Math 263–001 Test 2
Instructor: David Love February 29, 2012

- Show **all** algebraic work to receive full credit.
- Please turn OFF all cell phones, pagers, and other communication devices and put them out of sight.
- All textbooks, notes, etc. must be put away. A 3×5 note card is allowed.

Student's Name (please print): Key

1. In statistics, what is a "population?"

   An entire group of individuals that we want information about.

2. What does it mean for an observed effect to be "statistically significant?"

   That the effect is large enough that it would rarely occur by chance.

3. What is a "factor" in the design of experiments?

   An explanatory variable; something that is changed to observe the effect on the response variable.

4. What does it mean for events A and B to be independent? What is the mathematical criteria for their independence?

   Knowing that one occurred tells you nothing about whether the other occurred

   $$P(A \text{ and } B) = P(A)\,P(B)$$

   $$P(A \mid B) = P(A)$$

5. What does it mean for events A and B to be disjoint? What is the mathematical criteria for their being disjoint?

They have no outcomes in common.

$P(A \text{ or } B) = P(A) + P(B)$

$P(A \text{ and } B) = 0$

6. Events A and B have probabilities $P(A) = 0.2$, $P(B) = 0.5$ and $P(A \text{ or } B) = 0.5$. Find $P(A \text{ and } B)$. Are A and B independent? Disjoint?

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$0.5 = 0.2 + 0.5 - P(A \text{ and } B)$

$\rightarrow P(A \text{ and } B) = 0.2$

If indep, $P(A \text{ and } B) = (0.2)(0.5) = 0.1$

$\rightarrow$ Not indep

Not disjoint, $P(A \text{ and } B) \neq 0$

7. Three independent random variables, X, Y, and Z have means $\mu_X = 0.4$, $\mu_Y = 4$ and $\mu_Z = 3.6$, and standard deviations $\sigma_X = 24$, $\sigma_Y = 9$ and $\sigma_Z = 32$. Find the mean, variance and standard deviation of $X + Y + Z$.

Mean $= \mu_{X+Y+Z} = \mu_X + \mu_Y + \mu_Z = 0.4 + 4 + 3.6 = 8$

Variance $= \sigma^2_{X+Y+Z} = \sigma^2_X + \sigma^2_Y + \sigma^2_Z = 24^2 + 9^2 + 32^2 = 1681$

Stdev $= \sigma_{X+Y+Z} = \sqrt{\sigma^2_{X+Y+Z}} = \sqrt{1681} = 41$

8. The random variable X has the distribution

Value of X	-2	0	9
Probability	.17	.57	.26

$1 - .57 - .26 = .17$

(a) Find the $P(X \geq 0)$

$= P(X = 0) + P(X = 9)$

$= 0.57 + 0.26$

$= \underline{0.83}$

(b) Find the mean of X.

$\mu_X = \sum p_i x_i = (0.17)(-2) + (0.57)(0) + (0.26)(9)$

$= \underline{2}$

(c) Find the standard deviation of X.

$\sigma_X = \sqrt{\sum p_i (x_i - \mu_X)^2}$

$= \sqrt{(0.17)(-2-2)^2 + (0.57)(0-2)^2 + (0.26)(9-2)^2}$

$= \sqrt{17.74} = \underline{4.212}$

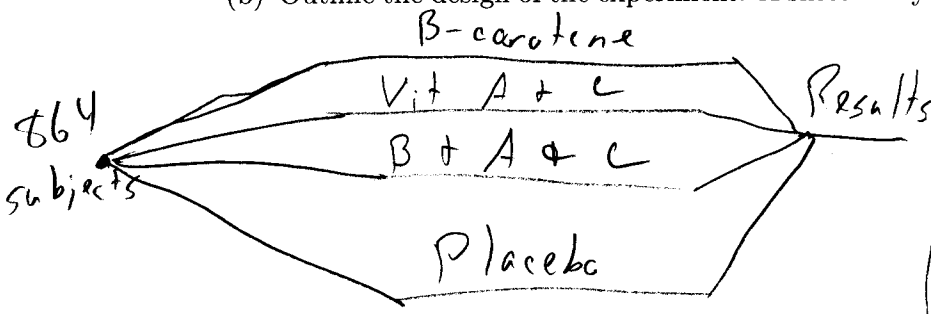
9. People who eat lots of fruits and vegetables have lower rates of colon cancer that those who eat little of these foods. Fruits and vegetables are rich in antioxidants such as vitamins A, C, and E. Will taking these antioxidants help prevent colon cancer? A clinical trial studied this question with 864 people who were at risk for this type of cancer. The subjects were divided into four groups, daily β-carotene, daily vitamins A and C, all three vitamins every day and a placebo. After four years, the researchers reported, "no significant difference" in the cancer rate among the groups.

(a) What are the explanatory and response variables in this experiment.

Explanatory: Amount of each vitamin

Response: Rate of colon cancer.

(b) Outline the design of the experiment. A sketch may reduce the length of your discussion.



* Randomly split into 4 groups of 216.

(c) The study was double-blind. What does this this mean?

Neither subject nor vitamin dispensors knew which group each subject was in

(d) What does "no significant difference" mean in describing the outcome of the experiment?

Any difference between the groups may have happened by chance

10. The table below gives the IQ rating as well as a rating for creativity for 250 individuals in a psychological study.

	Low IQ	High IQ
Low Creativity	85	10
High Creativity	30	125

(a) Find the probability that a randomly selected individual from this study will will be classified as having a high IQ or as having high creativity

$P(\text{High IQ or High Creativity}) = \frac{30 + 10 + 125}{250} = 0.66$

(b) What is the probability that a person has high IQ given that this person is a high creativity person?

$P(\text{High IQ} \mid \text{High Creativity}) = \frac{125}{125 + 30} = 0.81$

Or $= \frac{P(\text{High IQ} + \text{High Creativity})}{P(\text{High Creativity})}$

$= \frac{\left(\frac{125}{250}\right)}{\left(\frac{125 + 30}{250}\right)} = \frac{0.5}{0.62} = 0.81$