Table of z values and probabilities for the standard normal distribution. z is the first column plus the top row. Each cell shows $P(X \leq z)$. For example $P(X \leq 1.04) = .8508$. For $z < 0$ subtract the value from 1, e.g., $P(X \leq -1.04) = 1 - .8508 = .1492$.

z	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

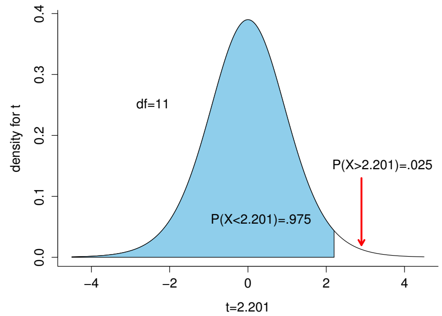


Table of t values and right tail probabilities. Degrees of freedom are in the first column (df). **Right tail probabilities** are in the first row. For example for $d.f. = 7$ and $\alpha = .05$ the critical t value for a two-tail test is 2.365 and for $d.f. = 10$ and $\alpha = .1$ the critical t value for a one-tail test is 1.372.

df	.1	.05	.025	.01	.005
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
50	1.299	1.676	2.009	2.403	2.678
75	1.293	1.665	1.992	2.377	2.643
100	1.290	1.660	1.984	2.364	2.626

Table of F values for right tail probabilities of .05. Degrees of freedom for denominator are in the first column and degrees of freedom for the numerator are in the top row.										
denom.	numerator df									
df	1	2	3	4	5	7	10	15	50	100
1	161.45	199.5	215.71	224.58	230.16	236.77	241.88	245.95	251.77	253.04
2	18.51	19	19.16	19.25	19.3	19.35	19.4	19.43	19.48	19.49
3	10.13	9.55	9.28	9.12	9.01	8.89	8.79	8.7	8.58	8.55
4	7.71	6.94	6.59	6.39	6.26	6.09	5.96	5.86	5.7	5.66
5	6.61	5.79	5.41	5.19	5.05	4.88	4.74	4.62	4.44	4.41
6	5.99	5.14	4.76	4.53	4.39	4.21	4.06	3.94	3.75	3.71
7	5.59	4.74	4.35	4.12	3.97	3.79	3.64	3.51	3.32	3.27
8	5.32	4.46	4.07	3.84	3.69	3.5	3.35	3.22	3.02	2.97
9	5.12	4.26	3.86	3.63	3.48	3.29	3.14	3.01	2.8	2.76
10	4.96	4.1	3.71	3.48	3.33	3.14	2.98	2.85	2.64	2.59
11	4.84	3.98	3.59	3.36	3.2	3.01	2.85	2.72	2.51	2.46
12	4.75	3.89	3.49	3.26	3.11	2.91	2.75	2.62	2.4	2.35
13	4.67	3.81	3.41	3.18	3.03	2.83	2.67	2.53	2.31	2.26
14	4.6	3.74	3.34	3.11	2.96	2.76	2.6	2.46	2.24	2.19
15	4.54	3.68	3.29	3.06	2.9	2.71	2.54	2.4	2.18	2.12
16	4.49	3.63	3.24	3.01	2.85	2.66	2.49	2.35	2.12	2.07
17	4.45	3.59	3.2	2.96	2.81	2.61	2.45	2.31	2.08	2.02
18	4.41	3.55	3.16	2.93	2.77	2.58	2.41	2.27	2.04	1.98
19	4.38	3.52	3.13	2.9	2.74	2.54	2.38	2.23	2	1.94
20	4.35	3.49	3.1	2.87	2.71	2.51	2.35	2.2	1.97	1.91
21	4.32	3.47	3.07	2.84	2.68	2.49	2.32	2.18	1.94	1.88
22	4.3	3.44	3.05	2.82	2.66	2.46	2.3	2.15	1.91	1.85
23	4.28	3.42	3.03	2.8	2.64	2.44	2.27	2.13	1.88	1.82
24	4.26	3.4	3.01	2.78	2.62	2.42	2.25	2.11	1.86	1.8
25	4.24	3.39	2.99	2.76	2.6	2.4	2.24	2.09	1.84	1.78
26	4.23	3.37	2.98	2.74	2.59	2.39	2.22	2.07	1.82	1.76
27	4.21	3.35	2.96	2.73	2.57	2.37	2.2	2.06	1.81	1.74
28	4.2	3.34	2.95	2.71	2.56	2.36	2.19	2.04	1.79	1.73
29	4.18	3.33	2.93	2.7	2.55	2.35	2.18	2.03	1.77	1.71
30	4.17	3.32	2.92	2.69	2.53	2.33	2.16	2.01	1.76	1.7
40	4.08	3.23	2.84	2.61	2.45	2.25	2.08	1.92	1.66	1.59
60	4	3.15	2.76	2.53	2.37	2.17	1.99	1.84	1.56	1.48
100	3.94	3.09	2.7	2.46	2.31	2.1	1.93	1.77	1.48	1.39
1000	3.85	3	2.61	2.38	2.22	2.02	1.84	1.68	1.36	1.26

Chapter 1: no key formulas.
Chapter 2: Relative Frequency=freq. of the class/n.
Approx. Class Width:
=(largest value-smallest value) /number of classes.
Chapter 3: sample and population means

$$\bar{x} = \sum x_i/n \text{ and } \mu = \sum x_i/N$$

Weighted mean and geometric mean

$$\bar{x} = \sum w_i x_i/w_i \text{ and } \bar{x}_g = [(x_1)(x_2)\dots(x_n)]^{1/n}.$$

Interquartile Range: IQR $= Q_3 - Q_1$.
Population and sample variance

$$\sigma^2 = \frac{\sum(x_i-\mu)^2}{N} \text{ and } s^2 = \frac{\sum(x_i-\bar{x})^2}{n-1}.$$

Population and sample standard deviation

$$\sigma = \sqrt{\sigma^2} \text{ and } s = \sqrt{s^2}.$$

Coefficient of Variation

$$\left(\frac{\text{Standard deviation}}{\text{Mean}} \times 100\right)\%$$

z-Score: $z_i = \frac{x_i - \bar{x}}{s}$.
Population and Sample Covariance

$$\sigma_{xy} = \frac{\sum(x_i-\mu_x)(y_i-\mu_y)}{N} \text{ and } s_{xy} = \frac{\sum(x_i-\bar{x})(y_i-\bar{y})}{n-1}$$

Population and Sample Pearson Correlation

$$\rho_{xy} = \sigma_{xy}/(\sigma_x\sigma_y) \text{ and } r_{xy} = s_{xy}/(s_x s_y).$$

Chapter 4: Counting Rule for Combinations

$$C_n^N = \binom{N}{n} = \frac{N!}{n!(N-n)!}.$$

Counting Rule for Permutations

$$P_n^N = n!\binom{N}{n} = \frac{N!}{(N-n)!}.$$

Probability Rules: $P(A) = 1 - P(A^C)$

Chapter 4 continued:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A \cap B) = P(B)P(A|B) = P(A)P(B|A).$$

Multiplication Law for Independent Events

$$P(A \cap B) = P(B)P(A).$$

Bayes' Theorem

$$P(A_i|B) = \frac{P(A_i)P(B|A_i)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2) + \cdots + P(A_n)P(B|A_n)}$$

Chapter 5:
Discrete Uniform Probability Mass Function: $f(x) = 1/n$.
Expected Value of a Discrete R. V.: $E(x) = \mu = \sum x f(x)$.
Variance of a Discrete R. V.:

$$Var(x) = \sigma^2 = \sum(x-\mu)^2 f(x).$$

Number of Experimental Outcomes Providing Exactly x Successes in n Trials

$$\binom{n}{x} = \frac{n!}{x!(n-x)!}.$$

Binomial Probability Mass Function

$$P(X = x) = f(x) = \binom{n}{x} p^x (1-p)^{(n-x)}.$$

Expected Value for Binomial Distribution: $E(x) = \mu = np$.
Variance for Binomial Distr.: $Var(x) = \sigma^2 = np(1-p)$.
Poisson Probability Mass Function:

$$P(X = x|\mu) = f(x) = \frac{\mu^x e^{-\mu}}{x!}.$$

Hypergeometric Probability Mass Function and Expected Value:

$$f(x) = \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}} \text{ and } E(x) = \mu = \frac{nr}{N}.$$

Chapter 5 continued: Variance for the Hypergeometric Distribution:

$$Var(x) = \sigma^2 = n\left(\frac{r}{N}\right)\left(1-\frac{r}{N}\right)\left(\frac{N-n}{N-1}\right).$$

Chapter 6: Uniform PDF

$$f(x) = \begin{cases} \frac{1}{b-a} & \text{if } a \le x \le b \\ 0 & \text{otherwise} \end{cases}$$

Normal PDF The density function is

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right).$$

Converting to the Standard Normal rv:

$$z = \frac{x-\mu}{\sigma}.$$

Exponential PDF and CDF for $x \ge 0$

$$f(x) = \mu^{-1}e^{-x/\mu} \text{ and } P(x \le x_0) = 1 - e^{-x_0/\mu}.$$

Chapter 7: expected value of $\bar{x}$

$$E(\bar{x}) = \mu.$$

Standard Deviation of $\bar{x}$ (Standard Error)

$$\sigma_x = \frac{\sigma}{\sqrt{n}}.$$

Expected Value and Std Dev (Standard Error) of $\bar{p}$

$$E(\bar{p}) = p \text{ and } \sigma_{\bar{p}} = \sqrt{\frac{p(1-p)}{n}}$$

Finite Pop. Correction Factor: $\sqrt{(N-n)/(N-1)}$.
Chapter 8: Interval Estimate of Population Mean, σ known and unknown

$$\bar{x} \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \text{ and } \bar{x} \pm t_{\alpha/2}\frac{s}{\sqrt{n}}$$

Necessary Sample Size for Interval Estimate of μ

$$n = \frac{(z_{\alpha/2})^2\sigma^2}{E^2}$$

Chapter 8 continued: Interval Estimate of p

$$\bar{p} \pm z_{\alpha/2} \frac{p(1-p)}{\sqrt{n}}$$

Necessary Sample Size for Interval Estimate of p

$$n = \frac{(z_{\alpha/2})^2 p^*(1-p^*)}{E^2}$$

Chapter 9: Test Statistic for Hypothesis Tests About μ, σ known and unknown

$$z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \text{ and } t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Test Stat for Hypothesis About p

$$z = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

Chapter 10: Point Estimate and Standard Error for Difference in Two Population Means

$$\bar{x}_1 - \bar{x}_2 \text{ and } \sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

Interval Estimate and Test Statistic for Difference in Two Means with Known Variances

$$\bar{x}_1 - \bar{x}_2 \pm z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \text{ and } z = \frac{\bar{x}_1 - \bar{x}_2 - D_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Interval Estimate and Test Statistic for Difference in Two Means with Unknown Variances

$$\bar{x}_1 - \bar{x}_2 \pm t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \text{ and } t = \frac{\bar{x}_1 - \bar{x}_2 - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Degrees of Freedom for t, Two Independent Random Samples

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1-1}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2-1}\left(\frac{s_2^2}{n_2}\right)^2}$$

Chapter 10 continued: Test Statistic (Matched Samples)

$$t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}}$$

ANOVA Related:

$$\bar{x}_j = \frac{\sum_{i=1}^{n_j} x_{ij}}{n_j} \quad s_j^2 = \frac{\sum_{i=1}^{n_j}(x_{ij} - \bar{x}_j)^2}{n_j - 1} \quad \bar{\bar{x}} = \frac{\sum_{j=1}^{k}\sum_{i=1}^{n_j} x_{ij}}{n_T}$$

$$MSTR = \frac{SSTR}{k-1} \quad \text{SSTR} = \sum_{j=1}^{k} n_j(\bar{x}_j - \bar{\bar{x}})^2 \quad MSE = \frac{SSE}{n_T - k}$$

$$SSE = \sum_{j=1}^{k}(n_j - 1)s_j^2 \quad F = MSTR/MSE$$

$$\text{SST} = \sum_{j=1}^{k}\sum_{i=1}^{n_j}(x_{ij} - \bar{\bar{x}})^2 \quad \text{SST=SSTR+SSE}$$

Chapter 11: not covered in this course
Chapter 12: $y = \beta_0 + \beta_1 x + \epsilon$

$$E(y) = \beta_0 + \beta_1 x \quad \hat{y} = b_0 + b_1 x \quad b_0 = \bar{y} - b_1\bar{x}$$

$$b_1 = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2} \quad SSE = \sum(y_i - \hat{y}_i)^2$$

$$SST = \sum(y_i - \bar{y})^2 \quad SSR = \sum(\hat{y}_i - \bar{y})^2 \quad \text{SST=SSR+SSE}$$

$$r^2 = \frac{SSR}{SST} \quad r_{xy} = (\text{sign of } b_1)\sqrt{r^2} \quad s^2 = MSE = \frac{SSE}{n-2}$$

Standard Error of the Estimate, $s = \sqrt{MSE}$.

$$\sigma_{b_1} = \frac{\sigma}{\sqrt{\sum(x_i - \bar{x})^2}} \quad s_{b_1} = \frac{s}{\sqrt{\sum(x_i - \bar{x})^2}} \quad t = \frac{b_1}{s_{b_1}}$$

For simple regression, $MSR = SSR$ because there is only one independent variable.

$$F = \frac{MSR}{MSE} \quad s_{\hat{y}*} = s\sqrt{\frac{1}{n} + \frac{(x^* - \bar{x})^2}{\sum(x_1 - \bar{x})^2}}$$

Confidence Interval for $E(y^*)$: $\hat{y}^* \pm t_{\alpha/2} s_{\hat{y}*}$

$$s_{\text{pred}} = s\sqrt{1 + \frac{1}{n} + \frac{(x^* - \bar{x})^2}{\sum(x_1 - \bar{x})^2}}$$

Chapter 12 continued: Prediction Interval for y^*:

$$\hat{y}^* \pm t_{\alpha/2} s_{\text{pred}}$$

Residual for Observation i: $y_i - \hat{y}_i$
Chapter 13:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \epsilon$$

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p$$

$$\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \cdots + b_p x_p$$

$$SST = SSR + SSE \quad R^2 = \frac{SSR}{SST}$$

$$R_a^2 = 1 - (1 - R^2)\frac{n-1}{n-p-1}$$

$$MSR = \frac{SSR}{p} \quad MSE = \frac{SSE}{n-p-1} \quad F = \frac{MSR}{MSE}$$

$$t = \frac{b_i}{s_{bi}}$$

Other Math Rule Reminders:

$$e^x = \exp(x)$$

$$\ln 1 = 0 \quad \ln e = 1$$

$$x! = (x)(x-1)(x-2)\cdots(2)(1)$$

$$0! = 1 \quad x^0 = 1$$

Use the output below to answer the appropriate questions in the exam. Be sure to check which table the question references. The ANOVA table shows results for year 2012 data where the observational units are states (including DC) and the response is percentage of adults that are college graduates and the treatments are the following mutually exclusive US regions: (1) Borders the Mississippi River, (2) East of the Mississippi, (3) West of the Mississippi. The data on percentage of college graduates comes from the Current Population Survey.

ANOVA Table 1

	SS	DF	MS	F	p
Treatments	194.895	2	97.447	______	0.0916
Error	1860.987	48	38.771		

Here is regression output from a model where percentage of college graduates among adults 25 years + is the independent variable and unemployment rate is the dependent variable. The data are for 2012 and are available from the CPS (link is above) and the Bureau of Labor Statistics.

Regression Table 2

Regression Statistics	
R Square	0.0035189
Adjusted R Square	−0.0168174
Standard Error	1.7366635
Observations	51

ANOVA

	SS	DF	MS	F	p
Regression	0.522	1	0.522	0.173	0.6792427
Residual	147.784	49	3.016		

	coefficients	standard error	t stat	p-value
intercept	6.8375656	1.2071347	5.6642939	0.0000008
pct.coll.grads	0.0159326	0.0383016	0.4159776	0.6792427

VERSION B

Choose the best answer. Do not write letters in the margin or communicate with other students in any way. If you have a question note it on your exam and ask for clarification when your exam is returned. In the meantime choose the best answer. Neither the proctors nor Dr. Cox will answer questions during the exam.

Please check each question and possible answers thoroughly as questions at the bottom of a page sometimes run onto the next page. Please verify that your test version and scantron version are the same.

This exam has 30 questions.

1. I have checked that my ID is bubbled in correctly. If it is bubbled in incorrectly I will get this question wrong. I also understand that questions and their possible answers may run onto the next page and so I should always check the top of the next page for possible answers. I understand that if I have a question I should simply make a note on my exam and ask Dr. Cox afterwards. I should always choose the best answer.

   (a) False.
   (b) I didn't read the directions.
   (c) True.

2. Suppose you have a random variable that is uniformly distributed with a maximum of 268 and a minimum of 75. What is the expected value of this random variable?

   (a) 171.5
   (b) 191.5
   (c) 156.5
   (d) 222.95

3. What is the probability of observing a z value less than 1.198?

   (a) 0.8845
   (b) 0.1155
   (c) 1.0045
   (d) 0.8145

4. Suppose that you have a sample with 20 observations. You are going to use this sample to construct a confidence interval for the population mean. How many degrees of freedom are there?

   (a) 19
   (b) 4.472136
   (c) 20
   (d) 10

5. Suppose that the known standard deviation for the numbers of hours that students work in a week is 13.4. If I draw a sample of 41 what is the standard error?

   (a) 2.0927284
   (b) 1.6741827

(c) 0.3268293
(d) 2.7205469

6. Consider a $(1-\alpha)\times 100\%$ confidence interval for μ. If the confidence interval contains 0 then we will fail to reject $H_0 : \mu = 0$ at the α level of significance.

   (a) true.
   (b) false.
   (c) true if σ is known and false if σ is unknown and therefore estimated with s.

7. Suppose that the number of times a college student changes their major follows a Poisson distribution with a mean of 2. What is the probability that a student will change their major exactly 2 time(s)?

   (a) 0.1624023
   (b) 0.7293294
   (c) 0.4060058
   (d) 0.2706706

8. Consult Table 1. The F statistic is missing. What is the value of the F statistic?

   (a) 2.38735
   (b) 3.0156
   (c) 0.3901678
   (d) 2.513

9. Consult Table 1. From the table you can conclude that the total number of observations used in this analysis/experiment was?

   (a) 49
   (b) 2
   (c) 48
   (d) 51

10. Consult Table 1. From the table what can you conclude concerning the null hypothesis?

   (a) depends on the number of observations.
   (b) rejcet the null

(c) fail to reject
(d) cannot be determined

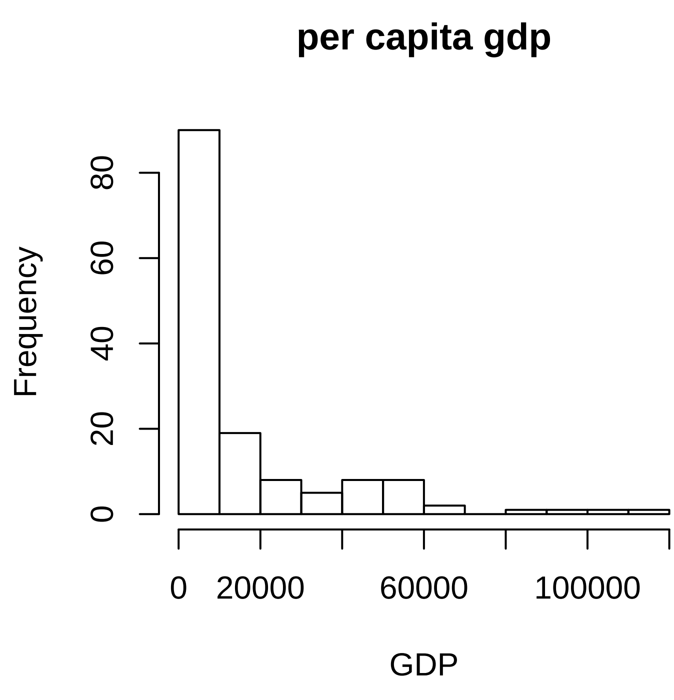
11. Consult Table 1. What proportion of the variation in the percentage of college graduates is explained by the region of the country?

    (a) 0.1099665
    (b) 0.1004866
    (c) 0.0947987.
    (d) 0.0877836

12. Consult Table 1. What is the critical value for a test a the .05 level?

    (a) 1.97
    (b) 3.19
    (c) 2.78
    (d) 3.89

13. The graph(s) shown here is/are



(a) box and whiskers plots
(b) scatter plots
(c) histograms
(d) stem and leaf displays

14. The probability that a z value is less than -.5 is

(a) .5
(b) .3413
(c) .6915
(d) .3085

15. Suppose that you collect data on apartment prices in Tempe. You look at 35 different apartments and find a mean of 727 and a standard deviation of 186.9. Construct a 95% confidence interval for the mean apartment price. The interval is

(a) [666.7976037, 787.2023963]
(b) [656.7976037, 797.2023963]
(c) [596.5178433, 712.0821567]
(d) [662.7976037, 791.2023963]

16. Suppose that you collect data on apartment prices in Tempe. You look at 35 different apartments and find a mean of 727 and a standard deviation of 186.9. Test the hypothesis, $H_0 : \mu = 695$ at the .05 level of significance.

(a) the test statistic is 1.012919 so we fail to reject
(b) the test statistic is 1.012919 so we rejcet the null
(c) the test statistic is 0.7316271 so we fail to reject
(d) the test statistic is 1.2242109 so we rejcet the null

17. Suppose you have a random variable that is uniformly distributed with a maximum of 3484 and a minimum of 975. What is the expected value of this random variable?

(a) 2229.5
(b) 2249.5
(c) 2214.5
(d) 2898.35

18. Choose the best answer (that goes without saying but I say it anyway). The central limit theorem

    (a) applies to data that follow the normal distribution
    (b) applies to data drawn from any distribution
    (c) applies to data drawn from any symmetric distribution
    (d) applies to data when the true standard deviation is known

19. Consider the regression output in Table 2. What is the estimated variance of the error term?

    (a) 0.173
    (b) 3.016
    (c) 0.8683317
    (d) 1.7366635

20. Consider the regression output in Table 2. What is the percentage of variation in unemployment rate that can be explained by the variation in percentage of college graduates?

    (a) 0.6481052%
    (b) 0.3518948%
    (c) 0.4222738%
    (d) −1.68174%

21. Consider the regression output in Table 2. What is the predicted unemployment rate in a state where the percentage of college graduates is 25%?

    (a) 7.1880828
    (b) 7.2836783
    (c) 7.2358806
    (d) 7.1562176

22. Consider the regression output in Table 2. Suppose you want to test the hypothesis that percentage of college graduates has no impact on unemployment rate, i.e. $H_0 : \beta_1 = 0$. What is the test statistic for this hypothesis?

    (a) 0.4159776
    (b) 0.0383016

(c) 0.6792427
(d) 5.6642939

23. Consider the regression output in Table 2. Suppose you want to test the hypothesis that percentage of college graduates has no impact on unemployment rate, i.e. $H_0 : \beta_1 = 0$. What is you conclusion for this hypothesis test?

    (a) This is inconclusive unless we know whether it is a right tail or a left tail test.
    (b) This cannot be determined without the appropriate df.
    (c) fail to reject
    (d) rejcet the null

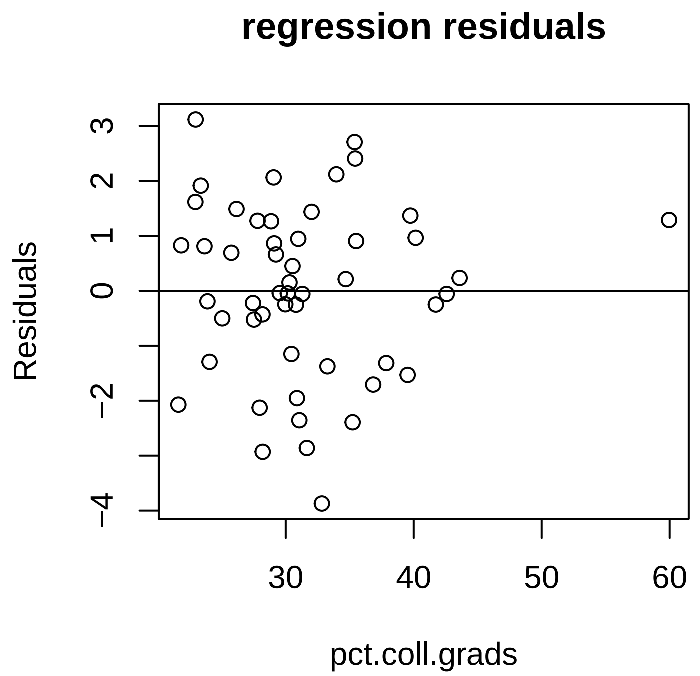
24. Consider the regression output in Table 2. Construct a 90% confidence interval for the estimated coefficient on the independent variable (the X variable). The interval is

    (a) [−0.0547034, 0.0865686]
    (b) [−0.0482819, 0.0801471]
    (c) [−0.0418605, 0.0737257]
    (d) [−0.0531101, 0.0721324]

25. Suppose that you observe that the residuals resulting from regression analysis are typically positive for small and large values of your X variable but typically negative for medium values of your X variable.

    (a) the true relationship between X and Y might not be linear.
    (b) the value of R square will be smaller than in cases where this is not true.
    (c) the residuals will not have mean 0.
    (d) the residuals will not have constant variance.
    (e) the residuals will not be normally distributed.

26. Here is a plot of the residuals from the regression. Based on this plot



(a) the residuals do not appear to be normally distributed.
(b) the residuals do not appear to have mean 0.
(c) the residuals do not appear to have constant variance
(d) the residuals appear to be correlated
(e) none of the above

27. Suppose that to the regression shown in Table 2 we add another explanatory variable.

(a) the estimated intercept will increase.
(b) the p-value will go down.
(c) the p-value will go up.
(d) the R^2 will go up.
(e) the R^2 will go down.

The following 3 questions relate to the table below which shows the members of the US House of Representatives by party and gender. The numbers are from a report from the Congressional Research Service.

Party	Male	Female	total
Democrat	128	65	193
Republican	224	23	247
Total	352	88	440

28. Using the table showing the members of the US House. What is P(Female|Republican)?

    (a) 0.0522727
    (b) 0.1026786
    (c) 0.3562753
    (d) 0.0651822
    (e) 0.0931174

29. Using the table showing the members of the US House. What is P(Female∩Republican)?

    (a) 0.2
    (b) 0.0888636
    (c) 0.0522727
    (d) 0.0931174
    (e) 0.1026786

30. Using the table showing the members of the US House. What is P(Democrat)? (You are looking for the probability that a randomly drawn member of the House is a democrat.)

    (a) 0.7813765
    (b) 0.5613636
    (c) 0.6579545
    (d) 0.4386364
    (e) 0.3070455

Key

1. c
2. a
3. a
4. a
5. a
6. a, the statement is true which you might have seen reading the text, or figured from the interpretations of the null hypothesis and the CI, or by working the math back out as in

$$0 \in CI \implies \bar{x} \pm t_{crit}SE > 0 \implies \bar{x} > \pm t_{crit}SE \implies t_{stat} = \bar{x}/SE > \pm t_{crit}.$$

7. d
8. d, the F statistic is the MSTR/MSE
9. d
10. c
11. c, similar to the case in regression you simply find SSTR/SST
12. b
13. c
14. d
15. d
16. a
17. a
18. b, it doesn't matter the original distribution of the data, the central limit theorem will hold as long as the mean and variance are finite. As such all of the answers are true but only one is the best.
19. b
20. b
21. c
22. a, read from the table
23. c
24. b, take the parameter estimate +- the critical t value*standard error, you must look up the critical t value from the t table

25. a, you might draw this to help you see what is going on, it is similar to the graph I showed at the end of the lecture notes for chapter 12
26. e, there are no readily apparent patterns in the residuals.
27. d, R^2 could stay the same but barring that miracle it will increase.
28. e, 23/247
29. c, 23/440
30. d, 193/440