

Quantitative Proficiency Test

Question 1

What is the determinant of:

$$\begin{bmatrix} 6 & 9 \\ 4 & 2 \end{bmatrix}$$

- ☐ 6
- ☐ 42
- ☐ 432
- ☐ -24



Time left:
42:49

QUESTIONS

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35
36	37	38	39	40
41	42	43	44	45
46	47	48	49	50
51	52	53	54	55
56	57	58	59	60

Question 2

Which combination of the following statements is true about this dictionary?

```
dict = {'A': 1, 'B': 2}
1. 'A' in dict
2. '1' in dict
```

- ☐ Both statements
- ☐ Neither statement
- ☐ Statement 1
- ☐ Statement 2

Question 3

Which matrix is linearly independent?

☐ $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} \begin{bmatrix} 8 \\ 9 \\ 10 \end{bmatrix} \begin{bmatrix} 18 \\ 22 \\ 26 \end{bmatrix}$

☐ $\begin{bmatrix} -2 \\ 5 \end{bmatrix} \begin{bmatrix} 16 \\ -40 \end{bmatrix}$

☐ $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

☐ $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$

Question 4

For the equation:

$$2xy^2 + 2xy + x^2y = 12$$

what is the slope of the tangent line at $(x, y) = (2, 1)$?

☐ $1/2$

☐ 2

☐ $-1/2$

☐ -2

Question 5

Consider the following partial differential equation:

$$\frac{\delta u}{\delta x} - 2 \frac{\delta^2 u}{\delta y^2} = 0$$

where $u = u(x, y)$ is the unknown function. Define the

following functions:

$$u_1(x, y) = e^{2x-y}, u_2(x, y) = \sin(2x - y), \text{ and } u_3(x, y) = \cos(2x - y)$$

Which of these functions are solutions to the partial differential equation?

- ☐ All the functions
- ☐ u_1 and u_2
- ☐ None of the functions
- ☐ Only u_1

Question 6

What is the output for this line of code:

```
12+2*24/3*4+4
```

- ☐ 20
- ☐ 452
- ☐ 3.75
- ☐ 80

Question 7

The Pearson correlation coefficient between 2 variables is:

- ☐ All of these
- ☐ Close to 1 if they tend to move in the same direction.
- ☐ Close to 0 if they move independently of each other.

- ☐ Close to -1 if they tend to move in the opposite direction.

Question 8

Simplify:

$$\sin^2 x + \cos^2 x =$$

- ☐ $2 \sin(x) \cos(x)$
- ☐ 1
- ☐ $\tan^2 x$
- ☐ None of these

Question 9

Which of the following functions is continuous on all x ?

- ☐ $y = \tan(x)$
- ☐ $y = |x|$
- ☐ $y = \ln(x)$
- ☐ $y = 1/x$

Question 10

What is the sum of n integers from 1 to n ?

- ☐ $\frac{n(n+1)}{2}$
- ☐ $\frac{n(n-1)}{2}$
- ☐ $\frac{n^2-1}{2}$

☐ $\frac{(n+1)(n-1)}{2}$

Question 11

Which of the statements below is the derivative of $f(x)$ at $x = a$?

☐ $\lim_{x \rightarrow 0} \frac{f(x) + f(a)}{x - a}$

☐ $\lim_{x \rightarrow 0} \frac{f(x) - f(a)}{x - a}$

☐ $\lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$

☐ $\lim_{x \rightarrow a} \frac{f(x) + f(a)}{x - a}$

Question 12

Factor:

$$2x^3 - 10x^2 - 28x$$

☐ $(2x^2 + 4)(x - 7)$

☐ $2x(x + 2)(x - 7)$

☐ $x(2x - 4)(x + 7)$

☐ $(x^3 - 2)(x^2 - 10)(x - 28)$

Question 13

Which of the following is the general solution for the differential equation:

$$y'' - 10y' + 25y = 0$$

where A and B are arbitrary constants?

☐ $Ae^{5x} + Bxe^{-5x} = y$

☐ $Ae^{5x} + Be^{-5x} = y$

☐ $Ae^{5x} + Be^{5x} = y$

☐ $Ae^{5x} + Bxe^{5x} = y$

Question 14

What z-value is 2 standard deviations below the mean?

☐ -1.96

☐ -2

☐ -1.65

☐ -2.58

Question 15

Python data structures include all of the following items except:

☐ Set☐ Dictionary☐ Glossary☐ Data frame

Question 16

The value of the limit

$$\lim_{x \rightarrow 0} \frac{\sin(2x)}{x}$$

is:

☐ 1/2☐ 1☐ 2☐ ∞

Question 17

According to the Central Limit Theorem, as a sample size gets large, the sampling distribution of the sample mean can be approximated as the:

☐ Uniform Distribution☐ Exponential Distribution☐ Normal Distribution☐ Student's T Distribution

Question 18

What does the following Python code return?

```
def func(x,y):  
    if (x == 0):  
        return y  
    else:  
        return func(x-1, x-y)
```

```
func(4,7)
```

☐ -5

☐ 4☐ 5☐ -4

Question 19

An example of a point estimate is:

☐ Mean☐ All of these☐ Mode☐ Median

Question 20

What is the range of:

$$y = 3 \sin(\theta)$$

☐ $-\infty$ to ∞ ☐ -3 to 3☐ $-\pi$ to π ☐ -1 to 1

Question 21

What is the output of the following program?

```
print("Hello World"[::-1])
```


- ☐ Hello worl
- ☐ d
- ☐ dlroW olleH
- ☐ The program gives an error

Question 22

What type of copy command is used in the program below?

```
a=[[3,4,5],[6,7,19],[8,15,17]]  
b=list(a)
```

- ☐ Hollow copy
- ☐ Cannot be determined
- ☐ Shallow copy
- ☐ Deep copy

Question 23

Let $f : \mathfrak{R} \rightarrow [0, 1]$ and $g : \mathfrak{R} \rightarrow [0, \infty)$ be defined by

$f(x) = \sin x$ for every $x \in \mathfrak{R}$ and
 $g(x) = e^x$ for every $x \in \mathfrak{R}$

Consider the following statements:

1. f is one-to-one
2. f is onto
3. g is one-to-one
4. g is onto

Which of the statements are true?

- ☐ None of the statements
- ☐ All of the statements
- ☐ Statement 2
- ☐ Statements 2 and 3

Question 24

What is the output of the following program:

```
for letter in "Hello there":  
    i = letter  
print(i)
```

- ☐ The program gives an error
- ☐ "e"
- ☐ "Hello there"
- ☐ "H"

Question 25

Python has all of the following characteristics except:

- ☐ Object-orientated
- ☐ Interactive
- ☐ Compiled
- ☐ Interpreted

Question 26

Consider the following statements concerning a positive integer n :

1. if n is a multiple of 8, then n^2 is a multiple of 4
2. if n^2 is a multiple of 18, then n is a multiple of 9
3. if n^2 is a multiple of 18, then n is a multiple of 2

Which of the statements is true?

- ☐ None of the statements
- ☐ Statements 1 and 3
- ☐ All the statements
- ☐ Statements 2 and 3

Question 27

Let $f : \mathfrak{R}^2 \rightarrow \mathfrak{R}$ be defined by

$$f((x, y)) = \sin(xy), \text{ for every } (x, y) \in \mathfrak{R}^2$$

The value of $f_x((1, 0)) + f_y((1, 0)) + f_{xx}((1, 0))$ is:

- ☐ Undefined
- ☐ 1
- ☐ -1
- ☐ 0

Question 28

Find x:

$$\log_3(2x + 3) = 5$$

- ☐ 12
- ☐ 10
- ☐ 120
- ☐ 1

Question 29

Express as summation:

$$1 - \frac{1}{2} + \frac{1}{4} - \frac{1}{8} + \frac{1}{16} - \frac{1}{32} + \frac{1}{64}$$

- ☐ $\sum_{n=1}^6 (-1)^n 2^n$
- ☐ $\sum_{n=0}^6 (-1)^n 2^{-n}$
- ☐ $\sum_{n=0}^6 (-1)^n 2^n$
- ☐ $\sum_{n=1}^6 (-1)^n 2^{-n}$

Question 30

Which of the following integrals can be evaluated?

- ☐ $\int_{-1}^1 \frac{x+1}{x-1} dx$
- ☐ $\int_{-1}^1 \sin^{-1}(x) dx$
- ☐ $\int_{-1}^1 \frac{1}{x} dx$
- ☐ $\int_0^\pi \tan(x) dx$

Question 31

You flip a coin. If you get heads you win \$5, if you get tails you lose \$3. What is the expected payoff of one flip?

- ☐ 1
- ☐ -1
- ☐ 2
- ☐ -2

Question 32

Which of the following is true about Python?

- ☐ Identifiers are case-sensitive, the language is strongly-typed.
- ☐ Identifiers are not case sensitive, the language is not strongly-typed.
- ☐ Identifiers are case-sensitive, the language is not strongly-typed.
- ☐ Identifiers are not case sensitive, the language is strongly-typed.

Question 33

What is the output of this program?

```
primes = [2, 3, 5, 7, 11, 13, 17, 19]
x = [i for i in primes[1:]] + [j for j in primes[0:]]
print(x)
```

- ☐ [5, 8, 12, 18, 24, 30, 36]
- ☐ [2, 3, 5, 7, 11, 13, 17, 19]
- ☐ The program gives an error
- ☐ [3, 5, 7, 11, 13, 17, 19, 2, 3, 7, 11, 13, 17]

Question 34

A type I error is:

- ☐ Rejecting the null hypothesis when it is false.
- ☐ Rejecting the null hypothesis when it is true.
- ☐ Rejecting the alternative hypothesis when it is true.
- ☐ Rejecting the alternative hypothesis when it is false.

Question 35

If you have imported the math module using the following statement, how would you call the exponential function (exp(x))?

```
import math as mt
```

- ☐ exp(1)
- ☐ mt.exp(1)
- ☐ The exponential function has not been imported
- ☐ math.exp(1)

Question 36

What is the inverse of:

$$\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$$

- ☐ $\begin{bmatrix} 4 & -2 \\ -2 & 1 \end{bmatrix}$

- ☐ $\begin{bmatrix} 4 & 2 \\ 2 & -1 \end{bmatrix}$
- ☐ doesn't exist
- ☐ $\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$

Question 37

If $f : (-\pi/6, \pi/6) \rightarrow \mathfrak{R}$ is defined by

$f(x) = 2^x \tan(3x)$ for every $x \in (-\pi/6, \pi/6)$,

then $f'(0)$ is:

- ☐ 0
- ☐ 3
- ☐ $\ln 2$
- ☐ 2π

Question 38

V_1 is an eigenvector of A . Which of these statements is true?

- ☐ $AV_1 = \lambda_1 V_1$
- ☐ $AV_1 = A^T V_1$
- ☐ $AV_1 = I$
- ☐ $AV_1 = 0$

Question 39

Find the solution to the following differential equation:

$$y'' + 16y = 0, \quad y(0) = 2, \quad y'(0) = 8$$

- ☐ $y(t) = 2e^{4t}$
- ☐ $y(t) = e^{-4t} + e^{4t}$
- ☐ $y(t) = 2 \cos 4t$
- ☐ $y(t) = 2 \cos 4t + 2 \sin 4t$

Question 40

Find a particular solution to the differential equation:

$$y' = 6x^2 - 2 \text{ at } (2, 22)$$

- ☐ $y = 2x^2 + 6x + 8$
- ☐ $y = 2x^3 - 2x + 10$
- ☐ $y = 2x^3 + 6x^2 + 6x - 12$
- ☐ $y = 4x^2 + 6$

Question 41

Given the first two terms in the Taylor series, what is the third term?

$$f(x) = f(a) + f'(a)(x-a) + \underline{\hspace{2cm}} + \dots$$

- ☐ $\frac{f''(a)}{2}(x-a)^2$
- ☐ $\frac{f''(a)}{2}(x-a)$
- ☐ $f''(a)(x-a)^2$
- ☐ $f''(a)(x-a)$

Question 42

What is the output of the following code?

```
A = {1, 2, 3}
B = {1, 3, 4, 5}
C = {1, 2, 5, 7}
print(A & B | C)
```

- ☐ {1, 2, 3}
- ☐ {1, 3}
- ☐ {1, 2, 3, 5, 7}
- ☐ {1, 2, 3, 4, 5, 7}

Question 43

Let $x_0 \in (0, \infty)$ be the value of $x \in (0, \infty)$ that minimizes the function $f : (0, \infty) \rightarrow \mathcal{R}$ defined by

$$f(x) = x^2 + x^{-2} \text{ for every } x \in (0, \infty)$$

and $y_0 = f(x_0)$ be the value of this minimum.

Then $x_0 + y_0$ is:

- ☐ $3/2$
- ☐ 3
- ☐ 2
- ☐ $1/2$

Question 44

Which of the following is the inverse function of:

$$\sin(x^3 + 1)$$

- ☐ $\sqrt[3]{\sin^{-1}(x) - 1}$
- ☐ $\sin^{-1}(\sqrt[3]{x} - 1)$
- ☐ $\sin^{-1}(\sqrt[3]{x - 1})$
- ☐ $\sqrt[3]{\sin^{-1}(x) - 1}$

Question 45

Find the equivalent statement.

$$P(A|B)P(B) =$$

- ☐ $P(A)$
- ☐ $\frac{P(B|A)}{P(A)}$
- ☐ $P(B|A)P(A)$
- ☐ $P(A) + P(B)$

Question 46

How many permutations are there of the letters in the string "ABCD"?

- ☐ 120
- ☐ 16
- ☐ 24
- ☐ 6

Question 47

Which of the following statements is true about a population?

- ☐ The population is a subset of a sample.
- ☐ A measurable quality of a population is a statistic.
- ☐ Reports of a population have a margin of error.
- ☐ A population contains all members of a specified group.

Question 48

Which library is used when creating a data frame?

- ☐ DataFrame
- ☐ Numpy
- ☐ Pandas
- ☐ Data.Frame

Question 49

Which of the following is an independent event?

- ☐ Picking a king given the first card was a queen.
- ☐ Pick a card. Then pick another card.
- ☐ None of these
- ☐ Pick a card. Put it back. Pick another card.

Question 50

What is the sum of:

$$\begin{bmatrix} 5 \\ 0 \\ 4 \end{bmatrix} + \begin{bmatrix} 6 \\ 6 \\ 2 \end{bmatrix} + \begin{bmatrix} 1 \\ 9 \\ 4 \end{bmatrix}$$

- ☐ $\begin{bmatrix} 12 \\ 15 \\ 10 \end{bmatrix}$
- ☐ $\begin{bmatrix} 561 \\ 69 \\ 424 \end{bmatrix}$
- ☐ $\begin{bmatrix} 30 \\ 0 \\ 32 \end{bmatrix}$
- ☐ 1054

Question 51

What is the range of this data set?

 $[11, 2, 3, 3, 6]$

- ☐ 5
- ☐ 9
- ☐ 3
- ☐ 11

Question 52

What is the probability of drawing 4 cards of the same suit from a 52 card deck?

- ☐ $(\frac{12}{51})(\frac{11}{50})(\frac{10}{49})$
- ☐ $(\frac{3}{4})(\frac{3}{4})(\frac{3}{4})(\frac{3}{4})$
- ☐ $(\frac{1}{4})(\frac{1}{4})(\frac{1}{4})(\frac{1}{4})$
- ☐ $(\frac{13}{52})(\frac{12}{51})(\frac{11}{50})(\frac{10}{49})$

Question 53

The value of the integral

$$\int_1^{\infty} x e^{-x^2} dx$$

is:

- ☐ $-1/2$
- ☐ ∞
- ☐ $1/2e$
- ☐ $e/2$

Question 54

If rank $A = N$, then

$$\text{rank} A^T =$$

- ☐ N
- ☐ $\frac{1}{N}$
- ☐ $\frac{N}{N+1}$
- ☐ None of these

Question 55

Evaluate:

$$\int x^2 e^x dx$$

- ☐ $(x^2 + 2x + 2)e^x + C$
- ☐ $(x^2 - 2x + 2)e^x + C$
- ☐ $x^2 + 2x + e^x + C$
- ☐ $x^2 - 2x + 2e^x + C$

Question 56

If $f(x)$ is continuous on $[a, b]$ and $F(x) = \int_a^x f(t) dt$ then which of the following is equivalent to:

$$\int_a^b f(x) dx$$

- ☐ $\frac{d}{dx} F(b) - \frac{d}{dx} F(a)$
- ☐ $F(b) - F(a)$
- ☐ $b - a$
- ☐ $\frac{F(b) - F(a)}{b - a}$

Question 57

For each $n = 1, 2, 3, \dots$, define

$$f_n(x) = \frac{nx^2}{1+n} \text{ for every } x \in \mathfrak{R}$$

Then the function f defined by

$$f(x) = \lim_{n \rightarrow \infty} f_n(x)$$

exists for each $x \in \mathfrak{R}$ and is equal to:

- ☐ $f(x) = x$

☐ $f(x) = 0$

☐ $f(x) = 2x$

☐ $f(x) = x^2$

Question 58

What is the probability of getting no prime numbers if 2 dice are thrown?

☐ $\frac{1}{2}$

☐ $\frac{1}{8}$

☐ $\frac{2}{3}$

☐ $\frac{1}{4}$

Question 59

How many combinations are there of choosing 7 items from 9?

☐ 36

☐ 27

☐ 72

☐ 63

Question 60

Given the function:

$$f(x, y) = x + y$$

with the constraint that $x^2 + y^2 = 1$, at which points do the maximum and minimum of $f(x, y)$ occur?

- ☐ $\left(\frac{1}{2}, \frac{1}{2}\right)$ and $\left(-\frac{1}{2}, -\frac{1}{2}\right)$
- ☐ $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ and $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$
- ☐ $\left(\frac{2}{\sqrt{2}}, \frac{2}{\sqrt{2}}\right)$ and $\left(-\frac{2}{\sqrt{2}}, -\frac{2}{\sqrt{2}}\right)$
- ☐ $(\sqrt{2}, \sqrt{2})$ and $(-\sqrt{2}, -\sqrt{2})$

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