**C - Disease Detectives C - Rickards Invitational - Rickards Invitational Div. C - 12-05-2020**

Hi, Welcome to the Rickards Invitational Disease Detectives Test Division B for the 2020-2021 Tournament Season.

**Directions:** You and your partner will have 50 minutes to complete the test. Each team may bring one 8.5”x11” sheet of paper that may contain information on both sides in any form and from any source along with two stand-alone non-programmable, non-graphing calculators.
Notes:

- Please show all work and indicate units as necessary.
- There will be no penalty for guessing.
- Tie-breaker questions are indicated with an asterisk(*).
- Tiebreaker points are only used to break ties and are only available in tiebreaker questions.
- There are 60 questions and 9 tiebreaker questions with their point values in the parentheses ( ) near the end of the question.
- Please don’t search the Internet for Answers during the Test.

Good luck!

**1. (1.00 pts)** What is a difference between Clinical Approach and Public Health Approach?

- (◉) A) A: Public Health Approach is designed for the General Public while Clinical Approach is designed for an Individual.
- ( ) B) B: Clinical Approach focuses on Prevention while Public Health Approach focuses on Diagnosis.
- ( ) C) C: Public Health Approach is a Branch of Government while Clinical Approach is Private and does not work with the Government.
- ( ) D) D: Clinical Approach deals with a Patient's Medical History while Public Health Approach does not have Access to this Information.

**2. (1.00 pts)** What was the Name for the 2009 Pandemic?

**Expected Answer:** Ex. H1N1 Pandemic, Swine Flu Pandemic, etc.

**3. (1.00 pts)** Who is regarded as the “Father of Field Epidemiology”?

**Expected Answer:** Answer: John Snow

**4. (2.00 pts)** What are the Four Steps in Solving Health Problems?

**Expected Answer:** Step 1-Collect Data – Surveillance, determine Time/Place/Person triad Step 2- Assessment- Inference Step 3- Hypothesis testing – Determine how and why Step 4- Action-Intervention

**5. (1.00 pts)** What is an Example of a Physical Disease Agent?

**Expected Answer:** Ex: Radiation, Injury

**6. (1.00 pts)** Which is the Second Step in the Chain of Infection?

- A) A: Agent
- B) B: Mode of Transmission
- C) C: Reservoir
- D) D: Portal of Exit

**7. (2.00 pts)** True or False, a Prion is an Agent.

- True
- False

**8. (1.00 pts)** What is an Example of an Animal Reservoir?

**Expected Answer:** Example: Sheep and Livestock.

**9. (2.00 pts)** Compare and Contrast, Endemic and Epidemic.

**Expected Answer:** Epidemic: Large numbers of people over a wide geographic area affected but, Disease is not present at all times. Endemic: A Disease present at all times

**10. (2.00 pts)** Give an Example of an Endemic Disease and to What Place.

**Expected Answer:** Example: Chagas Disease, Central America and Mexico. Resourse: https://byjus.com/biology/endemic-diseases/

**11. (1.00 pts)** Name a Zoonotic Disease.

**Expected Answer:** Example: Rabies Reference: https://www.cdc.gov/media/releases/2019/s0506-zoonotic-diseases-shared.html

**12. (2.00 pts)** What are the Five Steps in the 5 Step Process for Surveillance?

- A) Data Collection, Analyze Scientific Articles, Interpret Data, Data Exportation, Data Exportation.
- B) Data Collection, Data Analysis, Data Dissemination, Data Interpretation, Call to Action.
- C) Data Collection, Analyze Statistics, Interpret Data, Export Data, Link to Action.
- (◉) D) Data Collection, Data Analysis, Data Interpretation, Data Dissemination, Link to Action.

**13. (2.00 pts)**
What Type of Surveillance is in this Scenario, You go to your General Physician and He diagnoses you with Chicken Pox then, he reports it to the Local Public Health Agency.

- A) Syndromic Surveillance
- B) Sentinel Surveillance
- (◉) C) Passive Surveillance
- D) Active Surveillance

**14. (2.00 pts)** What is the Bradford Hill Criteria used for?

**Expected Answer:** Sample Answer: The Risk Ratio is used to compare the risk of a health event (disease, injury, risk factor, or death) among one group with the risk among another group.

**15. (3.00 pts)** How many steps are there in an Outbreak Investigation, What are the Names, and Give a Short Description.
EXAMPLE:
1. Variable, a Letter that represents an Unknown Number.
2. Inequality, an Expression that has a ≥, ≤, >, or a < sign.
3. ……

**Expected Answer:** Steps: 13 1. Prepare for Field Work, 2. Establish the Existence of an Outbreak, 3. Verify the Diagnosis, 4. Construct a working case definition , 5. Find cases systematically and record information , 6. Perform Descriptive Epidemiology - Describe and Orient the Data in Terms of Time, Place and Person, 7. Develop Hypotheses, 8. Evaluate Hypotheses Epidemiologically, 9. Reconsider, Refine, and Re-evaluate Hypotheses, 10. Compare and Reconcile with laboratory and/or environmental studies, 11. Implement Control and Prevention Measures, 12. Initiate or maintain surveillance, 13. Communicate Findings, Publish your findings(Ex. News Article)

**16. (2.00 pts)** What is a Symptom of Having the West Nile Virus?

**Expected Answer:** Symptoms Include: High fever, Headache, Neck Stiffness, Stupor, Disorientation, Coma, Tremors, Convulsions, Muscle Weakness, Vision Loss, Numbness and Paralysis. https://www.cdc.gov/westnile/symptoms/index.html#:~:text=Symptoms%20of%20severe%20illness%20include,age%20are%20at%20greater%20risk.

**17. (3.00 pts)** What is a Way to Prevent Tick-Borne Illnesses?

- A) Make sure that the contents have been properly cooked.
- B) Wear Light Clothing.
- C) Spray yourself with Insect Repellent.
- D) Drink water that has been Boiled.

**18. (1.00 pts)** What is a Way of Prevention from the HTLV Type 1 Virus?

**Expected Answer:** Do not Exchange Body Fluids with an Infected or Not Know Infection State. Evidence: https://rarediseases.org/rare-diseases/htlv-type-i-and-type-ii/

**19. (1.00 pts)** An Area Map is also Known as ...

- A) A Pie Chart
- B) A Choropleth Map
- C) A Spot Map
- D) A Bar Chart

**20. (1.00 pts)** The Population-Based Approach is the Same as _____.

Public Health Approach

**21. (1.00 pts)** What is a Mode of Prevention of a Transmittable Disease?

**Expected Answer:** Example: Quarantine and Isolation https://www.soinc.org/sites/default/files/uploaded_files/20_DD_HANDOUT_PART_3_0.pdf

**22. (3.00 pts)** What does the Prevalence of a Health Event Tell You/Refer to?

**Expected Answer:** Sample Answer: The Total Number of Existing Cases in a Point in Time.

**23. (1.00 pts)** What is an Example of a Non-Transmittable Disease?

**Expected Answer:** Sample Answers: Heart Disease/Obesity.

In an alternate universe, the Trost branch of the Paradis research division inadvertently produced a zombie virus while experimenting on captured titans. Inevitably, this non-communicable virus spread from the lab. While the royal capital research division knows the outbreak began in Trost, they are unsure how the initial exposure began (the researchers of that branch have become zombies). The town of Trost has two rivers that are used for drinking water, which we will call “River 1” and “River 2”. After collecting data on the local cases, the head team, which has named the virus the Untote virus, is fairly certain that the outbreak was caused by exposure to River 1, and plans to conduct a study to determine this. For their study, the researchers compared a sample of participants who used River 1 before it was closed off to a sample of participants who used River 2, before they developed any symptoms.

**24. (1.00 pts)** What type of study are the researchers conducting?

**Expected Answer:** Cohort

**25. (1.00 pts)** Is this type of study prospective or retrospective?

**Expected Answer:** Prospective

**26. (2.00 pts)** Name one advantage and one disadvantage of this type of study:

**Expected Answer:** Advantages may include: cohorts can be matched, good measure of exposure, correct time sequence, easy risk calculation, etc. Disadvantages may include: no randomization, blinding is difficult, relatively expensive, etc.

The results collected by the team is shown in the table below:

| Untote Virus | Exposed to River 1 | Not Exposed to River 1 |
|---|---|---|
| Developed disease | 4 | 16 |
| Did not develop disease | 46 | 44 |

**27. (1.00 pts)** What is the appropriate measure of frequency for the collected data?

**Expected Answer:** Relative Risk

**28. (1.00 pts)** Calculate this measure of frequency for this data:

**Expected Answer:** 0.30

**29. (1.00 pts)** Explain what the value indicates.

**Expected Answer:** Any variation of: The risk of infection is lower among those exposed to River 1 compared to the risk of infection among those not exposed to River 1.

**30. (1.00 pts)**
The town of Trost has only a limited ability to purify the river water. Who should receive access to this technology: the residents living near River 1, or the residents living nea River 2? Why?

**Expected Answer:** Residents living near River 2 because infection is more likely due to exposure to the water in River 2.

Unfortunately, a new strain of the Untote virus has emerged. Previously, infected individuals were harmless, but now, they are actively seeking to consume uninfected individuals. Even worse, the virus has now become communicable!

If a healthy individual is bitten by a zombie (assuming they survive) they become infected. At this point, the virus has spread to all of the towns within Wall Maria, but it has no spread through Wall Rose yet.

**31. (1.00 pts)**
To determine the extent of the spread, the royal capital has asked for reports from the local doctors of each town (or at least, the ones who are still alive). What type of surveillance is this?

**Expected Answer:** Active surveillance

The research team has been able to learn more about the mutated Untote virus based on the reports they have collected. While the virus begins acting roughly 24 hours after infection, symptoms are only felt one week after being bitten by a zombie, specifically after being exposed to the saliva of a zombie. In the first week of symptoms, infected individuals only seem to have inflammation in the nape of their necks and slight dizziness. Over the next week, individuals develop increased irritability, numbness in their extremities, slowed reaction times, and increased appetite. It is only in the following week that brain activity ceases, and individuals become fully fledged “zombies.”

**32. (1.00 pts)** What is the incubation period of this virus?

**Expected Answer:** One week

**33. (5.00 pts)** What are the parts of the chain of infection? Apply the chain of infection to the communicable Untote virus.

**Expected Answer:** Reservoir: infected individual / river water Portal of Exit: mouth Mode of Transmission: saliva Portal of Entry: exposed wound Susceptible Host: any uninfected individual

**34. (2.00 pts)**
Fearing for the kingdom’s safety, the nobility of the royal capital have begun throwing suggestions to end this outbreak, which include completely sealing off Wall Rose and even opening up Wall Maria to allow the titans to eat the infected individuals. Which health approach do these suggestions fall under, and why?

**Expected Answer:** Public health approach because they are concerned with the health of the entire kingdom.

**35. (1.00 pts)** Describe one primary prevention measure that the kingdom could take.

**Expected Answer:** Anything aimed at preventing disease or injury before it ever occurs

**36. (1.00 pts)** Describe one secondary prevention measure that the kingdom could take.

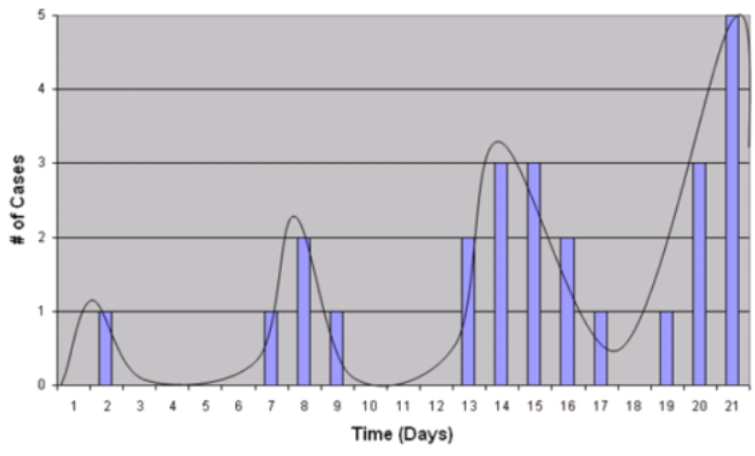
**Expected Answer:** Anything about reducing the impact of a disease or injury that has already occurred.

**37. (1.00 pts)** Describe one tertiary prevention measure that the kingdom could take.

**Expected Answer:** Anything about softening the impact of an ongoing illness or injury that has lasting effects.

**38. (1.00 pts)** Describe one quaternary prevention measure that the kingdom could take.

**Expected Answer:** Anything about identifying a patient at risk of overmedicalisation, protecting them from new medical invasion, and suggesting interventions which are ethically acceptable.




**39. (1.00 pts)** The graph above displays the progression of cases since the virus mutated. Which type of spread does this graph display?

**Expected Answer:** Propagated or person-to-person spread

**40. (8.00 pts)**
The Royal Capital is finally about to begin the process of creating a vaccine for this virus. Assuming that this kingdom has access to the same resources that our modern society has, outline how the researchers might go about developing this vaccine.

**Expected Answer:** Give points based on answer

Researchers at the CDC were exploring the effects of influenza on the body. They collected samples of 1000 people, and then studied those in the sample who had influenza.

**41. (1.00 pts)**
If there's a 7% chance that any given person has influenza, and the researchers sample 1000 people, what is the probability that exactly 60 of the people chosen have influenza (round to three significant figures)?

**Expected Answer:** 0.0237

**42. (1.00 pts)** What type of distribution does the above scenario represent?

**Expected Answer:** binomial

**43. (1.00 pts)** If the researchers kept choosing people until they found someone with influenza, which type of distribution would this be?

**Expected Answer:** geometric

**44. (1.00 pts)** In that scenario, what is the probability that the first person with influenza will be the 5th person chosen (round to three significant figures)?

**Expected Answer:** 0.0524

**45. (5.00 pts)**
A box of pasta claims that “Italians eat 100 pounds of pasta per year” whereas “Americans eat 12 pounds of pasta per year.” Do you believe that these statistics are accurate Would you use these numbers as the basis for a nutritional study? Why or why not?

**Expected Answer:** No right answers, I want to make them think

State whether each of the following observations is an example of discrete or continuous data.

**46. (1.00 pts)** The number of medals a competitor wins in a specified year.

**Expected Answer:** discrete

**47. (1.00 pts)** The concentration of ‘brain power increasing chemicals’ in a sample of water.

**Expected Answer:** continuous

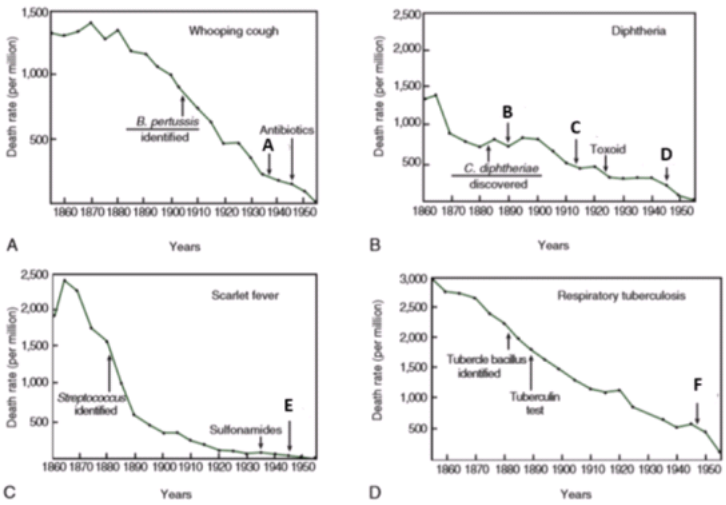
**48. (1.00 pts)** The length of time it takes for a school attending an in person competition to come home.

**Expected Answer:** continuous

**49. (1.00 pts)** The number of previous state championships a school has had.

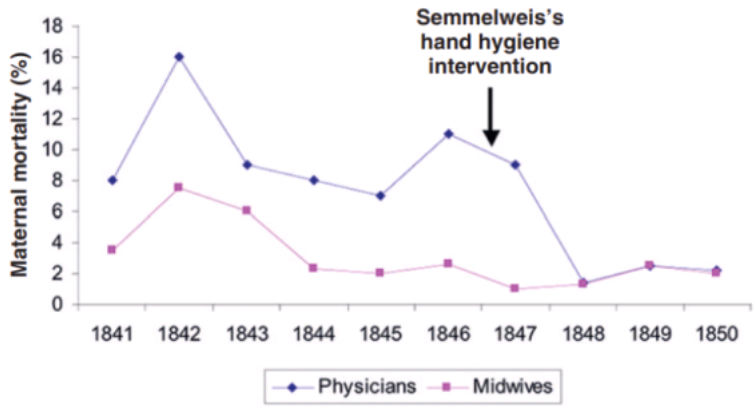
**Expected Answer:** discrete

**50. (6.00 pts)**
The following figure shows graphs showing death rates in England and Wales for (A) whooping cough, (B) diphtheria, (C) scarlet fever (kids younger than fever), and (D) respiratory tuberculosis. Each arrow represents an important event that caused a decrease in death rates. Identify the significant events (labeled A through E).




**Expected Answer:** A. Vaccine B. Antitoxin C. Schick test D. Penicillin E. Penicillin F. Chemotherapy

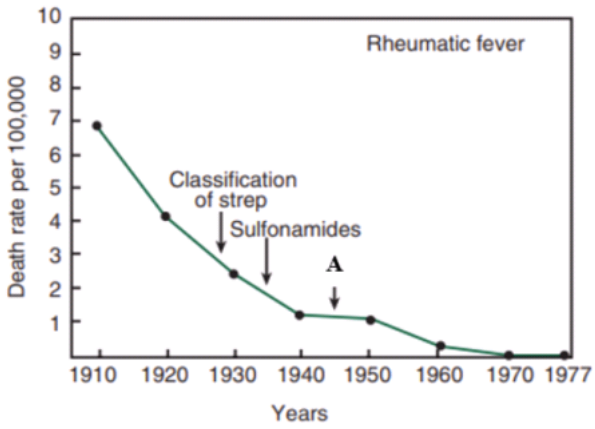
The following graph shows the maternal mortality due to childbed fever, by type of care provider. (Data from Vienna, Austria, 1841-1850)




**51. (3.00 pts)** Before Semmelweis's hand hygiene intervention was applied, why was the maternal mortality % of physicians so much higher than midwives?

**Expected Answer:** Various answers are acceptable, we generally looked for statements involving the physician being in more contact or they most likely had more patients. Competitors can also note that Semmelweis proposed his hand hygiene prevention many years prior to its establishment as a policy (1842), yet he had a bad reputation among physicians.

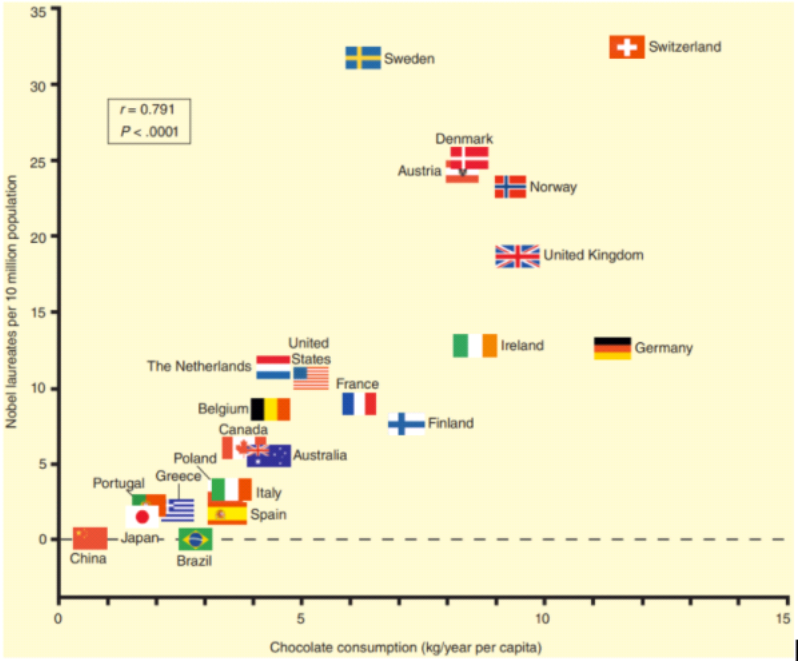
**52. (4.00 pts)** The following graph shows the crude death rates from rheumatic fever (United States, 1910-1977)




Answer the following three questions regarding the arrow 'A':
What is A? Who was the first person to study 'A'? Which two Oxford scientists are credited with developing 'A' for practical purposes?

**Expected Answer:** A is Penicillin. The first person to study it was Alexander Fleming, who closed his research in 1931. Howard Flory and Ernst Chain continued the research at Oxford and developed it to be used in mice.

Take a look at the following graph:




**53. (1.00 pts)** What kind of correlation fallacy is this?

**Expected Answer:** Illusory correlation

**54. (1.00 pts)** Classify the correlation strength (e.g. Weak Positive, No relationship)

**Expected Answer:** Strong positive

**55. (1.00 pts)** Do you believe chocolate consumption correlates to a country's nobel laureate concentration? Why or why not?

**Expected Answer:** Up to the participants. This question was only used as a final tiebreaker. We would have chosen the winner of the tie based on how in-depth their response goes.

**56. (1.00 pts)** A case-control study is characterized by all of the following except:

○ A) It is relatively inexpensive compared to most other epidemiological study designs

B) Patients with the disease (cases) are compared with persons without the disease (controls)

C) Incidence rates may be computed directly

D) Assessment of past exposure may be biased

E) Definition of cases may be difficult

**57. (1.00 pts)**
The physical examination records of every incoming undergraduate (class of 1935) at the University of Florida was examined in 1977 to see if the recorded height and weight at the time of admission to the university was related to the development of Type 2 Diabetes. This is an example of:

A) A cross-sectional study

B) A case-control study

C) A prospective cohort study

D) A retrospective cohort study

E) An experimental study

**58. (1.00 pts)** There are four phases in testing a new drug in the United States. In which phase do trials begin?

**Expected Answer:** Phase 1

**59. (1.00 pts)** What is the 3rd phase of a drug (in the U.S)?

**Expected Answer:** Safety and Efficacy

The following figure is used in this question:

**Number of Patients Needed in an Experimental and a Control Group for a Given Probability of Obtaining a Significant Result (Two-Sided Test)**

| | DIFFERENCES IN THE CURE RATES BETWEEN THE TWO TREATMENT GROUPS | | | | | |
|---|---|---|---|---|---|---|
| Lower of the Two Cure Rates | 0.05 | 0.10 | 0.15 | 0.20 | 0.25 | 0.30 |
| 0.05 | 420 | 130 | 69 | 44 | 36 | 31 |
| 0.10 | 680 | 195 | 96 | 59 | 41 | 35 |
| 0.15 | 910 | 250 | 120 | 71 | 48 | 39 |
| 0.20 | 1,090 | 290 | 135 | 80 | 53 | 42 |
| 0.25 | 1,250 | 330 | 150 | 88 | 57 | 44 |
| 0.30 | 1,380 | 360 | 160 | 93 | 60 | 44 |
| 0.35 | 1,470 | 370 | 170 | 96 | 61 | 44 |
| 0.40 | 1,530 | 390 | 175 | 97 | 61 | 44 |

$\alpha = 0.05$; power $(1 - \beta) = 0.80$.

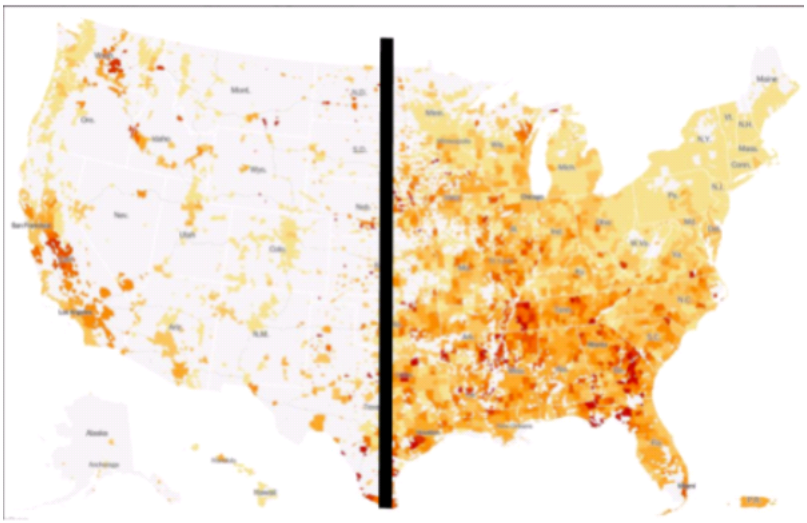
**60. (1.00 pts)**
A drug company finds that a new drug, Rickardsonium (R), has a 50% cure rate as compared with drug Kangium (K), which only has a 25% cure rate. You are asked to design a clinical trial comparing R & K. Estimate the number of patients needed in each therapy group.

**Expected Answer:** 57

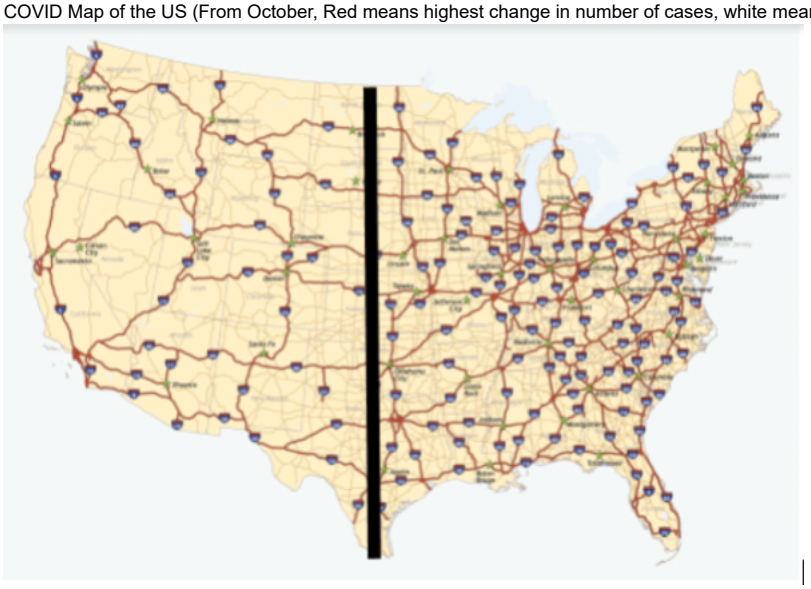
**61. (1.00 pts)** Why does a difference in cure rate of 0.05 require so many more patients compared to a difference in cure rate of 0.30?

**Expected Answer:** Students could cite the law of large numbers, the necessity to add more tests to see if the differences in the cure rates were legitimate, or by chance.

The following questions involve these figures:



COVID Map of the US (From October, Red means highest change in number of cases, white means no change in number of cases - NY Times, October)



The following is a map of the U.S. interstates. (Focus on the Western side marked with a bold line)

**62. (2.00 pts)** You might notice that there seems to be an overlap with the hotspots of COVID in the Western side, and the interstates of the US. Why is that so?

**Expected Answer:** Any two of the following: Covid spread to the west happened later than the east, so you saw the outlines from the vehicles (pun intended); less packed compared to the east, so you could clearly define the paths; this was in october; people were travelling during this time; areas to 'camp' needed to be reached somehow, and that was through the interstates, so any rest stop or path along the road could've helped spread the virus.

**63. (2.00 pts)** If we were to assume people only traveled through the Interstates, how would a timelapse of the spread of the viruses look like?

**Expected Answer:** First the interstates would be outlined (the rest areas and supporting cities along the way) and then it would gradually fill between the lines. You could also expec the California area to spread much faster than the midwest.

**64. (8.00 pts)**
The COVID map in the previous figure was from October. If you were in the CDC's directorship role at the time, what would your plan be to help mitigate this spread before Thanksgiving?

**Expected Answer:** Close off highways to non-essential trips, emphasize masks and a lack of excessive stops during routes; advise people to stay home. (develop a vaccine got 1/3rd of a point) Development of a tracking system (id cards) to see where and when certain people are (locating possible transmitters)

**65. (4.00 pts)** How does the overlap between new cases on the West and the map of interstates affect this policy? How does it affect travel restrictions?

**Expected Answer:** The overlap emphasizes the restrictions on non-essential trips and removal of excessive routes. Travel would not be advised, transportation of goods could be shifted from the interstates to the airways. Other appropriate answers are accepted.

**66. (3.00 pts)** List the three measures of central tendency. Describe how to calculate at least one of these measures.

**Expected Answer:** (Arithmetic) Mean or Average Median Mode Grader's discretion for the calculation description

**67. (2.00 pts)** Find the five-number summary for the following data set:

| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | 37 | 2 | 17 | 50 | 10 | 40 |

**Expected Answer:** 2, 10, 20, 40, 50

An observational study has resulted in the following tables. The next few questions will use these tables.

| Demographic 1 | Experienced Symptoms | No symptoms |
|---|---|---|
| Exposed | 13 | 708 |
| Unexposed | 50 | 169 |

| Demographic 2 | Experienced symptoms | No symptoms |
|---|---|---|
| Exposed | 14 | 136 |
| Unexposed | 24 | 73 |

| Demographic 3 | Experienced Symptoms | No symptoms |
|---|---|---|
| Exposed | 4 | 106 |
| Unexposed | 32 | 17 |

| Demographic 4 | Experienced symptoms | No symptoms |
|---|---|---|
| Exposed | 26 | 109 |
| Unexposed | 22 | 16 |

**68. (4.00 pts)**
Determine the Cochran-Mantel-Haenszel estimate for an odds-ratio for the 4 contingency tables. Assume all necessary requirements are satisfied for this calculation. Explain how you got this answer.

**Expected Answer:** OR = SUM(a*d/n) / SUM(b*c/n) SUM(a*d/n) = (13*169 / 940) + (14*73 / 247) + (4*17 / 159) + (26*16 / 173) = 9.30718 SUM(b*c/n) = (708*50 / 940) + (136*24 / 247) + (106*32 / 159) + (109*22 / 173) = 86.06875 OR = 0.10814

**69. (4.00 pts)**
Determine the Cochran-Mantel-Haenszel estimate for a risk ratio for the 4 contingency tables above. Again, assume all necessary requirements are satisfied for this calculation. Explain how you got this answer.

**Expected Answer:** RR = SUM(a(c+d) / n) / SUM(c(a+b) / n) SUM(a(c+d) / n) = (13(50+169) / 940) + (14(24+73) / 247) + (4(32+17) / 159) + (26(22+16) / 173) = 15.47039 SUM(c(a+b) / n) = (50(13+708) / 940) + (24(14+136) / 247) + (32(4+106) / 159) + (22(26+109) / 173) = 92.23196 RR = 0.16773

**70. (2.00 pts)** What is the null hypothesis of a Cochran-Mantel-Haenszel test? What is the alternative hypothesis?

**Expected Answer:** Accept any of the following for the null hypothesis: Odds ratio = 1; no association between treatment and outcome; the relative proportions of one variable are independent of the other variable within the repeats; no consistent difference in proportions in the 2×2 tables Accept any of the following for the alternative hypothesis: Odds ratio =/= (not equal to) 1; there is an association between treatment and outcome; the relative proportions of one variable are dependent of the other variable within the repeats; there is a consistent difference in proportions in the 2×2 tables

**71. (4.00 pts)** Calculate the Cochran-Mantel-Haenszel test statistic. Assume all necessary requirements are satisfied for this calculation. Explain how you got this answer.

**Expected Answer:** Application of the following equation: Where, = 195.3135

**72. (2.00 pts)** What distribution does the Cochran-Mantel-Haenszel test follow? What are the degrees of freedom?

**Expected Answer:** What distribution does the Cochran-Mantel-Haenszel test follow? What are the degrees of freedom? Follows: chi-squared distribution Degrees of freedom: 1 (one)

Conclusion:
Congratulations on finishing! Don't forget to check your answers. Once you do, feel free to submit. Good luck with your other events!