14.2: Appendix F | Mathematical Phrases, Symbols, and Formulas

English Phrases Written Mathematically

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

Table F1

Formulas

Formula 1: Factorial

n!=n(n−1)(n−2)...(1)n!=n(n−1)(n−2)...(1)" role="presentation" style="position: relative;">$n! = n(n-1)(n-2)\dots(1)$ $n! = n(n-1)(n-2)\dots(1)$

0!=10!=1" role="presentation" style="position: relative;">$0! = 10! = 1$

Formula 2: Combinations

(nr)=n!(n−r)!r!(nr)=n!(n−r)!r!" role="presentation" style="position: relative;">$\binom{n}{r} = \frac{n!}{(n-r)!r!}\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Formula 3: Binomial Distribution

X~B(n,p)X~B(n,p)" role="presentation" style="position: relative;">$X \sim B(n,p)X \sim B(n,p)$

P(X=x)=(nx)pxqn−xP(X=x)=(nx)pxqn−x" role="presentation" style="position: relative;">$P(X = x) = \binom{n}{x} p^x q^{n-x} P(X = x) = \binom{n}{x} p^x q^{n-x}$, for x=0,1,2,...,nx=0,1,2,...,n" role="presentation" style="position: relative;">$x = 0, 1, 2, \dots, n\ x = 0, 1, 2, \dots, n$

Formula 4: Geometric Distribution

X~G(p)X~G(p)" role="presentation" style="position: relative;">$X \sim G(p)X \sim G(p)$

P(X=x)=qx−1pP(X=x)=qx−1p" role="presentation" style="position: relative;">$P(X = x) = q^{x-1}pP(X = x) = q^{x-1}p$, for x=1,2,3,...x=1,2,3,..." role="presentation" style="position: relative;">$x = 1, 2, 3, \dots\ x = 1, 2, 3, \dots$

Formula 5: Hypergeometric Distribution

X~H(r,b,n)X~H(r,b,n)" role="presentation" style="position: relative;">$X \sim H(r,b,n)X \sim H(r,b,n)$

P(X=x)=((rx)(bn−x)(r+bn))P(X=x)=((rx)(bn−x)(r+bn))" role="presentation" style="position: relative;">$P(X = x) = \left(\frac{\binom{r}{x}\binom{b}{n-x}}{\binom{r+b}{n}}\right)P(X = x) = \left(\frac{\binom{r}{x}\binom{b}{n-x}}{\binom{r+b}{n}}\right)$

Formula 6: Poisson Distribution

X~P(μ)X~P(μ)" role="presentation" style="position: relative;">$X \sim P(\mu)X \sim P(\mu)$

P(X=x)=μxe−μx!P(X=x)=μxe−μx!" role="presentation" style="position: relative;">$P(X = x) = \frac{\mu^x e^{-\mu}}{x!}P(X = x) = \frac{\mu^x e^{-\mu}}{x!}$

Formula 7: Uniform Distribution

X~U(a,b)X~U(a,b)" role="presentation" style="position: relative;">$X \sim U(a,b) X \sim U(a,b)$

f(X)=1b−af(X)=1b−a" role="presentation" style="position: relative;">$f(X) = \frac{1}{b-a} f(X) = \frac{1}{b-a}$, a<x<ba<x<b" role="presentation" style="position: relative;">$a < x < b$ $a < x < b$

Formula 8: Exponential Distribution

X~Exp(m)X~Exp(m)" role="presentation" style="position: relative;">$X \sim Exp(m) X \sim Exp(m)$

f(x)=me−mxm>0,x≥0f(x)=me−mxm>0,x≥0" role="presentation" style="position: relative;">$f(x) = me^{-mx} m > 0, x \geq 0 f(x) = me^{-mx} m > 0, x \geq 0$

Formula 9: Normal Distribution

X~N(μ,σ2)X~N(μ,σ2)" role="presentation" style="position: relative;">$X \sim N(\mu, \sigma^2) X \sim N(\mu, \sigma^2)$

f(x)=1σ2πe−(x−μ)22σ2f(x)=1σ2πe−(x−μ)22σ2" role="presentation" style="position: relative;">$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}} f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$, –∞<x<∞−∞<x<∞" role="presentation" style="position: relative;">$-\infty < x < \infty$ $-\infty < x < \infty$

Formula 10: Student's *t*-distribution

X~tdfX~tdf" role="presentation" style="position: relative;">$X \sim t_{df} X \sim t_{df}$

f(x)=(1+x2n)−(n+1)2Γ(n+12)nπΓ(n2)f(x)=(1+x2n)−(n+1)2Γ(n+12)nπΓ(n2)" role="presentation" style="position: relative;">$f(x) = \frac{\left(1+\frac{x^2}{n}\right)^{\frac{-(n+1)}{2}} \Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi}\Gamma\left(\frac{n}{2}\right)}$

$f(x) = \frac{\left(1+\frac{x^2}{n}\right)^{\frac{-(n+1)}{2}} \Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi}\Gamma\left(\frac{n}{2}\right)}$

X=ZYnX=ZYn" role="presentation" style="position: relative;">$X = \frac{Z}{\sqrt{\frac{Y}{n}}} X = \frac{Z}{\sqrt{\frac{Y}{n}}}$

Z~N(0,1),Y~Χdf2Z~N(0,1),Y~Xdf2" role="presentation" style="position: relative;">$Z \sim N(0,1)$, $Y \sim X^2_{df} Z \sim N(0,1)$, $Y \sim X^2_{df}$, nn" role="presentation" style="position: relative;">nn = degrees of freedom

Formula 11: Chi-Square Distribution

X~Χdf2X~Xdf2" role="presentation" style="position: relative;">$X \sim X^2_{df} X \sim X^2_{df}$

f(x)=xn−22e−x22n2Γ(n2)f(x)=xn−22e−x22n2Γ(n2)" role="presentation" style="position: relative;">$f(x) = \frac{x^{\frac{n-2}{2}} e^{\frac{-x}{2}}}{2^{\frac{n}{2}}\Gamma\left(\frac{n}{2}\right)} f(x) = \frac{x^{\frac{n-2}{2}} e^{\frac{-x}{2}}}{2^{\frac{n}{2}}\Gamma\left(\frac{n}{2}\right)}$,

x>0x>0" role="presentation" style="position: relative;">$x > 0 x > 0$, nn" role="presentation" style="position: relative;">nn = positive integer and degrees of freedom

Formula 12: F Distribution

X~Fdf(n),df(d)X~Fdf(n),df(d)" role="presentation" style="position: relative;">$X \sim F_{df(n),df(d)} X \sim F_{df(n),df(d)}$

df(n)=df(n)=" role="presentation" style="position: relative;">$df(n) = df(n) =$ degrees of freedom for the numerator

df(d)=df(d)=" role="presentation" style="position: relative;">$df(d) = df(d) =$ degrees of freedom for the denominator

f(x)=Γ(u+v2)Γ(u2)Γ(v2)(uv)u2x(u2−1)[1+(uv)x−0.5(u+v)]f(x)=Γ(u+v2)Γ(u2)Γ(v2)(uv)u2x(u2−1)[1+(uv)x−0.5(u+v)]" role="presentation" style="position: relati

$f(x) = \frac{\Gamma(\frac{u+v}{2})}{\Gamma(\frac{u}{2})\Gamma(\frac{v}{2})} (\frac{u}{v})^{\frac{u}{2}} x^{(\frac{u}{2}-1)} [1 + (\frac{u}{v})x^{-0.5(u+v)}]$

X=YuWvX=YuWv" role="presentation" style="position: relative;">$X = \frac{Y_u}{W_v} X = \frac{Y_u}{W_v}$, YY" role="presentation" style="position: relative;">YY, WW" role="presentation" style="position: relative;">WW are chi-square

Symbols and Their Meanings

Chapter (1st used)	Symbol	Spoken	Meaning
Sampling and Data	" role="presentation" style="positi $\sqrt{}$	The square root of	same
Sampling and Data	ππ" role="presentation" style="position: relative;">π π	Pi	3.14159… (a specific number)
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	x¯" role="presentation" style="position: relative;">$\bar{x}$ $\bar{x}$	x-bar	sample mean
Descriptive Statistics	μμ" role="presentation" style="position: relative;">μ μ	mu	population mean
Descriptive Statistics	**s** s_x *sx*	s	sample standard deviation

Chapter (1st used)	Symbol	Spoken	Meaning
Descriptive Statistics	s2s2" role="presentation" style="position: relative;">s^2 s^2 sx2sx2" role="presentation" style="position: relative;">s_x^2 s_x^2	s squared	sample variance
Descriptive Statistics	σσ" role="presentation" style="position: relative;">σ σ σxσx" role="presentation" style="position: relative;">σ_x σ_x σx	sigma	population standard deviation
Descriptive Statistics	σ2σ2" role="presentation" style="position: relative;">σ^2 σ^2 σx2σx2" role="presentation" style="position: relative;">σ_x^2 σ_x^2	sigma squared	population variance
Descriptive Statistics	ΣΣ" role="presentation" style="position: relative;">Σ Σ	capital sigma	sum
Probability Topics	{}{}" role="presentation" style="position: relative;">{} {}	brackets	set notation
Probability Topics	SS" role="presentation" style="position: relative;">S S	S	sample space
Probability Topics	AA" role="presentation" style="position: relative;">A A	Event A	event A
Probability Topics	P(A)P(A)" role="presentation" style="position: relative;">$P(A)$ $P(A)$	probability of A	probability of A occurring
Probability Topics	P(A|B)P(A|B)" role="presentation" style="position: relative;">$P(A\|B)$ $P(A\|B)$	probability of A given B	prob. of A occurring given B has occurred
Probability Topics	P(A OR B)P(A OR B)" role="presentation" style="position: relative;">$P(A\ \mathrm{OR}\ B)$ $P(A\mathrm{OR}B)$	prob. of A or B	prob. of A or B or both occurring
Probability Topics	P(A AND B)P(A AND B)" role="presentation" style="position: relative;">$P(A\ \mathrm{AND}\ B)$ $P(A\mathrm{AND}B)$	prob. of A and B	prob. 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*′)	prob. of complement of A	same
Probability Topics	G_1	green on first pick	same
Probability Topics	$P(G_1)$	prob. of green on first pick	same
Discrete Random Variables	*PDF*	prob. distribution function	same
Discrete Random Variables	*X*	X	the random variable X
Discrete Random Variables	*X* ~	the distribution of X	same
Discrete Random Variables	*B*	binomial distribution	same
Discrete Random Variables	*G*	geometric distribution	same
Discrete Random Variables	*H*	hypergeometric dist.	same
Discrete Random Variables	*P*	Poisson dist.	same
Discrete Random Variables	λλ" role="presentation" style="position: relative;">λ λ	Lambda	average of Poisson distribution
Discrete Random Variables	≥≥" role="presentation" style="position: relative;">$\geq$ $\geq$	greater than or equal to	same
Discrete Random Variables	≤≤" role="presentation" style="position: relative;">$\leq$ $\leq$	less than or equal to	same
Discrete Random Variables	=	equal to	same
Discrete Random Variables	≠	not equal to	same
Continuous Random Variables	*f*(*x*)	*f* of *x*	function of *x*
Continuous Random Variables	*pdf*	prob. density function	same
Continuous Random Variables	*U*	uniform distribution	same
Continuous Random Variables	*Exp*	exponential distribution	same
Continuous Random Variables	*k*	*k*	critical value
Continuous Random Variables	*f*(*x*) =	*f* of *x* equals	same
Continuous Random Variables	*m*	*m*	decay rate (for exp. dist.)
The Normal Distribution	*N*	normal distribution	same
The Normal Distribution	*z*	*z*-score	same
The Normal Distribution	*Z*	standard normal dist.	same
The Central Limit Theorem	*CLT*	Central Limit Theorem	same

Chapter (1st used)	Symbol	Spoken	Meaning
The Central Limit Theorem	X¯X¯" role="presentation" style="position: relative;">$\overline{X}$ $\overline{X}$	*X*-bar	the random variable *X*-bar
The Central Limit Theorem	μxμx" role="presentation" style="position: relative;">μ_x μ_x	mean of *X*	the average of *X*
The Central Limit Theorem	μx¯μx¯" role="presentation" style="position: relative;">$\mu_{\bar{x}}$ $\mu_{\bar{x}}$	mean of *X*-bar	the average of *X*-bar
The Central Limit Theorem	σxσx" role="presentation" style="position: relative;">σ_x σ_x	standard deviation of *X*	same
The Central Limit Theorem	σx¯σx¯" role="presentation" style="position: relative;">$\sigma_{\bar{x}}$ $\sigma_{\bar{x}}$	standard deviation of *X*-bar	same
The Central Limit Theorem	ΣXΣX" role="presentation" style="position: relative;">ΣX ΣX	sum of *X*	same
The Central Limit Theorem	ΣxΣx" role="presentation" style="position: relative;">Σx Σx	sum of *x*	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	tα2tα2" role="presentation" style="position: relative;">$t_{\frac{\alpha}{2}}$ $t_{\frac{\alpha}{2}}$	student t with *a*/2 area in right tail	same
Confidence Intervals	p′p′" role="presentation" style="position: relative;">p' p'; p^p^" role="presentation" style="position: relative;">$\hat{p}$ $\hat{p}$	*p*-prime; *p*-hat	sample proportion of success
Confidence Intervals	q′q′" role="presentation" style="position: relative;">q' q'; q^q^" role="presentation" style="position: relative;">$\hat{q}$ $\hat{q}$	*q*-prime; *q*-hat	sample proportion of failure
Hypothesis Testing	H0H0" role="presentation" style="position: relative;">H_0 H_0	*H*-naught, *H*-sub 0	null hypothesis
Hypothesis Testing	HaHa" role="presentation" style="position: relative;">H_a H_a	*H*-*a*, *H*-sub *a*	alternate hypothesis
Hypothesis Testing	H1H1" role="presentation" style="position: relative;">H_1 H_1	*H*-1, *H*-sub 1	alternate hypothesis
Hypothesis Testing	αα" role="presentation" style="position: relative;">α α	alpha	probability of Type I error
Hypothesis Testing	ββ" role="presentation" style="position: relative;">β β	beta	probability of Type II error
Hypothesis Testing	X1¯−X2¯X1¯−X2¯" role="presentation" style="position: relative;">$\overline{X1} - \overline{X2}$ $\overline{X1} - \overline{X2}$	*X*1-bar minus *X*2-bar	difference in sample means
Hypothesis Testing	μ1−μ2μ1−μ2" role="presentation" style="position: relative;">$\mu_1 - \mu_2$ $\mu_1 - \mu_2$	*mu*-1 minus *mu*-2	difference in population means
Hypothesis Testing	P′1−P′2P′1−P′2" role="presentation" style="position: relative;">$P'_1 - P'_2$ $P'_1 - P'_2$	*P*1-prime minus *P*2-prime	difference in sample proportions
Hypothesis Testing	p1−p2p1−p2" role="presentation" style="position: relative;">$p_1 - p_2$ $p_1 - p_2$	*p*1 minus *p*2	difference in population proportions
Chi-Square Distribution	Χ2X2" role="presentation" style="position: relative;">X^2 X^2	Ky-square	Chi-square
Chi-Square Distribution	OO" role="presentation" style="position: relative;">O O	Observed	Observed frequency
Chi-Square Distribution	EE" role="presentation" style="position: relative;">E E	Expected	Expected frequency
Linear Regression and Correlation	*y* = *a* + *bx*	*y* equals a plus *b*-*x*	equation of a line
Linear Regression and Correlation	y^y^" role="presentation" style="position: relative;">$\hat{y}$ $\hat{y}$	*y*-hat	estimated value of *y*
Linear Regression and Correlation	rr" role="presentation" style="position: relative;">r r	correlation coefficient	same
Linear Regression and Correlation	εε" role="presentation" style="position: relative;">ε ε	error	same

Chapter (1st used)	Symbol	Spoken	Meaning
Linear Regression and Correlation	*SSE*	Sum of Squared Errors	same
Linear Regression and Correlation	1.9*s*	1.9 times *s*	cut-off value for outliers
F-Distribution and ANOVA	*F*	*F*-ratio	*F*-ratio

Table F2 Symbols and their Meanings