

# Appendix: Logarithms in R

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Logging splits up multiplication into addition. So,  $\log(m*n)$  is the same as  $\log(m) + \log(n)$

You can check this

```
m<-10
n<-11
log(m*n)
```

```
## [1] 4.70048
```

```
log(m)+log(n)
```

```
## [1] 4.70048
```

```
log(m*n) == log(m)+log(n)
```

```
## [1] TRUE
```

Exponentiation undoes logs

```
exp(log(m*n))
```

```
## [1] 110
```

```
m*n
```

```
## [1] 110
```

The key equation in BLAST's E values is

$$u = \ln(Kmn)/\lambda$$

This can be changed to

$$[\ln(K) + \ln(mn)]/\lambda$$

We can check this

```
K <- 1
m <- 10
n <- 11
lambda <- 110
```

```
log(K*m*n)/lambda
```

```
## [1] 0.04273164
```

```
(log(K) + log(m*n))/lambda
```

```
## [1] 0.04273164
```

```
log(K*m*n)/lambda == (log(K) + log(m*n))/lambda
```

```
## [1] TRUE
```