

Concordia University  
Department of Electrical and Computer Engineering  
ENGR 371 - Probability and Statistics

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Final Examination

April 29, 2010

1) **(10 Marks)** In a particular area, there are just three makes of cars available: Ford (60% of the total), Renault (30%) and Honda (10%). The carburetors on Fords have a 0.09 probability of failure, those on Renaults have a 0.05 chance and those on Hondas have a 0.02 chance of failure. If a car with a failed carburetor is selected at random, what is the probability that it is a Ford?

2) **(10 Marks)** A multiple-choice quiz has 200 questions each with 4 possible answers of which only 1 is the correct answer. What is the probability that sheer guesswork yields from 25 to 30 correct answers for 80 of the 200 problems about which the student has no knowledge? [**HINT: approximation may be helpful here**]

3) **(10 Marks)** Let  $X$  and  $Y$  represent two random variables whose joint density function is

$$f_{XY}(x, y) = \begin{cases} 24xy, & 0 \leq x \leq 1, 0 \leq y \leq 1, x + y \leq 1 \\ 0, & \text{elsewhere} \end{cases}$$

- a) Find  $f_Y(y)$ .
- b) Are  $X$  and  $Y$  independent? Explain.
- c) Find  $P\left(Y < \frac{1}{8} \mid X = \frac{3}{4}\right)$ .

4) **(10 Marks)** Two independent experiments are being run in which two different types of paints are compared. Eighteen specimens are painted using type A and the drying time, in hours, is recorded on each. The same is done with type B.

- a) Suppose that the population standard deviations are both known to be 1.0. Assuming that the mean drying time is equal for the two types of paint, find  $P(\bar{X}_A - \bar{X}_B > 1.0)$ , where  $\bar{X}_A$  and  $\bar{X}_B$  are average drying times for samples of size  $n_A = n_B = 18$ .
- b) Repeat Part (a) when the population standard deviations are unknown, but they are still equal and estimated to be  $s = 0.96$ .

5) **(10 Marks)** A random sample of 100 automobile owners shows that, in the province of Quebec, an automobile is driven on the average 23,500 kilometers per year with a standard deviation of 3900 kilometers.

- a) Construct a 99% confidence interval for the average number of kilometers an automobile is driven annually in Quebec.
- b) What can we assert with 99% confidence about the possible size of our error if we estimate the average number of kilometers driven by car in Quebec to be 23,500 kilometers per year?

6) **(10 Marks)** The life in hours for a battery is known to be normally distributed with standard deviation  $\sigma = 1$  hours. A random sample of 16 batteries has a mean life of  $\bar{x} = 20.3$  hours.

- a) Test  $H_0 : \mu = 20$  versus  $H_1 : \mu > 20$  for  $\alpha = 0.05$ .
- b) What is the P-value of the test in part (a)?
- c) What is the  $\beta$  error for the test in part (a) if the true mean is 20.75 hours?