

# TD2 : éléments de Probabilité II.

**Entropie des langues.** Calculer l'entropie des langues anglaises et française.

Letter	Frequency	Letter	French [3]	German [4]	Spanish [5]	Esperanto [6]	Italian [7]	Turkish	Swedish [8]
a	8.167%	a	7.636%	6.51%	12.53%	12.12%	11.74%	11.68%	9.3%
b	1.492%	b	0.901%	1.89%	1.42%	0.98%	0.92%	2.95%	1.3%
c	2.782%	c	3.260%	3.06%	4.68%	0.78%	4.5%	0.97%	1.3%
d	4.253%	d	3.669%	5.08%	5.86%	3.04%	3.73%	4.87%	4.5%
e	12.702%	e	14.715%	17.40%	13.68%	8.99%	11.79%	9.01%	9.9%
f	2.228%	f	1.066%	1.66%	0.69%	1.03%	0.95%	0.44%	2.0%
g	2.015%	g	0.866%	3.01%	1.01%	1.17%	1.64%	1.34%	3.3%
h	6.094%	h	0.737%	4.76%	0.70%	0.38%	1.54%	1.14%	2.1%
i	6.966%	i	7.529%	7.55%	6.25%	10.01%	11.28%	8.27%*	5.1%
j	0.153%	j	0.545%	0.27%	0.44%	3.50%	0.00%	0.01%	0.7%
k	0.772%	k	0.049%	1.21%	0.00%	4.16%	0.00%	4.71%	3.2%
l	4.025%	l	5.456%	3.44%	4.97%	6.14%	6.51%	5.75%	5.2%
m	2.406%	m	2.968%	2.53%	3.15%	2.99%	2.51%	3.74%	3.5%
n	6.749%	n	7.095%	9.78%	6.71%	7.96%	6.88%	7.23%	8.8%
o	7.507%	o	5.378%	2.51%	8.68%	8.78%	9.83%	2.45%	4.1%
p	1.929%	p	3.021%	0.79%	2.51%	2.74%	3.05%	0.79%	1.7%
q	0.095%	q	1.362%	0.02%	0.88%	0.00%	0.51%	0	0.007%
r	5.987%	r	6.553%	7.00%	6.87%	5.91%	6.37%	6.95%	8.3%
s	6.327%	s	7.948%	7.27%	7.98%	6.09%	4.98%	2.95%	6.3%
t	9.056%	t	7.244%	6.15%	4.63%	5.27%	5.62%	3.09%	8.7%
u	2.758%	u	6.311%	4.35%	3.93%	3.18%	3.01%	3.43%	1.8%
v	0.978%	v	1.628%	0.67%	0.90%	1.90%	2.10%	0.98%	2.4%
w	2.360%	w	0.114%	1.89%	0.02%	0.00%	0.00%	0	0.03%
x	0.150%	x	0.387%	0.03%	0.22%	0.00%	0.00%	0	0.1%
y	1.974%	y	0.308%	0.04%	0.90%	0.00%	0.00%	3.37%	0.6%
z	0.074%	z	0.136%	1.13%	0.52%	0.50%	0.49%	1.50%	0.02%

(a) anglais

(b) autres langues

FIG. 1: fréquence des lettres d'alphabets (source : wikipedia).

**Somme et autres opérations de variables aléatoires.** Soit les deux variables aléatoires continues  $X$  et  $Y$  ayant les densités de probabilité  $f(x)$  et  $g(y)$ . Donner la densité de probabilité de  $Z = X + Y$ ,  $Z = X - Y$ ,  $Z = X/Y$  et  $Z = XY$ .