JOINT RETURN VALUE ESTIMATION OF EXTREMES OF SIGNIFICANT WAVE HEIGHTS AND WIND SPEED IN COLOMBO, SRI LANKA

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The study of the behaviour of the extreme values of ocean wave heights and wind speed is very important in flood risk assessment and coastal designs. Especially offshore and coastal structures are often exposed to extreme sea conditions. In this study, three hourly data of significant wave heights and significant wind speed from September, 2005 to September, 2007 obtained from the Meteorology Department were used. The Peaks over threshold method was used to find threshold values for wind speed and wave heights. The possible range of threshold values were identified by using the mean residual life plot and the specific threshold values were selected using the Generalized Pareto distribution. The estimates showed less variation of scale and shape parameters of the distribution. Threshold values for these parameter estimates were found as 8 miles per hour and 1.5 meters, respectively. Sample data were obtained above the selected specific threshold values.

Since there was a dependent structure between the two variables (the Kendall's rank correlation, p-value < 0.05), to obtain the joint distribution of the variables, Copula method was used. The copula combines the marginal distributions into a joint distribution. The advantage of the copula method is that no assumption is needed for the variables to be independent or normal or having same type of marginal distributions. Best marginal distribution and the best Copula were identified based on Akaike Information Criterion (AIC) and Bayesian Information Criteria (BIC). To obtain the marginal distributions for the copula, Gamma, Normal, Lognormal, Weibull, Logistic and Exponential distributions were fitted. The parameters of the distributions were estimated using the Maximum likelihood method. Lognormal distribution was identified as the best fitted marginals based on AIC and BIC values for both extreme wind speed and wave heights. Five copula functions, Normal, Frank, Joe, Gumbel-Hougaard and the Clayton were fitted for the sample data and identified that the Joe Copula was the best copula based on the AIC and BIC values. The parameters of the copulas were estimated using the itau method.

Combining the identified marginal distributions by using the Joe Copula, the joint distribution of the extreme wind speed and sea wave heights was obtained. Return periods were calculated using the fitted joint distribution. The results show that for an extreme wind speed of 22.4 miles per hour with a corresponding wave height of 3.14 meters has a return period of 14 days.