Course Discussion Progress Resources

Unit 0. Course Overview, Syllabus, Guidelines, and Homework on Course > Prerequisites

Homework 0: Probability and Linear

- 1. Homework 0 Reviewing > Probability, Matrices and Vectors > algebra Review
- Previous Next >

1. Homework 0 Reviewing Probability, Matrices and Vectors

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Probability

You will need a sound foundation of probability to follow along in this course.

If you have not already, we suggest that you first take a probability course equivalent to 6.431x Probability-the Science of Uncertainty and Data, Course 1 of 4 in our Micromasters program. This course is offered again in September 2020.

If you do not have a probability background but would like to start pursuing the SDS Micromasters immediately, you may start with Course 2 of 4: 14.310x/Fx Data Analysis for Social Scientists and its SDS exam Data Analysis in Social Sciences–Assessing your Knowledge. This course does **NOT require probability as prequisite** and is offered this term. The setup of this course is more complicated than usual; see enrollment logistics video.

Matrices, Vectors and Basic Notions of Linear Algebra

Starting in *Unit 3 Method of Estimations*, you will also need to be very comfortable with **matrices and vectors**.

In addition, in *Unit 6. Linear Regression*, the notion of rank will be beneficial but not strictly necessary. Finally, basic understanding of the meaning of eigenvalues and eigenvectors will also be helpful but not necessary for doing well in this course.

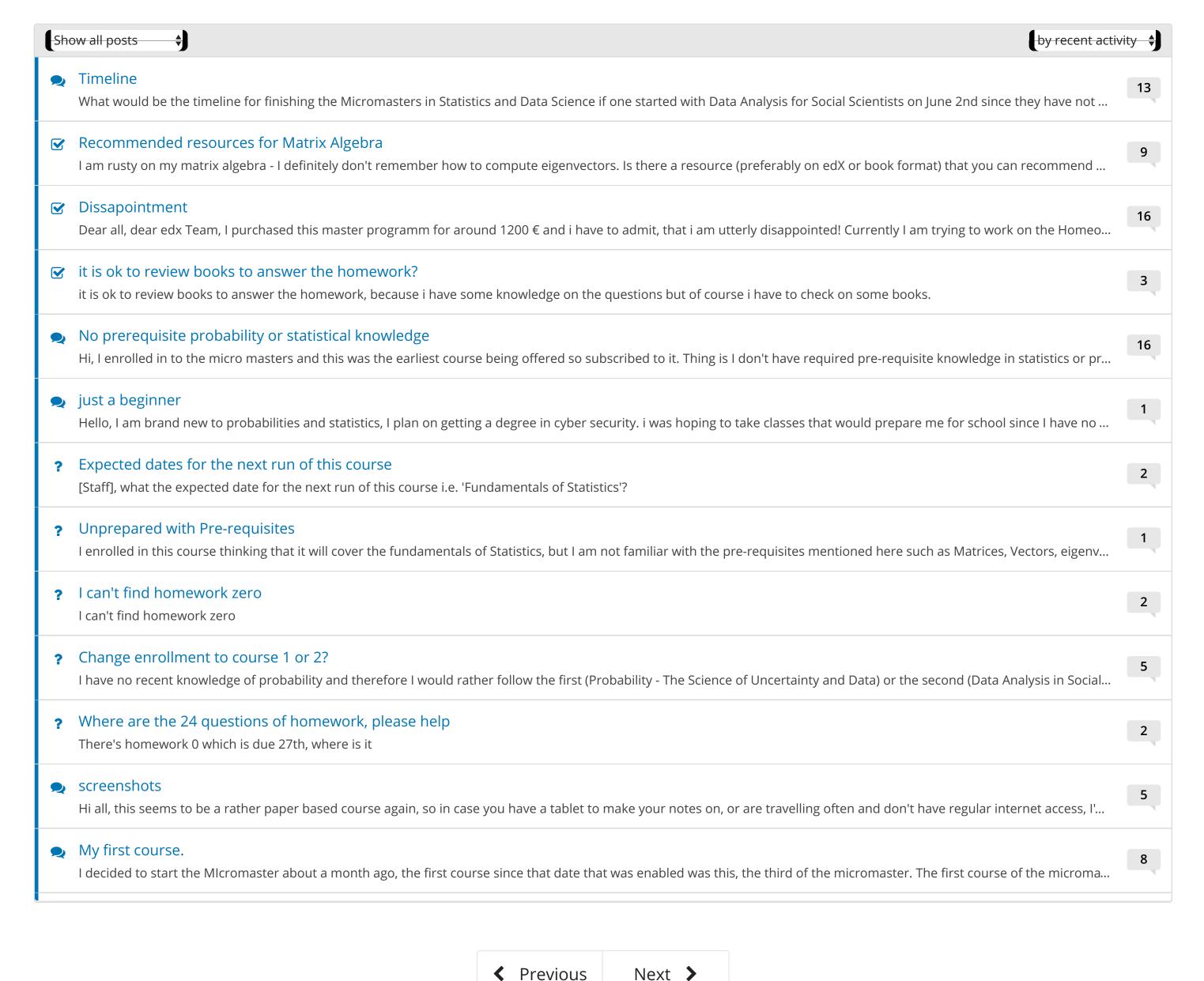
This homework

In this prerequisite homework, you will test and review your knowledge of probability, and matrices and vectors, and basic concepts on linear independence and rank. You will also have a chance to work on optional ungraded exercises eigenvalues and eigenvectors. These exercises are here to help you start preparing for the later units.

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and Linear algebra Review / 1. Homework 0 Reviewing Probability, Matrices and Vectors

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If Stuck, Try A Numerical Approach 1 I realize this might be a bit late but one way to approach some of these questions (as a last resort only) is to try to generate distributions and compute the variables asked for ... **Moment Generating Functions** 2 Hi All, For those who have a gap in knowledge about moments like me, without taking the previous course in this series, and yet wikipedia also fails to enlighten enough to an... Hint for E[X^3] and E[X^4] in "3. Gaussian random variables"? 34 Hi, I don't know how to solve these two in a relatively easy way. Any hint? I searched on the internet that one may use the Moment-generating function to solve them, but it w... hi - can staff check my answer to Var(X square)? 1 i typed the result of the answer and that was not accepted? tks, First part - expectations of Gaussian RV 8 I tried different ways. And checked all the hints posted in this forum. But I'm still stuck on these. Anyone found some background material on this? Thanks a lot :) To all the people who took the previous course 2 If you have read the summary of the textbook you will notice that in section 4.4 the subject of Transforms is discussed. In this section moments are also explained and how y... Answers 10 Even after all the attempts the answer that is on the solution is so confusing that one cant even think of that solution. I have taken probability course but these concepts does... One more way to compute E[X^3] and E[X^4] 3 Are we supposed to know Kurtosis, Skewness from the previous course? 2 I see people here discussing here these concepts. I can not recall where they were discussed in the probability course. Are we supposed to know them?

Next >

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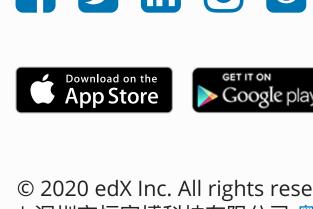


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Next >



Unit 0. Course Overview, Syllabus, Guidelines, and Homework on

Homework 0: Probability and Linear Course > Prerequisites

> algebra Review > 5. Exponential random variables

5. Exponential random variables

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Sums and products

2/3 points (graded)

Previous

Let X be an exponential random variable with parameter $\lambda > 0$ and Y be a Poisson random variable with parameter $\mu > 0$. Assume that X and Y are independent. Compute the following quantities:

$$\mathbb{E}\left[X^2 + Y^2\right] = \boxed{\frac{2}{12} + \mu + \mu^2}$$

$$\frac{2}{\lambda^2} + \mu + \mu^2$$

$$\mathbb{E}\left[X^2Y\right] = \boxed{\frac{2}{\lambda^2} \cdot \mu}$$

$$Var (2X + 3Y) = 4/lambda+9*mu$$

$$\frac{4}{\lambda} + 9 \cdot \mu$$

You have used 3 of 3 attempts

STANDARD NOTATION

Show Answer

Show Answer

Estimators

Submit

1/1 point (graded)

Let X_1, \ldots, X_n be i.i.d exponential random variables with parameter λ and let $Z_i = \mathbf{1} (X_i \le 1), i = 1, \ldots, n$. Recall that $\mathbf{1} (X \le 1)$ denotes the **indicator function** that takes the value 1 when $X \leq 1$ and 0 otherwise.

What is the limit in probability, as n goes to infinity, of $\frac{1}{n}\sum_{i=1}^{n}Z_{i}$?

$$\frac{1}{n} \sum_{i=1}^{n} Z_i \xrightarrow{\mathbf{P}} \boxed{1-e^{-\lambda}}$$

$$1 - e^{-\lambda}$$

You have used 2 of 3 attempts

Properties of the exponential distribution

the lightbulb lasts for at least 2 years. Round your answer to the nearest $10^{-2}\,\mathrm{.}$

Submit

STANDARD NOTATION

2/2 points (graded) Let X be an exponential random variable with parameter $\lambda=2$ that models the lifetime (in years) of a lightbulb. Compute the probability that

$$\mathbf{P}(X \ge 2) = \boxed{0.02}$$

Given the lightbulb has lasted 2 years, find the probability that it lasts for $\,k\,$ more years for any positive integer $\,k\,$.

$$\mathbf{P}(X \ge k + 2|X \ge 2) = \begin{bmatrix} e^{-2 \cdot k} \end{bmatrix}$$

STANDARD NOTATION

Submit

You have used 1 of 3 attempts

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Discussion

Topic: Unit 0. Course Overview, Syllabus, Guidelines, and Homework on Prerequisites:Homework 0: Probability and Linear algebra Review / 5. Exponential random variables

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3

6

2

3

6

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Exponential random variables Expectation values Hi, Why in the solution E(X^2)=2/lambda^2 rather than 2*lambda^2? It looks like the relationship of Var(X) = E(X^2)-E(X)^2 no longer hold using the value provided in the soluti...

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 Image: Control of the control of the

Properties of exponential distribution

Lightbulb question k+2 years? 2

Dear All, I apparently don't have enough of Probability background, that is why I am missing a point with this task. I got it wrong in the second part. Solution says, (1 - CDF(k + ...

In the second part you should calculate the probability that the lightbulb will last another k years, given it has lasted 2 years. Is this probability not P(k+2) and hence e^(2k-4)?

? Estimators -- Limit in probability 4 new Apologies if it sounds naive but this seems completely new to me. I'm unable to grasp what is meant by "limit in probability, as n goes to infinity". Does it mean the limiting pd...

? Sums and products: Compound Poisson-Gamma in disguise?

Properties of the exponential distribution: Part 2 9 Is Part 2 which asks us to find *P(X \geq k+2 | X \geq 2)* also going to be decimal form? Or would the answer be acceptable in expression in terms of *k*? Thanks

Please note that for Exponential Distribution is Lambda, but for Poisson is Mu

I missed that by mistake, and although my answer was correct, conceptually, I missed that for Poisson I shouldn't be using Lambda, but Mu instead. If it would've been Lambd... Key Lectures/topics to know from the *Probability Course*?

Dear stuff, could you tell us what lectures from the *probability class* are *key* to do well on this class? It would help us both, review material or try to catch up, in these day...

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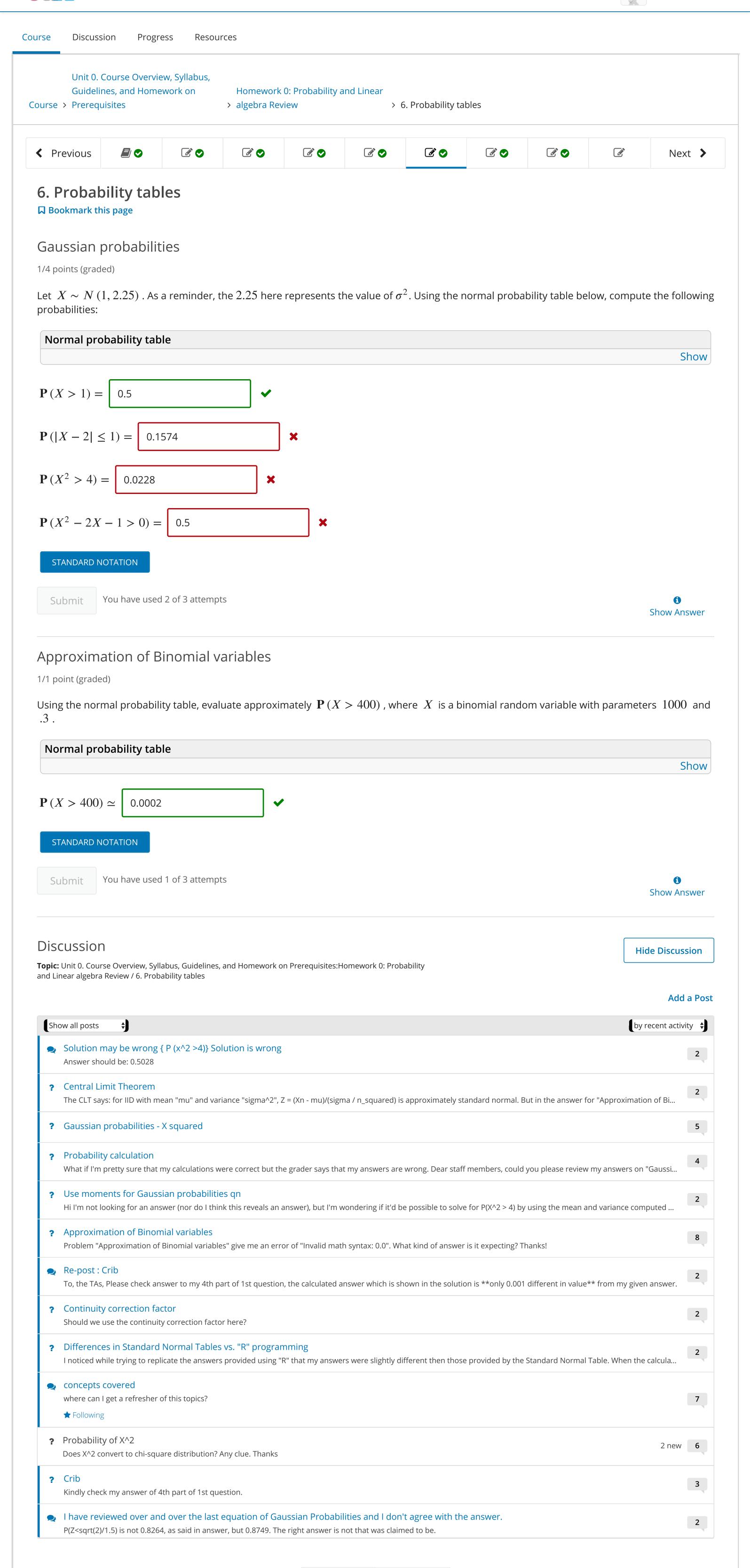












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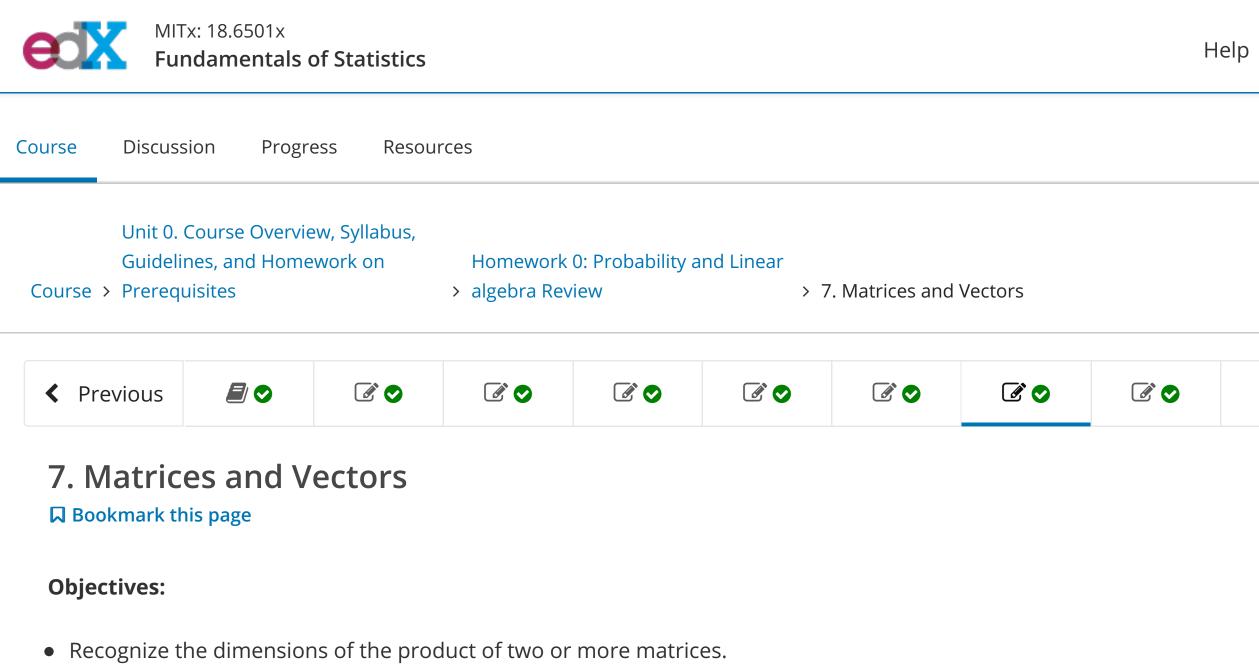


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• (Optional) Understand the concept of **eigenvalues** and **eigenvectors** of an $n \times n$ matrix.

Matrix Multiplication

6/6 points (graded)

2

m

Let
$$\mathbf{A} = \begin{pmatrix} 1 & -1 & 2 \\ 0 & 3 & -4 \end{pmatrix}$$
 and let $\mathbf{B} = \begin{pmatrix} -1 & 0 & 0 \\ 2 & 0 & 1 \\ 0 & 1 & 3 \end{pmatrix}$. The dimensions of the product \mathbf{AB} are:

• Understand the concept of rank of a matrix, and how it relates to the invertibility of an $n \times n$ matrix.

More generally, let ${\bf A}$ be an $m \times n$ matrix and ${\bf B}$ be an $n \times k$ matrix. What is the size of ${\bf AB}$?

✓ rows × 3

✓ rows X j

m ✓ rows × k ✓ columns.

In addition, if ${\bf C}$ is a $k \times j$ matrix, what is the size of ${\bf ABC}$?

Submit You have used 1 of 3 attempts

Vector Inner product

1/1 point (graded)

Suppose $\mathbf{u} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$. The product $\mathbf{u}^T \mathbf{v}$ evaluates the **inner product** (also called the **dot product**) of \mathbf{u} and \mathbf{v} , which evaluates to

columns.

columns.

The inner product of \mathbf{u} and \mathbf{v} is sometimes written as $\langle \mathbf{u}, \mathbf{v} \rangle$.

Submit You have used 1 of 3 attempts

Suppose $\mathbf{u} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$. The product $\mathbf{u}\mathbf{v}^T$ evaluates the **outer product** of \mathbf{u} and \mathbf{v} , which is a 2×2 matrix in this case.

What is $(\mathbf{u}\mathbf{v}^T)_{1,1}$?

What is $(\mathbf{u}\mathbf{v}^T)_{1,2}$?

-1

3

4/4 points (graded)

Vector Outer product

\ \ \ /1,1

1

What is $(\mathbf{u}\mathbf{v}^T)_{2,1}$?

-3

What is $(\mathbf{u}\mathbf{v}^T)_{2,2}$?

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Discussion

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Notation for matrix

Hi How is the notation for matrix in the answer? Please give me example how to write any matrix 2x2

It is really hard to understand these question
In the way they are formatted. Is it possible to fix?

Linear Algebra Refresher

If you guys need a refresher on linear algebra, this is a good 4-page summary. https://minireference.com/static/tutorials/linear_algebra_in_4_pages.pdf

Outer Product

I am from India and in my whole education I never heard of Outer product of matrix, I think it is taught in western countries. good to know new things. I googled it and solved ...

Extra resource for linear algebra
If anyone needs to refresh their understanding of vectors and matrices, 3Blue1Brown has a great intuitive introduction to all the concepts necessary to complete this homew...

Variable issue

Greetings mentors and classmates. Hope you are all doing well. In the matrix multiplication question the second and third subquestions seem to be variable kind of questions.

Greetings mentors and classmates, Hope you are all doing well, In the matrix multiplication question the second and third subquestions seem to be variable kind of questions...

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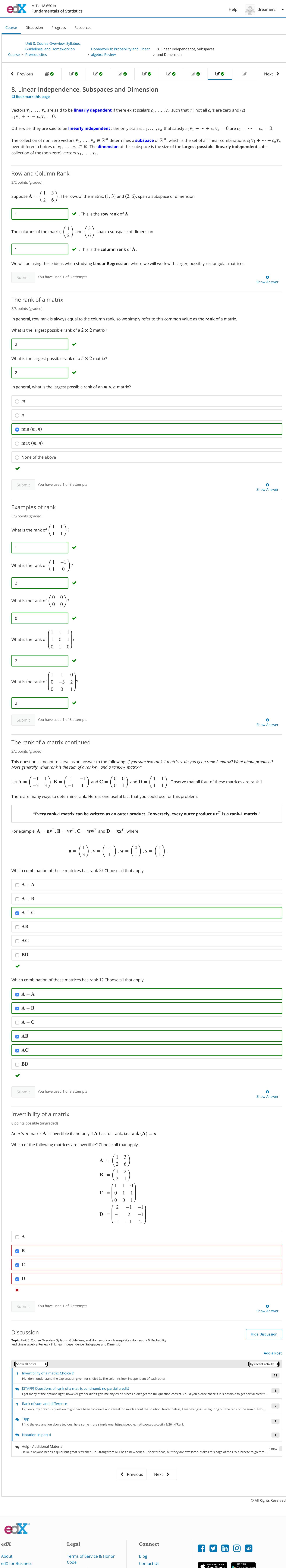
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