

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
35	1.306	1.690	2.030	2.438	2.724
40	1.303	1.684	2.021	2.423	2.704
45	1.301	1.679	2.014	2.412	2.690
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

<p>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</p> $\bar{x} = \sum x_i/n \text{ and } \mu = \sum x_i/N$ <p>Weighted mean and geometric mean</p> $\bar{x} = \sum w_i x_i / w_i \text{ and } \bar{x}_g = [(x_1)(x_2) \dots (x_n)]^{1/n}.$ <p>Interquartile Range: IQR = $Q_3 - Q_1$. Population and sample variance</p> $\sigma^2 = \frac{\sum (x_i - \mu)^2}{N} \text{ and } s^2 = \frac{\sum (x_i - \bar{x})^2}{n - 1}$ <p>Population and sample standard deviation</p> $\sigma = \sqrt{\sigma^2} \text{ and } s = \sqrt{s^2}.$ <p>Coefficient of Variation</p> $\left(\frac{\text{Standard deviation}}{\text{Mean}} \times 100 \right) \%$ <p>z-Score: $z_i = \frac{x_i - \bar{x}}{s}$. Population and Sample Covariance</p> $\sigma_{xy} = \frac{\sum (x_i - \mu_x)(y_i - \mu_y)}{N} \text{ and } s_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{n - 1}$ <p>Population and Sample Pearson Correlation</p> $\rho_{xy} = \sigma_{xy} / (\sigma_x \sigma_y) \text{ and } r_{xy} = s_{xy} / (s_x s_y).$ <p>Chapter 4: Counting Rule for Combinations</p> $C_n^N = \binom{N}{n} = \frac{N!}{n!(N-n)!}$ <p>Counting Rule for Permutations</p> $P_n^N = n! \binom{N}{n} = \frac{N!}{(N-n)!}$ <p>Probability Rules: $P(A) = 1 - P(A^c)$</p>	<p>Chapter 4 continued:</p> $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $P(A B) = \frac{P(A \cap B)}{P(B)}$ $P(A \cap B) = P(B)P(A B) = P(A)P(B A).$ <p>Multiplication Law for Independent Events</p> $P(A \cap B) = P(B)P(A).$ <p>Bayes' Theorem</p> $P(A_i B) = \frac{P(A_i)P(B A_i)}{P(A_1)P(B A_1) + P(A_2)P(B A_2) + \dots + P(A_n)P(B A_n)}$ <p>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.:</p> $Var(x) = \sigma^2 = \sum (x - \mu)^2 f(x).$ <p>Number of Experimental Outcomes Providing Exactly x Successes in n Trials</p> $\binom{n}{x} = \frac{n!}{x!(n-x)!}$ <p>Binomial Probability Mass Function</p> $P(X = x) = f(x) = \binom{n}{x} p^x (1-p)^{(n-x)}.$ <p>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> $P(X = x \mu) = f(x) = \frac{\mu^x e^{-\mu}}{x!}.$ <p>Hypergeometric Probability Mass Function and Expected Value:</p> $f(x) = \frac{\binom{r}{x} \binom{N-r}{n-x}}{\binom{N}{n}} \text{ and } E(x) = \mu = \frac{nr}{N}.$	<p>Chapter 5 continued: Variance for the Hypergeometric Distribution:</p> $Var(x) = \sigma^2 = n \left(\frac{r}{N} \right) \left(1 - \frac{r}{N} \right) \left(\frac{N-n}{N-1} \right).$ <p>Chapter 6: Uniform PDF</p> $f(x) = \begin{cases} \frac{1}{b-a} & \text{if } a \leq x \leq b \\ 0 & \text{otherwise} \end{cases}$ <p>Normal PDF The density function is</p> $f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right).$ <p>Converting to the Standard Normal rv:</p> $z = \frac{x - \mu}{\sigma}.$ <p>Exponential PDF and CDF for $x \geq 0$</p> $f(x) = \mu^{-1} e^{-x/\mu} \text{ and } P(x \leq x_0) = 1 - e^{-x_0/\mu}.$ <p>Chapter 7: expected value of \bar{x}</p> $E(\bar{x}) = \mu.$ <p>Standard Deviation of \bar{x} (Standard Error)</p> $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}.$ <p>Expected Value and Std Dev (Standard Error) of \bar{p}</p> $E(\bar{p}) = p \text{ and } \sigma_{\bar{p}} = \sqrt{\frac{p(1-p)}{n}}$ <p>Finite Pop. Correction Factor: $\sqrt{(N-n)/(N-1)}$. Chapter 8: Interval Estimate of Population Mean, σ known and unknown</p> $\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \text{ and } \bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$ <p>Necessary Sample Size for Interval Estimate of μ</p> $n = \frac{(z_{\alpha/2})^2 \sigma^2}{E^2}$
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<p>Chapter 8 continued: Interval Estimate of p</p> $\hat{p} \pm z_{\alpha/2} \frac{p(1-p)}{\sqrt{n}}$ <p>Necessary Sample Size for Interval Estimate of p</p> $n = \frac{(z_{\alpha/2})^2 p^*(1-p^*)}{E^2}$ <p>Chapter 9: Test Statistic for Hypothesis Tests About μ, σ known and unknown</p> $z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \text{ and } t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$ <p>Test Stat for Hypothesis About p</p> $z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$	<p>Chapter 10 continued: Test Statistic (Matched Samples)</p> $t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}}$ <p>ANOVA Related:</p> $\bar{x}_j = \frac{\sum_{i=1}^{n_j} x_{ij}}{n_j} \quad s_j^2 = \frac{\sum_{i=1}^{n_j} (x_{ij} - \bar{x}_j)^2}{n_j - 1} \quad \bar{\bar{x}} = \frac{\sum_{j=1}^k \sum_{i=1}^{n_j} x_{ij}}{n_T}$ $MSTR = \frac{SSTR}{k-1} \quad SSTR = \sum_{j=1}^k n_j (\bar{x}_j - \bar{\bar{x}})^2 \quad MSE = \frac{SSE}{n_T - k}$ $SSE = \sum_{j=1}^k \sum_{i=1}^{n_j} (x_{ij} - \bar{x}_j)^2 \quad F = MSTR/MSE$ $SST = \sum_{j=1}^k \sum_{i=1}^{n_j} (x_{ij} - \bar{\bar{x}})^2 \quad SST = SSTR + SSE$ <p>Chapter 11: not covered in this course Chapter 12: $y = \beta_0 + \beta_1 x + \epsilon$</p> $E(y) = \beta_0 + \beta_1 x \quad \hat{y} = b_0 + b_1 x \quad b_0 = \bar{y} - b_1 \bar{x}$ $b_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \quad SSE = \sum (y_i - \hat{y}_i)^2$ $SST = \sum (y_i - \bar{y})^2 \quad SSR = \sum (\hat{y}_i - \bar{y})^2 \quad SST = SSR + SSE$ $r^2 = \frac{SSR}{SST} \quad r_{xy} = (\text{sign of } b_1) \sqrt{r^2} \quad s^2 = MSE = \frac{SSE}{n-2}$ <p>Standard Error of the Estimate, $s = \sqrt{MSE}$.</p> $\sigma_{b_1} = \frac{\sigma}{\sqrt{\sum (x_i - \bar{x})^2}} \quad s_{b_1} = \frac{s}{\sqrt{\sum (x_i - \bar{x})^2}} \quad t = \frac{b_1}{s_{b_1}}$ <p>For simple regression, $MSR = SSR$ because there is only one independent variable.</p> $F = \frac{MSR}{MSE} \quad s_{\hat{y}^*} = s \sqrt{\frac{1}{n} + \frac{(x^* - \bar{x})^2}{\sum (x_1 - \bar{x})^2}}$ <p>Confidence Interval for $E(y^*)$: $\hat{y}_{\alpha/a}^* \pm s_{\hat{y}^*}$</p> $s_{\text{pred}} = s \sqrt{1 + \frac{1}{n} + \frac{(x^* - \bar{x})^2}{\sum (x_1 - \bar{x})^2}}$	<p>Chapter 12 continued: Prediction Interval for y^*:</p> $\hat{y}^* \pm t_{\alpha/a} s_{\text{pred}}$ <p>Residual for Observation i: $y_i - \hat{y}_i$ Chapter 13:</p> $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p + \epsilon$ $E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p$ $\hat{y} = b_0 + b_1 x_1 + b_2 x_2 + \dots + b_p x_p$ $SST = SSR + SSE \quad R^2 = \frac{SSR}{SST}$ $R_a^2 = 1 - (1 - R^2) \frac{n-1}{n-p-1}$ $MSR = \frac{SSR}{p} \quad MSE = \frac{SSE}{n-p-1} \quad F = \frac{MSR}{MSE}$ $t = \frac{b_i}{s_{b_i}}$ <p>Other Math Rule Reminders:</p> $e^x = \exp(x)$ $\ln 1 = 0 \quad \ln e = 1$ $x! = (x)(x-1)(x-2) \dots (2)(1)$ $0! = 1 \quad x^0 = 1$
<p>Chapter 10: Point Estimate and Standard Error for Difference in Two Population Means</p> $\bar{x}_1 - \bar{x}_2 \text{ and } \sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$ <p>Interval Estimate and Test Statistic for Difference in Two Means with Known Variances</p> $\bar{x}_1 - \bar{x}_2 \pm z_{\alpha/2} \sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} \quad \text{and } z = \frac{\bar{x}_1 - \bar{x}_2 - D_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$ <p>Interval Estimate and Test Statistic for Difference in Two Means with Unknown Variances</p> $\bar{x}_1 - \bar{x}_2 \pm t_{\alpha/2} \sigma_{\bar{x}_1 - \bar{x}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}} \quad \text{and } t = \frac{\bar{x}_1 - \bar{x}_2 - D_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ <p>Degrees of Freedom for t, Two Independent Random Samples</p> $df = \frac{1}{\frac{1}{n_1-1} \left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2-1} \left(\frac{s_2^2}{n_2}\right)^2} \left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right)$		

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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. Dr. Cox will post a key the day after the exam or in the case of the final exam the day after all finals are given. Grades will be posted on Bb after scores are returned from the testing center.

Please check each question and possible answers thoroughly as questions at the bottom of a page sometimes run onto the next page.

Relax. You studied. You know the material. You can do great.

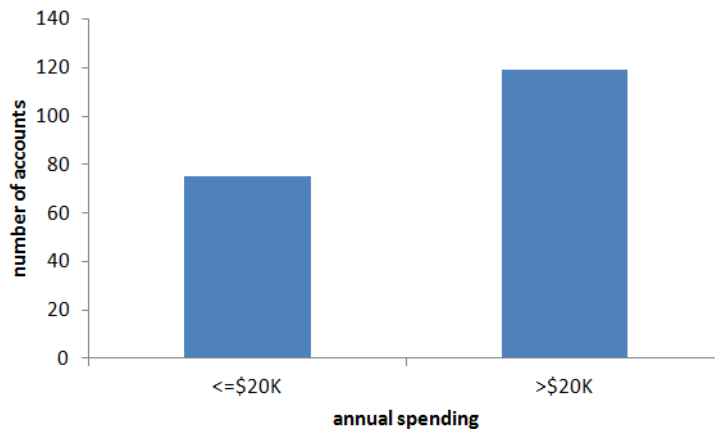
1. I have checked that my ID is bubbled in correctly. If it is bubbled in incorrectly I will get this question wrong.

- (a) True.
- (b) False.

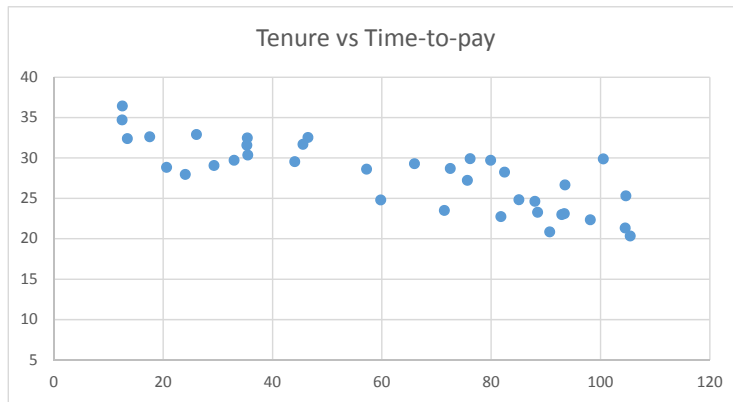
2. Debt is an example of

- (a) categorical data.
- (b) either categorical or quantitative data.
- (c) dollar data.
- (d) quantitative data.

3. The display below has



- (a) too many classes.
 - (b) the right number of classes.
 - (c) too few classes.
 - (d) a class range that is too narrow.
4. The graph below shows the relationship between tenure and time-to-pay with tenure in months measured on the x axis. In this example



- (a) the covariance is negative.
 - (b) the data do not follow the empirical rule.
 - (c) the covariance is positive but the correlation is negative.
 - (d) the covariance is positive.
5. A study by the Institute for Higher Education Policy found the values in the joint probability table below. The underlying data are for former college students that had taken out student loans. The table shows whether the student received a college degree versus whether they are successfully making their student loan payments. What is the probability that a former student with a loan is delinquent on their loan payments?

	holds a college degree		
loan status	yes	no	total
satisfactory	.26	.24	.50
delinquent	.16	.34	.50
total	.42	.58	1

- (a) .16.
 - (b) .34.
 - (c) .50.
 - (d) .42.
6. A telemarketer will make 20 calls in one hour. The probability of making a sale on any given call is .15. What is the probability that he will make exactly two sales during the hour?
- (a) .176.
 - (b) .300.
 - (c) .404.
 - (d) .229.
7. Using the Poisson PMF, when the mean is 30, what is $P(X=30)$?
- (a) .028.
 - (b) .044.
 - (c) .073.
 - (d) .117.
8. Suppose that the number of service requests a plumbing business receives between 3 and 5 o'clock follows the Poisson distribution with a mean of 13. What is the probability that the company will receive exactly 7 service requests between those hours?
- (a) .015.
 - (b) .028.
 - (c) .042.
 - (d) .082.
 - (e) .111.
9. A random variable which can take on only two possible values has which distribution?
- (a) Poisson.
 - (b) Binomial.
 - (c) Uniform.
 - (d) Discrete.

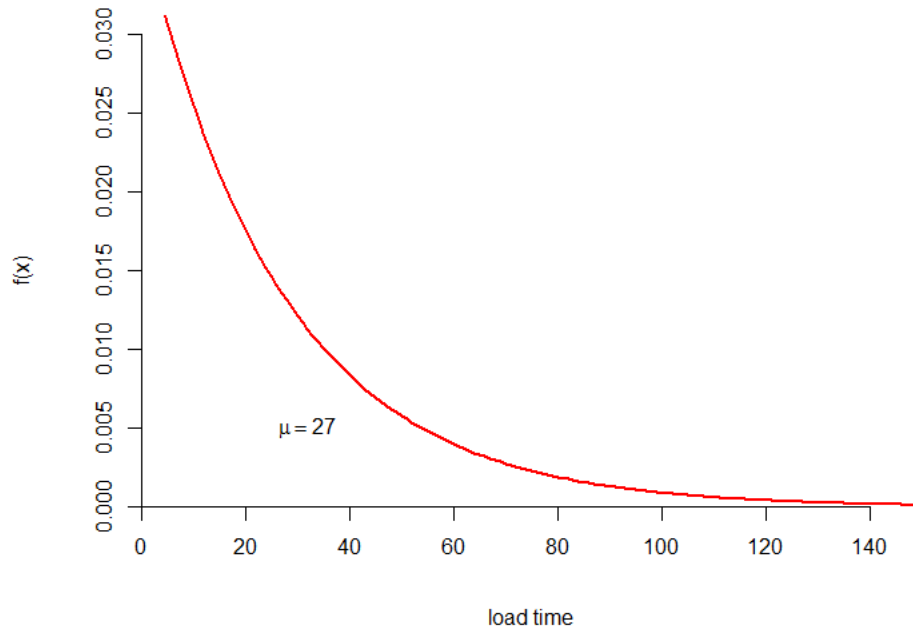
- (e) Taylor Series.
10. Suppose at ASU that 56% of students take out some form of loan to pay for their schooling. In a class of 350 students what is the expected number of students with a loan?
- (a) 210.
(b) 19.
(c) 350.
(d) .56.
(e) 196.
11. Suppose you have a random variable that is uniformly distributed between 50 and 175. What is the expected value for this random variable?
- (a) 112.5.
(b) 50.
(c) 175.
(d) 225.
(e) 125.
12. Suppose you have data for several years of inflation adjusted bids for major road resurfacing projects in the greater Phoenix MSA. The bids are given in terms of per mile cost. You observe that bids are fairly evenly distributed on the interval \$110,000 to \$126,000. Given this information what is the probability of observing a bid $>$ \$120,000?
- (a) .752.
(b) .425.
(c) .625.
(d) .50.
(e) .375.
13. Assume that the flight time for U.S. Airways flight 1267 from Philadelphia to Dallas follows the uniform probability distribution between 210 and 250 minutes. What is the probability that a randomly selected flight will take more than 225 minutes?
- (a) .425.

- (b) .625.
 - (c) .50.
 - (d) .375.
 - (e) .525.
14. A Thai restaurant advertises that carryout orders take about 30 minutes. Assume that the time it takes for an order to be ready follows the exponential distribution with a mean of 30. What is the probability that an order will take longer than 40 minutes?
- (a) .472.
 - (b) .528.
 - (c) 0.
 - (d) .264.
 - (e) .736.
15. For a sample of 18 cars you find the standard deviation of the price is 6150 (measured in dollars). What is the standard error?
- (a) 72833.
 - (b) 375.
 - (c) 342.
 - (d) 1492.
 - (e) 1449.
16. For any sample where the minimum is less than the maximum
- (a) the standard deviation of the underlying random variable will equal the standard error.
 - (b) the standard deviation of the underlying random variable will be greater than the standard error.
 - (c) the standard deviation of the underlying random variable will be less than the standard error.
 - (d) the standard error will equal the variance.
 - (e) the distribution will be skewed by the standard deviation.
17. As n gets “large” the distribution of \bar{x} approaches

- (a) the normal distribution.
 - (b) the distribution of X .
 - (c) the distribution of X but with a smaller standard deviation.
 - (d) the uniform distribution.
 - (e) the centralized distribution.
18. The average wage for hourly wage workers at a pickle factory is \$14.35 with a known standard deviation of \$3.7. If we take a survey of 40 employees what is the probability of getting an average wage of more than \$15.5?
- (a) .0.
 - (b) 1.
 - (c) .05.
 - (d) .024.
 - (e) .143.
19. Suppose that you have a sample of 22 and you need to find the t value for sample with a mean of 56 and a standard deviation of 3.7. How many degrees of freedom are there in this case?
- (a) Degrees of freedom are not used in this type of problem.
 - (b) 22.
 - (c) 21.
 - (d) 23.
 - (e) 34.
20. Construct a 90% confidence interval for the mean when $\bar{x} = 50$ and there are 31 observations. Suppose $\sigma = 7$. What is the confidence interval? Don't round until the final step.
- (a) [48.24, 51.76].
 - (b) [47.93, 52.07].
 - (c) [47.54, 52.46].
 - (d) [47.87, 52.13].
 - (e) [46.54, 53.45].

21. I took a sample of 24 Tempe one-bedroom apartments and found the average monthly rent was \$731 and the standard deviation was \$176.9. Based on this construct a confidence interval with a confidence coefficient of .95. Which interval below is correct?
- (a) [638.0, 824.0].
 - (b) [660.2, 801.8].
 - (c) [644.3, 792.1].
 - (d) [629.6, 832.4].
 - (e) [656.3, 805.7].
22. A sample of 15 recent business graduate had an average starting salary of \$51,317 with a standard deviation of \$7,127. What is the 99% confidence interval for the expected starting salary?
- (a) [44266, 57918].
 - (b) [45839, 56795].
 - (c) [48076, 54558].
 - (d) [46577, 56057].
 - (e) [47710, 54924].
23. The probability of a Type I error is represented by
- (a) α
 - (b) β
 - (c) c.c.
 - (d) t
 - (e) z
24. Conduct a test of the hypothesis that the average fill level of a 15.6 oz box of cereal is exactly 15.6 oz. In this case $H_0 : \mu = 15.6$. You have a sample of 45 boxes with an average fill level of 15.63 and you know from past test that the true standard deviation for the population is .11 oz. Conduct this test use $\alpha = .01$.
- (a) fail to reject H_0 , $z=1.83$.
 - (b) reject H_0 , $z=1.83$.
 - (c) fail to reject H_0 , $z=2.38$.
 - (d) reject H_0 , $z=2.38$.

25. Suppose that Swift trucking observes that load times are skewed as depicted here and that the average load time is 27 minutes. What is a reasonable estimate for the proportion of trucks that will take between 25-35 minutes to load?



- (a) .62.
(b) .50.
(c) .25.
(d) .33.
(e) .12.
26. A statistician working for the USDA in the GIPSA is investigating a claim that a particular hog auction is underpaying. Nationally the price for carcasses is normally distributed with an average of \$59.02 with a known standard deviation of \$.42. The statistician is looking for evidence of local farmers claims about the low prices and attends a series of 22 auctions where the average price is \$58.77. What can the statistician conclude?
- (a) fail to reject the null hypothesis that price are equal to the national average because the test statistic is not in the rejection region.

- (b) reject the null hypothesis that the prices are at or above the national level, there is strong evidence that local prices are lower with a p value $< .01$.
- (c) fail to reject the null hypothesis that prices are at or above the national level, the p value is around .26.
- (d) reject the null hypothesis that the prices are at or above the national level, there is evidence that local prices are lower with a p value around .05.
- (e) fail to reject the null hypothesis that prices are at or below the national level, the p value is around .26.

Key

1. a

2. d

3. c

4. a

5. c

6. d. Use the formula

$$\binom{20}{2} .15^2 (1 - .15)^{(20-2)} = .229.$$

7. c. Use the formula for the Poisson distribution,

$$P(X = x) = \frac{\mu^x e^{-\mu}}{x!} = \frac{30^3 e^{-30}}{30!} = .0726.$$

8. b. Use the formula for the Poisson distribution,

$$P(X = x) = \frac{\mu^x e^{-\mu}}{x!} = \frac{13^7 e^{-13}}{7!} = .0281.$$

9. b. Binomial.

10. e. $(.56)(350) = 196$.

11. a.

$$\frac{50 + 175}{2} = 112.5.$$

12. e.

$$1 - \frac{120 - 110}{126 - 110} = .375.$$

13. b.

$$1 - \frac{225 - 210}{250 - 210} = .625.$$

14. d.

$$P(X > 40 | \mu = 30) = e^{-40/30}.$$

15. e.

$$\frac{6150}{\sqrt{18}} = 1449.5.$$

16. b. Note that for $n > 1$, $s/\sqrt{n} < s$.

17. a.

18. d. Find the z value of

$$z = \frac{15.5 - 14.35}{3.7/\sqrt{40}} = 1.966.$$

Then go to the z table to find a probability of about .024.

19. c.

20. b. Find the margin of error

$$z \frac{\sigma}{\sqrt{n}} = 1.645 \frac{7}{\sqrt{31}} = 2.068.$$

Then 50 ± 2.068 gives approximately $[47.93, 52.07]$.

21. e. The population standard deviation is unknown so we use a t value to construct the interval,

$$731 \pm (2.069)(36.11) \implies [656.3, 805.7].$$

22. b. You should have found a t value of 2.977 and a standard error of 1840 which would give you an interval of $[45839, 56795]$.

23. a.

24. a. find the test statistic

$$z = \frac{15.63 - 15.6}{.11/\sqrt{45}} = 1.83$$

and $1.83 < 2.576$ so we fail to reject.

25. e. Based on the graph you should use the exponential distribution to estimate the proportion. Begin with the probability that the load time will be more than 25 minutes

$$e^{-25/27} = .396.$$

Then find the probability that the load time will more than 35 minutes,

$$e^{-35/27} = .2735.$$

Then the probability of a load time between 25 and 35 minutes is $.396 - .2735 = .12$ (about) which means we can estimate that .12 is the proportion of trucks that will take between 25 and 35 minutes to load.

26. b. $H_0 : \mu \geq 59.02$ is the correct null hypothesis since the USDA-GIPSA is looking for evidence that the prices low, i.e., that the auction is underpaying. The test statistic is $z = -2.792$ and this is a one-tail test with a p -value of around .0026 which you can find on the z table. This means the statistician will reject the null hypothesis.