median	qi	2022	
## 9	9	mu_p	0.854	0.800	0.906	0.95	median	qi	2023	



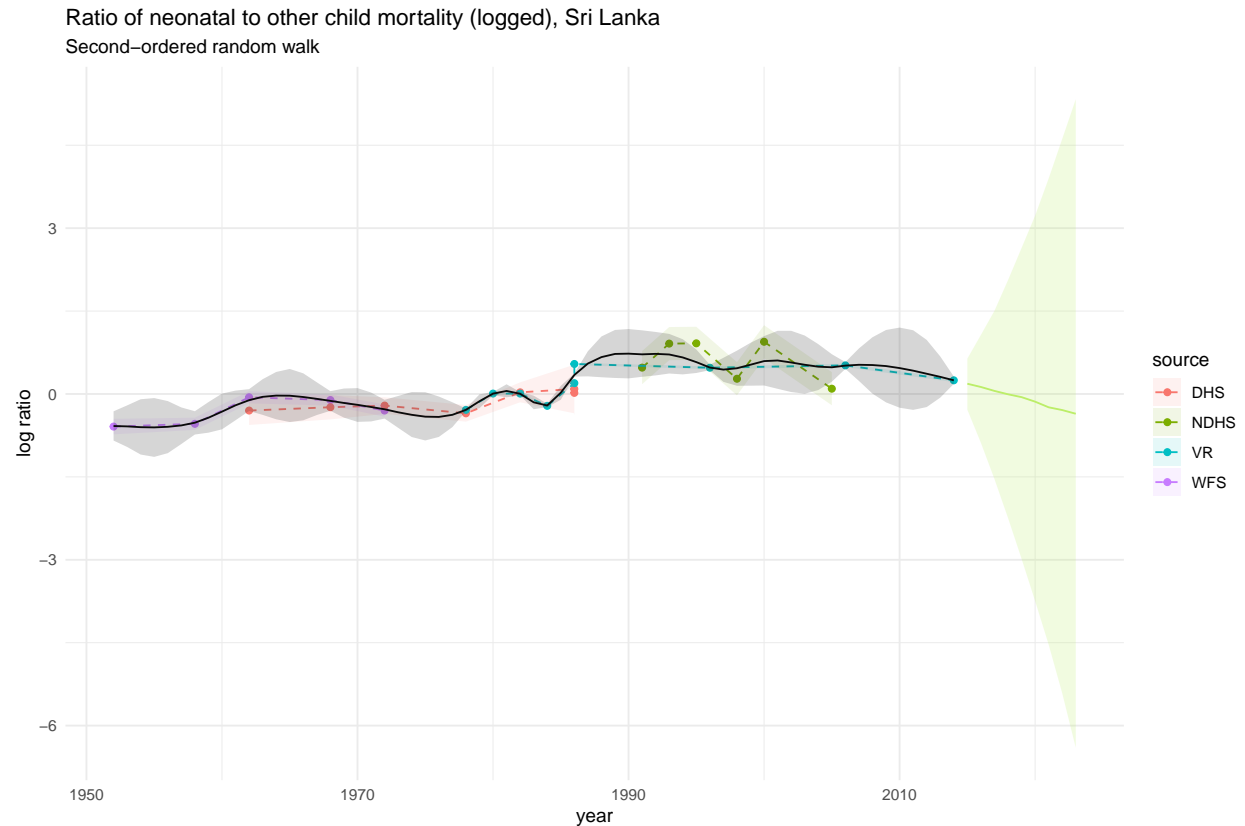
Question 2: Code up and estimate a first order random walk model to fit to the Sri Lankan data, taking into account measurement error, and project out to 2023.

```
## # A tibble: 9 x 9
##   p .variable .value .lower .upper .width .point .interval year
##   <int> <chr>    <dbl> <dbl> <dbl> <dbl> <chr> <chr>    <int>
## 1     1 mu_p      0.246 -0.114 0.602 0.95 median qi      2015
## 2     2 mu_p      0.244 -0.273 0.753 0.95 median qi      2016
## 3     3 mu_p      0.248 -0.363 0.834 0.95 median qi      2017
## 4     4 mu_p      0.241 -0.477 0.938 0.95 median qi      2018
## 5     5 mu_p      0.239 -0.581 1.03  0.95 median qi      2019
## 6     6 mu_p      0.225 -0.643 1.11  0.95 median qi      2020
## 7     7 mu_p      0.223 -0.735 1.17  0.95 median qi      2021
## 8     8 mu_p      0.230 -0.762 1.24  0.95 median qi      2022
## 9     9 mu_p      0.230 -0.849 1.31  0.95 median qi      2023
```



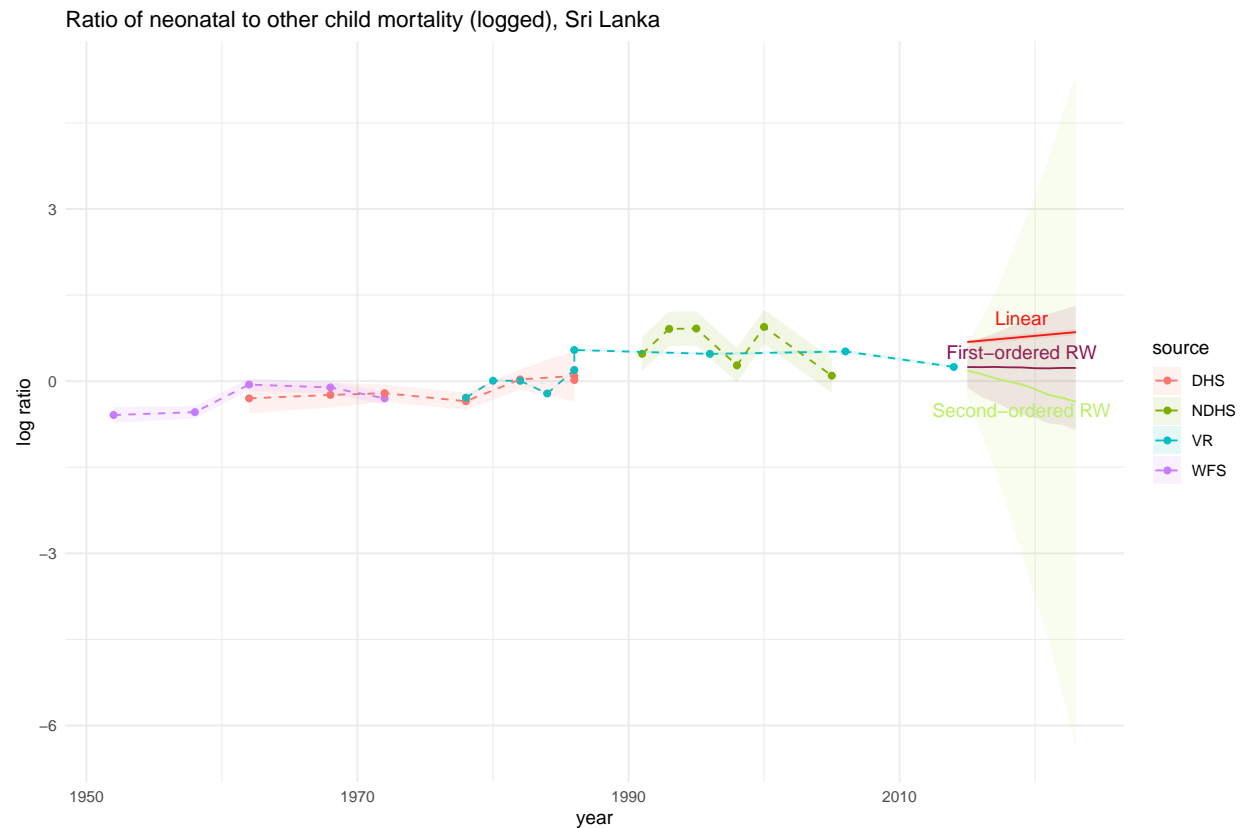
Question 3: Now alter your model above to estimate and project a second-order random walk model (RW2).

```
## # A tibble: 9 x 9
##   p .variable .value .lower .upper .width .point .interval year
##   <int> <chr>      <dbl> <dbl> <dbl> <dbl> <chr> <chr> <int>
## 1 1 mu_p        0.185 -0.285 0.640 0.95 median qi    2015
## 2 2 mu_p        0.126 -0.884 1.07 0.95 median qi    2016
## 3 3 mu_p        0.0554 -1.54 1.50 0.95 median qi    2017
## 4 4 mu_p       -0.00557 -2.24 2.06 0.95 median qi    2018
## 5 5 mu_p       -0.0573 -2.98 2.64 0.95 median qi    2019
## 6 6 mu_p       -0.139 -3.75 3.23 0.95 median qi    2020
## 7 7 mu_p       -0.241 -4.53 3.90 0.95 median qi    2021
## 8 8 mu_p       -0.291 -5.41 4.61 0.95 median qi    2022
## 9 9 mu_p       -0.358 -6.40 5.33 0.95 median qi    2023
```



Question 4: Run the first order and second order random walk models, including projections out to 2023. Compare these estimates with the linear fit by plotting everything on the same graph.

The linear projection reflects an upward trend with the smallest prediction interval, the first-ordered random walk projection seems to go flat, and the second-ordered one indicates a downward tendency after 2014 with the widest prediction interval.

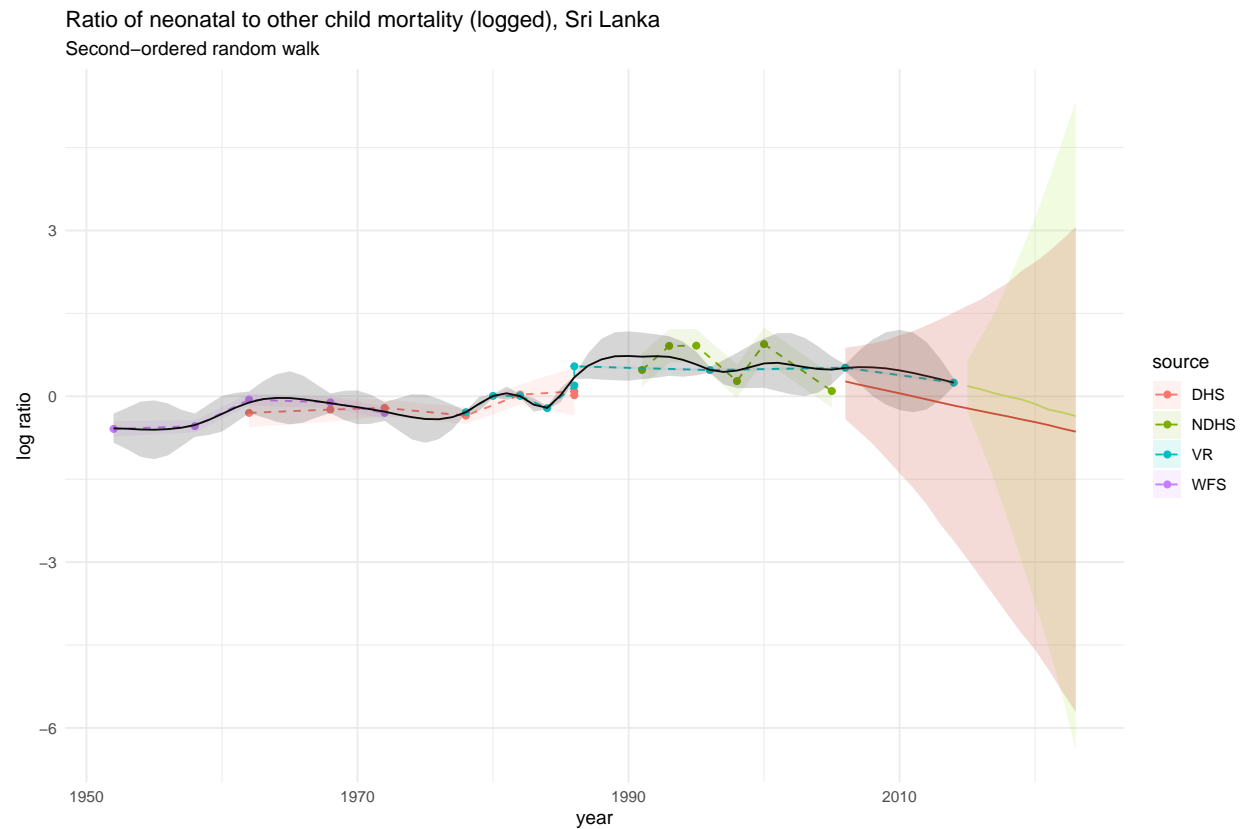


Question 5: Rerun the RW2 model excluding the VR data. Briefly comment on the differences between the two data situations.

```
## # A tibble: 18 x 9
##       p .variable .value .lower .upper .width .point .interval year
##   <int> <chr>      <dbl> <dbl> <dbl> <dbl> <chr> <chr>    <int>
## 1     1 mu_p      0.269 -0.416 0.877 0.95 median qi      2006
## 2     2 mu_p      0.212 -0.633 0.915 0.95 median qi      2007
## 3     3 mu_p      0.159 -0.859 0.959 0.95 median qi      2008
## 4     4 mu_p      0.107 -1.12 1.01 0.95 median qi      2009
## 5     5 mu_p      0.0543 -1.39 1.10 0.95 median qi      2010
## 6     6 mu_p     -0.000869 -1.66 1.18 0.95 median qi      2011
## 7     7 mu_p     -0.0561 -1.96 1.28 0.95 median qi      2012
## 8     8 mu_p     -0.112 -2.31 1.39 0.95 median qi      2013
## 9     9 mu_p     -0.167 -2.62 1.51 0.95 median qi      2014
## 10    10 mu_p     -0.217 -2.94 1.64 0.95 median qi      2015
## 11    11 mu_p     -0.267 -3.28 1.75 0.95 median qi      2016
## 12    12 mu_p     -0.317 -3.62 1.91 0.95 median qi      2017
## 13    13 mu_p     -0.364 -3.96 2.05 0.95 median qi      2018
## 14    14 mu_p     -0.418 -4.29 2.27 0.95 median qi      2019
## 15    15 mu_p     -0.467 -4.59 2.43 0.95 median qi      2020
## 16    16 mu_p     -0.522 -4.95 2.62 0.95 median qi      2021
## 17    17 mu_p     -0.584 -5.34 2.83 0.95 median qi      2022
## 18    18 mu_p     -0.639 -5.71 3.07 0.95 median qi      2023
```

Without VR data, the second-ordered random walk model yields smaller estimates of the log ratios than the

observed values from 2006 to 2014 and predicts lower log ratios for the period from 2015 to 2023.



Question 6: Briefly comment on which model you think is most appropriate, or an alternative model that would be more appropriate in this context.

The second-ordered random walk model fitted to all available data seems to be the most appropriate since it reflects the gradual downward trend of the read data. That said, it is not doing a great job of capturing the real situation in Sri Lanka since the prediction interval is quite large.