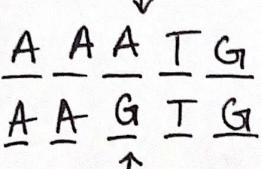


Problem Set 1 (due 2/15/23)

① 

$$\frac{1}{2} * \frac{1}{2} * \frac{1}{2} = \boxed{\frac{1}{8} \text{ or } 12.5\%}$$

Set 2

$$\frac{1}{2} * \frac{1}{2} * \frac{1}{2} * \frac{1}{2} * \frac{1}{2} = \boxed{\frac{1}{32} \text{ or } 3.125\%}$$

Set 3

$$\frac{1}{2} * \frac{1}{2} * \frac{1}{2} * \frac{1}{2} * \frac{1}{2} = \boxed{\frac{1}{32} \text{ or } 3.125\%}$$

② a) observed genotype frequency

$$SS = 11/127 = 0.0866$$

$$SS^- = 55/127 = 0.433$$

$$S-S^- = 61/127 = 0.480$$

observed allele frequency

$$S = \frac{2(11) + 55}{2(127)} = 0.303$$

$$S^- = \frac{55 + 2(61)}{2(127)} = 0.696$$

b) HWE expectations

$$p = 0.303$$

$$q = 0.696$$

$$SS \quad p^2 = 0.0918$$

$$SS^- \quad 2pq = 0.4217$$

$$S-S^- \quad q^2 = 0.484$$

$$\chi^2 = \sum \frac{(obs. - exp.)^2}{exp.}$$

$$= \frac{(0.0866 - 0.0918)^2}{0.0918} + \frac{(0.433 - 0.4217)^2}{0.4217} + \frac{(0.480 - 0.484)^2}{0.484}$$

$$\chi^2 = 0.000630$$

Observed genotype frequencies agree with HWE expectations because the variance between obs. & exp. is < 0.05

c) observed heterozygosity

$$H_0 = 1 - 0.0918 - 0.480$$

$$H_0 = 0.433$$

expected heterozygosity

$$H_E = 1 - 0.0918 - 0.484$$

$$H_E = 0.424$$

③ a) obs. genotype frequency

$$AA \quad 0/10 = 0$$

$$AG \quad 10/10 = 1$$

$$GG \quad 0/10 = 0$$

obs. allele frequency

$$A \quad \frac{2(0) + 10}{20} = 1/2$$

$$G \quad \frac{2(0) + 10}{20} = 1/2$$

b) HWE expectations

$$P = 0.5$$

$$q = 0.5$$

$$AA \quad p^2 = 0.25$$

$$AG \quad 2pq = 0.5$$

$$GG \quad q^2 = 0.25$$

$$\chi^2 = \sum \frac{(obs. - exp.)^2}{exp.}$$

$$= \frac{(0 - 0.25)^2}{0.25} + \frac{(1 - 0.5)^2}{0.5} + \frac{(0 - 0.25)^2}{0.25}$$

$$= 0.25 + 0.5 + 0.25$$

$$\chi^2 = 1$$

if I'm interpreting this correctly...
 Our χ^2 test says that the variance between obs. and expected is still small enough to be seen by chance because our χ^2 of 1 is < 3.84

c)

AG x AG

↓
① AA
② GG

AG x AG

↓
③ AG
④ AG

AG x AG

↓
⑤ GG
⑥ AG

AG x AG

↓
⑦ AA
⑧ GG

AG x AG

↓
⑨ AA
⑩ AG

Genotype	Count	<u>obs. genotype freq.</u>	<u>obs. allele freq.</u>
AA	3	AA $3/10 = 0.3$	A $\frac{2(3) + 4}{20} = 1/2$
AG	4	AG $4/10 = 0.4$	
GG	3	GG $3/10 = 0.3$	G $\frac{2(3) + 4}{20} = 1/2$

the rest would be the same as above... so let's try again with some more extreme genotype counts...

Problem Set 1^{contd} (due 2/15/23)

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③ c) contd

Genotype	count	obs. genotype freq	obs. allele freq
AA	1	AA $1/10 = 0.1$	A $\frac{2(1) + 7}{20} = \frac{9}{20} = 0.45$
AG	7	AG $7/10 = 0.7$	
GG	2	GG $2/10 = 0.2$	G $\frac{2(2) + 7}{20} = \frac{11}{20} = 0.55$

HWE expectations

$$P = 0.45$$

$$q = 0.55$$

$$AA \quad P^2 = 0.2025$$

$$AG \quad 2pq = 0.495$$

$$GG \quad q^2 = 0.3025$$

$$\chi^2 = \frac{(0.1 - 0.2025)^2}{0.2025} + \frac{(0.7 - 0.495)^2}{0.495} + \frac{(0.2 - 0.3025)^2}{0.3025}$$

$$\chi^2 = 0.1715\dots$$

$\chi^2 < 3.84$ which is still small enough ~~variation~~ variation to be seen by chance

④