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Population genetics problems

Hardy-Weinberg equilibrium

1- blood group system $< \begin{matrix} S \\ s \end{matrix}$ $n = 1000$

99 SS

418 Ss

483 ss

$$Freq(S) = \frac{(2 \cdot 99) + 418}{2 \cdot 1000} = 0.308$$

$$Freq(s) = 1 - 0.308 = 0.692$$

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$Freq(SS) = 0.308^2 = 0.09486$ $\xrightarrow{\cdot n}$ 94,86

$Freq(Ss) = 2 \cdot 0,308 \cdot 0,692 = 0.426272$ → 426,27

$Freq(ss) = 0.692^2 = 0.47886$ → 478,86

$$x^2 = \frac{(Obs - Exp)^2}{Exp}$$

Genotype	Obs	Exp	x^2
SS	99	94,86	0,18
Ss	418	426,27	0,16
ss	483	478.86	0,0357
	1000		0,3757

df: 3-1-1=1

0,3757 → $x^2 = 0,3757$ $x^2_{0,05} = 3,84$

0,3757 < 3.84 = This population is in Hardy-Weinberg equilibrium

2- PKU → autosomal recessive inheritance

1: 10.000 → ~~pq~~

p= Freq dominant allele

q= Freq recessive allele

$Freq(qq) = q^2 = \frac{1}{10000}$ $q = \sqrt{\frac{1}{10000}} = 0.01$ $p = 1 - 0,01 = 0.99$

$Freq(pq) = 2 \cdot 0.99 \cdot 0,01 = 0,0198$ → $\boxed{1.98\%}$ is heterozygots

③ - Dominant Men ← X-linked → Dominant Women

p = Dominant = 0,12 $X^{-}Y$

q = Recessive = 1-0,12 = 0.88 XY

$p^2 = 0,12^2 = 0.0144$

$2pq = 2 \cdot 0,12 \cdot 0.88 = 0.2112$

$\}$ + = 0.2256 → 22.56%

Recessive: $0.88^2 = 0.774$

Recessive Men ← X-linked → Recessive Women

In this case will be the same, be cause men only have one X chromosome

$p = 0,12$ $X^{-}Y$

$q = 0.88 = XY$

$q^2 = 0,88^2 = 0.7744$

+

$2pq = 2 \cdot 0,12 \cdot 0,88 = 0,2112$

$\}$ 0.9856

If this dissea is recessive, women need to have two chromosomes affected. In this case, the probability will be

$0,12^2 = 0,0144$ → 1,44%

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n= 100

A: Stubble allele (lethal in homozygosity) = p

a = Wild allele = q

$p = \frac{42}{200} = 0,21$ $\quad q = 1 - q = 0.79$ $\quad x^2 = \frac{(Obs - Exp)^2}{Exp}$

freq(AA) = $0.21^2 = 0.0441$ → 4.41

Freq(Aa) = $2 \cdot 0.21 \cdot 0.79 = 0.3318$ → 33.18

freq(aa) = $0.79^2 = 0.6241$ → 62.41

Genotype	Obs	Exp	x^2
AA	0	4.41	4.41
Aa	42	33.18	2.34
aa	58	62.41	0.3116
	100		7.06

df: 1

$x^2 = 7.06$ $\quad x^2_{0.05} = 3.84$

7.06 > 3.84 The population is not in HWE

5 - 4 alleles with 6-9 repeals of TTA

$p = 0.43$

$q = 0.37$

$r = 0.18$

$s = 0.02$

$\frac{K(4+1)}{2} = \frac{20}{2} = 10$ genotyes

pp qr
pq qs
pr rr
ps rs
qq ss

Expected Frequency of heterozygotes: $2pq + 2pr + 2ps + 2qr + 2qs + 2rs = 0,6454$

6- $A > a$

A: dominant allele $= p$ — we know that $Freq(aa) = 0.04$

a: recessive allele $= q$ — $Freq(a) = \sqrt{0.04} = 0.2$

$q = 0.2 \quad p = 1 - 0.2 = 0.8$

If the dominant phenotype = AA:

all offspring will be AA → 0%

if the dominant phenotype = Aa

	A	a
A	AA	Aa
a	Aa	aa

aa → $\boxed{25\%} = \frac{1}{4}$

if one organism is AA and the other = Aa

	A	A
A	AA	AA
a	Aa	Aa

→ 0%

7- $N = 93$

$AA = 0.226$

$Aa = 0.4$

$aa = 0.374$

$Freq(A) = \dfrac{2 \cdot 0.226 + 0.4}{2} = 0.426 = p$

$Freq(a) = 1 - 0.426 = 0.574 = q$

$p^2 = 0.181476$

$q^2 = \cancel{0.4890}\ 0.329476$

$2pq = 0.4890$

Genotype	Obs	Exp	x^2
AA	0.226	0.181476	0.011
Aa	0.4	~~0.329476~~ 0.4890	0.016
aa	0.374	0.329476	0.00601
			0.033

$x^2 = \dfrac{(Obs - Exp)^2}{Exp}$

$df = 1$

$x^2 = 0.033 \quad x^2_{0.05} = 3.84$

$0.033 < 3.84$

This population is in Hardy-Weinberg equi.

8- ~~Ada~~ $A > a$

A = dominant $= p$

a = recessive $= q$

$aa = 0.35$

$Freq(a) = \sqrt{0.35} = 0.592 = q \quad p = 1 - 0.592 = 0.408$

$Freq(AA) = 0.408^2 = 0.166$

$Freq(Aa) = 2 \cdot 0.592 \cdot 0.408 = 0.484$

$Freq(aa) = 0.35$

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BB = 0.81

Bb = 0.18

bb = 0.01

Bulls · BB

Bb

Bb

BB × BB = BB

BB × Bb = BB / Bb

BB × bb : Bb

Bb × Bb = 25% BB, 25% bb, 50% Bb

Bb × bb : Bb / bb

(BB) 0.81 · 3 = 2.43

(Bb) = 0.18 · 3 = 0.54

(Bb) = 0.01 · 3 = 0.03

$BB = \frac{2.43 + 1}{6} = 0.57$

$Bb = \frac{0.54 + 2}{6} = 0.423$

$bb = \frac{0.03 + 0}{6} = 0.005$

$B = \frac{0.57 \cdot 2 + 0.423}{2} = 0.7815$

$b = \frac{0.005 \cdot 2 + 0.423}{2} = 0.2126$

Freq (BB) = 0.7815^2 = 0,611

freq (Bb) = 2 · 0.7815 · 0.2126 = 0.332

Freq (bb) = 0.045

$x^2 = \frac{(Obs - Exp)^2}{Exp}$

Genotype	Obs	freq	x^2
BB	0.57	0.611	0.00277
Bb	0.423	0.332	0.0262
bb	0.005	0.045	0,035
			0,064

df = 1 $x^2 = 0.064$ $x^2_{0.05} = 3.84$

0,064 < 3.84

This population is in HWE

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n = 20

alleles = n · 2 = 40

two peolpe = Cc ~~2p~~ 2

18 people = CC = ~~q~~

$freq(a) = \frac{2}{40} = 0,05$ $0.05^2 = 0.0025$ → $\boxed{0,25\%}$