Given name:_____ **Family name**:_____

Student number:_____ **Signature**:_____

Tutorial (circle one):
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UNIVERSITY OF TORONTO
Faculty of Arts and Science

STA130H1 (Introduction to Statistical Reasoning)
MIDTERM TEST
February 24, 2016, 2:10 p.m.

Duration: 100 minutes. Total points: 44.

Aids allowed: a simple non-programmable calculator

This examination paper consists of **6** single-sided pages (including this cover page), and **8** questions. The backs of the pages can be used to continue an answer (be sure to INDICATE THIS), or as scrap paper. The value of each question is indicated in [square-brackets].

NOTE: A standard normal probability table is included at the end.

DO NOT OPEN THIS TEST UNTIL YOU ARE TOLD TO DO SO.

For graders' use only:

	Score
1 (5)	
2 (4)	
3 (3)	
4 (4)	
Subtotal	

	Score
5 (4)	
6 (6)	
7 (9)	
8 (9)	
Subtotal	

Total (44)	

1. Suppose X is a random quantity which equals 0 with probability 1/2, or equals 2 with probability 1/3, or equals 8 with probability 1/6.

   (a) [2] Compute the expected value $E(X)$.

   (b) [2] Compute the variance $Var(X)$.

   (c) [1] Compute the standard deviation $sd(X)$.

2. Suppose Y is a random quantity having normal probabilities with mean 40 and variance 25.

   (a) [2] Compute $P(Y < 44)$. [Hint: don't forget the standard normal probability table included at the end of this test.]

   (b) [2] Compute $P(Y > 38)$.

3. [3] Suppose we roll an ordinary fair six-sided die. Let X be three times the observed die value plus four. (For example, if the die shows 5, then $X = 3 \times 5 + 4 = 19$.) Compute (with explanation) the expected value $E(X)$.

4. [4] In three or four complete English sentences, without using any technical symbols or equations, explain the basic idea of what a P-value is and what it is for, in simple terms that could be understood by someone who has never taken a statistics course.

5. A recent poll[1] repoted in the media[2] asked about "happiness". They surveyed $n = 1,530$ Canadian adults, and found that 79% of them reported being happy[3].

   (a) [1] Based on the above, how many of the surveyed adults reported being happy?

   (b) [3] Let p be the true fraction of all Canadian adults who would report being happy, and let $\hat{p}$ be the sample fraction from a survey of this size. Then in terms of p and n, what are the mean and variance and sd of $\hat{p}$?

6. Consider the happiness poll from the previous question.

   (a) [4] Using the conservative option, compute a 95% confidence interval for p based on the poll's findings.

   (b) [2] State your conclusion from the confidence interval as a complete English sentence.

[1] http://angusreid.org/wp-content/uploads/2016/01/2016.01.26-life-satisfaction.pdf
[2] http://www.thestar.com/life/2016/02/01/two-thirds-of-canadians-pretty-happy-poll-finds.html
[3] For "Happy", we combined the responses "Very happy" and "Pretty happy" together.

7. Consider the happiness poll from the previous two questions.

   (a) [2] Consider testing the null hypothesis that $p = 0.77$ against the alternative hypothesis that $p > 0.77$. Specify in a complete English sentence what the P-value would correspond to in this case.

   (b) [3] Compute this P-value, using (with explanation) a normal approximation.

   (c) [2] Determine (with explanation) whether or not the null hypothesis should be rejected in this case, according to standard scientific practice.

   (d) [2] State in a complete English sentence your conclusion from this hypothesis test.

8. The above happiness poll also included separate results for each province. In Ontario, they surveyed $n_1 = 511$ adults, and found that 80% of them reported being happy. In Quebec, they surveyed $n_2 = 360$ adults, and found that 77% of them reported being happy. Write p_1 and $\hat{p}_1$ for the true and sample fractions who report being happy in Ontario, and p_2 and $\hat{p}_2$ for Quebec.

   (a) [3] In terms of p_1 and p_2 and n_1 and n_2, what are the mean and variance and sd of the sample difference $\hat{p}_2 - \hat{p}_1$?

   (b) [4] Using the bold option, compute a 95% confidence interval for the difference $p_2 - p_1$ based on the poll's findings.

   (c) [2] State your final conclusion as a complete English sentence.

End of examination
Total pages: 6
Total points: 44