

Probability/Bayes Problem Set

I have neither given nor received unauthorized aid: _____

1. (15 pts) Section 7.1 Do #39, page 452. Do not use the argument from the back of the book for this. Explain COMPLETELY in your own words.

2. (15 pts) p. 452 Do #40, page 452. Show you work and explain. ALL PARTS.

BAYES (ungraded - could be on exam - Bayes will be provided)

Section 7.3 Do #10, page 476. Show all work and explain. (use #9 as warm up).

3. (25 pts) - grading only a) and b)

Show all work and explain, see related video (Probability Theory 2 time 11:00) and assumptions.

Suppose a six-sided die is loaded so that:

- 1,3,4 and 6 come up equally often.
- 2 comes up as 3 times often as 3.
- 5 comes up as twice as often as 6.

a) Find the probability distribution of this die.

b) What is the probability that you roll an odd number with this die?

OPTIONAL EXTENSION (ungraded) Using the same die as above .

- c) What is the probability that you roll the die twice in a row, and the 2 rolls sum to 7?
- d) What is the probability that you roll the die twice in a row and the 2 rolls sum to 7 **GIVEN** the first roll is an even number? (see Piazza for important hint)
- e) Based on your answers, to a and b, are these 2 events independent? Explain.

4. (20 pts) Read Section 7.4 pp. 477- 479.

- Define “Expected Value” in your own words.
- Redo example 3 p. 479, and find the expected value of a SINGLE die.
- What is surprising (or maybe confusing) about this answer?
- What does it mean if the expected value is NOT a value that can actually happen?

5. (25 pts) Spock and Kirk are exploring a new planet, Probbly. They need to find out the approximate length of a year on this planet (because otherwise an unnamed crew member will be vaporized). Lucky for them they have access to a database of birthdays. Spock does a non-trivial analysis and discovers that in a group of 33 people there is a 50/50 chance that at least 2 people will share a birthday. You, an unnamed crew member, must use this information to find the approximate length of a year on this planet.

This **must** be solved using a spreadsheet (why? See Piazza):

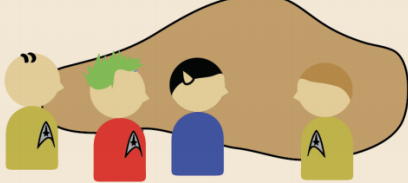
- Using the example on p. 461 - 462, use a spreadsheet with formulas (you may optionally include a Python Program as well - but **do the spreadsheet first to check your formulas with the example in the the book**) which calculates the probabilities of n people sharing a birthday for a year of any length, and returns at which n the probability of 2 or more people sharing a birthday becomes more than 50%. (this is surprisingly challenging to code, so I am just grading the spreadsheet solution)
- Now use your spreadsheet/program to identify the length of a year on Planet Probbly. There is a right answer. Check your results. You may use as many pages as needed.

Bonus - illustrate this problem as a comic book. Stick figures ok. Post to Piazza.

This question is inspired by Sriram's tutorial on Pollard Rho - which some of you used when code breaking.

<https://www.cs.colorado.edu/~srirams/courses/csci2824-spr14/pollardsRho.html>

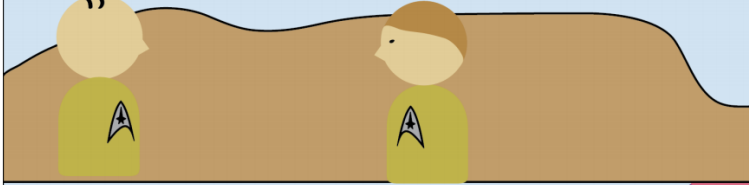
C Kirk: Good God men,
did NOBODY here pay attention in Discrete Mathematics?



Non-descript Crewman: I did, Captain.
My instructor said this day would come.

Using Spocks analysis it appears that...
...this planet has approximately 772 days!

C Kirk: Excellent! Relay this information immediately.

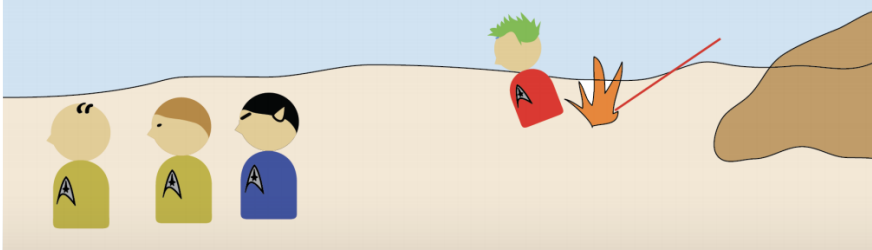


ZZZZZZAAAAAPPPPP!!!!

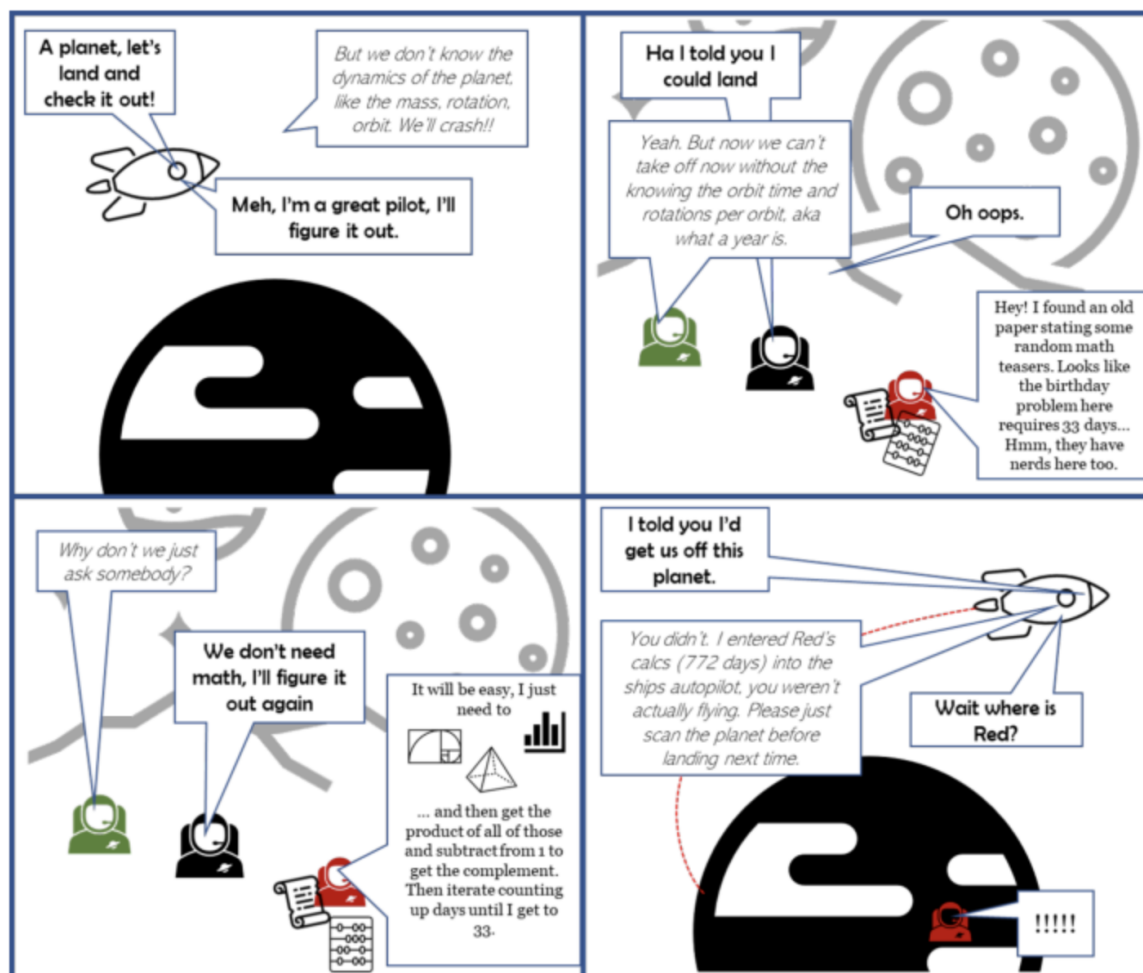


C Kirk:
Hmmm... A rare misfire by the Enterprise. Nevermind, now is
our chance to flee!

Spock: The needs of the many outweigh the needs of the few!



**The
End**



Pictures/icons thanks to Microsoft PowerPoint.



