Comments on the Cochrane Paper

Background

[Image]

[Image]

The distribution of cardiovascular events is lognormal (or equivalent). This is because the risk ratio is bounded at 0. Why is the risk ratio bounded at 0? The risk ratio is the ratio of two probabilities.

This is also because the risk ratio is multiplicative. Why is the risk ratio multiplicative? You multiply it to get the increased risk for the danger group.

Also, lognormals are bounded by zero. Note that logarithms of risk ratios are additive.

Objectives:

1. How to read risk ratios?
2. How to pick a scientific paper?

In[∘]:=
```
InverseCDF[LogNormalDistribution[mu, sigma], p]
```

Out[∘]=

$$\begin{cases} e^{mu-\sqrt{2}\,sigma\,\text{InverseErfc}[2p]} & 0<p<1 \\ 0 & p\le 0 \\ \infty & \text{True} \end{cases} \quad \text{if } 0\le p\le 1$$

The paper updated these values to 21 × %. with risk ratio 0.97. Confidence interval of 95 × % twin tailed so (0.025, 0.975) to be 0.66 – 0.93.

Using this updated version available in the image.

In[∘]:=
```
dist = LogNormalDistribution[mu, sigma] /.
  Solve[{InverseCDF[LogNormalDistribution[mu, sigma], 0.975] == 0.93,
     InverseCDF[LogNormalDistribution[mu, sigma], 0.025] == 0.66}, {mu, sigma}][[1]]
```

```
$Failed
```

Out[∘]=

```
LogNormalDistribution[-0.244043, 0.0874875]
```

In[∘]:=
```
psi = {Mean[dist], StandardDeviation[dist]}
```

Out[∘]=

```
{0.786458, 0.0689371}
```

Use the parameters ψ. Reverse engineer the normal distribution.

In[∘]:=
```
ndist = NormalDistribution[psi[[1]], psi[[2]]]
```

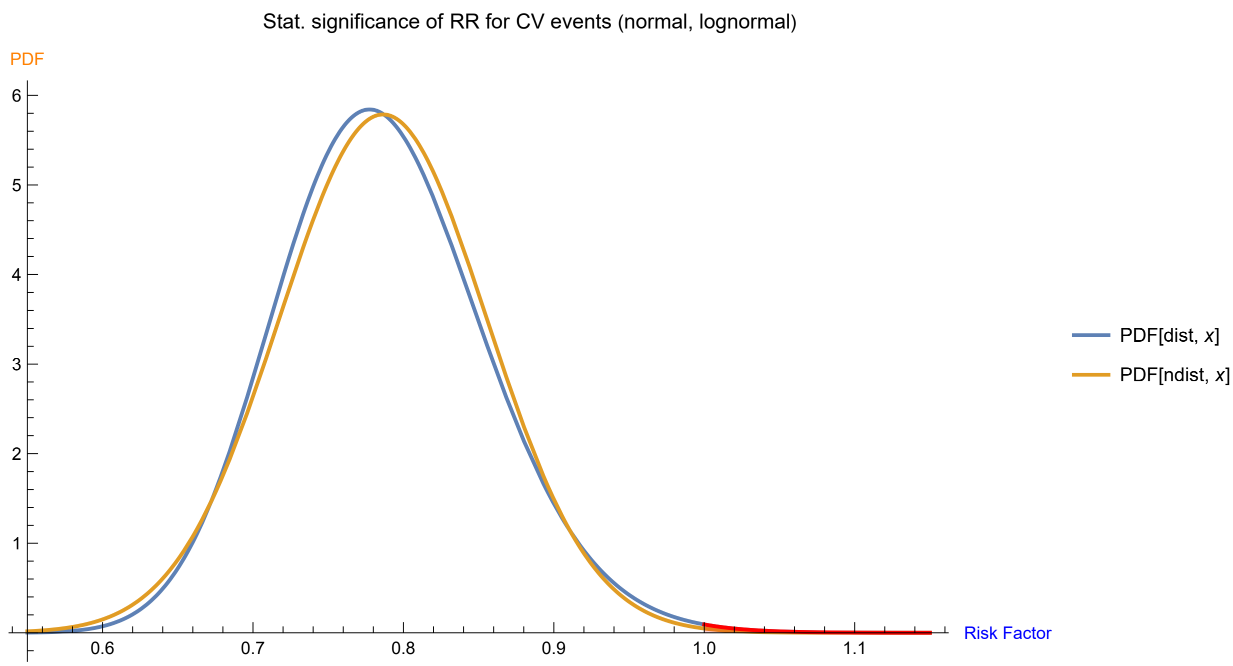
Out[•]=

```
NormalDistribution[0.786458, 0.0689371]
```

In[•]:=

```
Show[Plot[{PDF[dist, x], PDF[ndist, x]}, {x, 0.55, 1.15},
  AxesLabel → {Style["Risk Factor", Blue], Style["PDF", Orange]},
  PlotLabel → "Stat. significance of RR for CV events (normal, lognormal)",
  PlotLegends → Placed["Expressions", {Right, Right}]],
 Plot[PDF[dist, x], {x, 1, 1.15}, Filling → Bottom, PlotStyle → Red],
 ImageSize → Full, ImageResolution → 1000]
```

Out[•]=



There is a 99.7 × % confidence that reducing saturated fats reduces cardiovasculate events.

In[•]:=

```
CDF[dist, 1]
```

Out[•]=

```
0.99736
```

Suppose you lower your saturated fat. You are 70 times more likely to be correct.

In[•]:=

```
CDF[dist, 1] / SurvivalFunction[dist, 1]
```

Out[•]=

```
377.818
```

All-Cause Mortality

In[•]:=

```
dist2 = LogNormalDistribution[mu, sigma] /.
  Solve[{InverseCDF[LogNormalDistribution[mu, sigma], 0.975] == 1.03,
     InverseCDF[LogNormalDistribution[mu, sigma], 0.025] == 0.90}, {mu, sigma}][[1]]
```

```
$Failed
```

Out[•]=

```
LogNormalDistribution[-0.0379009, 0.0344188]
```

In[•]:=

```
psi2 = {Mean[dist2], StandardDeviation[dist2]}
```

Out[•]=

```
{0.963379, 0.0331682}
```

In[•]:=

```
ndist2 = NormalDistribution[psi2[[1]], psi2[[2]]]
```

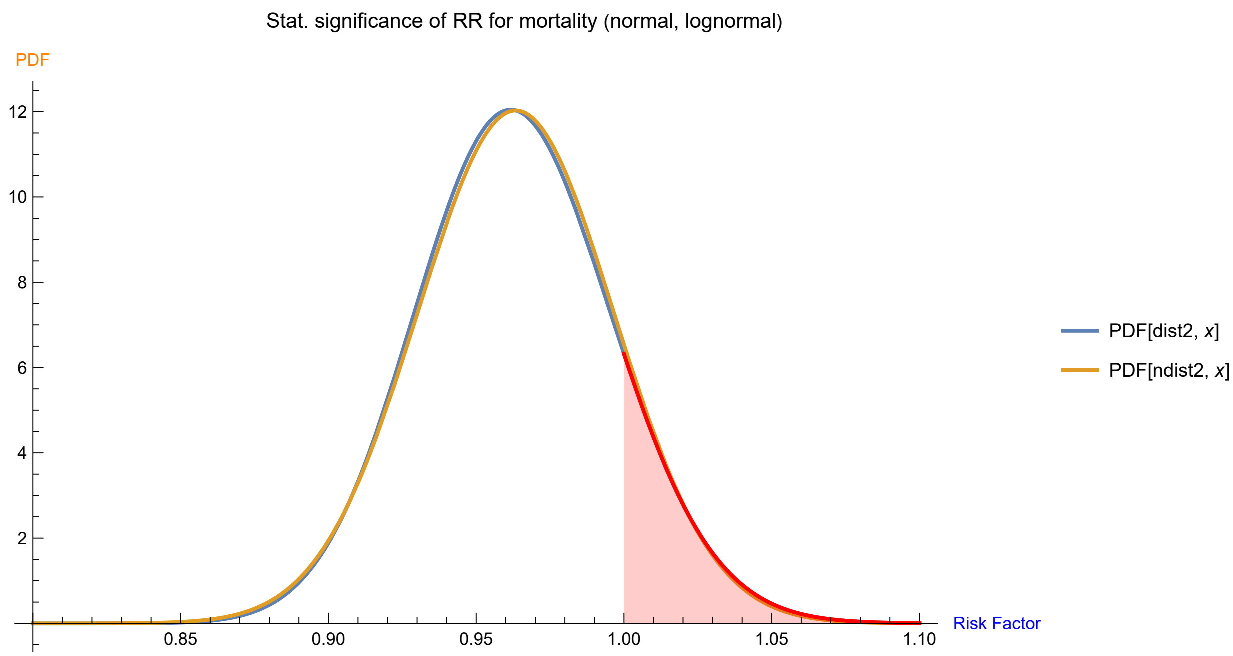
Out[•]=

```
NormalDistribution[0.963379, 0.0331682]
```

In[•]:=

```
Show[Plot[{PDF[dist2, x], PDF[ndist2, x]}, {x, 0.80, 1.10},
   AxesLabel → {Style["Risk Factor", Blue], Style["PDF", Orange]},
   PlotLabel → "Stat. significance of RR for mortality (normal, lognormal)",
   PlotLegends → Placed["Expressions", {Right, Right}]],
  Plot[PDF[dist2, x], {x, 1, 1.10}, Filling → Bottom, PlotStyle → Red],
  ImageSize → Full, ImageResolution → 1000]
```

Out[•]=



There is a 86.4 × % confidence that reducing saturated fats reduces cardiovascular events.

In[•]:=

```
CDF[dist2, 1]
```

Out[•]=

```
0.864588
```

In[•]:=

```
CDF[dist2, 1] / SurvivalFunction[dist2, 1]
```

Out[•]=

```
6.38486
```

Additional Comments

Mortality is consistent with cardiovascular events. You can use the known distribution from a wider sample. For example, people do not live longer due to cardiovascular events. There is an upper bound mistake, not a mean mistake.