Name: ______________________

PSY 216: Elementary Statistics
Exam 3

This exam consists of 25 multiple-choice questions and 5 essay / problem questions. For each multiple-choice question, circle the one letter that corresponds to the correct answer. Each multiple-choice question is worth 2 points. If you do not show your work in the essay / problem questions, you cannot receive partial credit. Each of the essay / problem questions is worth 10 points. You have until 10:50 AM to finish the exam. Budget your time wisely.

1. A *point estimate*
   A. allows us to estimate $\overline{X}$ given μ.
   B. is synonymous with *confidence interval*.
   C. is a sample statistic used to estimate the value of a population parameter.
   D. is a population parameter used to estimate the value of a population statistic.

2. What is a sampling distribution?
   A. It is a frequency distribution of point estimates.
   B. It is a frequency distribution of the size of the samples.
   C. It is the cumulative frequency distribution of the point estimates.
   D. It is the cumulative frequency distribution of the size of the samples.

3. The *standard error of the mean*
   A. is written as $s_{\overline{X}}$.
   B. is the standard deviation of the sampling distribution.
   C. is a measure of how good the point estimate is likely to be.
   D. All of the above.

4. To decrease the size of the standard error of the mean, you need to
   A. increase the size of the sample.
   B. decrease the size of the sample.
   C. increase the standard deviation of the sample.
   D. decrease the mean of the sample.

5. The *central limit theorem* states that
   A. the mean of the sampling distribution will be 0 as long as the sample size is sufficiently large.
   B. the standard deviation of the sampling distribution will be 1 as long as the sample size is sufficiently large.
   C. Both answers A and B
   D. the shape of the sampling distribution will be normal (Gaussian) as long as the sample size is sufficiently large.

6. If the 95% confidence interval is 90.0 to 100.0, then we can safely conclude that
   A. the sample mean is within that interval 95% of the time.
   B. the population mean is within that interval 95% of the time.
   C. the mean of the population is 95.
   D. if we collected 20 samples, and made twenty 95% confidence intervals from the 20 samples, that approximately 19 of those confidence intervals would contain the population mean, and about 1 would not.

7. Two hypotheses are *mutually exclusive* if
   A. at least one of the hypotheses must always be true.
   B. both hypotheses cannot be true simultaneously.
   C. Both answers A and B.
   D. one contains a $\leq$ sign and the other contains a $\geq$ sign.

8. Two hypotheses are *exhaustive* if
   A. at least one of the hypotheses must always be true.
   B. both hypotheses cannot be true simultaneously.
   C. Both answer A and B.
   D. one contains a $<$ sign and the other contains a $>$ sign.

9. A researcher concludes that the treatment had no effect, when it fact it did. The researcher has committed a
   A. type-I (α) error.
   B. type-I (β) error.
   C. type-II (α) error.
   D. type-II (β) error.

10. A researcher concludes that the treatment had an effect, when it fact it did not. The researcher has committed a
   A. type-I (α) error
   B. type-I (β) error
   C. type-II (α) error
   D. type-II (β) error

11. A university wants to know if its incoming first year students have a higher high school GPA than the population of first year students. It is known that the high school GPA of all first year students has a mean value of 3.14 with a standard deviation of 0.159. What type of statistical test should the university perform?
   A. A z-score test.
   B. A one-sample t-test.
   C. A two-sample, between-subjects t-test.
   D. A two-sample, within-subjects t-test.

12. A researcher performed an inferential statistical test on a computer. The output indicated that $p = .049$. If you assume the most typical α level in psychology, what conclusion should you make?
    A. Reject H_0.
    B. Reject H_1.
    C. Fail to reject H_0.
    D. Fail to reject H_1.

13. Consult the attached table of z-scores. What is the critical z for $\alpha = .01$, two-tailed, $n = 10$?
    A. 2.31
    B. 2.55
    C. 0.496
    D. 0.480

14. Which of the following statements about *degrees of freedom* is / are true?
    A. They are the number of scores that are free to vary while maintaining some restriction on the data set.
    B. They are another name for *sample size*.
    C. They are used to determine which z score distribution to use.
    D. All of the above.

15. Consult the attached table of critical t-values. A one-sample t-test was performed. The observed $t = 2.04$, $\alpha = .05$, one-tailed, $N = 12$. Which of the following statements is correct?
    A. You fail to reject H_0 because $2.04 \leq 2.201$
    B. You can reject H_0 because $2.04 > 1.796$
    C. You fail to reject H_0 because $2.04 \leq 2.179$
    D. You can reject H_0 because $2.04 > 1.782$

16. One group of students took a difficult math test while the professor paced around the students, staring at the students. Another group of students took the same math test while the professor paced around, but he did not stare at the students. If the researchers were interested in the effects of staring at the individuals, which of the following statements is correct?
    A. There are no control groups in this study; both conditions are experimental conditions.
    B. The students who were stared at were in the control condition, while the students who were not stared at were in the experimental condition.
    C. The students who were stared at were in the experimental condition, while the students who were not stared at were in the control condition.
    D. There is insufficient information to decide whether answer B or answer C is correct.

17. A *within-subjects design* occurs
    A. when each person in the experiment experiences both the control and the experimental conditions.
    B. when each person in the experiment experiences one, but not both of the control and experimental conditions.
    C. whenever you have a single sample design.
    D. whenever you have a two-sample design.

18. Within-subjects designs tend to be more powerful than between-subjects designs. This implies that
    A. within-subjects designs are more likely to reject H_1 when H_1 is false than are between-subjects designs.
    B. within-subjects designs are less likely to reject H_1 when H_1 is false than are between-subjects designs.
    C. within-subjects designs are more likely to reject H_0 when H_0 is false than are between-subjects designs.
    D. within-subjects designs are less likely to reject H_0 when H_0 is false than are between-subjects designs.

19. Which of the following factors tends to make within-subjects designs more powerful than between-subjects designs?
    A. The degrees of freedom are smaller in a within-subjects design than in a between-subjects design.
    B. The degrees of freedom are larger in a within-subjects design than in a between-subjects design.
    C. The standard error of the difference of the means tends to be smaller in a within-subjects design than in a between-subjects design.
    D. The standard error of the difference of the means tends to be larger in a within-subjects design than in a between-subjects design.

20. Which of the following is correct about the *assumption of homogeneity of variance*?
    A. It is an assumption of two-sample t-tests that states that the variability in each of the conditions is approximately the same.
    B. There is a special t-test to use when the assumption has been violated.
    C. The t-test is not robust when this assumption is violated.
    D. All of the above.

21. A statistical test that is *robust*
    A. gives good results even when its assumptions have been violated.
    B. gives good results even when the sample size is small.
    C. can be used with between-subjects designs, but not within-subjects designs.
    D. All of the above.

22. t-tests assume that
    A. the data in each condition are normally distributed, but violating this assumption does not matter much, unless the violation is extreme.
    B. the data in the two conditions are independent of each other.
    C. the data are on an interval or ratio scale.
    D. All of the above.

23. Which of the following statements is true regarding accepting H_0?
    A. It is perfectly acceptable to accept H_0.
    B. You should not accept H_0 because it is always possible that with additional information (e.g. a larger sample), we would have sufficient evidence to reject H_0.
    C. You should not accept H_0 because it is what we are trying to reject.
    D. You should not accept H_0 because it can only be true if the sample mean exactly equals the population mean, and this will rarely, if ever, happen.

24. *Effect size*
    A. is a type of inferential statistic that is useful when the assumption of homogeneity of variance has been violated.
    B. is a measure of the size of the difference between the means of the two conditions.
    C. is represented by $1 - \beta$.
    D. All of the above.

25. Which of the following influence the power of a single-sample t-ratio?
    A. Number of participants.
    B. The α level.
    C. The difference between the sample and population mean.
    D. All of the above.

26. For each of the following hypotheses, write the null and alternative hypotheses in statistical notation. For each pair of hypotheses, indicate whether they are one-tailed or two-tailed.

A. Psychology majors have better language skills than engineering majors have.

Is this a one-tailed or two-tailed test (circle one).

B. People who carry handkerchiefs have a different level of introversion than people who do not carry handkerchiefs.

Is this a one-tailed or two-tailed test (circle one).

C. Students who are comfortable using computers have a higher GPA than the population, 2.87.

Is this a one-tailed or two-tailed test (circle one).

D. The correlation between how much people like math and how much they like psychology is different from 0.

Is this a one-tailed or two-tailed test (circle one).

27. The following table contains the neuroticism scores of 12 individuals. What is the 95% confidence interval of the mean? What does the confidence interval tell us?

	Score
	87
	94
	55
	87
	55
	93
	69
	77
	72
	73
	68
	82
Mean:	76
Standard Deviation:	13.18401

28. List and briefly describe the steps that you should follow when performing an inferential statistical test.

29. A phrenologist wants to know if people with large heads have a higher intelligence than average. The 36 people with a large head have a mean intelligence of 53, with a standard deviation of 17.7482. The average intelligence in the population is 50. Answer the phrenologist's question, showing *all* relevant work (e.g. hypotheses, etc.)

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30. **Remove this page from your test and turn in the rest of the test before answering this question. You may not have the rest of your test back once it has been turned in. You may use whatever resources *you* have (including the web) to answer this, and only this, question. Failure to turn in the rest of the test prior to working on this question will automatically result in a score of 0 on the test.**

Start SPSS and load the standard class data set (you can get the standard class data set from the web.) Write your answer to the following question: is the mean response to the question "One of my favorite pastimes is talking to people" (the TALK variable) less than 3 (undecided)? Be sure to show all the information you are supposed to show when performing hypothesis tests. Write your name on the SPSS output and turn it in.

Table of Critical t Values

	One-Tailed Test								
	0.250	0.200	0.150	0.100	0.050	0.025	0.010	0.005	0.0005
	Two-Tailed Test								
df	0.500	0.400	0.300	0.200	0.100	0.050	0.020	0.010	0.001
1	1.000	1.376	1.963	3.078	6.314	12.706	31.821	63.656	636.578
2	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	31.600
3	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	12.924
4	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.768
24	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.689
28	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.660
30	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.646
31	0.682	0.853	1.054	1.309	1.696	2.040	2.453	2.744	3.633
32	0.682	0.853	1.054	1.309	1.694	2.037	2.449	2.738	3.622
33	0.682	0.853	1.053	1.308	1.692	2.035	2.445	2.733	3.611
34	0.682	0.852	1.052	1.307	1.691	2.032	2.441	2.728	3.601
35	0.682	0.852	1.052	1.306	1.690	2.030	2.438	2.724	3.591
36	0.681	0.852	1.052	1.306	1.688	2.028	2.434	2.719	3.582
37	0.681	0.851	1.051	1.305	1.687	2.026	2.431	2.715	3.574
38	0.681	0.851	1.051	1.304	1.686	2.024	2.429	2.712	3.566
39	0.681	0.851	1.050	1.304	1.685	2.023	2.426	2.708	3.558
40	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.551
41	0.681	0.850	1.050	1.303	1.683	2.020	2.421	2.701	3.544
42	0.680	0.850	1.049	1.302	1.682	2.018	2.418	2.698	3.538
43	0.680	0.850	1.049	1.302	1.681	2.017	2.416	2.695	3.532
44	0.680	0.850	1.049	1.301	1.680	2.015	2.414	2.692	3.526
45	0.680	0.850	1.049	1.301	1.679	2.014	2.412	2.690	3.520
46	0.680	0.850	1.048	1.300	1.679	2.013	2.410	2.687	3.515
47	0.680	0.849	1.048	1.300	1.678	2.012	2.408	2.685	3.510
48	0.680	0.849	1.048	1.299	1.677	2.011	2.407	2.682	3.505
49	0.680	0.849	1.048	1.299	1.677	2.010	2.405	2.680	3.500
50	0.679	0.849	1.047	1.299	1.676	2.009	2.403	2.678	3.496
51	0.679	0.849	1.047	1.298	1.675	2.008	2.402	2.676	3.492
52	0.679	0.849	1.047	1.298	1.675	2.007	2.400	2.674	3.488
53	0.679	0.848	1.047	1.298	1.674	2.006	2.399	2.672	3.484
54	0.679	0.848	1.046	1.297	1.674	2.005	2.397	2.670	3.480
55	0.679	0.848	1.046	1.297	1.673	2.004	2.396	2.668	3.476
56	0.679	0.848	1.046	1.297	1.673	2.003	2.395	2.667	3.473
57	0.679	0.848	1.046	1.297	1.672	2.002	2.394	2.665	3.469
58	0.679	0.848	1.046	1.296	1.672	2.002	2.392	2.663	3.466
59	0.679	0.848	1.046	1.296	1.671	2.001	2.391	2.662	3.463
60	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.460

Areas under the unit normal distribution

z	Area Below	Area Above	z	Area Below	Area Above	z	Area Below	Area Above
0.00	0.500	0.500	0.50	0.691	0.309	1.00	0.841	0.159
0.01	0.504	0.496	0.51	0.695	0.305	1.01	0.844	0.156
0.02	0.508	0.492	0.52	0.698	0.302	1.02	0.846	0.154
0.03	0.512	0.488	0.53	0.702	0.298	1.03	0.848	0.152
0.04	0.516	0.484	0.54	0.705	0.295	1.04	0.851	0.149
0.05	0.520	0.480	0.55	0.709	0.291	1.05	0.853	0.147
0.06	0.524	0.476	0.56	0.712	0.288	1.06	0.855	0.145
0.07	0.528	0.472	0.57	0.716	0.284	1.07	0.858	0.142
0.08	0.532	0.468	0.58	0.719	0.281	1.08	0.860	0.140
0.09	0.536	0.464	0.59	0.722	0.278	1.09	0.862	0.138
0.10	0.540	0.460	0.60	0.726	0.274	1.10	0.864	0.136
0.11	0.544	0.456	0.61	0.729	0.271	1.11	0.867	0.133
0.12	0.548	0.452	0.62	0.732	0.268	1.12	0.869	0.131
0.13	0.552	0.448	0.63	0.736	0.264	1.13	0.871	0.129
0.14	0.556	0.444	0.64	0.739	0.261	1.14	0.873	0.127
0.15	0.560	0.440	0.65	0.742	0.258	1.15	0.875	0.125
0.16	0.564	0.436	0.66	0.745	0.255	1.16	0.877	0.123
0.17	0.567	0.433	0.67	0.749	0.251	1.17	0.879	0.121
0.18	0.571	0.429	0.68	0.752	0.248	1.18	0.881	0.119
0.19	0.575	0.425	0.69	0.755	0.245	1.19	0.883	0.117
0.20	0.579	0.421	0.70	0.758	0.242	1.20	0.885	0.115
0.21	0.583	0.417	0.71	0.761	0.239	1.21	0.887	0.113
0.22	0.587	0.413	0.72	0.764	0.236	1.22	0.889	0.111
0.23	0.591	0.409	0.73	0.767	0.233	1.23	0.891	0.109
0.24	0.595	0.405	0.74	0.770	0.230	1.24	0.893	0.107
0.25	0.599	0.401	0.75	0.773	0.227	1.25	0.894	0.106
0.26	0.603	0.397	0.76	0.776	0.224	1.26	0.896	0.104
0.27	0.606	0.394	0.77	0.779	0.221	1.27	0.898	0.102
0.28	0.610	0.390	0.78	0.782	0.218	1.28	0.900	0.100
0.29	0.614	0.386	0.79	0.785	0.215	1.29	0.901	0.099
0.30	0.618	0.382	0.80	0.788	0.212	1.30	0.903	0.097
0.31	0.622	0.378	0.81	0.791	0.209	1.31	0.905	0.095
0.32	0.626	0.374	0.82	0.794	0.206	1.32	0.907	0.093
0.33	0.629	0.371	0.83	0.797	0.203	1.33	0.908	0.092
0.34	0.633	0.367	0.84	0.800	0.200	1.34	0.910	0.090
0.35	0.637	0.363	0.85	0.802	0.198	1.35	0.911	0.089
0.36	0.641	0.359	0.86	0.805	0.195	1.36	0.913	0.087
0.37	0.644	0.356	0.87	0.808	0.192	1.37	0.915	0.085
0.38	0.648	0.352	0.88	0.811	0.189	1.38	0.916	0.084
0.39	0.652	0.348	0.89	0.813	0.187	1.39	0.918	0.082
0.40	0.655	0.345	0.90	0.816	0.184	1.40	0.919	0.081
0.41	0.659	0.341	0.91	0.819	0.181	1.41	0.921	0.079
0.42	0.663	0.337	0.92	0.821	0.179	1.42	0.922	0.078
0.43	0.666	0.334	0.93	0.824	0.176	1.43	0.924	0.076
0.44	0.670	0.330	0.94	0.826	0.174	1.44	0.925	0.075
0.45	0.674	0.326	0.95	0.829	0.171	1.45	0.926	0.074
0.46	0.677	0.323	0.96	0.831	0.169	1.46	0.928	0.072
0.47	0.681	0.319	0.97	0.834	0.166	1.47	0.929	0.071
0.48	0.684	0.316	0.98	0.836	0.164	1.48	0.931	0.069
0.49	0.688	0.312	0.99	0.839	0.161	1.49	0.932	0.068

z	Area Below	Area Above	z	Area Below	Area Above	z	Area Below	Area Above
1.50	0.933	0.067	2.00	0.977	0.023	2.50	0.994	0.006
1.51	0.934	0.066	2.01	0.978	0.022	2.51	0.994	0.006
1.52	0.936	0.064	2.02	0.978	0.022	2.52	0.994	0.006
1.53	0.937	0.063	2.03	0.979	0.021	2.53	0.994	0.006
1.54	0.938	0.062	2.04	0.979	0.021	2.54	0.994	0.006
1.55	0.939	0.061	2.05	0.980	0.020	2.55	0.995	0.005
1.56	0.941	0.059	2.06	0.980	0.020	2.56	0.995	0.005
1.57	0.942	0.058	2.07	0.981	0.019	2.57	0.995	0.005
1.58	0.943	0.057	2.08	0.981	0.019	2.58	0.995	0.005
1.59	0.944	0.056	2.09	0.982	0.018	2.59	0.995	0.005
1.60	0.945	0.055	2.10	0.982	0.018	2.60	0.995	0.005
1.61	0.946	0.054	2.11	0.983	0.017	2.61	0.995	0.005
1.62	0.947	0.053	2.12	0.983	0.017	2.62	0.996	0.004
1.63	0.948	0.052	2.13	0.983	0.017	2.63	0.996	0.004
1.64	0.949	0.051	2.14	0.984	0.016	2.64	0.996	0.004
1.65	0.951	0.049	2.15	0.984	0.016	2.65	0.996	0.004
1.66	0.952	0.048	2.16	0.985	0.015	2.66	0.996	0.004
1.67	0.953	0.047	2.17	0.985	0.015	2.67	0.996	0.004
1.68	0.954	0.046	2.18	0.985	0.015	2.68	0.996	0.004
1.69	0.954	0.046	2.19	0.986	0.014	2.69	0.996	0.004
1.70	0.955	0.045	2.20	0.986	0.014	2.70	0.997	0.003
1.71	0.956	0.044	2.21	0.986	0.014	2.71	0.997	0.003
1.72	0.957	0.043	2.22	0.987	0.013	2.72	0.997	0.003
1.73	0.958	0.042	2.23	0.987	0.013	2.73	0.997	0.003
1.74	0.959	0.041	2.24	0.987	0.013	2.74	0.997	0.003
1.75	0.960	0.040	2.25	0.988	0.012	2.75	0.997	0.003
1.76	0.961	0.039	2.26	0.988	0.012	2.76	0.997	0.003
1.77	0.962	0.038	2.27	0.988	0.012	2.77	0.997	0.003
1.78	0.962	0.038	2.28	0.989	0.011	2.78	0.997	0.003
1.79	0.963	0.037	2.29	0.989	0.011	2.79	0.997	0.003
1.80	0.964	0.036	2.30	0.989	0.011	2.80	0.997	0.003
1.81	0.965	0.035	2.31	0.990	0.010	2.81	0.998	0.002
1.82	0.966	0.034	2.32	0.990	0.010	2.82	0.998	0.002
1.83	0.966	0.034	2.33	0.990	0.010	2.83	0.998	0.002
1.84	0.967	0.033	2.34	0.990	0.010	2.84	0.998	0.002
1.85	0.968	0.032	2.35	0.991	0.009	2.85	0.998	0.002
1.86	0.969	0.031	2.36	0.991	0.009	2.86	0.998	0.002
1.87	0.969	0.031	2.37	0.991	0.009	2.87	0.998	0.002
1.88	0.970	0.030	2.38	0.991	0.009	2.88	0.998	0.002
1.89	0.971	0.029	2.39	0.992	0.008	2.89	0.998	0.002
1.90	0.971	0.029	2.40	0.992	0.008	2.90	0.998	0.002
1.91	0.972	0.028	2.41	0.992	0.008	2.91	0.998	0.002
1.92	0.973	0.027	2.42	0.992	0.008	2.92	0.998	0.002
1.93	0.973	0.027	2.43	0.992	0.008	2.93	0.998	0.002
1.94	0.974	0.026	2.44	0.993	0.007	2.94	0.998	0.002
1.95	0.974	0.026	2.45	0.993	0.007	2.95	0.998	0.002
1.96	0.975	0.025	2.46	0.993	0.007	2.96	0.998	0.002
1.97	0.976	0.024	2.47	0.993	0.007	2.97	0.999	0.001
1.98	0.976	0.024	2.48	0.993	0.007	2.98	0.999	0.001
1.99	0.977	0.023	2.49	0.994	0.006	2.99	0.999	0.001

1. Standard error of the mean: $s_{\overline{X}} = \frac{s_X}{\sqrt{N}}$

2. Confidence intervals: $\overline{X} \pm z \cdot s_{\overline{X}}$
3. z-score statistic: $z = \frac{\overline{X} - \mu}{s_{\overline{X}}}$
4. Unbiased estimate of the population standard deviation: $\hat{s} = \sqrt{\frac{N}{N-1} s^2}$
5. t-test statistics: $t = \frac{\overline{X} - \mu}{s_{\overline{X}}}$
6. Degrees of freedom for a single-sample t-test, df = N - 1
7. t value for a correlation test: $t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$, df = N - 2
8. Between-subjects, two sample t-test value: $t = \frac{\overline{X_{exp}} - \overline{X_{control}}}{s_{\overline{X_{exp}} - \overline{X_{control}}}}$, $s_{\overline{X_{exp}} - \overline{X_{control}}} = \sqrt{s^2_{\overline{X_1}} + s^2_{\overline{X_{21}}}}$, df = $N_1 + N_2 - 2$ (formula is valid only if $N_1 = N_2$)
9. Within-subjects, two sample t-test: $s_{\overline{X_{exp}} - \overline{X_{control}}} = \sqrt{s^2_{\overline{X_1}} + s^2_{\overline{X_{21}}} - 2rs_{\overline{X_1}}s_{\overline{X_2}}}$, df = N - 1 where N is the number of *pairs* of scores