TD 2 : Wind Profiles and Weibull Distribution

Exercice 1 : Variation à l'échelle annuelle du vent

Mois	J	F	M	A	M	Jn	Jt	A	S
Vit. Vent à 100 m (m/s)	11.9	12.9	12	11.9	11.9	12,1	12.1	11.7	11.4

Mois	O	N	D
Vit. Vent à 100 m (m/s)	11.2	11.6	12.4

Tableau 1. Variations mensuelles de la vitesses du vent à Oujda (Maroc)

1/ donner l'expression de densité de probabilité relative à la distribution du vent.
2/ Calculer la Fonction de distribution cumulative de Weibull pour différentes valeurs du facteur de forme K = (2, 3, 4) , C=7,2 m/s.

Exercice 2 : THE ANALYSIS OF WIND DATA WITH RAYLEIGH DISTRIBUTION [2]

In this study, Elmadağ region which is district of Ankara is selected. Elmadağ is in the Central Anatolia Region in Turkey, has 39°54'N ve 33°23'E coordinates, and its altitude is 1178 meters. Hourly wind speed data obtained from State Meteorological Station which belongs 2012- 2013 years is gotten at 10 meter from the ground surface. According to these measurements, the mean speed data of twelve months are calculated as in Table 2.

Months	Mean Wind Speed (m/s)	Months	Mean Wind Speed (m/s)
January	6.78	July	4.95
February	5.86	August	6.08
March	3.71	September	1.89
April	4.67	October	2.14
May	4.98	November	2.65
June	6.41	December	7.29

Table 2. Monthly mean wind speed data

Mean wind speed of region at 10 meter measurement height is 4.78 m/s. The lowest mean wind speed data is calculated in September and highest mean wind speed data is calculated in December.

The results using only mean wind speed data are given in Table 3.

1/ Calculate Weibull distribution for each month $k=2$

2/ You are asked to draw the Rayleigh probability density function diagram for a wind speed between 0 m/s and 25 m/s.

Months	V_{mean}	c	E_y(W)
January	6.78	7.65	364.61
February	5.86	6.61	235.41
March	3.71	4.19	59.74
April	4.67	5.27	119.15
May	4.98	5.62	144.49
June	6.41	7.23	308.12
July	4.95	5.59	141.89
August	6.08	6.86	262.94
September	1.89	2.13	7.90
October	2.14	2.42	11.47
November	2.65	2.99	21.77
December	7.29	8.23	453.23
Annual mean	4.78	5.40	127.77

Table 3. Rayleigh analysis results

References

[2] Yağmur ARIKAN1, Özge Pınar ARSLAN 1, Ertuğrul ÇAM, « THE ANALYSIS OF WIND DATA WITH RAYLEIGH DISTRIBUTION AND OPTIMUM TURBINE AND COST ANALYSIS IN ELMADAĞ,TURKEY", Yağmur ARIKAN et al./ IU-JEEE Vol. 15(1), (2015), 1907-1912.

TD2 : Wind Profiles and Weibull distribution

Ex1

1/ $P(v) = \left(\frac{k}{c}\right)\left(\frac{v}{c}\right)^{k-1} \exp\left(-\left(\frac{v}{c}\right)^{k}\right)$: Weibull distribution

P : probabilité

V : vitesse du vent

K : facteur déforme de la courbe

C : facteur d'échelle de la courbe

K = 2 : Distribution de Rayl Rayleigh

2/ K = 2

c = 7,2 m/s

V = 11,9 m/s

$P(v) = \left(\frac{2}{7,2}\right)\left(\frac{11,9}{7,2}\right) \exp\left(-\left(\frac{11,9}{7,2}\right)^{2}\right) = 9029 = 2,9\%$

Probabilité pour que la vitesse du vent soit à 11,9 m/s est 2,9 %

V = 12,9 m/s

$P(V=12,9) = 0,02 = 2\%$

$P(V=12) = 0,0289 = 2,8\%$

$P(V=12,1) = 9027 = 2,7\%$

$P(V=11,7) =$

$P(V=11,4) =$

Ex2 :

$P(V=6,78) = \left(\frac{2}{7,65}\right)\left(\frac{6,78}{7,65}\right) \exp\left(-\left(\frac{6,78}{7,65}\right)^{2}\right) = 0,1056 = 10,5\%$

Jan : $P(V=6,78)$

Fe : $P(V=5,86) = \left(\frac{2}{6,61}\right)\left(\frac{5,86}{6,61}\right) \exp\left(-\left(\frac{5,86}{6,61}\right)^{2}\right) = 0,1222 = 12,2\%$

March : $P(V=3,71) = \left(\frac{2}{4,19}\right)\left(\frac{3,71}{4,19}\right) \exp\left(-\left(\frac{3,71}{4,19}\right)^{2}\right) = 0,1929 = 19,2\%$

April : $P(V=4,67) = \left(\frac{2}{5,27}\right)\left(\frac{4,67}{5,27}\right) \exp\left(-\left(\frac{4,67}{5,27}\right)^{2}\right) = 0,1533 = 15,3\%$

May : $P(V=4,98) = \left(\frac{2}{5,62}\right)\left(\frac{4,98}{5,62}\right) \exp\left(-\left(\frac{4,98}{5,62}\right)^{2}\right) = 0,1438 = 14,3\%$

June : $P(V=6,41) = \frac{2}{7,23} \cdot \frac{6,41}{7,23} \cdot \exp\left(-\left(\frac{6,41}{7,23}\right)^2\right) = 0,1117 = 11,1\%$

July $P(V=4,95) = \frac{2}{5,59} \cdot \frac{4,95}{5,59} \exp\left(-\left(\frac{4,95}{5,59}\right)^2\right) = 0,1446 = 14,4\%$

August : $P(V=6,08) = \frac{2}{6,86} \cdot \frac{6,08}{6,86} \exp\left(-\left(\frac{6,08}{6,86}\right)^2\right) = 0,1177 = 11,77\%$

Sept : $P(V=1,89) = \frac{2}{2,13} \cdot \frac{1,89}{2,13} \cdot \exp\left(-\left(\frac{1,89}{2,13}\right)^2\right) = 0,379 = 37,9\%$.

Oct $P(V) = \frac{2}{2,42} \cdot \frac{2,14}{2,42} \cdot \exp\left(-\left(\frac{2,14}{2,42}\right)^2\right) = 0,334 = 33,4\%$.

Nov $P(V) = \frac{2}{2,99} \cdot \frac{2,65}{2,99} \cdot \exp\left(-\left(\frac{2,65}{2,99}\right)^2\right) = 0,2702 = 27,02\%$.

Dec $P(V) = \frac{2}{8,23} \frac{7,29}{8,23} \exp\left(-\left(\frac{7,29}{8,23}\right)^2\right) = 0,098 = 9,8\%$.

$P(V) = 0,1457 = 14,97\%$.