1. $q^2 = .09$ ∴ $q = .3$ ∴ $p = .7$

$p^2 + 2pq + q^2 = 1$

$2 \cdot (.3) \cdot (.7) = .42 = 42\%$ HETEROZYGOUS

AP Biology

Biometry Accessory Problem Set

1. **Sickle-cell anemia is an interesting genetic disease. Normal homozygous individials (SS) have normal blood cells that are easily infected with the malarial parasite. Thus, many of these individuals become very ill from the parasite and many die. Individuals homozygous for the sickle-cell trait (ss) have red blood cells that readily collapse when deoxygenated. Although malaria cannot grow in these red blood cells, individuals often die because of the genetic defect. However, individuals with the heterozygous condition (Ss) have some sickling of red blood cells, but generally not enough to cause mortality. In addition, malaria cannot survive well within these "partially defective" red blood cells. Thus, heterozygotes tend to survive better than either of the homozygous conditions. If 9% of an African population is born with a severe form of sickle-cell anemia (ss), what percentage of the population will be more resistant to malaria because they are heterozygous (Ss) for the sickle-cell gene?**
2. **There are 100 students in a class. Ninety-six did well in the course whereas four blew it totally and received a grade of F. Sorry. In the highly unlikely event that these traits are genetic rather than environmental, if these traits involve dominant and recessive alleles, and if the four (4%) represent the frequency of the homozygous recessive condition, please calculate the following:**
    1. **The frequency of the recessive allele.** 20%
    2. **The frequency of the dominant allele.** 80%
    3. **The frequency of heterozygous individuals.** 32%

$q = .2$

$p = .8$

2

$\Psi_w = \Psi_s + \Psi_p$

$.45 - .32$

3. A cell is in equilibrium with its environment. The solute potential of the cell's cytoplasm is –0.45MPa. The water potential of the surrounding solution is –0.32Mpa. When the cell was first put into the solution, it was flaccid.

    a. Since the cell was put into this solution, its solute potential and pressure potential have both risen.
    b. The pressure potential of the cell is now +0.32MPa.
    c. The cell has a higher solute potential than the surrounding solution
    d. The cell's water potential is now lower than that of the surrounding solution.
    e. Initially, the cell's solute potential was lower than that outside.
    f. Initially, the cell's water potential was lower than that outside.
    g. There is still a concentration gradient that tends to draw water into the cell.
    h. The cell is still flaccid.
    i. The pressure potential of the cell is equal to that outside the cell
    j. There is lower free energy inside the cell than outside.
    k. There is lower molarity inside the cell than outside.
    l. The cell is isotonic to its surroundings.

2. G

RECEPTOR

4. A cell is in equilibrium with its surroundings. The molarity of the surrounding solution is 0.5M. To convert molarity to solute potential in MPa, use the formula: $\Psi_S = -(i\,CRT)$ where

i = ionization constant (assume that is 1)

C=molar concentration (given above)

R = pressure constant (R=0.00831 liter MPa/mole °K)

T = temperature in °K (room temp is about 293°K)

$\Psi_P = 0$

$\Psi_w = \Psi_P + \Psi_S$

$\Psi_S = (1)(.5M)(.00831 \frac{L\,MPa}{mol\,°K})(293°K)$

a. Calculate the solute potential of the surrounding solution. -1.217
b. Find the water potential of the surrounding solution. -1.217
c. What is the water potential of the cytoplasm of the cell?
d. **True, false, or not enough information**: The cell's molar concentration is equal to the molar concentration of the surrounding solution.

5. Calculate the standard deviation for the following population of scores:
   8 5 3 7 5 6 4 7 2 6 5 3
   6 4 5 7 8 6 5 6
6. Calculate the mean, *SS*, variance, and standard deviation for the following sample:
   6 8 4 3 5 7 4 3

7. For the following data:
   1 4 3 6 2 7 18 3 7 2 4 3
   Compute the mean, standard deviation, median, and semi-quartile range. Then explain which measures of central tendency and variability provide a better description of the sample.

AP Biometry Answers

A = true B = false C = not enough information

PROBLEM 3:

1. A 42%

2. B =+0.13

3. B .... LOWER

4. B ... EQUAL

5. A

6. A

7. A

8. B .... TURGID

9. B .... GREATER

10. B ....EQUAL INSIDE AND OUT

11. B .....HIGHER

12. B ..... HYPERTONIC

PROBLEM 4:

a. Ψ_S = - 1.22 MPa

b. Ψ = - 1.22 MPa

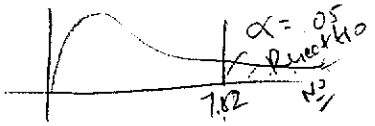
c. Ψ = - 1.22 Mpa

d. C we would need to know the pressure potential of the cell. IF the cell is flaccid, then molarity is equal to the molarity outside (and so is solute potential). IF the cell is turgid, the the molarity inside is greater than that outside (and the solute potential is lower).

5. σ = 1.59
6. The sample mean is 5, the SS is 24, the variance is 3.43, and the standard deviation is 1.85

7. The mean is 5, and the standard deviation is 4.53. The median is 3.5. Most of the scores are clustered around 3 or 4 so the median provides a better description, while the outlier (18) distorts the mean and standard deviation.

Chi-Square Hypothesis Tests Review



Name FITCH

1. A study was conducted to determine where moose are found in a region containing a larger burned area. A map of the study area was partitioned into the following four habitat types.

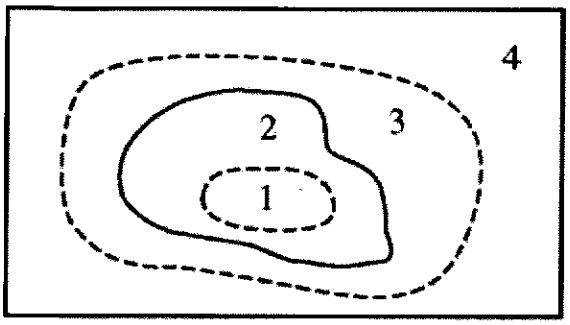
(1) Inside the burned area, not near the edge of the burned area,
(2) Inside the burned area, near the edge,
(3) Outside the burned area, near the edge, and
(4) Outside the burned area, not near the edge.

$\chi^2 = \frac{(14.78)^2}{39.78} + \frac{(10.183)^2}{11.812} + \frac{(17.83)^2}{12.168} + \frac{(13.24)^2}{53.235}$

$= 5.519 + 8.77 + 26.127 + 3.293$

$= 43.68$

The figure below shows these four habitat types.



Note: Figure not drawn to scale.

$df = v = n - 1 = 3$

$P.01 = 11.34 < \chi^2 3.68 \therefore P > .005$ (12.838)

$\therefore$ REJECT HYPOTHESIS OF RANDOM DIST

Ho: proportions of moose per habitat are as given

Ha: at least one proportion is diff.

The proportion of total acreage in each of the habitat types was determined for the study area. Using an aerial survey, moose locations were observed and classified into one of the four habitat types. The results are given in the table below. EXPECT

Habitat Type	Proportion of Total Acreage	Number of Moose Observed		
1	0.340	25	39.78	14.78
2	0.101	22	11.817	10.183
3	0.104	30	12.168	17.83
4	0.455	40	53.235	13.235
Total	1.000	117		

The researchers who are conducting the study expect the number of moose observed in a habitat type to be proportional to the amount of acreage of that type of habitat. Are the data consistent with this expectation? Conduct an appropriate statistical test to support your conclusion. = RANDOM DISTRIBUTION NO

2. The M&M/Mars Company, headquartered in Hackettstown, New Jersey, makes milk chocolate candies. In 2005, they decided to replace the tan-colored M&M's with a new color. After conducting an extensive national preference survey, they decided to replace the tan M&M's with blue M&M's. Two large bags of M&M's are analyzed and the following counts are found:

E 263.64 263.92 263.64 486.72 405.6 324.48

Brown	Yellow	Red	Blue	Orange	Green	TOTAL
294	346	295	421	386	286	2028

After the introduction of the blue M&M's, the company changed the proportions of colors, and the company's Consumer Affairs Department announced:

On average, the new mix of colors of M&M's Milk Chocolate Candies will contain 13 percent of each of browns and reds, 14 percent yellows, 16 percent greens, 20 percent oranges, and 24 percent blues... While we mix the colors as thoroughly as possible, the above ratios may vary somewhat, especially in the smaller bags. This is because we combine the various colors in large quantities for the last production state (printing). The bags are then filled on high-speed packaging machines by weight, not by count.

Using the information above, does the data provide sufficient evidence to support the color proportions as claimed by the M&M/Mars Company?

A Br Y R Bl O G

$\frac{(30.36)^2}{263.64} + \frac{(62.08)^2}{263.92} + \frac{(51.36)^2}{263.64} + \frac{(65.72)^2}{486.72} + \frac{(19.6)^2}{405.6} + \frac{(38.48)^2}{324.48}$

$df = 5$

$P.005 = 16.75$

$3.496 + 13.57 + 3.73 + 8.87 + .95 + 4.56 = 35.176$ $\chi^2 > \therefore$ REJECT HYPOT

$35.176 > 16.75$

3. Criminologists have long debated whether there is a relationship between weather and violent crime. The author of the paper "Is There a Season for Homicide?" (*Criminology (2008): 287 - 296)* classified 1361 homicides according to season, resulting in the following data. Does this data support the theory that the homicide rate is not the same over the four seasons?

Winter	Spring	Summer	Fall	Total
328	334	372	327	1361

E 340.05 12.25 6.25 31.75 13.25 A A A A

.44 + .11 2.96 .52 = 4.03 χ^2

3 df .9 = .584 .1 = 6.251

$.9 > \chi^2 > .1$ ∴ FAIL TO REJECT HYPOTHESIS

REJECT IF $\chi^2 \leq .05$

SMALLER χ^2 OR ↓, MORE ASSURED REJECT

4. In a recent survey conducted by *The Denver Post*, the respondents (all over 20 years of age) followed the distribution below regarding their highest level of education:

Highest level	No high school diploma	High school graduate	Some college	College graduate	Some post-graduate work	Post-graduate degree
% of respondents	7%	24%	31%	27%	5%	6%

0 9.3 23.3 11.3 34.7 14 7.3

A similar survey of 150 adults was conducted in the Chatfield area and the number of respondents in each category (in the same order given above) is as follows: 14, 35, 17, 52, 21, and 11. Does the data provide sufficient evidence of a difference in the proportion of people reaching certain levels of education in the Chatfield area compared to the Denver area? Use an alpha level of .01.

A 2.3 .7 19.7 7.7 9 1.3

.756 + .02 12.52 2.185 16.2 .48

(P) $\chi^2 = 31.97$ df = 5 .01 = 15.086

∴ REJECT HYPOTHESIS

IF THE SUM OF THE "OFF EXPECTATIONS" AFTER PTS IS GREAT ENOUGH, EXPECTATIONS INCORRECT