

Title

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# 1 Introduction

Write the introduction in here.

Second paragraph of the introduction ...

In Section 2 we see how to do various useful things. In Section 2.1 we import pdf files. In Section 2.2 we create a table. In Section 2.3 we produce some mathematics. In Section 2.4 we produce lists. In Section 2.5 we consider citing books, papers etc..

## 2 Name of section 2

How to do important things like importing graphs, create tables and produce beautiful mathematics.

### 2.1 Including a pdf file as a figure

Figure 1 shows that, even for pairs of sites situated at opposite points of the network, there is strong spatial association in the storm peak values.

Figure 1: Scatter plots of contemporaneous  $H_s^{sp}$  values at pairs of sites. Left: contiguous sites (site 30: latitude=3, longitude=6 and site 31: latitude=3 and longitude=7). Right: distant sites (site 1: latitude=1, longitude=1 and site 72: latitude=6, longitude=12)

### 2.2 Tables

Table 1 is an example of a fairly simple table.

model	neg. log-lik	d.f.	ALRS	$p$ -value
constant	22763.20			
linear	22742.59	2	34.23	$3.7 \times 10^{-8}$
quadratic	22737.09	3	20.50	$1.3 \times 10^{-4}$
cubic	22737.02	4	2.09	0.72

Table 1: Summary of point process modelling in which the location parameter  $\mu$  is modelled as a polynomial function of longitude and latitude and  $\sigma$  and  $\xi$  are constant. The likelihood ratio tests compare the model with the model in the row above. neg. log-lik = negated maximised log-likelihood; d.f. = degrees of freedom; ALRS = adjusted likelihood ratio statistic.

Table 2 is an example of the use of the `\multicolumn` command to produce column headings that span more than one column.

return period	wave height (m)		windpseed (m/s)	
	estimate	95% CI	estimate	95% CI
10 years	8.7	( 8.0, 10.7)	10.2	( 5.7, 14.4)
100 years	22.1	(20.6, 25.6)	34.9	(30.1, 42.4)
1,000 years	35.5	(32.4, 42.5)	63.5	(67.3, 76.9)
10,000 years	40.3	(35.2, 52.8)	78.6	(70.9, 98.0)

Table 2: Estimates and 95% confidence intervals of return levels of  $H_s$ .

## 2.3 Mathematics

### Maths in text

Maths in text needs to be enclosed between dollar signs, e.g. `$x$` gives  $x$  (rather than `x`) and `$f$` gives maths font  $f$  (rather than `f`).

We get Greek symbols like this:  $\lambda, \alpha, \beta, \gamma, \delta, \phi, \theta, \dots$  ...and mathematical operators like this:  $1/x, x^{-1}, x_2, xy, \log x, 1+x, -2, x^2, \exp(x), \sin x$ .

### Displayed equations

Using the `equation` environment: `\begin{equation} ... \end{equation}`. An exponential distribution, with mean  $1/\lambda$ , has probability density function (p.d.f.)

$$f_X(x) = \lambda e^{-\lambda x}, \quad x > 0. \quad (2.1)$$

This comment refers to equation (2.1).

An alternative way to produce this displayed equation is to enclose it between `\[` and `\]` ...

$$f_X(x) = \lambda e^{-\lambda x}, \quad x > 0.$$

...but no equation number is produced.

### Multi-line displayed equations

Using the `align` environment (produces equation numbers) ...

Suppose that we have a random sample  $X_1, \dots, X_n$  from an exponential distribution with mean  $1/\lambda$ . The likelihood function for  $\lambda$  is given by

$$\begin{aligned} L(\lambda) &= \prod_{i=1}^n \lambda e^{-\lambda x_i} \\ &= \lambda^n e^{-\lambda \sum_{i=1}^n x_i} \end{aligned} \quad (2.2)$$

$$= \lambda^n e^{-\lambda \sum_{i=1}^n x_i} \quad (2.3)$$

$$= \lambda^n \exp \left\{ -\lambda \sum_{i=1}^n x_i \right\}. \quad (2.4)$$

Which of the above expressions do you think looks best? Equation (2.3) is rather ugly...

Using the `align*` environment (produces no equation numbers) ...

$$\begin{aligned} P(M_n \leq z) &= P(X_1 \leq z, X_2 \leq z, \dots, X_n \leq z) \\ &= P(X_1 \leq z) \times P(X_2 \leq z) \times \dots \times P(X_n \leq z) \\ &= F(z)^n. \end{aligned}$$

Some more examples ... The cumulative distribution function (c.d.f.) of a Generalized Extreme Value (GEV) distribution is given by

$$P(X \leq x) = \exp \left\{ - \left[ 1 + \xi \left( \frac{x - \mu}{\sigma} \right) \right]^{-1/\xi} \right\}, \quad \text{for } 1 + \xi \left( \frac{x - \mu}{\sigma} \right) > 0.$$

We estimate  $\theta$  using the estimator

$$\hat{\theta} = \frac{\frac{1}{M} \sum_{i=1}^M \hat{H}(Y_i)}{\frac{1}{N} \sum_{j=1}^N \hat{G}(Z_j)},$$

where

$$\hat{G}(y) = \frac{1}{M} \sum_{i=1}^M I(Y_i \leq y) \quad \text{and} \quad \hat{H}(z) = \frac{1}{N} \sum_{j=1}^N I(Z_j \leq z).$$

Two examples of defining a quantity conditional on the value of another quantity. First using the `cases` environment ...

$$|x| = \begin{cases} x & \text{if } x \geq 0, \\ -x & \text{if } x \leq 0. \end{cases}$$

... and now using the `array` environment ...

$$|x| = \begin{cases} x & \text{if } x \geq 0, \\ -x & \text{if } x \leq 0. \end{cases}$$

**Note:** Mathematics should read just like sentences of text, with punctuation, i.e. commas, full stops etc.

## 2.4 Lists

Some useful symbols presented as bullet/numbered/lettered points using the `itemize` environment ...

- $\overset{\text{i.i.d.}}{\sim}$ ; as in  $X_1, \dots, X_n \overset{\text{i.i.d.}}{\sim} N(\mu, \sigma^2)$ .
- 2.  $\overset{\text{indep}}{\sim}$ ; as in  $X_i \overset{\text{indep}}{\sim} N(\mu_i, \sigma^2)$ , for  $i = 1, \dots, n$ .
- (d)  $\overset{\text{d}}{=}$ ; as in  $X_1 \overset{\text{d}}{=} X_2$ , i.e.  $X_1$  has the same distribution as  $X_2$ .
- (i)  $W \rightsquigarrow \chi_p^2$ , i.e.  $W$  is approximately chi-squared with  $p$  degrees of freedom.
- $X_1 \perp\!\!\!\perp X_2$ , i.e.  $X_1$  is independent of  $X_2$ .

The `enumerate` environment can be used to number items automatically using 1., 2., etc.

## **2.5 Citing books, papers etc.**

Remember to read the guidelines on the STATG099 Moodle page.

? is a good introduction to extreme value theory.

Many papers (?) have also been written about extreme value theory.

## **3 Conclusion**