A Survey of Text Font Families

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In a TUGboat article twenty years ago, Berthold Horn [1] noted that there were over 14,000 fonts in Type 1 format but only a handful of TEX math fonts to accompany them. There are now considerably more choices of math fonts than there were then, and it seems appropriate to ask instead *where are the text fonts?* It's not that there are fewer than there were in the 1990's, but our typographic expectations are considerably higher than they used to be. Moreover, the appropriate count should be text font families rather than individual faces, and for most purposes, one should count only serifed font families, as those are the only serious candidates for the main text family where the output may include paper or pdf.

For LATEX usage, the current minimal standard for a text font family is, in my opinion:

(A) upright and italic shapes in both regular and bold weights (four styles);

(B) real (i.e., not faked by reducing capital letters) SMALL CAPS in upright regular weight;

(C) full set of common f-ligatures—`f_i`, `f_l`, `f_f`, `f_f_i`, `f_f_l` (fi, fl, ff, ffi, ffl) in each style;

(D) oldstyle figures 0123456789 in regular weight, upright shape.

Both Computer Modern and its modernized form Latin Modern (`lmodern`) meet these expectations, and more, but many fonts derived from legacy PostScript fonts do not. Most commonly, (C) fails, but (B) and/or (D) may also be lacking, and in some cases, (A) fails, usually because there is no ***Bold Italic***.

A more demanding user would likely raise the bar to the following stronger conditions:

(A′) upright and italic shapes in two weights (four styles) and preferably three weights (six styles) such as regular, semibold and bold;

(B′) real SMALL CAPS in all upright styles, and preferably in all styles;

(C′) full set of common f-ligatures—`f_i`, `f_l`, `f_f`, `f_f_i`, `f_f_l` (fi, fl, ff, ffi, ffl) in each style;

(D′) oldstyle figures 0123456789 in all styles.

(E′) other figure styles (e.g., proportional lining, tab oldstyle, superior) in at least upright regular style.

This article examines a number of font families, both free of cost and commercial, the latter mostly from the current Adobe Folio, seeking to tabulate the properties that matter to LATEX. (These also apply to XELATEX and LuaLATEX, but the focus of this article is LATEX packages.) Only fonts with serifs are considered, as that is overwhelmingly the most common main text font style except when intended for output to a low resolution screen, where sans serif, or perhaps a slab serif renders more clearly. In most cases, the fonts are in OpenType format, which may be used directly in LuaLaTeX or XeLaTeX, and which may be converted using utilities such

as `otfinst` or `autoinst` to PostScript font families with LaTeX support files. It seems that there are now close to thirty font families, many of them free, which come very close to satisfying conditions (A′)–(E′).

The fonts fall into two groups—those which are available at no cost for general use, and those which are not. Those in the first group are mostly available on CTAN, but may not be included in TeX Live because their licenses impose some sort of restriction that makes them not free in the strictest sense.

I don't have licenses for most of the commercial fonts listed below, and in those cases I've relied on information from the web site

`http://www.myfonts.com`

from which one may obtain glyph lists and other essential information about most commercial fonts. To search manually, go to the site and follow `Find Fonts -> Search`, and enter the font name, e.g., `Goudy Oldstyle`, which leads to a screen with broad matching to that name. If you select

```
Goudy Oldstyle
family of 5 fonts from Adobe
```

you reach a screen showing the five individual fonts. Press the first (Regular weight, upright shape) to see a selection of its glyphs. Press `Glyphs` to see the entire glyph catalog for that selection, from which you may determine that Regular weight, upright shape has oldstyle figures, small caps, only `f_i` and `f_l` ligatures, and a limited selection `{1,2,3}` of superior figures. (This is more or less typical for fonts derived from older PostScript fonts.) Examining the other variants establishes that they all have oldstyle figures, but none has small caps.

While in the screen showing all glyphs, click on a letter to bring up an enlarged image, which may be saved for further examination. The glyph images are drawn from anti-aliased `.gif` bitmaps which seem to have been made at the scale `1px=3em`, which is handy for estimating the vertical stem widths, which provides information about the relative weight of a font. The information provided in the tables below comes from these estimated values, values obtained from FontForge for fonts to which I own licenses, and from early PostScript versions of the fonts, to which I hold licenses.

1 Keys to font tables

In the tables below, the following abbreviations are used:

fLigs indicates the type of f-ligatures available: A indicates that all (fi, fl, ff, ffi, ffl) are available in all variants, 2 indicates that only the two basic ones (fi, fl) are provided;

Smc indicates availability of real small caps: A indicates all variants, R indicates only Regular weight, upright shape, RB indicates Regular and Bold weights, upright shape only, while blank indicates none;

VStemW indicates the vertical stem widths (in `em` units, which in most cases means `100em=1pt`) of each weight available in an upright shape—these provide one measure of the relative weights of fonts, though other factors such contrast (ratio of widest to narrowest stems) and side-bearings play a rôle as well;

OsF means, if A, that all variants have oldstyle figures available as the default text figures, R means only Regular weight, upright shape only, while blank means that none does;

OF means, if A, that other figures sets are available—eg, superior figures other than just {1,2,3}, or proportional figures other than oldstyle;

XH means xheight in `em` units;

CH means capheight in `em` units;

IA means italic angle—eg, -10 means slanted 10 degrees clockwise from vertical.

2 Text fonts available at no cost for general use

Name	Source	fLigs	Smc	VStemW	OsF	OF	XH	CH	IA	Notes
Latin Modern	public–GUST	A	A	89/144	A		431	683	-14	1, 3, 10.
mathpazo	public	A	R	96/141	R		459	689	-10	5, 10.
LinLibertine	public	A	A	85/123/140	A	A	431	647	-12	14.
garamondx	URW–AFPL	A	A	91/133	A		426	692	-16	2, 14.
Bonum	TeX Gyre	A	A	100/176	A	A	485	681	-10.3	4, 13.
Pagella	TeX Gyre	A	A	96/141	A	A	459	689	-10	5, 13, 19.
Schola	TeX Gyre	A	A	112/180	A	A	466	722	-15	6, 13.
Termes	TeX Gyre	A	A	102/162	A	A	450	662	-15.5	7, 13, 14.
kpfonts	public	A	A	73/89/117/135	A	A	441	670	-11	10, 20.
newpxtext	public	A	A	96/141	A	A	459	689	-10	5, 18, 19.
newtxtext	public	A	A	102/162	A		450	662	-15.5	7, 14.
pxfonts	public	A	RB	96/141	A		459	689	-10	5, 10, 13.
GFSArtemisia	public	A	R	85/132	A		470	692	-12	22.
GFSBodoni	public	A	R	84/117	A		476	705	-12	1, 24.
GFSDidot	public	A	R	100/140	A		456	689	-12	5, 23.
CharisSIL	SIL	A	A	102/145			488	679	-11	8, 11.
fourier	GUT	2		99/160			490	693	-13	9, 10, 12.
mathptmx	public	2	RB	102/162	A		450	662	-15.5	7, 10, 12, 13.
baskervald	arkandis	A		103/153/180			415	667	-16	15.
venturis	arkandis	A	A	84/139/178	A		432	643	-16	16.
kerkis	public	A	RB	99/117/174	RB		485	681	-10.3	4, 10.
antt	public	A	A	75/97/118/143	A	A	473	703	-9.5	17.
charter	mathdesign	2		102/145			488	679	-11	10, 21.
utopia	mathdesign	2		99/160			490	693	-13	10, 21.
garamond	mathdesign	2		91/133			426	692	-16	10, 21.

NOTES

1. High contrast (ratio of widest stems to narrowest).
2. Scale down about 5%.
3. Extension of Computer Modern.
4. Extension of URW version of Bookman.
5. Extension of URW version of Palatino.
6. Extension of URW version of New Century Schoolbook. This is the font to use for briefs to the SCOTUS. Package `fouriernc` pairs it with `fourier` math, should you wish to improve your case with mathematical arguments.
7. Extension of URW version of Times.
8. Extension of Bitstream Charter.
9. Extension of original Utopia, donated to TUG by Adobe. Can use expert fonts, if available (not free), for OsF and real small caps. (Venturis is another option.)
10. Text and math fonts included.
11. Not on CTAN. Download from `sil.org`. Lacks kerning tables.
12. Fake small caps.
13. Oldstyle figures available, but no option to make them the default text figures.
14. Can use `newtxmath` as math package.
15. Similar to Baskerville. The lack of SMALL CAPS and OsF is a drawback to serious LaTeX use. Math and tabular usage is problematic because the only figures provided are proportionally spaced.
16. Based on Utopia, but not as heavy. Full-featured. Can use `fourier` for math.
17. Antykwa Torunska text and math. Singular appearance. Call with `\usepackage[math]{anttor}`.
18. Resolves to Pagella, with added figures.
19. Can use `newpxmath` as math package.
20. Designs based originally on Palatino, but much modified to have a unique appearance.
21. Uses a variant of the mathdesign math fonts.
22. By default, uses `txfonts` for math.
23. The name is misleading as the Roman glyphs are based on URW's version of Palatino, which is old-style, not a Didone. Uses `pxfonts` for math.
24. By default, uses `CM` for math.

3 Commercial text fonts

Name	Source	fLigs	Smc	VStemW	OsF	OF	XH	CH	IA	Notes
ArnoPro	Adobe	A	A	61/84/124/142	A	A	398	618	-11	4.
BellMTStd	Adobe	A	R	84/105/137		A	410	644	-16	3.
BemboStd	Adobe	A	R	82/111/140/168	A	A	396	622	-11.5	4.
BerkeleyStd	Adobe	2		66/87/116			426	635	-8	2.
Berling	Adobe	2		88/126			447	709	-12	2.
BriosoPro	Adobe	A	A	57/78/86/108/131	A	A	405	622	-10	5.
CaeciliaLT	Adobe	2	A	55/86/113/147	A		516	699	-5	6.
Caslon224	Adobe	2		95/120/145/200			456	678	-13	2.
CaslonPro	Adobe	A	R	93/127/150	A	A	420	711	-22	
Caxton	Adobe	2		80/111/150			550	718	-21	2.
CentaurMTStd	Adobe	A	R	66/100	A	A	363	631	-13	7.
ChaparralPro	Adobe	A	A	55/80/120/172	A	A	420	650	-10	8.

DanteMTStd	Adobe	A	R	80/104/124	A	A	404	596	-9	9.
FairfieldStd	Adobe	2	R	80/111/150/201	A	A	418	678	-9	
FeniceStd	Adobe	2		72/108/182/252			508	692	-12	2.
GalliardStd	Adobe	2		88/132			442	680	-14	2.
GaramondPremierPro	Adobe	A	A	60/83/90/119/140	A	A	393	646	-18	
GoudyStd	Adobe	2	R	79/123/152/243	A		418	704	-7	10.
GuardiLTStd	Adobe	2		78/138/184			468	712	-12	2.
HiroshigeStd	Adobe	2		82/113/148/193			504	692	-9	2.
HorleyOldStyleMTStd	Adobe	2		66/85/106/142			419	705	-9	2.
JansonText	Adobe	2	R	100/157	A		440	711	-15	1.
JensonPro	Adobe	A	A	86/113/127	A	A	388	649	-8	4.
JoannaMTStd	Adobe	2	R	69/96/122/153			408	599	-3	11.
KeplerStd	Adobe	A	A	73/98/132/158/180	A	A	430	634	-13	12.
KinesisStd	Adobe	A	A	66/84/114/132	A	A	439	629	-6	13.
LeawoodStd	Adobe	2		86/134/183/207			554	709	-12	2.
LegacySerifStd	Adobe	2		79/105/141/183			422	635	-12	2.
LucidaOT	TUG	A	RB	104/150	A		530	723	-11.25	14.
MaiolaPro	Adobe	A	A	73/113	A	A	414	611	-11	4.
MeliorLTStd	Adobe	2		90/148			465	692	-12	2.
MendozaStd	Adobe	2		86/124/168			488	704	-9	2.
MeridienLTStd	Adobe	2		85/114/150			460	634	-12	2.
MinionPro	Adobe	A	A	85/116/134	A	A	437	650	-12	
MinsterStd	Adobe	2		87/121/167/228			456	722	-10	2.
NewAsterLTStd	Adobe	2		111/138/178/228			464	692	-16	2.
NewBaskervilleStd	Adobe	2	RB	105/152	A	A	427	660	-16	1, 20.
NewCaledoniaLTStd	Adobe	2	RB	100/129/169/220	A		422	664	-12	1.
NovareseStd	Adobe	2		64/99/149/218			460	640	-12	2, 15.
PerpetuaStd	Adobe	A	R	76/129	A	A	353	573	-12	16.
RockwellStd	Adobe	2		57/102/176/264			472	679	-13	2, 6.
RomicStd	Adobe	2		93/131/160/186			513	713	-13	2, 17.
SabonLTSd	Adobe	2	R	99/128	A		442	698	-12	
SouvenirStd	Adobe	2		92/148/183/239			473	732	-10	2.
StempelGaramond	Adobe	2	R	91/134	A		429	698	-16	18.
StempelSchneidlerStd	Adobe	2		50/68/96/151/184			450	715	-12	2.
StoneInformalStd	Adobe	2		96/140/212			500	700	-12	2.
StoneSerifStd	Adobe	2		97/140/211			500	700	-12	2.
TiepoloStd	Adobe	2		77/111/148			469	614	-9	2.
TiffanyStd	Adobe	2		114/149/295			449	715	-13	2.
TrumpMediaeval	Adobe	2	R	98/146	A		477	698	-12	
UsherwoodStd	Adobe	2		63/83/114/168			467	627	-12	2.
UtopiaStd	Adobe	A	RB	99/141/164/224	A	A	461	653	-13	19.
VeljovicStd	Adobe	2		77/110/150/204			452	626	-12	2.
VersaillesLTStd	Adobe	2		67/93/141/206			496	712	-12	2.
WarnockPro	Adobe	A	A	76/90/129/142	A	A	440	659	-15	
WeidemannStd	Adobe	2		69/97/129/160			507	711	-12	2.
WeissStd	Adobe	2		82/108			407	694	-8	2.

NOTES

1. High contrast (ratio of widest stems to narrowest).
2. No oldstyle figures or small caps.
3. No oldstyle figures.
4. Scale up by about 6%.
5. Too decorative for scientific text?
6. Slab serif, very geometric. Slides?
7. Limited small caps. Scale up 10–15%. Fine looking font.
8. Slab serif. Slides?
9. Limited small caps. Scale up 7%.
10. Goudy Oldstyle.
11. Very geometric.
12. Update of Utopia, even denser.
13. Slab serif with character
14. Scale down about 8%. Includes math fonts.
15. Upper case italic not slanted
16. Scale up by 15-18%.
17. Italic only in light.
18. Glyphs very similar to garamondx.
19. More extensive than Utopia in Fourier.
20. This text font is the basis for fonts used by the SMF (*Société Mathématique de France*) for its journals, the mathematical fonts deriving from Adobe Pi and a private release by Yannis Haralambous. See [2].

4 Personal views

Fonts without small caps in at least the upright shapes are severely lacking, as are those without a full set of common f-ligatures in each style. I think oldstyle figures make a real difference to the appearance of a document and should be available as the default text figures. These stylistic principles have a bearing on the assertions below.

Of the free fonts, I am most partial to LinLibertine, garamondx and mathpazo/newpx. LinLibertine and newpxtext (which is based on a slight modification of TeX Gyre Pagella) have the quantitative edge when scored by criteria (A′–E′), but I prefer the overall appearance of garamondx, even though I wish it were more generously spaced, in the manner of StempelGaramond. Mathpazo and newpx come with built-in math support, and matching math support for the first two are available as options to newtxmath. Garamondx may also be used with the mathdesign package using the garamond option.

Among the commercial fonts, there are some first-rate contenders. LucidaOT has the benefit of a math font designed from ground up to accompany the text font, and all at a very reasonable price. The "Pro" font families in the list comprise some of Adobe's most impressive offerings, some of them surely as close to technical perfection as font families can be. Those that are the most interesting to me—BriosoPro, WarnockPro, MaiolaPro—may lack the gravitas required of academic research papers and books, and GaramondPremierPro may now be so overused as to appear old hat. I find UtopiaStd and KeplerStd too plain and too cramped for comfortable reading. My favorites among the rest come down to BemboStd, CentaurMTStd and DanteMTStd which, despite their slight technical inadequacies, possess, so to speak, real character. There is much to be thankful for with the Adobe fonts that are not simply licensed from others. Unlike most foundries, their fonts have licenses that allow modifications.

Math fonts that are well-matched to the Adobe fonts are not so easy to find. The MinionPro package on CTAN provides a math package based on MnSymbol that is a good match to MinionPro, but which has some problematic features: (a) the symbols are on the small and light side—indeed, some are borrowed from Computer Modern; (b) math italic v and Greek small letter \nu are indistinguishable; (c) the scale is not adjustable; (d) the package is so cleverly constructed as to be quite difficult to modify. A number of Adobe text fonts may be adapted to the newtxmath package, with some amount of labor and skill required. The minion option to newtxmath provides one example of what can be done—the math italic and Greek symbols are taken from MinionPro text but other symbols are from newtxmath, the end result being a little heavier than MinionPro math. NewBaskervilleStd adapts well to newtxmath, but has some deficiencies—it lacks a full set of f-ligatures and has small caps only in upright shapes. Baskervald is not a good substitute for NewBaskervilleStd, having much heavier italics that don't match newtxmath well, among its other issues. It may be that Baskerville is the new black, so to speak. The recently issued (and very expensive) Baskerville 10 Pro has made quite a splash—for example, it is now the Metropolitan Opera's official font, replacing Garamond.

References

[1] Horn, Berthold. "Where Are the Math Fonts?" TUGboat **14**, 3 (1993), pp. 282–284.

[2] Haralambous, Yannis. "Une police mathématique pour la Société Mathématique de France : le SMF Baskerville" Cahiers GUTenberg **32**—actes du congrès GUT'99, Lyon, mai 1999.

Small samples from the free fonts

```
\usepackage[math]{anttor}
```

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3}\sum_i \left[\binom{n_1}{i}\binom{n_2}{n_3-n_1+i}\binom{n_3}{n_3-n_2+i}\right.\\
&\left.+\binom{n_1-1}{i}\binom{n_2-1}{n_3-n_1+i}\binom{n_3-1}{n_3-n_2+i}\right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H\in\mathcal{B}\subset\mathcal{A}} (-1)^{|\mathcal{B}|}t^{\dim T(\mathcal{B})}\\
&= \sum_{Y\in L''}\sum_{\mathcal{B}\in S(H,Y)} (-1)^{|\mathcal{B}|}t^{\dim Y}\\
&= \sum_{Y\in L''}\sum_{\mathcal{B}\in S(H,Y)} (-1)^{|\mathcal{B}-\mathcal{A}_H|}t^{\dim Y}\\
&= \sum_{Y\in L''} \mu(H,Y)t^{\dim Y}\\
&= \chi(\mathcal{A}'',t).
\end{aligned}
$$

```
\usepackage{baskervald}
\usepackage[sf]{libertine}
\usepackage[T1]{fontenc}
\usepackage[scaled=.84]{beramono}
\usepackage[lite]{mtpro2}% free version of mathtime pro 2
\usepackage[cal=boondoxo]{mathalfa}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3}\sum_i \left[\binom{n_1}{i}\binom{n_2}{n_3-n_1+i}\binom{n_3}{n_3-n_2+i}\right.\\
&\left.+\binom{n_1-1}{i}\binom{n_2-1}{n_3-n_1+i}\binom{n_3-1}{n_3-n_2+i}\right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H\in\mathscr{B}\subset\mathscr{A}} (-1)^{|\mathscr{B}|}t^{\dim T(\mathscr{B})}\\
&= \sum_{Y\in L''}\sum_{\mathscr{B}\in S(H,Y)} (-1)^{|\mathscr{B}|}t^{\dim Y}\\
&= \sum_{Y\in L''}\sum_{\mathscr{B}\in S(H,Y)} (-1)^{|\mathscr{B}-\mathscr{A}_H|}t^{\dim Y}\\
&= \sum_{Y\in L''} \mu(H,Y)t^{\dim Y}\\
&= \chi(\mathscr{A}'',t).
\end{aligned}
$$

`\usepackage{fourier}`

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$H_c = \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].$$

$$\begin{aligned} R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}-\mathscr{A}_H|} t^{\dim Y} \\ &= \sum_{Y \in L''} \mu(H,Y)\, t^{\dim Y} \\ &= \chi(\mathscr{A}'', t). \end{aligned}$$

`\usepackage{fouriernc}`

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$H_c = \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].$$

$$\begin{aligned} R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}-\mathscr{A}_H|} t^{\dim Y} \\ &= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\ &= \chi(\mathscr{A}'', t). \end{aligned}$$

```
\usepackage{gfsartemisia}
\usepackage[T1]{fontenc}
\usepackage[scaled=.84]{beramono}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathcal{B} \subset \mathcal{A}} (-1)^{|\mathcal{B}|} t^{\dim T(\mathcal{B})} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}-\mathcal{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathcal{A}'', t).
\end{aligned}
$$

```
\usepackage{gfsbodoni}
\usepackage[sf]{libertine}
\usepackage[T1]{fontenc}
\usepackage[scaled=.84]{beramono}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathcal{B} \subset \mathcal{A}} (-1)^{|\mathcal{B}|} t^{\dim T(\mathcal{B})} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}-\mathcal{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathcal{A}'', t).
\end{aligned}
$$

```
\usepackage{gfsdidot}
\usepackage[T1]{fontenc}
\usepackage[scaled=.84]{beramono}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R' &= \sum_{H \in \mathcal{B} \subset \mathcal{A}} (-1)^{|\mathcal{B}|} t^{\dim T(\mathcal{B})} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}-\mathcal{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathcal{A}'', t).
\end{aligned}
$$

```
\usepackage{kmath,kerkis}
\usepackage[T1]{fontenc}
\usepackage[scaled=.84]{beramono}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathcal{B} \subset \mathcal{A}} (-1)^{|\mathcal{B}|} t^{\dim T(\mathcal{B})} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}-\mathcal{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathcal{A}'', t).
\end{aligned}
$$

```
\usepackage{kpfonts}
\usepackage[cal=boondoxo]{mathalfa}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c = &\frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3}\sum_i\left[\binom{n_1}{i}\binom{n_2}{n_3-n_1+i}\binom{n_3}{n_3-n_2+i}\right.\\
&\left.+\binom{n_1-1}{i}\binom{n_2-1}{n_3-n_1+i}\binom{n_3-1}{n_3-n_2+i}\right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H\in\mathscr{B}\subset\mathscr{A}} (-1)^{|\mathscr{B}|}t^{\dim T(\mathscr{B})}\\
&= \sum_{Y\in L''}\sum_{\mathscr{B}\in S(H,Y)} (-1)^{|\mathscr{B}|}t^{\dim Y}\\
&= \sum_{Y\in L''}\sum_{\mathscr{B}\in S(H,Y)} (-1)^{|\mathscr{B}-\mathscr{A}_H|}t^{\dim Y}\\
&= \sum_{Y\in L''}\mu(H,Y)t^{\dim Y}\\
&= \chi(\mathscr{A}'',t).
\end{aligned}
$$

```
\usepackage{libertine}
\usepackage[T1]{fontenc}
\usepackage[scaled=.84]{beramono}
\usepackage[libertine]{newtxmath}
\usepackage[cal=boondoxo]{mathalfa}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c = &\frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3}\sum_i\left[\binom{n_1}{i}\binom{n_2}{n_3-n_1+i}\binom{n_3}{n_3-n_2+i}\right.\\
&\left.+\binom{n_1-1}{i}\binom{n_2-1}{n_3-n_1+i}\binom{n_3-1}{n_3-n_2+i}\right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H\in\mathscr{B}\subset\mathscr{A}} (-1)^{|\mathscr{B}|}t^{\dim T(\mathscr{B})}\\
&= \sum_{Y\in L''}\sum_{\mathscr{B}\in S(H,Y)} (-1)^{|\mathscr{B}|}t^{\dim Y}\\
&= \sum_{Y\in L''}\sum_{\mathscr{B}\in S(H,Y)} (-1)^{|\mathscr{B}-\mathscr{A}_H|}t^{\dim Y}\\
&= \sum_{Y\in L''}\mu(H,Y)t^{\dim Y}\\
&= \chi(\mathscr{A}'',t).
\end{aligned}
$$

```
\usepackage[sc]{mathpazo}
\usepackage[cal=boondoxo]{mathalfa}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\
&= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B} - \mathscr{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathscr{A}'', t).
\end{aligned}
$$

```
\usepackage{newpxtext,newpxmath}
```

Here is a short block of math taken from the file testmath.tex, distributed by the American Math. Society as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathcal{B} \subset \mathcal{A}} (-1)^{|\mathcal{B}|} t^{\dim T(\mathcal{B})} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathcal{B} \in S(H,Y)} (-1)^{|\mathcal{B} - \mathcal{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathcal{A}'', t).
\end{aligned}
$$

```
\usepackage{lmodern}
\usepackage{garamondx}
\usepackage[garamondx,cmbraces]{newtxmath}
\usepackage[cal=boondox]{mathalfa}
```

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\
&= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B} - \mathscr{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathscr{A}'', t).
\end{aligned}
$$

```
\usepackage[garamond]{mathdesign}
```

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$
\begin{aligned}
H_c =& \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} \right. \\
&\left. + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].
\end{aligned}
$$

$$
\begin{aligned}
R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\
&= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\
&= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B} - \mathscr{A}_H|} t^{\dim Y} \\
&= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\
&= \chi(\mathscr{A}'', t).
\end{aligned}
$$

`\usepackage[utopia]{mathdesign}`

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$H_c = \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].$$

$$\begin{aligned} R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B} - \mathscr{A}_H|} t^{\dim Y} \\ &= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\ &= \chi(\mathscr{A}'', t). \end{aligned}$$

`\usepackage[charter]{mathdesign}`

Here is a short block of math taken from the file testmath.tex, distributed by the AMERICAN MATH. SOCIETY as part of the *amsmath* package.

$$H_c = \frac{n_1!\,n_2!\,n_3!}{n_1+n_2+n_3} \sum_i \left[\binom{n_1}{i} \binom{n_2}{n_3-n_1+i} \binom{n_3}{n_3-n_2+i} + \binom{n_1-1}{i} \binom{n_2-1}{n_3-n_1+i} \binom{n_3-1}{n_3-n_2+i} \right].$$

$$\begin{aligned} R'' &= \sum_{H \in \mathscr{B} \subset \mathscr{A}} (-1)^{|\mathscr{B}|} t^{\dim T(\mathscr{B})} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B}|} t^{\dim Y} \\ &= \sum_{Y \in L''} \sum_{\mathscr{B} \in S(H,Y)} (-1)^{|\mathscr{B} - \mathscr{A}_H|} t^{\dim Y} \\ &= \sum_{Y \in L''} \mu(H,Y) t^{\dim Y} \\ &= \chi(\mathscr{A}'', t). \end{aligned}$$