

STA 361

Name Ivan Wang

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Midterm Exam (50 pts)

Spring 2025

Write your answers to the following questions in the space provided. You will not turn in any code, but you may wish to save your code for a future day when we go over the answers.

1. (8 pts)

- a) Create a vector called V1 that contains integers between 300 and 625 in increments of 13. State the sum of the elements in V1.

12025

- b) Create a vector called V2 that contains the first 50 perfect squares (i.e.  $1^2 = 1$ ,  $2^2 = 4$ , etc.). State the sum of elements in V2.

42925

- c) The `intersect(.)` function accepts two vectors as arguments and produces a new vector containing the elements that occur in both vectors. Create a new vector V3, which is the intersection of V1 and V2. State any elements in V3.

625

- d) Create a vector called V4 that contains integers between 250 and 2500 (inclusive). Obtain the value of the following expression, where  $\ln$  is the natural log (base  $e$ ):

$$\sum_{i=250}^{2500} \ln(i)$$

15436.42

2. Use a `while` loop to determine the first integer value of  $x$  such that the function:

$$g(x) = 3x^2 - 5x + 12$$

exceeds one million (1,000,000). For partial credit, you may write your code block in the space below. (6 pts)

```

g <- function(x) {
  return(3 * x^2 - 5 * x + 12)
}

x <- 0
func <- g(x)

while (func <= 1000000) {
  x <- x + 1
  func <- g(x)
}
  
```

$x = 579$



3. Suppose that  $Y$  is a discrete random variable following a geometric distribution (see the help file for `dgeom(.)`) with parameter  $p = 0.2$ . When necessary, round your answers to 4 decimal places. (14 pts)

a)  $P(Y \leq 6)$

0.7379

(-1)

b)  $P(Y > 10)$

0.1074

(-1)

c)  $P(Y = 4)$

0.1024

(-1)

d)  $P(2 \leq Y < 8)$

0.4722

e) The median of the distribution of  $Y$ .

4  $\times$

(-2)

f)  $P((Y \leq 2) \text{ or } (Y > 9))$

0.4942  $\times$

(-2)

g) The value  $c$  such that  $P(Y > c) = 0.05$

0  $\times$

(-2)

4. Define the matrix objects below and write your answers to the following questions in the space provided. The usual symbols may appear for matrix inverse and matrix transpose. (8 pts)

$A = \begin{bmatrix} 15 & -9 \\ 10 & 7 \\ 6 & 3 \end{bmatrix}$   $B = \begin{bmatrix} 8 & 13 & 3 \\ 26 & 9 & 24 \\ 3 & 12 & 17 \end{bmatrix}$   $C = \begin{bmatrix} 5 \\ 4 \\ 3 \end{bmatrix}$   $D = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$   $2 \times 2$

a) Obtain the sum of elements in the matrix  $AD$ .

64

b) Report the sum of the elements contained in  $B^{-1}A$ .

0.8202582

c) State the trace of matrix  $CC'$ . Recall that the `tr(.)` function in the "psych" package will compute the trace.

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d) State the (2,2) element of  $A'B$ .

-18

Handwritten calculation:  

$$\begin{array}{r} 17 \\ 17 \\ 6 \\ 6 \\ 6 \\ 9 \\ \hline 64 \end{array}$$



5. The data set food.txt (UBLearns) contains historical data on 36 food distributors. Each row describes a different distributor. (14 pts)

- a) Import the data set into R and state the number of variables that are in the resulting data frame.

8

- b) Obtain a data frame that only contains distributors that have the **promotion** variable equal to 1. State the number of rows in this data frame.

20

- c) Obtain a data frame containing the food distributor that has **market\_share** smaller than 2.5 and **nielsen\_rating** larger than 525. State the **id** of this distributor.

6

- d) Obtain a data frame containing the food distributor that has **month** "Apr" and **discount** 0. State the **market\_share** of this distributor.

2.3

- e) Obtain a data frame containing food distributors having **month** set to "Jan," "Feb," or "Mar." State the average **price** for distributors in this data frame.

2.245884

- f) Obtain a data frame containing food distributors that either have **year** equal to 2001 or have **nielsen\_rating** above 400. State the number of rows in this data frame.

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- g) Add a new variable to the original food data frame. The new variable is calculated as:

$$\text{discount} + \left( \frac{2.7 \times \text{price}}{\text{market\_share}} \right)$$

State the minimum observed value of this new variable.

2.342143