Last Name:

First Name:

Term Test #3, ECO220Y1Y, January 30, 2015, Prof. Murdock:

You have 110 minutes. Keep these papers closed on your desk until the start of the test is announced.

This test has 12 pages plus the aid sheets.

Once the test begins, you may detach the aid sheets and statistical tables (Standard Normal and Student *t*) from the end of this test. Aid sheets and statistical tables will not be collected.

There are 5 written questions with varying point values worth a total of 100 points.

Write your answers clearly, concisely, and completely below each question.

Show your work and make your reasoning clear.

Fully label all graphs.

Apply your understanding to the specific questions asked. Offer context-specific explanations rather than generic definitions or quotes from class or the book. Show that you can successfully *apply* your understanding to the specific circumstances presented.

A guide for your response ends each question to let you know what is expected: e.g. a quantitative analysis, a graph, and/or sentences.

If the guide asks for a fully-labeled graph, it is required. (In other words, failing to include a fully-labelled graph when it is requested in the guide will result in substantial lost points.)

For questions with multiple parts (e.g (a) – (c)), attempt each part even if you had trouble with earlier parts.

Pages 11 and 12 give extra space: use this *only* if necessary and clearly indicate the question number and make a clear note in the original space directing the grader to it.

Unless otherwise specified, you choose the significance level. (If there are no special considerations, you may choose a 5% significance level.)

Student #:

	Q1	Q2	Q3	Q4	Q5	Raw Total	Percent Mark
Point Value:	20	24	20	26	10	100	
Points Earned:							

(1) [20 pts] Consider two unrelated questions derived from Test #2, which the class wrote on November 28, 2014.

(a) [8 pts] Consider a 20 die-roll Monte Carlo simulation. In each simulation draw, 20 fair dice are rolled and the sample median is computed. 500,000 simulation draws are used. Below is a STATA summary of the simulation results.

```
                        Sample Median
-------------------------------------------------------------
      Percentiles      Smallest
 1%             2             1
 5%           2.5             1
10%             3             1       Obs                 500000
25%             3             1       Sum of Wgt.         500000

50%           3.5                     Mean           3.499456
                        Largest       Std. Dev.      .6615879
75%             4             6
90%             4             6       Variance       .4376986
95%           4.5             6       Skewness       .0046752
99%             5             6       Kurtosis       2.829294
```

Fully explain the multiple-choice question to the right. Highlight the key course concept it is testing. Explain why the correct choice is correct and why each other choice is wrong. Answer with 4 – 6 sentences.

If the Monte Carlo simulation is repeated but this time each sample has 100 observations (i.e. 100 dice rolled) instead of 20, which should you expect to INCREASE in the new STATA summary of the simulation results for the sample median?

(A) the 5th percentile
(B) the 50th percentile
(C) the 95th percentile
(D) the standard deviation
(E) the interquartile range

(b) [12 pts] Wait time for the "Airport Rocket" bus (X) is Uniformly distributed from 0 to 10 minutes. An airport monitor records wait times for 21 randomly selected travelers. (The chosen sampling procedure ensures that the independence assumption is reasonable.) What is the chance that the sample mean wait time is less than 4 minutes? Answer with a quantitative analysis and a fully-labeled graph that illustrates the answer and where the units on the x-axis are minutes.

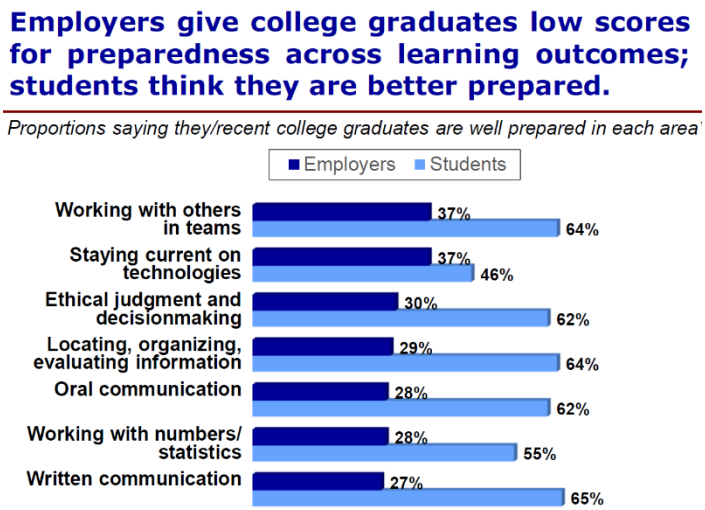
(2) [24 pts] A large online course has tens of thousands of students and a team of paid graders. The course coordinator must assess the accuracy of each grader. A grading error occurs when the recorded mark is too high or too low. Given the huge enrolment, the coordinator cannot observe a grader's overall error rate because each grader marks many thousands of papers during the course. Instead, the coordinator randomly samples 120 graded papers for each grader and re-grades them. If there is sufficient evidence to infer that that a grader's overall error rate is above 10% then the grader's employment will be terminated.

(a) [2 pts] What are the null and research hypothesis? Answer with precise hypotheses using standard notation.

(b) [8 pts] Which significance level would you recommend in this case? Why? How do considerations of Type I and Type II errors factor in? (Make sure your discussion is context-specific.) Answer with a significance level and 3 – 5 sentences.

(c) [14 pts] Given your chosen significance level, if a grader has an overall error rate of 15% how likely is it that the coordinator will *not* dismiss her/him? Answer with a quantitative analysis, fully labelled graphs, and 1 – 2 sentences.

(3) [20 pts] A 2015 report entitled "Falling Short? College Learning and Career Success" by Hart Research Associates (HRA) discusses a survey of random sample of 613 recent graduates from college or university and another random sample of 400 employers. The figure to the right, which is extracted from that report, summarizes some of the findings. (http://www.aacu.org/sites/default/files/files/LEAP/2015employerstudentsurvey.pdf)



(a) [12 pts] For "Working with numbers/statistics" is there a *statistically significant difference* between employers and recent graduates? If so, at which significance levels? A *significant difference*? Answer with hypotheses, a quantitative analysis and 2 – 3 sentences.

(b) [8 pts] Suppose HRA had surveyed only 40 recent graduates and 40 employers but that everything else, including the figure showing the results, is the same. Repeating the analysis from Part (a) but with these smaller sample sizes yields a test statistic of -2.45. Using this result (i.e. you do *not* need to show how to calculate -2.45), evaluate it and answer the following questions again. For "Working with numbers/statistics" is there a *statistically significant difference* between employers and graduates? If so, at which significance levels? A *significant difference*? Further, explain the reasons for any differences in your answers between Parts (a) and (b). Answer with a quantitative analysis and 3 – 4 sentences.

(4) [26 pts] In 2011, Philip Oreopoulos, a professor of economics at U of T, published a paper "Why Do Skilled Immigrants Struggle in the Labor Market? A Field Experiment with Thirteen Thousand Resumes" in the *American Economic Journal: Economic Policy*. Here is the paper's abstract:

> Thousands of randomly manipulated resumes were sent in response to online job postings in Toronto to investigate why immigrants, allowed in based on skill, struggle in the labor market. The study finds substantial discrimination across a variety of occupations against applicants with foreign experience or those with Indian, Pakistani, Chinese, and Greek names compared with English names. Listing language fluency, multinational firm experience, education from highly selective schools, or active extracurricular activities had no diminishing effect. Recruiters justify this behavior based on language skill concerns but fail to fully account for offsetting features when listed. (http://pubs.aeaweb.org/doi/pdfplus/10.1257/pol.3.4.148).

In this randomized field experiment, realistic but fake resumes were sent to real job postings. Consider only those resumes where the applicant had a Canadian education (e.g. a Rotman Commerce degree) and Canadian work experience. Each resume is *randomly assigned* either an English name (e.g. “Greg Johnson” or “Emily Brown”) or a Chinese, Indian, Pakistani, or Greek name (e.g. “Ali Saeed” or “Min Liu”). Below is a cross-tabulation of the results where Type 0 refers to English names and Type 1 refers to non-English (i.e. Chinese, Indian, Pakistani, or Greek) names and callback records whether or not the potential employer ever called back the resume sender (no = 0 and yes = 1).

type	callback 0	1	Total
0	2,597	429	3,026
1	3,252	363	3,615
Total	5,849	792	6,641

(a) [12 pts] How strong is the evidence supporting the conclusion that callback rates are lower for applicants who happen to have a non-English name? Answer with hypotheses, a quantitative analysis, a quantitative measure of the strength of the evidence and 1 precise sentence evaluating the strength of the evidence.

(b) [4 pts] Can you infer causality? Explain why or why not. Could systematic differences in things like education and work experience explain the difference in the callback rate? Answer in 2 – 3 sentences.

(c) [10 pts] How big is the difference in callback rates? What is the margin of error? Fully interpret your findings. Answers with a quantitative analysis and 2 – 3 sentences.

(5) [10 pts] To investigate customer satisfaction, a taxi fleet manager asks a random sample of passengers "How satisfied are you with the service on a scale from 0 to 10, where 0 is highly dissatisfied and 10 is perfectly satisfied." 45 respondents evaluate the driver with badge id #A43F. Here is a STATA summary:

```
                          rating
-------------------------------------------------------------
      Percentiles      Smallest
 1%             2             2
 5%             3             3
10%             4             3       Obs                  45
25%             5             3       Sum of Wgt.          45

50%             6                     Mean           5.511111
                        Largest       Std. Dev.      1.501851
75%             6             8
90%             7             9       Variance       2.255556
95%             9             9       Skewness       .3040799
99%             9             9       Kurtosis       3.640161
```

Find the relevant 90% confidence interval estimate. Fully interpret it. Be extremely clear on what it helps make an inference about and be context-specific. Answer with a quantitative analysis and 1 – 2 sentences.

EXTRA SPACE: If you use this space, clearly indicate the question number and make a clear note in the original space directing the grader here.

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