LibreTexts

11.2: B - Mathematical Phrases, Symbols, and Formulas

English Phrases Written Mathematically

When the English says:	Interpret this as:
X is at least 4. The minimum of X is 4. X is no less than 4. X is greater than or equal to 4.	$X \geq 4$
X is at most 4. The maximum of X is 4. X is no more than 4. X is less than or equal to 4. X does not exceed 4.	$X \leq 4$
X is greater than 4. X is more than 4. X exceeds 4.	$X > 4$
X is less than 4.	$X < 4$
X is 4. X is equal to 4. X is the same as to 4.	$X = 4$
X is not 4. X is not equal to 4. X is not the same as 4. X is different than 4.	$X \neq 4$

Symbols and Their Meanings

Chapter (1st used)	Symbol	Spoken	Meaning
Sampling and Data	$\sqrt{}$	The square root of	same
Descriptive Statistics	Q_1	quartile one	the first quartile
Descriptive Statistics	Q_2	quartile two	the second quartile
Descriptive Statistics	Q_3	quartile three	the third quartile
Descriptive Statistics	IQR	interquartile range	$Q_3 - Q_1 = IQR$
Descriptive Statistics	$\overline{x}$	x-bar	sample mean
Descriptive Statistics	μ	mu	population mean
Descriptive Statistics	s	s	sample standard deviation
Descriptive Statistics	s^2	s squared	sample variance
Descriptive Statistics	σ	sigma	population standard deviation
Descriptive Statistics	σ^2	sigma squared	population variance
Descriptive Statistics	Σ	capital sigma	sum
Probability Topics	$\{\}$	brackets	set notation

Chapter (1st used)	Symbol	Spoken	Meaning
Probability Topics	S	S	sample space
Probability Topics	A	event A	event A
Probability Topics	$P(A)$	probability of A	probability of A occurring
Probability Topics	$P(A\|B)$	probability of A given B	probability of A occurring given B has occurred
Probability Topics	$P(A \cup B)$	probability of A or B	probability of A or B or both occurring
Probability Topics	$P(A \cap B)$	probability of A and B	probability of both A and B occurring (same time)
Probability Topics	A'	A-prime; complement of A	complement of A; not A
Probability Topics	$P(A')$	probability of the complement of A	same
Probability Topics	G_1	green on first pick	same
Probability Topics	$P(G_1)$	probability of green on first pick	same
The Normal Distribution	N	normal distribution	same
The Normal Distribution	z	z-score	same
The Normal Distribution	Z	standard normal distribution	same
The Central Limit Theorem	$\overline{x}$	x-bar	the random variable x-bar
The Central Limit Theorem	$\mu_{\overline{x}}$	mean of x-bars	the average of x-bars
The Central Limit Theorem	$\sigma_{\overline{x}}$	standard deviation of x-bars	same
Confidence Intervals	CL	confidence level	same
Confidence Intervals	CI	confidence interval	same
Confidence Intervals	EBM	error bound for a mean	same
Confidence Intervals	EBP	error bound for a proportion	same
Confidence Intervals	t	Student's t-distribution	same
Confidence Intervals	df	degrees of freedom	same
Confidence Intervals	$t_{\frac{\alpha}{2}}$	Student's t with $\alpha/2$ area in each tail	same
Confidence Intervals	P'	P-prime	sample proportion of success or interest
Hypothesis Testing	H_0	H-naught, H-sub-0	null hypothesis
Hypothesis Testing	H_a	H-a, H-sub a	alternative (or research) hypothesis
Hypothesis Testing	H_1	H-1, H-sub 1	alternative (or research) hypothesis
Hypothesis Testing	α	alpha	probability of Type I error
Hypothesis Testing	β	beta	probability of Type II error

Chapter (1st used)	Symbol	Spoken	Meaning
Hypothesis Testing	$\overline{x}_1 - \overline{x}_2$	x1-bar minus x2-bar	difference in sample means
Hypothesis Testing	$\mu_1 - \mu_2$	mu-1 minus mu-2	difference in population means
Hypothesis Testing	$P_1' - P_2'$	P1-prime minus P2-prime	difference in sample proportions
Hypothesis Testing	$P_1 - P_2$	P1 minus P2	difference in population proportions
Linear Regression and Correlation	$Y = a + bX$	Y equals a plus b-X	equation of a straight line
Linear Regression and Correlation	$\hat{Y}$	Y-hat	estimated value of Y
Linear Regression and Correlation	r	sample correlation coefficient	same
Linear Regression and Correlation	ε	error term for a regression line	same
Linear Regression and Correlation	SSE	Sum of Squared Errors	same
F-Distribution and ANOVA	F	F-ratio	F-ratio

Formulas

Symbols you must know		
Population		**Sample**
N	Size	n
μ	Mean	$\overline{x}$
σ^2	Variance	s^2
σ	Standard deviation	s
P	Proportion	P'
	Single data set formulae	
Population		**Sample**
$Q_3 = \frac{3(N+1)}{4}, Q_1 = \frac{(N+1)}{4}$	Inter-quartile range $IQR = Q_3 - Q_1$	$Q_3 = \frac{3(n+1)}{4}, Q_1 = \frac{(n+1)}{4}$
$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2$	Variance	$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2$
$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2 \cdot f_i$	Variance	$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2 \cdot f_i$

Basic probability rules	
$P(A \cap B) = P(A \mid B) \cdot P(B)$	Multiplication rule
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	Addition rule
$P(A \cap B) = P(A) \cdot P(B)$ or $P(A \mid B) = P(A)$	Independence test

The following formulae require the use of the z, t, or F tables.	
$z=\frac{x-\mu}{\sigma}$	z-transformation for normal distribution
Test statistics	**Confidence intervals** [bracketed symbols equal margin of error] (subscripts denote locations on respective distribution tables)
$z_{obs}=\frac{\bar{x}-\mu_0}{\frac{\sigma}{\sqrt{n}}}$	*Interval for the population mean when sigma is known* $\bar{x}\pm\left[z_{(\alpha/2)}\frac{\sigma}{\sqrt{n}}\right]$
$z_{obs}=\frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}}$	*Interval for the population mean when sigma is unknown and* $n>100$ $\bar{x}\pm\left[z_{(\alpha/2)}\frac{s}{\sqrt{n}}\right]$
$t_{obs}=\frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}}$	*Interval for the population mean when sigma is unknown and* $n<100$ $\bar{x}\pm\left[t_{(n-1),(\alpha/2)}\frac{s}{\sqrt{n}}\right]$
$z_{obs}=\frac{P'-P_0}{\sqrt{\frac{P_0(1-P_0)}{n}}}$	*Interval for the population proportion* $P'\pm\left[z_{(\alpha/2)}\sqrt{\frac{P'(1-P')}{n}}\right]$
$t_{obs}=\frac{\bar{x}_d-\mu_d}{\frac{s_d}{\sqrt{n}}}$	*Interval for difference between two means with matched pairs* $\bar{x}_d\pm\left[t_{(n-1),(\alpha/2)}\frac{s_d}{\sqrt{n}}\right]$ *where* s_d *is the deviation of the differences*
$z_{obs}=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$	*Interval for difference between two independent means when* $n>100$ $(\bar{x}_1-\bar{x}_2)\pm\left[z_{(\alpha/2)}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}\right]$
$z_{obs}=\frac{(\bar{x}_1-\bar{x}_2)-(\mu_1-\mu_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$	*Interval for difference between two independent means when* $n<100$ $(\bar{x}_1-\bar{x}_2)\pm\left[t_{(n_1+n_2-2),(\alpha/2)}\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}\right]$
	Interval for difference between two population proportions $(P_1'-P_2')\pm\left[z_{(\alpha/2)}\sqrt{\frac{P_1'(1-P_1')}{n_1}+\frac{P_2'(1-P_2')}{n_2}}\right]$

Simple linear regression formulae for $Y=a+b(X)$	
$r_{XY}=\frac{\sum(X_i-\overline{X})*(Y_i-\overline{Y})}{\sqrt{\sum(X_i-\overline{X})^2*\sum(Y_i-\overline{Y})^2}}$ $r_{XY}=\frac{\sum X_iY_i-\frac{(\sum X_i)(\sum Y_i)}{n}}{\sqrt{\left[\sum X_i^2-\frac{(\sum X_i)^2}{n}\right]*\left[\sum Y_i^2-\frac{(\sum Y_i)^2}{n}\right]}}$	Correlation coefficient

$$b_1=\frac{\Sigma(X_i-\overline{X})(Y_i-\overline{Y})}{\Sigma(X_i-\overline{X})^2}$$ $$b_1=\frac{\sum X_iY_i-\frac{(\sum X_i)(\sum Y_i)}{n}}{\sum X_i^2-\frac{(\sum X_i)^2}{n}}$$ $$b_1=r_{XY}\left(\frac{s_Y}{s_X}\right)$$	Coefficient b (or b_1, slope)
$$b_0=\overline{Y}-b_1\overline{X}$$	Y-intercept (a, or b_0)
$s_e^2=\frac{\Sigma\left(Y_i-\hat{Y}_i\right)^2}{n-k}=\frac{\sum_{i=1}^n e_i^2}{n-k}$	Estimate of the error variance
$s_b=\frac{s_e^2}{\sqrt{\left(X_i-\overline{X}\right)^2}}=\frac{s_e^2}{(n-1)s_X^2}$	Standard error for coefficient b
$t_{obs}=\frac{b-\beta_0}{s_b}$	Hypothesis test for coefficient β
$b\pm\left[t_{n-2,\alpha/2}s_b\right]$	Interval for coefficient β
$\hat{Y}\pm\left[t_{\alpha/2}*s_e\left(\sqrt{\frac{1}{n}+\frac{\left(X_p-\overline{X}\right)^2}{s_X}}\right)\right]$	Interval for expected value of Y
$\hat{Y}\pm\left[t_{\alpha/2}*s_e\left(\sqrt{1+\frac{1}{n}+\frac{\left(X_p-\overline{X}\right)^2}{s_X}}\right)\right]$	Prediction interval for an individual Y
ANOVA formulae	
$SS_R=n_1(\bar{x}_1-\bar{x})^2+\cdots+n_g(\bar{x}_g-\bar{x})^2$	Sum of squares regression
$SS_E=(n_1-1)s_1^2+\cdots+(n_g-1)s_g^2$	Sum of squares error
$SS_T=SS_R+SS_E$	Sum of squares total
$R^2=\frac{SS_R}{SS_T}$	Coefficient of determination

The following is the breakdown of a one-way ANOVA table for linear regression.				
Source of variation	Sum of squares	Degrees of freedom	Mean squares	F-ratio
Regression	$n_1(\bar{x}_1-\bar{x})^2+\cdots+n_g(\bar{x}_g-\bar{x})^2$	1 or $g-1$	$MSR=\frac{SS_R}{df_R}$	$F=\frac{MS_R}{MS_E}$

Error	$(n_1-1)\,s_1^2+\cdots+(n_g-1)\,s_g^2$	$n-g$	$MSE=\frac{SS_E}{df_E}$	
Total	SS_R+SS_E	$n-1$		