Practice Questions for Exam 2

Use the following to answer problems 1 to 10

Thw Wisconsin Fast Plant grows fast. Ancymidol (ancy) slows growth. In a study $n_1 = 8$ control (no ancy) and $n_2 = 8$ plants treated with ancy were measured (cm) after two weeks. The height of control and ancy plants (cm) were as shown in the table

ancy	12.2	19.5	14.2	9.8	12.8	7.1	7.7	18.9
control	16.0	15.2	18.8	19.3	20.2	13.9	20.3	10.6

Let μ_1 and μ_2 be the average height in ancy plants and control plants respectively.

1. If researchers want to see if the average height of ancy exposed plants is any different from the control plants, they should consider testing the following hypotheses:

   a) $H_0 : \mu_1 \neq \mu_2$ vs. $H_A : \mu_1 = \mu_2$
   b) $H_0 : \mu_1 \neq \mu_2$ vs. $H_A : \mu_1 > \mu_2$
   c) $H_0 : \mu_1 \neq \mu_2$ vs. $H_A : \mu_1 < \mu_2$
   d) $H_0 : \mu_1 = \mu_2$ vs. $H_A : \mu_1 \neq \mu_2$

2. If the researchers want to prove that ancy reduces plant growth, they should consider testing the following hypotheses:

   a) $H_0 : \mu_1 \neq \mu_2$ vs. $H_A : \mu_1 = \mu_2$
   b) $H_0 : \mu_1 \neq \mu_2$ vs. $H_A : \mu_1 > \mu_2$
   c) $H_0 : \mu_1 = \mu_2$ vs. $H_A : \mu_1 < \mu_2$
   d) $H_0 : \mu_1 = \mu_2$ vs. $H_A : \mu_1 \neq \mu_2$

   A t-test was used and the R ouput is listed below:

```
> ancy <- c(12.2,19.5,14.2,9.8,12.8,7.1,7.7,18.9)
> control <- c(16,15.2,18.8,19.3,20.2,13.9,20.3,10.6)

  Welch Two Sample t-test

data:  ancy and control
t = -1.9545, df = 12.933, p-value = 0.03631
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:
     -Inf -0.3753676
sample estimates:
mean of x mean of y
  12.7750   16.7875
```

3. The p-value of the test is given by:
   a) -1.9545
   b) 12.933
   c) 15 (n_1+n_2-1)
   d) 0.03631

4. At 5% level of significance, the conclusion of a test based on the output will be

   a) Ancy does not reduce the average growth in plant significantly.
   b) Ancy significantly reduces the average growth in Wisconsin fast plants.
   c) There is 5% chance that the average growth in ancy plants and control plants will be different.
   d) The test for equality of average growth for the two groups is inconclusive at 5% level of significance.

5. At 1% level of significance, the conclusion of a test based on the output will be

   a) Ancy does not reduce the average growth in plant significantly.
   b) Ancy significantly reduces the average growth in Wisconsin fast plants.
   c) There is 1% chance that the average growth in ancy plants and control plants will be different.
   d) The test for equality of average growth for the two groups is conclusive at 1% level of significance.

6. The Satterthwaite-Welch degrees of freedom used for the t-test in this case is:
   a) -1.9545
   b) 12.933
   c) 15 (n_1+n_2-1)
   d) 0.03631

We also used a Wilcoxon-Mann Whitney test for the data. Answer the next two questions using the following R output:

```
> wilcox.test(ancy,control)

        Wilcoxon rank sum test

data:  ancy and control
W = 15, p-value = 0.08298
alternative hypothesis: true location shift is not equal to 0
```

```
> wilcox.test(ancy,control,alternative="less")

        Wilcoxon rank sum test

data:  ancy and control
W = 15, p-value = 0.04149
alternative hypothesis: true location shift is less than 0
```

7. The p-value for the non-directional test is:
   a) 0.08298
   b) 0.04149
   c) 15
   d) 8

8. The p-value for the directional test is:
   e) 0.08298
   f) 0.04149
   g) 15
   h) 8

9. At 5% level of significance, the conclusion for the non-directional test is:
   a) Average height of ancy plants is statistically different from the control plants.
   b) Average height of ancy plants is not statistically different from the control plants.
   c) Average height of ancy plants is statistically lower than the control plants.
   d) Average height of ancy plants is not statistically lower than the control plants.

10. At 5% level of significance, the conclusion for the directional test is:
    e) Average height of ancy plants is statistically different from the control plants.
    f) Average height of ancy plants is not statistically different from the control plants.
    g) Average height of ancy plants is statistically lower than the control plants.
    h) Average height of ancy plants is not statistically lower than the control plants.

Use the following information to answer questions 11-12

The NCHS-reported mean total cholesterol level in 2002 for all adults of 203. Suppose a new drug is proposed to lower total cholesterol. A study is designed to evaluate the efficacy of the drug in lowering cholesterol. A group of patients are enrolled in the study and asked to take the new drug for 12 weeks. At the end of 12 weeks, each patient's total cholesterol level is measured. The data was stored in a file “cholesterol “and used for a hypothesis test using R.

11. If we want to see if there is statistical evidence that the new drug significantly lowers total cholesterol level. The hypotheses are:
    a) $H_0 : \mu = 203$ vs. $H_A : \mu \neq 203$
    b) $H_0 : \mu \neq 203$ vs. $H_A : \mu = 203$
    c) $H_0 : \mu = 203$ vs. $H_A : \mu < 12$
    d) $H_0 : \mu = 203$ vs. $H_A : \mu < 203$

12. The appropriate R code to use here:

    a) t.test(cholesterol, mu=12, alternative="less")
    b) t.test(cholesterol, mu=203, alternative="one.sided")
    c) t.test(cholesterol, mu=203, alternative="two.sided")
    d) t.test(cholesterol, mu=203, alternative="less")

The following is the R ouput using an appropriate t.test

```
> t.test(cholesterol, mu=203, alternative="less")

        One Sample t-test

data:  cholesterol
t = -3.062, df = 10, p-value = 0.006002
alternative hypothesis: true mean is less than 203
95 percent confidence interval:
    -Inf 196.6192
sample estimates:
mean of x
 187.3636
```

13. The sample size for the hypothesis test done above is:
    a) 10
    b) 9
    c) 11
    d) Cannot be obtained from the information given above.

14. The test statistics value is: _____

15. At 5% level of significance, based on R output we
a) Reject alternative hypothesis
b) Reject null hypothesis
c) Accept null hypothesis

16. Base on test output, we conclude that
    a) We do not have statistically significant evidence at α=0.05 to show that the mean total cholesterol level is lower than the national mean in patients taking the new drug for 12 weeks.
    b) We have statistically significant evidence at α=0.05 to show that the mean total cholesterol level is lower than the national mean in patients taking the new drug for 12 weeks.
    c) Taking the new drug for 12 weeks does not help lower mean total cholesterol level.

17. Using the same data set to construct a confidence interval, a 90% interval will be
    a) Narrower than a 85% interval
    b) Wider than a 85% interval
    c) Either wider or narrower but we cannot determine until we compute it

18. A 95% confidence interval is computed for $\mu_1 - \mu_2$ and it contains the number, 0. What decision can be made regarding the hypothesis test of H_O: $\mu_1 - \mu_2 = 0$ against H_A: $\mu_1 - \mu_2 \neq 0$ at the 0.05 significance level?
    a) One must carry out the hypothesis test to make a conclusion.
    b) There is significant evidence that $\mu_1 - \mu_2 \neq 0$
    c) There is significant evidence that $\mu_1 - \mu_2 = 0$
    d) There is not significant evidence that $\mu_1 - \mu_2 \neq 0$

19. The power of a hypothesis test is the probability of
a) Rejecting a null hypothesis that is true
b) Rejecting a null hypothesis that is false
c) Failing to reject a null hypothesis that is true
d) Failing to reject a null hypothesis that is false

20. A small P-value is
a) Evidence for the null hypothesis
b) Evidence against the null hypothesis
c) Evidence against the alternative hypothesis
d) Evidence of a Type I error
e) Evidence of a Type II error

21. To compare the therapeutic value of different milk based supplement in malnourished children, researchers randomly assigned one of two common supplements (10% milk or 25% milk) to approximately 1,900 malnourished children in rural Malawi and measured their weights at the start of the study, and again after 8 weeks of therapy
    This is the
    a) Paired samples setting b) Independent samples setting

22. An animal scientist is planning an experiment to evaluate a new dietary supplement for beef cattle. One group of cattle will receive a standard diet and a second group will receive the standard diet plus the supplement. The researcher wants to have 90% power to detect an increase in mean weight gain of 20 kg, using a one-sided t test at α=0.05. Based on previous experience, he expects the SD to be 17 kg. How many cattle does he need for each group? The appropriate R code for this question is:

    a) power.t.test(delta=20,sd=17,sig.level=0.05,power=0.9,alternative="two.sided")
    b) power.t.test(delta=20,sd=17, sig.level=0.1,power=0.95,alternative="one.sided")
    c) power.t.test(delta=20,sd=17, sig.level=0.05,power=0.95,alternative="one.sided")
    d) power.t.test(delta=20,sd=17, sig.level=0.05,power=0.9,alternative="one.sided")

23. Indicate True or False for the following statements:

    ___ For a simple random sample the quality of an estimator depends on how large the population is.

    ___ The P-value is the probability that the null hypothesis is true.

    ___ Type I error is probability of rejecting the null hypothesis when in fact it is true.

    ___ In hypothesis testing, a Type II error occurs when the null hypothesis is not rejected when the alternative hypothesis is true.

    ___ Power of the test is probability of correctly rejecting the null hypothesis.

    ___ Null and alternative hypotheses are statements about sample parameters.

    ___ The standard error decreases as the sample size increases.

    ___ The confidence level for a confidence interval for a mean is the probability the procedure provides an interval that covers the sample mean.

    ___ With observational studies we cannot discuss causality.

    ____ The smaller the standard error, the larger the confidence interval.

    ____ The chi-square test statistic used in a goodness-of-fit test has k–1 degrees of freedom, where k is the number of categories.

24. In a paired-samples t-test, the appropriate sampling distribution to use is
    a) the distribution of means of measurements in each pair
    b) the distribution of means of pair differences under the null hypothesis

c) the distribution of sample means under the alternative hypothesis
d) the distribution of sample standard deviations under the null hypothesis

25. What type of data do you need for a chi-square test?
    a) Continuous b) Interval c) Categorical d)ratio

26. Researchers decide statistical significance based on the ____ associated with the data set.
    a) p-value b) null hypothesis c) chi square d) alternative hypothesis

Use following information to answer questions 27-30:

In a breeding experiment, white chickens with small combs were mated and produced 190 offspring of the types shown in below table. Are these data consistent with the Mendelian expected ratios of 9:3:3:1 for the four types?

Type	Number of offspring
White feathers, small comb	111
White feathers, large comb	37
Dark feathers, small comb	34
Dark feathers, large comb	8
Total	190

27. Let p1, p2, p3 and p4 be proportions of different type offspring. To verify if the data are consistent with the Mendelian expected ratios of 9:3:3:1 for the four types, we should test the following hypothesis
    $a)$: $H_0: p_1 = p_2 = p_3 = p_4\ vs.\ \ H_A: H_0$ is false.
    b) $H_0: \theta = 1\ \ vs.\ \ H_A: \theta \neq 1$
    c) $H_0: p_1 = \frac{9}{16};\ p_2 = \frac{3}{16};\ p_3 = \frac{3}{16}; p_4 = \frac{1}{16}\quad vs.\quad H_A: H_0$ is false.
    d) None of the above.

28. What's the expected number of offspring for the type of Dark feathers and small comb?
    a) 34 b) $\frac{1}{4} * 34$ c) $\frac{1}{16} * 190$ d) $\frac{1}{3} * 34$

29. Appropriate test to use in this case:

    a) Permutation test b) Chi-square Goodness of fit test
    c) Sign test d) t test

30. What's the degrees of freedom of the test?

    a) 1 b) 4 c) 3 d) cannot be determined