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1.

**SCROLL DOWN: PROBLEM 1 IS BELOW THE FOLLOWING RULES. DO NOT MISS IT.**

**Exam Rules:**

1. You have opened a timed exam with a **48 hours** time limit. Please use the timer to see the time remaining. If you had opened this exam too close to the exam **STRICT closing time, October 29 23:59UTC**, you will not have the full 48 hours, and the exam will close at the closing time.
2. This is an **open book exam** and you are allowed to refer back to all course material and use (online) calculators. However, you must abide by the honor code, and **must not ask for answers directly from any aide**. This means you may not refer to discussion forums from previous runs of this course.
3. You **must not share the exam content** with anyone in any way, including posting anywhere on the internet.
4. You will be given **no feedback** during the exam. This means that unlike in the problem sets, you will not be shown whether any of your answers are correct or not. This is to test your understanding, to prevent cheating, and to encourage you to try your very best before submitting. Solutions will be available after the exam closes.

5. You will be given **3 attempts** for each, multipart problem. Since you will be given no feedback, the extra attempt will be useful only in case you hit the "submit" button in a haste and wish to reconsider. With no exception, **your last submission will be the one that counts** . The exam will only be graded after the due date, and the Progress Page will show fake scores while the exam is open.
6. **Error and bug reports:** While the exam is open, you are **not allowed to post on the discussion forum on anything related to the exam, except to report bugs/platform difficulties** . If you think you have found a bug, please state on the forum only what needs to be checked on the forum. Your post must not shed any light on the contents or concepts in the exam. **Violators will receive a failing grade or grade reduction in this exam** .

### Problem 1

#### Setup:

For all problems on this page, suppose you have data

$$X_1, \dots, X_n \stackrel{\text{i.i.d.}}{\sim} \mathcal{N}(0, 1)$$

that is a random sample of **identically and independently distributed standard normal random variables**.

#### Useful facts:

The following facts might be useful: For a **standard normal** random variable  $X_1$ , we have:

$$\mathbb{E}[X_1] = 0, \quad \mathbb{E}[X_1^2] = 1, \quad \mathbb{E}[X_1^4] = 3.$$

---

### The i.i.d. assumption

5.0/5.0 points (graded)

Suppose  $X_1$  is an observation for Bob,  $X_5$  is an observation for Alice,  $X_7$  is an observation for Charlie.

Using the following facts about Bob:

$$P(-2 < X_1 < 2) \approx 0.95 \quad \text{and} \quad P(-\sqrt[5]{2} \leq X_1 \leq \sqrt[5]{2}) \approx 0.75,$$

compute the probability

$$P(-2 < X_5 < 2, -2 < (X_7)^5 < 2)$$

of an event involving Alice and Charlie?

(Enter the probability  $P(-2 < X_5 < 2, -2 < (X_7)^5 < 2)$  or if the probability is not determined uniquely, then enter **-1**.)

(Enter a numerical answer accurate to at least 3 decimal places.)

$$P(-2 < X_5 < 2, -2 < (X_7)^5 < 2) =$$

✓ Answer: 0.7152254

Submit

You have used 1 of 3 attempts

**i** Answers are displayed within the problem

## Sample mean

1.5/1.5 points (graded)

Consider the sample mean:

$$\bar{X}_n = \frac{1}{n}(X_1 + X_2 + \dots + X_n).$$

What are the mean  $\mathbb{E}[\bar{X}_n]$  and variance  $\text{Var}[\bar{X}_n]$  of  $\bar{X}_n$ ?

$\mathbb{E}[\bar{X}_n] =$   ✓ Answer: 0

$\text{Var}[\bar{X}_n] =$   ✓ Answer: 1/n

What kind of distribution does  $\bar{X}_n$  follow?

☒ Gaussian

☐ Student  $t$

☐ Chi square

☐ Gamma

☐ nonparametric



Submit

You have used 1 of 3 attempts

**i** Answers are displayed within the problem

## Quantiles

1/1 point (graded)

Consider the quantile  $Q_{n,\alpha}$  of order  $1 - \alpha$  for the random variable  $\bar{X}_n$ , that is, the number  $Q_{n,\alpha}$  such that

$$\mathbf{P}\left(\bar{X}_n \leq Q_{n,\alpha}\right) = 1 - \alpha, \quad 0 < \alpha < 1.$$

**Note:** The probability in the definition above is  $1 - \alpha$ , not  $\alpha$ .

For  $\alpha < 0.5$ , as the sample size  $n$  increases, does the quantile  $Q_{n,\alpha}$  decrease, increase, stays the same, oscillates?

☐ increases.

☒ decreases.

☐ stays the same

☐ oscillates.



Submit

You have used 1 of 3 attempts

**i** Answers are displayed within the problem

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**💬** The i.i.d. assumption

Is it sensible that a single question should carry so much weight? This one numerical answer in an exam is worth about 100 times the credit of a lecture exercise answer, for n...

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**💬** Can someone please explain the Quantiles part for me?

Maybe I am confused by the notation even at this point. But why is it decrease not increase? Here is my interpretation:  $P(\bar{X}_n \leq (X - \mu)/\sigma \sqrt{n}) = 1 - \alpha$ , so if n incr...

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💬 [Staff] <a href="#">Extension policy</a>	20
Staff - i know you try your best to accommodate all and everyone - but the current policy of constant last minute extensions is getting out of control. It is also completely unfai...	
💬 [Edited by staff to remove exam content]	4
Could play a role in the third part of the question (multiple choice where choosing distribution)	
✅ <a href="#">Will I be able to appear in the Midterm-1 next time?</a>	3
Hi, I've just enrolled on the course, and haven't been able to go through the materials. In fact I've not even started the course yet. I want to pursue the varified track, since I w...	
? <a href="#">Clarification on third part</a>	2
**Deleted by MW-CTA**	
✅ <a href="#">Probability values for bob</a>	2
**Deleted by MW-CTA**	
? <a href="#">Am I able to see if I get the questions right or not?</a>	3
When I click submit there is no indication of whether it is correct or incorrect for each question - will this be revealed? If I need to end my exam to see the results, does this m...	
✅ <a href="#">Clarification on first question Deleted by MW-CTA</a>	2
Deleted by MW-CTA	
💬 [Staff] <a href="#">Deleted by MW-CTA</a>	6
Deleted by MW-CTA	
✅ <a href="#">Midterm exam 1 weighting</a>	7
For the life of me, I cannot find the exam rules. Is it OK to post here a question about the relative weightings of exam and exercise/homework questions, without at all going i...	
💬 <a href="#">Network issues</a>	5
What happens if I face network connectivity issues while taking the midterm exam? Will the progress be saved and will I be able to log back in and continue? and what happen...	

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