Math 499 □ History of Mathematics □ Spring 2014

Midterm Mars 4, 2014

1. ETHNOMATHEMATICS

1.1. Question 1. (4 points) Define what is Ethnomathematics and provide an example to illustrate your definition. Be explicit in your explanations. First define what is the word Ethnomathematics and where it comes from. Then, explain the goal of Ethnomathematics.

1.2. Question 2: Hawaiian Aquaculture. Show your work.

1. (2 points) Assume that Hanauma Bay is a closed and protected environment. A sherman catches, tags, and releases 150 uhu. A week later, he returns and catches 100 uhu, 10 of which are tagged. What is a good estimate for the population of uhu in Hanauma Bay?

2. (2 points) A month later, he returns and catches 110 uhu, 7 of which are tagged. Now, what is a good estimate for the population size of uhu in Hanauma Bay?

3. (2 points) A year later, he returns and catches 75 uhu, 4% of which are tagged. Now, what is a good estimate for the population size of uhu in Hanauma Bay?

4. (1 points) Why must we assume that the bay is closed off from the open ocean? If we do not assume this, what can we say, if anything, about the population of uhu then?

5. (1 points) Why are permanently protected areas like Hanauma Bay important?

1.3. Question 3. In class we have seen the Lulu game. Let me remind you the rules of the challenge version. In the challenge version of this game, a turn consists of two tosses. On the first toss, if all 4 stones fall faceup, the player scores 10, then tosses all dice again. If all 4 do not fall faceup on the first toss, the dots of those faceup are scored and

only the facedown pieces are tossed a second time. The dots showing on the second toss are added to those from the first toss. The winner is the player who first reaches a score of 100. Answer the following questions:

1. (2 points) *What scores are possible for a turn? Explain in details.*
2. (2 points) *What is the absolute minimum number of turns a player need to play to win? Explain.*
3. (4 points) *Assume a player has a score of 92, what is the probability that he gets a score of 8 in his next turn? Show your work.*

2. BABYLONIANS MATHEMATICS. SHOW YOUR WORK OR YOU DO NOT GET CREDIT.

2.1. **Question 1.** (2 points) Express the numbers 429467 and 4360.128 in sexagesimal.

2.2. **Question 2.** (2 points) Compute the product $4, 10, 2 * 2, 4$.

2.3. **Question 3.** (4 points) Solve the following system "ala the Babylonian - false position" method. State clearly what steps you are taking

$$3x + 4y = 1100$$
$$-x + 2y = 2000$$

2.4. **Question 4.** (4 points) Modify the Babylonian root finding method (for $\sqrt{2}$) to find the square root of any number. Use your method to approximate $\sqrt{5}$. Begin with $x_0 = 2$ and run the algorithm up to the first 3 decimals correct.

3. GREEK MATHEMATICS

3.1. **Question 1.** (4 points) List names of Greek mathematicians and their role in the development of mathematics.

3.2. **Question 2.** (4 points) Prove that the bisectors of the three angles of a triangle meet in a point. Explain in details your proof.

3.3. **Question 3.** (4 points) State and prove Thales theorem. Illustrate using a picture.

3.4. **Question 4.** Extra Bonus question (4 points). Explain what is axiomatic mathematics and how Euclid used it in the "Elements".

4. BUSINESS MATHEMATICS

4.1. **Question 1.** (2 points) A company can produce a maximum of 2500 widgets in a year. If they sell x widgets during the year then their profit, in dollars, is given by,

$$P(x) = 500,000,000 - 1,540,000x + 1450x^2 - \frac{1}{3}x^3$$

How many widgets should they try to sell in order to maximize their profit?

4.2. **Question 2.** (6 points) A management company is going to build a new apartment complex. They know that if the complex contains x apartments the maintenance costs for the building, landscaping etc. will be,

$$C(x) = 70,000 + \frac{2736}{5}x - \frac{211}{50}x^2 + \frac{1}{150}x^3$$

The demand function is given by:

$$p(x) = 350 - 0.05x - 0.001x^2$$

The land they have purchased can hold a complex of at most 400 apartments. How many apartments should the complex have in order to minimize the maintenance costs? What is the marginal cost, marginal revenue and marginal profit when $x = 175$ and x $= 325$? What do these numbers tell you about the cost, revenue and profit?

4.3. **Question 3.** (4 points) Show using formulas that for any problem, maximizing the profit is equivalent to have the marginal cost equals the marginal revenue.