

AMS5 - Final
Thursday, June 11th, 2009

READ THE INSTRUCTIONS CAREFULLY

1. Write your answers in a Blue Book. Put your name, your student ID number, your section day/time and your TA's name on the front of your blue book.
2. Write the exam code (at the top right of this page) on the front of your blue book.
3. This exam consists of three (3) long questions, two (2) short questions, and one (1) bonus questions. [The bonus question is not included in this practise final]
4. The three long questions are Q1, Q2 and Q3. You must answer Q1 and **one** of questions Q2 and Q3 (your choice).
5. The two short questions are Q4 and Q5. You must answer both of them.
6. You are advised to read the questions carefully, and answer the question asked.
7. Begin your answer to each question on a new page.
8. You must show working for all questions to get full marks.
9. A normal table and a χ^2 -table can be found at the end of this exam. [They are not included in this practice exam, but will be included in the actual exam.]
10. Hand in this question paper with your answers.
11. Two of the questions have bonus parts, and there is one bonus question [These are not included in this practise version, but were on the actual final]. You can get full marks without answering the bonus questions. Correct answers to the bonus questions will earn you additional marks, but you cannot score more than 100%.

1. (10 marks) A dreidel is a 4-sided spinning top, where the sides are marked with the Hebrew letters “*nun*” (N), “*gimmel*” (G), “*hay*”, (H) and “*shin*” (S).

My eldest son claims that he can spin the dreidel in a special way such that “*nun*” comes up more often than expected for an unbiased dreidel. He spun the dreidel 80 times, and told me that he got “*nun*” 28 times.

- (a) What is a 95% confidence interval for the percentage of all spins that will show a “*nun*”? Does this cover the true percentage for an unbiased dreidel?
- (b) Do the 28 “*nun*”s give evidence that my son does indeed have a special way of spinning the dreidel?
- (c) My other son is sceptical of his older brother’s claim. He watched the dreidel being spun, and as well as the 28 “*nun*”s, he noticed that “*gimmel*” came up 15 times, “*hay*” came up 21 times, and “*shin*” came up 16 times. Does he conclude that his brother has a special way of spinning the dreidel?
- (d) Does your answer to b) agree with your answer to c). Explain briefly.

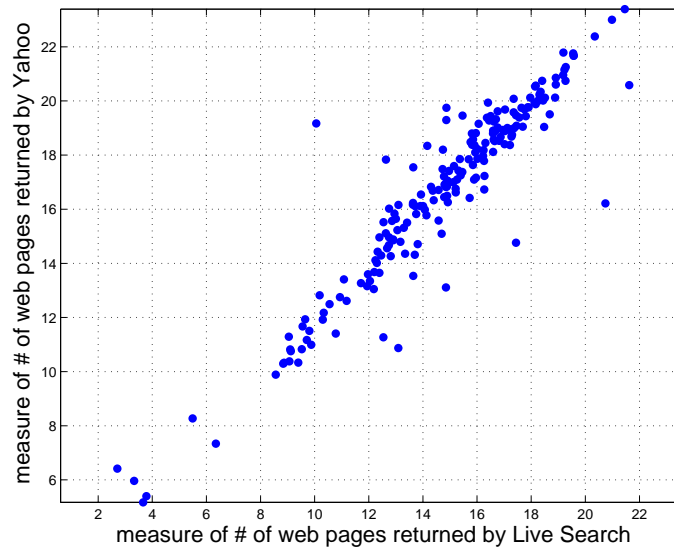
2. (8 marks) If you type your surname into the search box on Yahoo, one of the pieces of information it returns is the number of web pages in its index that contain your name. If you do the same search on Live Search you will typically get a different answer.

Because I'm a stats professor with no life, I did this for each of your surnames¹.

- (a) Do you expect the distribution of the number of pages found on each search engine to follow the normal curve? Explain briefly.

After suitably transforming the data², I get the scatterplot shown below, which is nicely "football shaped".

For Live Search the mean is 14.95 and the SD is 3.29. For Yahoo the mean is 16.93 and the SD is 3.37. The correlation coefficient is 0.94.



- (b) I looked up my own surname (Morris), on Live Search, and the returned measure was 17.5. What would you expect the result from Yahoo to be? What would you expect for Prof. Kottas, whose measure from Live Search was 10.5?
- (c) What would the RMS errors in these estimates be?
- (d) Of all names that return a measure of 17.5 on Live Search, what percentage will have measures greater than 20 on Yahoo?

¹Actually, I wrote a program to do it.

²By taking logarithms.

3. (8 marks) Read the Background, Methods, Results and Conclusions sections of the paper “Study of the Therapeutic Effects of Intercessory Prayer (STEP) in cardiac bypass patients: A multicenter randomized trial of uncertainty and certainty of receiving intercessory prayer” attached to the back of this exam.
- (a) What are the hypotheses the researchers studied?
 - (b) Formulate these as null hypotheses. What are the corresponding alternative hypotheses?
 - (c) Was this an observational study or a controlled experiment? Why?
 - (d) What do the researchers conclude?
 - (e) The investigators arranged for prayers to be said for those in the study who were assigned to the treatment groups, but they could not control whether others (e.g. family members of the patients) were saying prayers. Could this have affected the conclusions?
 - (f) From the data regarding the groups
 - 1) who were prayed for but were uncertain of whether they were being prayed for, and
 - 2) who were prayed for and knew they were being prayed for,can you conclude that there was a difference in complications between the two groups?
 - (g) Explain why the test you performed in part (f) is valid in this case.

4. (6 marks) Due to the financial crisis and the ever-increasing cost of tuition, one day you add up the total of your student loans and your credit cards, and find yourself with \$36,000 of debt.

You decide that the best way out of this hole is to hitch-hike to Vegas with the \$1,000 that you have saved up towards the trip to Central America you plan on taking after graduation, and to try to win enough to cover your debt. You mention this plan to two friends.

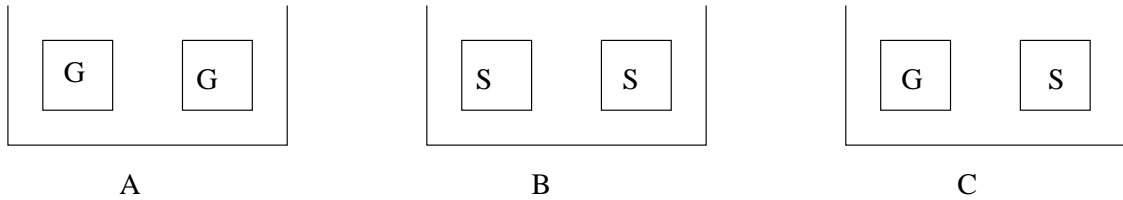
Friend A suggests that when you arrive in Vegas, you put the whole \$1,000 on a single number at roulette.

Friend B suggests that you divide the money into lots of \$250, and bet \$250 on red on as many different tables as you have lots of \$250, repeating until you either have \$36,000 or \$0.

- (a) If you follow friend A's advice, what is the chance that you pay off your debt?
- (b) After one round of following friend B's strategy, what are the possible outcomes in terms of how much money you have? What is the chance of each of these outcomes?
- (c) To compute your expected winnings after one round of following friend B's strategy, you multiply each monetary outcome by its probability, and then sum the results. How much money do you expect to have after following one round of friend B's strategy?

[Recall that a roulette table has 38 numbered slots, 18 of which are red, 18 of which are blue, and 2 of which are green. The slots are numbered 00, 0, then 1 through 36. If you bet red and win, you get back your stake, plus the same amount. If you bet on a single number, you get back your stake, plus 36 times the amount that you have bet.]

5. (4 marks) In front of you are the three boxes shown below. Box A contains 2 gold coins, box B contains 2 silver coins, and box C contains one gold coin and one silver coin.



- (a) You pick one box at random, then pick one coin from the box. Using only your intuition (without doing any calculation) – if the coin you have picked is gold, what is the chance that the other coin that is still in the box that you have chosen is also gold? Explain your answer.

Because the chosen coin is gold, we know that we have not chosen box B, so consider from this point on only boxes A and C. Label the coins in box A with 1 and 2, and the coins in box C with 3 and 4.

- (b) Considering now only boxes A and C, how many different ways are there to draw a gold coin?
- (c) In how many of these cases is the other coin in the box containing the chosen one also gold?
- (d) What is the probability that, if the first coin chosen from a randomly selected box is gold, the other coin still in the box is also gold?

Study of the Therapeutic Effects of Intercessory Prayer (STEP) in cardiac bypass patients: A multicenter randomized trial of uncertainty and certainty of receiving intercessory prayer

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Background Intercessory prayer is widely believed to influence recovery from illness, but claims of benefits are not supported by well-controlled clinical trials. Prior studies have not addressed whether prayer itself or knowledge/certainty that prayer is being provided may influence outcome. We evaluated whether (1) receiving intercessory prayer or (2) being certain of receiving intercessory prayer was associated with uncomplicated recovery after coronary artery bypass graft (CABG) surgery.

Methods Patients at 6 US hospitals were randomly assigned to 1 of 3 groups: 604 received intercessory prayer after being informed that they may or may not receive prayer; 597 did not receive intercessory prayer also after being informed that they may or may not receive prayer; and 601 received intercessory prayer after being informed they would receive prayer. Intercessory prayer was provided for 14 days, starting the night before CABG. The primary outcome was presence of any complication within 30 days of CABG. Secondary outcomes were any major event and mortality.

Results In the 2 groups uncertain about receiving intercessory prayer, complications occurred in 52% (315/604) of patients who received intercessory prayer versus 51% (304/597) of those who did not (relative risk 1.02, 95% CI 0.92-1.15). Complications occurred in 59% (352/601) of patients certain of receiving intercessory prayer compared with the 52% (315/604) of those uncertain of receiving intercessory prayer (relative risk 1.14, 95% CI 1.02-1.28). Major events and 30-day mortality were similar across the 3 groups.

Conclusions Intercessory prayer itself had no effect on complication-free recovery from CABG, but certainty of receiving intercessory prayer was associated with a higher incidence of complications. (*Am Heart J* 2006;151:934-42)

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More than 350 000 Americans and 800 000 people worldwide have coronary artery bypass graft (CABG) surgery every year.¹ Despite advances in surgical techniques, anesthesia, and postoperative care in recent years, major and minor complications occur within 30 days of CABG (1997 Society of Thoracic Surgeons Adult Cardiac Surgery Database).² Patients undergoing CABG often report that they are depressed,³ and depression is associated with cardiac events⁴ and mortality⁵ after CABG. Many patients report using private or family prayer to cope with this stressful experience.⁶

Although the effects of private prayer on outcome after CABG are unknown, 4 trials investigated the effects of intercessory prayer in heterogeneous groups of cardiac patients. Results have been mixed—intercessory prayer was beneficial in 2 studies^{7,8} and had no effect in