MAT 2379A
Midterm Examination

October 22, 2014 **Professor Raluca Balan**
Time: 80 minutes

Student Number:_____

Family Name: _____ **First Name:** _____

This is a closed book examination. A formula sheet and some statistical tables are included with the exam. Only Faculty standard calculators are permitted. Record your answer to each question in the table below.

Question	Answer
1	
2	
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12	

NOTE: At the end of the examination, hand in only this page. You may keep the questionnaire.

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1. IR8 rice (also called miracle rice) is a genetically modified rice which was introduced in Asia in the 1960's and marked the beginning of the Green Revolution. Since then, more than 400 improved rice varieties have been created by the International Rice Research Institute. Dwarfism and high yields are two desirable traits of a rice plant. Assume that both traits are recessive. Consider crossing two plants which do not give high yields, but are heterozygous for this trait. Suppose that one of the plants is a dwarf, and the other one is a regular size plant which is heterozygous for this trait. What is the probability that the offspring is a dwarf plant with high yields?

   A) $1/8$ B) $1/2$ C) $1/4$ D) 0 E) $1/16$

2. Enterococci are bacteria that cause blood infections in hospitalized patients. One antibiotic used to battle enterocossi is vancomycin. A study revealed that in Canada, the enterocossi bacteria is resistent to vancomycin in 22% of all hospitalized patients who have this kind of infection. Consider a random sample of three patients with blood infections caused by the enterocossi bacteria. Assume that all three patients are treated with the antibiotic vancomycin. What is the probability that the enterocossi bacteria is resistent to the antibiotic for at least one patient?

   A) 0.041 B) 0.476 C) 0.062 D) 0.525 E) 0.224

3. Vaccines are effective ways which help the human body to develop immunity against bacteria or viruses. Some vaccines are produced using live bacteria or viruses, which have been altered so that they cannot cause the disease. Let X be the number of bacteria (in thousands) found in a patient, three days after receiving a vaccine containing this bacteria. The observed values of X for 7 patients are given below:

   $$121 \quad 147 \quad 315 \quad 125 \quad 134 \quad 305 \quad 157.$$

   Find the median and the interquartile range for this data set.

   A) The median is 125 and the interquartile range is 158.
   B) The median is 125 and the interquartile range is 101.5.
   C) The median is 186.3 and the interquartile range is 180.
   D) The median is 147 and the interquartile range is 180.
   E) The median is 147 and the interquartile range is 100.

4. The eye colour of any member of a group of 1770 German men is either blue or brown, and the hair colour is either blond or brown. In this group, there are 320 men who have brown hair and brown eyes, and there are 250 men who have brown hair and blue eyes. Finally, 400 have blond hair and brown eyes. What is the probability that a randomly chosen member of the group has blond hair and blue eyes?

   A) 0.5 B) 0.169 C) 0.226 D) 0.452 E) 0.1

5. The following data gives the blood cholesterol level of five randomly chosen women (in grammes per litre):

   $$3.0 \quad 1.8 \quad 2.1 \quad 2.7 \quad 1.4$$

   Calculate the sample mean and the sample variance for this data.

   A) The sample mean is 2.1, the sample variance is 0.475.
   B) The sample mean is 2.1, the sample variance is 6.475.
   C) The sample mean is 2.2, the sample variance is 0.425.
   D) The sample mean is 2.2, the sample variance is 0.34.
   E) The sample mean is 2.0, the sample variance is 0.275.

6. This morning, there were 15 persons who donated blood at a clinic of the Canadian Blood Society. Here is the distribution of their blood types:

Blood type	O	A	B	AB
Number of donors	8	3	3	1

   We select at random 2 persons from these 15 donors. What is the probability that we select exactly one person with blood type O?

   A) 0.2667 B) 0.2489 C) 0.5333 D) 0.4978 E) 0.7156

7. Glaucoma is a disease of the eye that is manifested by high intraocular pressure. Assume that in the general population, the intraocular pressure has approximately a normal distribution with mean 16 mm Hg and standard deviation 3 mm Hg. The normal range for intraocular pressure is considered to be between 12 mm Hg and 20 mm Hg. What proportion of the general population has intraocular pressure in the normal range?

   A) 0.8164 B) 0.0918 C) 0.9082 D) 0.1426 E) 0.2875

8. Recent studies suggest that there is a link between the use of alcohol-containing mouthwashes (like Listerine) and oral cancer. Data from several dentist offices show that 33% of the patients with oral cancer have used Listerine on a regular basis for more than 5 years, while among the patients who do not have oral cancer, 27% have used Listerine on a regular basis for more than 5 years. It is estimate that approximately 5% of the general population has oral cancer. What is the probability that a patient will develop oral cancer, given that he/she has used Listerine on a regular basis for more than 5 years?

   A) 0.05 B) 0.10 C) 0.06 D) 0.01 E) 0.07

9. A patient with high blood pressure is called hypertensive, and a patient with normal blood pressure is called normotensive. Suppose that 78% of hypertensives and 21% of normotensives are classified as hypertensives by an automated blood-pressure machine. What is the positive predictive value (PPV) and negative predictive value (NPV) of this machine, assuming that 14% of the adult population is hypertensive?

   A) PPV=0.12, NPV=0.80
   B) PPV=0.38, NPV=0.96
   C) PPV=0.38, NPV=0.84
   D) PPV=0.40, NPV=0.84
   E) PPV=0.12, NPV=0.96

10. Let X be the final mark of a randomly selected student who took the course MAT2379A in the fall 2013. Assume that this mark is rounded to the closest integer value (on a scale from 0 to 100). The following table gives the values of the cumulative distribution function F of X, for some particular marks x:

mark x	30	40	60	69	74	79	84	89	100
$F(x)$	0	0.067	0.105	0.133	0.246	0.333	0.467	0.8	1

   What is the probability that a randomly selected student in this class obtained the grade B or B+?
   (Recall that the grade B corresponds to a final mark in the range 70-74, and the grade B+ corresponds to a final mark in the range 75-79.)

   A) 0.333 B) 0.133 C) 0.466 D) 0.379 E) 0.2

11. Let X be a random variable with a binomial distribution with $n = 20$ trials and probability of success $p = 0.3$. We would like to compute $P(10 \leq X < 13)$ using R. Which one of the following commands gives this probability?

    A) `pbinom(13,20,0.3)-pbinom(10,20,0.3)`
    B) `dbinom(10,20,0.3)+dbinom(11,20,0.3)+dbinom(12,20,0.3)`
    C) `pbinom(13,20,0.3)-pbinom(9,20,0.3)`
    D) `pbinom(10,20,0.3)+pbinom(11,20,0.3)+pbinom(12,20,0.3)`
    E) `dbinom(12,20,0.3)-dbinom(9,20,0.3)`

12. Nearsightedness, or myopia, has become more prevalent in recent years, especially in children. Although the cause for myopia is unknown, many eye doctors think that this is related to eye fatigue from computer use, coupled with a genetic predisposition. Let X be the number of diopters of nearsightedness of a randomly selected child with myopia, of age 2-16. (We record the value with the most severe form of myopia between the left and the right eye. For instance, for a child with -1.25 in the left eye and -2.50 in the right eye, the value of X is -2.5.) Using data from a large network of optometry offices specializing in pediatric care, we obtain the following frequency table for the values of X:

x	less than -6.00	[-6.00, -4.00)	[-4.00, -2.00)	[-2.00, 0.00)
frequency	3%	7%	36%	54%

    A value less than -6.00 is called high myopia. If a sample of 10 children with myopia is randomly selected, what is the probability that at least two of them have high myopia?

    A) 0.0016 B) 0.2626 C) 0.0642 D) 0.1316 E) 0.0345

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