

MTH6157 Survival Models

Week 2 exercises using R

- Survival is modelled using the Exponential Model with a constant force of mortality of 0.00027
 - Calculate ${}_2p_{46}$
 - Calculate ${}_3q_{56}$

```
> mu = 0.00027
```

```
> t = 2
```

```
> p = exp(-mu*t)
```

```
> p
```

```
[1] 0.9994601
```

```
> s = 3
```

```
> q = 1 - exp(-mu*s)
```

```
> q
```

```
[1] 0.000809672
```

- Mortality for a group of people in their 70's and 80's is to be estimated using Gompertz Law with the force of mortality given by

$$\mu_x = (0.0037)1.054^x$$

- Calculate μ_x for $x = 70, 71, \dots, 89$ using basic R functionality
- Plot a graph of the force of mortality under this model
- Hence calculate ${}_5p_x$ for $x = 70, 75$ and 80 in two different ways:
 - using basic R functionality
 - using the `flexsurv` package functionality

(a)

```
> x <- c(70:89)
```

```
> x
```

```
[1] 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84
```

```
[16] 85 86 87 88 89
```

```
> mu_x <- 0.0037*(1.054^x)
```

```
> mu_x
```

```
[1] 0.1469077 0.1548407 0.1632021 0.1720150
```

```
[5] 0.1813038 0.1910942 0.2014133 0.2122896
```

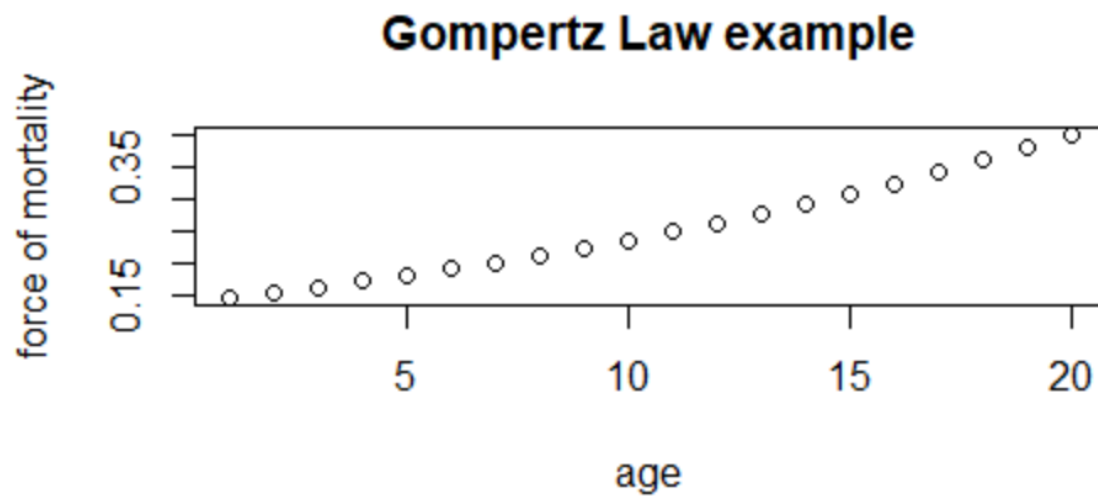
```
[9] 0.2237533 0.2358359 0.2485711 0.2619939
```

```
[13] 0.2761416 0.2910532 0.3067701 0.3233357
```

```
[17] 0.3407958 0.3591988 0.3785955 0.3990397
```

(b)

```
> plot(mu_x, xlab = "age", ylab = "force of mortality", main = "Gompertz Law example")
```



(c)

```
> library(flexsurv)
```

```
> shape = log(1.054)
```

```
> rate = 0.0037
```

```
> shape
```

```
[1] 0.05259245
```

```
> rate
```

```
[1] 0.0037
```

```
> hgompertz(x, shape, rate)
```

```
[1] 0.1469077 0.1548407 0.1632021 0.1720150
```

```
[5] 0.1813038 0.1910942 0.2014133 0.2122896
```

```
[9] 0.2237533 0.2358359 0.2485711 0.2619939
```

```
[13] 0.2761416 0.2910532 0.3067701 0.3233357
```

```
[17] 0.3407958 0.3591988 0.3785955 0.3990397
```

```
> p5 <- 1 - pgompertz(x, shape, rate)
```

```
> p5
```

```
[1] 0.0656793828 0.0564833358 0.0481808148
```

```
[4] 0.0407473574 0.0341503315 0.0283496926
```

```
[7] 0.0232989350 0.0189462089 0.0152355674
```

```
[10] 0.0121082981 0.0095042904 0.0073633842
```

```
[13] 0.0056266481 0.0042375354 0.0031428783
```

```
[16] 0.0022936828 0.0016457061 0.0011598061
```

```
[19] 0.0008020701 0.0005437382
```

so

```
5p70 = 0.0656793828
```

```
5p75 = 0.0341503315
```

```
5p80 = 0.0095042904
```