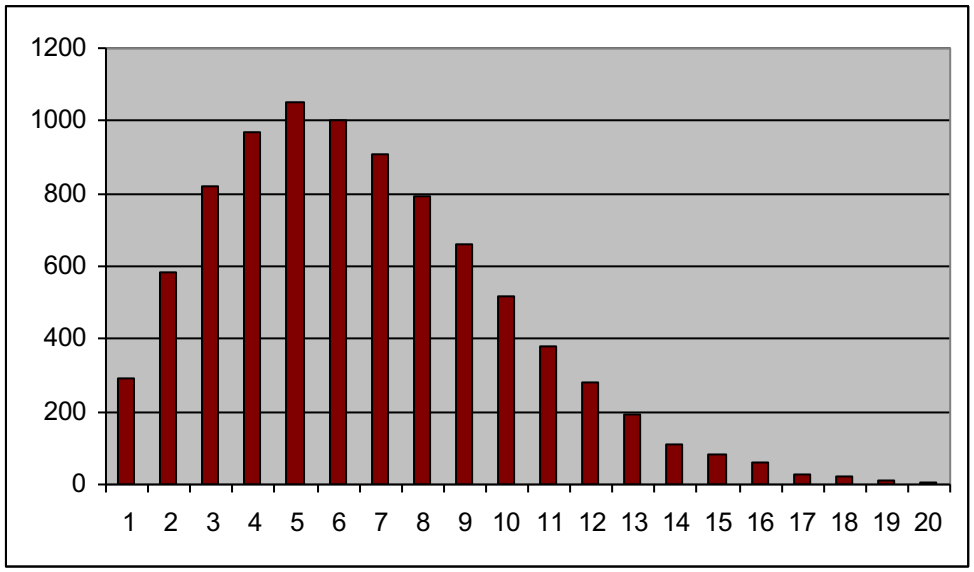
Electricity production from a wind turbine with given wind distribution at the site

Data :

- Nominal wind turbine power for a wind of 10 m/s: 150 kWe

(i.e. above v_{nom} = 10 m/s, the turbine power is constant at 150 kW)

- Wind velocities (Weibull-like) distribution [*y* hours/yr at *x* m/s]:



x	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
y	290	585	820	970	1050	1000	910	790	660	520	380	280	190	110	80	60	30	20	10	5

- Operating range of the wind turbine: 5 m/s (cut-in speed) $\leq$ v $\leq$ 25 m/s (cut-out speed) (i.e. below 5 m/s wind speed, the turbine does not operate)
- Mechanical efficiency of the wind turbine: 70 % (in other words: C_p = 0.59 * 0.7 = 0.41)
- Air density: 1.22 kg/m^3

Questions:

- What is the diameter D of the turbine?
- Evaluate the total electricity produced during a year by this turbine
- Evaluate the *mean* equivalent power of this turbine
- What is the equivalent annual load factor at nominal power?
- Calculate the wind mean velocity and mean cubic velocity (within the operating range, and for the total wind distribution).
- Estimate the Weibull c- and k-parameters from the above wind velocities distribution