Investigation 2

II. INDEPENDENT EVENTS OCCURRING SIMULTANEOUSLY

1. Both heads: 1/2 × 1/2 = 1/4; one head, one tail: 1/2 × 1/2 = 1/4; head on one coin and tail on the other: 1/4 + 1/4 = 1/2; both coins tails: 1/2 × 1/2 = 1/4. Two coins fall heads, heads about 1/4 of the time; heads, tails (and vice versa) about 1/2 of the time; and tails, tails, about 1/4 of the time. Stated as a ratio instead of a fraction, the expected result is 1:2:1.

Table 2.3

Classes	Combinations	Class Occurring	Observed	Expected	(O-E)
3 heads	HHH	1/2 × 1/2 × 1/2 = 1/8		7	
2 heads, 1 Tail	HHT, HTH, THH	3(1/2 × 1/2 × 1/2) = 3/8		21	
1 head, 2 Tails	HTT, THT, TTH	3(1/2 × 1/2 × 1/2) = 3/8		21	
3 tails	TTT	1/2 × 1/2 × 1/2 = 1/8		7	
Total	8 possible	8/8 = 1	56	56	

4. Table 2.4

Classes	Combinations	Probability of Each Class Occurring
4 heads	HHHH	1/2 × 1/2 × 1/2 × 1/2 = 1/16
3 heads : 1 tail	HHHT, HHTH, HTHH, THHH	4(1/2 × 1/2 × 1/2 × 1/2) = 4/16
2 heads : 2 tails	HHTT, HTTH, THHT, TTHH, HTHT, THTH	6(1/2 × 1/2 × 1/2 × 1/2) = 6/16
3 tails : 1 head	HTTT, THTT TTHT, TTTH	4(1/2 × 1/2 × 1/2 × 1/2) = 4/16
4 tails	TTTT	1/2 × 1/2 × 1/2 × 1/2 = 1/16

5. a. $(1/2)^4 = 1/16$
   b. $4(1/2)^3(1/2) = 4/16 = 1/4$
   c. $6(1/2)^2(1/2)^2 = 6/16 = 3/8$
   d. Two boys and two girls. There are more ways (6) in which a family can consist of 2 boys and 2 girls.
   e. A boy 1/2, a girl 1/2.

III. BINOMIAL EXPANSION

1. a. $(1/2)^5 = 1/32 = a^5$ d. $10(1/2)^2(1/2)^3 = 10/32 = 5/16 = 10a^2b^3$
   b. $5(1/2)^4(1/2) = 5/32 = 5a^4b$ e. $5(1/2)(1/2)^4 = 5/32 = 5ab^4$
   c. $10(1/2)^3(1/2)^2 = 10/32 = 5/16 = 10a^3b^2$ f. $(1/2)^5 = 1/32 = b^5$
2. a. 1 boy and 5 girls: $6!/5!1!\ (1/2)(1/2)^5 = 6/64 = 3/32$
   b. 3 boys and 3 girls: $6!/3!3!\ (1/2)^3(1/2)^3 = 20/64 = 5/16$
   c. All 6 girls: $6!/0!6!\ (1/2)^0(1/2)^6 = (1/2)^6 = 1/64$
3. A normal child: 3/4; an albino: 1/4.
   a. All 4 normal: $(3/4)^4 = 81/256$
   b. 3 normal and 1 albino: $4(3/4)^3(1/4) = 108/256 = 27/64$
   c. 2 normal and 2 albino: $6(3/4)^2(1/4)^2 = 54/256$
   d. 1 normal and 3 albinos: $4(3/4)(1/4)^3 = 12/256$
   e. All 4 albinos: $(1/4)^4 = 1/256$

IV. EITHER-OR SITUATIONS (MUTUALLY EXCLUSIVE EVENTS)

1. Either *C* or *c* gametes; 1/2 + 1/2 = 1 or 100%
2. Either the genotype *AA* or the genotype Aa: 1/4 + 2/4 = 3/4
   a. Either *aaB-* or *aabb*: 3/16 + 1/16 = 4/16 = 1/4
   b. Either *aabb* or *AaBb*: 1/16 + 4/16 = 5/16
   c. Either *A-bb* or *AAbb*: 3/16 + 1/16 = 5/16
   d. Either *A-B-* or *aabb*: 9/16 + 1/16 = 10/16 = 5/8

V. PROBABILITY AND GENETIC COUNSELING

a. 4 × 7: 1(*aa*) × 1(*Aa*) × 1/2 = 1/2

b. 5 × 1: 1(*Aa*) × 2/3(*Aa*) × 1/4 = 2/12 = 1/6

c. 6 × 13: 1(*Aa*) × 1/2(*Aa*) × 1/4 = 1/8

d. 10 × 14: 2/3(*Aa*) × 1/2(*Aa*) × 1/4 = 2/24 = 1/12

e. 3 × 17: 2/3(*Aa*) × 1/3(*Aa*) × 1/4 = 2/36 = 1/18

Note: #17 has a 1/3 probability because his overall is his mother's probability of being heterozygous (2/3) times his probability (1/2) if his mother was heterozygous.

f. 3 × 15: 2/3(*Aa*) × 1/2(*Aa*) × 1/4 = 2/24 = 1/12

g. 16 × 17: 1/2(*Aa*) × (2/3 × 1/2)(*Aa*) x 1/4 = 2/48 = 1/24