McGill University

MATH 323

Assignment 1

19 January, 2017

- The deadline for submission is 2 February 2017, 10 PM.
- Upload your paper in PDF format (scan it if using pen and paper) to the folder named "Assignment-1" located under "Assignments" tab in myCourses.
- Write your name and Student ID on top of the first page.
- Explain your argument clearly. Solutions without proper justification may not receive full credit.
- Answer all questions. The problems carry a total of 16 marks. Maximum you can score is 15.

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1. Three boys (B1, B2, and B3) and three girls (G1, G2, and G3) line up in a random order for a photograph.

(a) What is the probability that all three girls stand next to each other (e.g., B2-G2-G3-G1-B1-B3)?

(b) What is the probability that the boys and girls alternate (e.g., G2-B3-G3-B1-G1-B2)?

(2.5+2.5)

2. Definitions of 'simple random sampling without replacement' (SRSWOR) and 'simple random sampling with replacement' (SRSWR) are given at the end of this document.

(a) 10 cards were drawn WITH REPLACEMENT from a standard deck of cards. What is the probability that cards of both color (red and black) were selected?

(b) 10 cards were drawn WITHOUT REPLACEMENT from a standard deck of cards. What is the probability that cards of both color (red and black) were selected?

(2.5+2.5)

3. Two cards were drawn WITHOUT REPLACEMENT from a standard deck of cards. Let A (resp. B) denote the event that the first card (resp. second card) chosen was a diamond.

(a) Find $\mathbb{P}(B)$.

(b) Show that A and B are **not** independent events.

(2+1)

4. In a town, 40% of the population has HIV. An HIV test for a person that actually has the disease comes back positive with probability 0.9. If a person does not have the disease, then the test comes back negative with probability 0.95.

If a person is chosen at random from the town population and his/her test comes back positive, then what is the probability that the person actually has HIV?

(3)

Simple random sampling WITH replacement (SRSWR):

- You have n items in a box, and you want to select a sample of m items.
- You select one item uniformly at random, note which item it is, and RETURN IT to the box.
- Repeat this m times.

Note: An item can be selected more than once in this sampling scheme.

Simple random sampling WITHOUT replacement (SRSWOR):

- You have n items in a box, and you want to select a sample of m items, where $m \leq n$.
- You select one item uniformly at random, note which item it is, but then you DO NOT return it to the box.
- Next, select one item uniformly from the REMAINING items.
- Repeat until you have m items.