

Quantitative Methods for Lawyers

Problem Set #1

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Instructions: You may work in groups but each student must do their own work and submit his/her own problem set. If you work with others, please denote this fact in the upper right corner of your problem set (including the names of everyone in your group). Please show all of your work in order to receive credit. **Due at Noon - February 29, 2012.** Please submit a **hard copy** either to me or to Sue Nelson in Room 465.

Problem 1 *Calculating Summary Statistics*

For the Hypothetical Dataset of Exam Scores: 42, 50, 51, 53, 54, 55, 55, 55, 62, 64, 68, 73, 77, 77, 78, 79, 79, 79, 80, 80, 80, 81, 81, 81, 82, 82, 86, 86, 86, 87, 88, 90, 91, 94, 98

(a) Calculate the Range

(b) Calculate IQR

(c) Sketch a Box and Whisker Plot

(d) Calculate (By Hand or Using Excel) the following: the Mean, Variance and Standard Deviation of the Distribution. Please show all of your work (including as necessary your excel output/formula).

(e) Please Calculate the Skewness of the Distribution and briefly describe (in words) the resulting calculation (including labeling it using the forms of Skewness presented in this class) Please show all of your work (including as necessary your excel output/formula).

(f) Please Calculate the Kurtosis of the Distribution and describe (in words) the resulting calculation and label it using the forms of Kurtosis presented in this class. Please show all of your work (including as necessary your excel output/formula).

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Problem 2 *Conditional Probability*

Assume you are observing someone rolling a pair of dice. Further assume the dice are fair and six sided. What is the probability of someone rolling a 6 if you somehow happen to know that the number thrown is less than 9? Please show all of your work.

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Problem 3 *Binomial Distribution and Hypothesis Testing*

(a) Calculate the probability of flipping heads (with a fair coin) in at least 11 out of 12 trials. Please show all of your work.

(b) Using an $\alpha = 0.05$, if you observed an someone flip 11 out 12 heads - would you be prepared to conclude that the coin was unfair? Please evaluate this proposition. State the null and alternative hypotheses, calculate and explain your conclusion using the precise language of hypothesis testing. Please show all of your work.

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Problem 4 *Hypothesis Testing*

Some expert claims that the probability of each person owning an *IPhone* at Michigan State University is 17%. It is observed that out of 50 randomly sampled people at MSU, only 5 people owned an *IPhone*.

Using an $\alpha = 0.05$, is there sufficient evidence to conclude that the population proportion differs from 17%? State the null and alternative hypotheses, calculate and explain your conclusion using the precise language of hypothesis testing. Please show all of your work.

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Problem 5 *Expected Value*

A standard deck of cards contains 52 cards. Ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K. Assume we assign a points to these cards as follows:

- For all number cards (2, 3, 4, 5, 6, 7, 8, 9, 10) assign points equal to the number shown on card
- J = 15 points, Q = 20 points, K = 25 points
- Aces are Worth 30 Points

Calculate the Expected Value (Expected Points) for the Draw of a Card from Standard Deck containing 52 cards. Please show all of your work.

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Problem 6 *Bayes Rule*

Imagine you are scheduled to take a Flight between City A and City B. Assume there is exactly 1 flight per day and there is a flight every day of the year (365 days per year). Historically, the flight is on time 73% of the time.

While waiting at the gate at the airport, you bump into Ryan ‘Up in the Air’ Bingham. Ryan is an expert flier who has logged more than 10,000,000 miles on this airline. Through this experience, he has (or at least believes that he has) developed the ability to predict when a flight will or will not be on time.

Ryan takes a look around and tells you “listen I have bad news - I predict that this flight is going to be delayed.” Since you have a very tight connecting flight, you wonder whether given Ryan’s prediction you have cause to be worried.

You ask Ryan a few quick questions in order to try to determine whether he actually has the ability to predict on time performance. During that conversation he reveals that when a flight is late, he correctly forecasts a delay 85% of the time. When it is on time, he incorrectly forecasts a delay 15% of the time.

In light of all of the information above – what is the probability that you flight will be on time? From a Bayesian perspective, was Ryan’s prediction actually helpful?

Please show all of your work.

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Problem 7 *Research Design*

Please Complete Question #5 on Page 51 of Lawless, Robbennolt & Ulen. Please show all of your work.

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Problem 8 *Survey Design*

Please Complete Question #4 on Page 90 of Lawless, Robbennolt & Ulen. Please show all of your work.

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Problem 9 *Sampling*

Please Complete Question #4 on Page 163 of Lawless, Robbennolt & Ulen. Please show all of your work.

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Problem 10 *Chi Square Analysis*

Imagine that a friend comes to you concerned about treatment by her employer. She is part of the sales force of a large company and is suspicious that her employer is discriminating against women in the distribution of highly prized “sales leads.” Specifically, assume that in the given industry there are two types of sales leads – “Grade A sales leads” (which are more likely to ultimately yield sales) and “grade B sales leads” (which are far less likely to generate a sale).

Assume there are 2000 sales employees (1250 men & 750 women) working at the given company. According to the stated policy contained in the employee handbook, when a Grade A lead comes in the door, it is suppose to be randomly assigned to a member of the sales forces. Despite the stated policy, your friend believes that certain members of management are violating that policy and sending more high value leads to the male members of the sales force.

Your friend is very upset and is considering bringing a legal claim against her employer. Before doing so, you suggest that it would be a good idea to evaluate the possibility that the following distribution of leads could have been generated by a random process . Namely, you believe that falsifying that proposition would be part of evidence you might need to sustain a legal claim.

Please conduct a Chi Square Analysis on the data contained in Table 1 below. Please show all of your work. In light of your analysis, what are you prepared to conclude regarding the assignment of leads?

	Male	Female	Total
Given a “Grade A” Sales Lead	1000	450	1450
NOT Given a “Grade A” Sales Lead	250	300	550
Total	1250	750	2000

Table 1: “Grade A” Leads, By Gender

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