LaTeX in Real-World Math Typesetting NFSS vs. NFNF

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- Text only—no problem, of course
- Math, including “heavy,” often required
- Not unusual to have a caption with

$$F(p,t) = \frac{1}{\sqrt{2\pi}} e^{-2\pi p(x-\omega t)}$$

or, even worse,

$$\boldsymbol{F(p,t) = \frac{1}{\sqrt{2\pi}} e^{-2\pi p(x-\omega t)}}$$

- Section titles, for example, may require a very different font style than the main text

The solid curves represent the estimated effects and the dotted curves show the corresponding 95% bootstrap intervals when the cross validated smoothing parameters $\boldsymbol{\lambda}_{cv} = (.0001,\ .01,\ 10)^T$ and $\boldsymbol{w}_0 = (1/N, \ldots, 1/N)$ are used. (a) The estimated PB mean OOW curve $\hat{\beta}_0(t;\ \boldsymbol{w}_0)$. (b) The estimated NB treatment effect $\hat{\beta}_1(t;\ \boldsymbol{w}_0)$. (c) The estimated baseline OOW effect $\hat{\beta}_2(t;\ \boldsymbol{w}_0)$.

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- Some more samples of another journal, normally set in Times; this time in Garamond Condensed, Optima, and Sabon …

Define the dualizing parameterization function:

$$\bar{f}_P(x,u) = f(x) + \delta_{R_-^{m_1}\times\{0_{m-m_1}\}}(G(x)+u) + \delta_X(x), \qquad x \in R^n,\ u \in R^m, \tag{3}$$

where 0_{m-m_1} is the origin of R^{m-m_1}, $G(x) = (g_1(x), \ldots, g_m(x))$, and δ_D is the indicator function of the set D, i.e.,

$$\delta_D(z) = \begin{cases} 0, & \text{if } z \in D, \\ +\infty, & \text{otherwise.} \end{cases}$$

Thus, a class of generalized augmented Lagrangians for (P) with the dualizing parameterization function $\bar{f}_P$ defined by (3) can be expressed as

$$l_P(x,y,r) = \inf\{\bar{f}_P(x,u) - \langle y,u\rangle + r\sigma(u) \colon u \in R^m\}, \tag{4}$$

where σ is a generalized augmenting function.

When $\sigma(u) = \frac{1}{2}\|u\|_2^2$, it follows from Example 11.57 in Rockafellar and Wets (1998) (setting $D = R_-^{m_1} \times 0_{m-m_1}$) that

$$l_P(x,y,r) = \begin{cases} f(x) + (r/2)\left[\sum_{j=1}^{m_1}(r^{-1}y_j + g_j(x))^{+2} - \sum_{j=1}^{m_1}(r^{-1}y_j)^2\right] \\ \quad + \sum_{j=m_1+1}^{m}\left\{y_j g_j(x) + (r/2)g_j^2(x)\right\}, & \text{if } x \in X, \\ +\infty, & \text{otherwise,} \end{cases}$$

which is just the augmented Lagrangian defined in formula (6.7) in Rockafellar (1993).

THEOREM 4.2. *Consider the constrained program* (P), *its generalized augmented Lagrangian dual problem* (D_A), *and its nonlinear Lagrangian dual problem* (D_N). *If the generalized augmenting function* σ *is continuous at* $0 \in R^m$ *and the increasing function* c *defining the nonlinear Lagrangian* L *is continuous, then the following two statements are equivalent*:

(i) $M_A = M_P$;

(ii) $M_N = M_P$.

4.2. Exact penalization. Now we apply Theorems 3.1 and 3.2 to the constrained program (P).

Let, for $u \in R^m$,

$$\bar{p}_1(u) = \inf\{f(x) \colon x \in X, g_j(x) \le u_j, j = 1, \ldots, m_1, g_j(x) = u_j, j = m_1+1, \ldots, m\},$$

and

$$p_1(u) = \inf\{\bar{f}_P(x,u) \colon x \in R^n\}, \qquad \forall u \in R^m,$$

where $\bar{f}_P(x,u)$ is defined by (3).

It is clear that $p_1(u) = \bar{p}_1(-u), \forall u \in R^m$.

PROOF. Let (P_γ) be as defined in Example 2.3. As noted in Example 2.3, problem (P_γ) is equivalent to problem (P) in the sense that the two problems have the same set of (local) solutions while the infimum of problem (P_γ) is exactly M_P^γ. Let l'_γ be defined as in Example 2.3.

Let

$$\theta_\gamma(x,r) = f^\gamma(x) + r\left[\sum_{j=1}^{m_1} g_j^{+\gamma}(x) + \sum_{j=m_1+1}^{m} |g_j(x)|^\gamma\right], \qquad x \in X,\ r > 0. \tag{43}$$

By Theorem 4.4, the following two statements are true:

(a) If there exists $\bar{r}' > 0$ such that whenever $r \ge \bar{r}'$, θ_γ is an exact penalty function for (P_γ) in the sense that

$$M_P^\gamma = \inf\{\theta_\gamma(x,r) \colon x \in X\} \tag{44}$$

and

$$\arg\min(P_\gamma) = \arg\min_x \theta_\gamma(x,r), \tag{45}$$

where $\arg\min(P_\gamma)$ is the set of optimal solutions of (P_γ), then there exist a constant $M_1 > 0$ and a neighborhood W of $0 \in R^m$ such that

$$\bar{p}_1^\gamma(u) \ge \bar{p}_1^\gamma(0) - M_1 \sum_{j=1}^{m} |u_j|^\gamma, \qquad \forall u \in W, \tag{46}$$

which is equivalent to the existence of a constant $M_2 > 0$ such that

$$\bar{p}_1(u) \ge \bar{p}_1(0) - M_2 \sum_{j=1}^{m} |u_j|^\gamma, \qquad \forall u \in W. \tag{47}$$

- … and more samples that show math styles for a basic serif font and a corresponding sans-serif font (of designer's choice?)—both regular and condensed

- … and more samples that show math styles for a basic serif font and a corresponding sans-serif font (of designer's choice?)—both regular and condensed
- For this sample, two such font pairs chosen:
  - Times and GillSans
  - Sabon and Helvetica

ROMAN Roman, SMALL CAPS, *italic*, **bold** **BOLD SMALL CAPS**, ***bold italic***.

$$\mathrm{rm} \cdot \mathbf{bf} \cdot \mathit{it} \cdot \boldsymbol{bi} \cdot a + b^c \oplus \boldsymbol{\alpha} + \mathbf{H} = 0 + T_{\mathrm{om}} + \mathbf{H}'$$

sf, *sfi*, `tt`, SCsc

BOLD Roman, SMALL CAPS, *italic*, bold BOLD SMALL CAPS, *bold italic*.

$$\boldsymbol{\mathrm{rm} \cdot \mathrm{bf} \cdot \mathit{it} \cdot bi \cdot a + b^c \oplus \alpha + \mathrm{H} = 0 + T_{\mathrm{om}} + \mathrm{H}'}$$

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sf, *sfi*, `tt`, SCsc

m1tii

	´0	´1	´2	´3	´4	´5	´6	´7	
´02x			F	J	P	T	U	V	″1x
´03x	W	Y	d	f	r	v	w	y	
´04x		†	‡	§	¶	℘	*v*	*w*	″2x
´05x	↼	↽	⇀	⇁	ʿ	ʾ	(	)	
´06x	.	,	:	;	(	)	[	]	″3x
´07x	{	}	.	,	<	/	>	⋆	
´10x		*A*	*B*	*C*	*D*	*E*	*F*	*G*	″4x
´11x	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*	
´12x	*P*	*Q*	*R*	*S*	*T*	*U*	*V*	*W*	″5x
´13x	*X*	*Y*	*Z*	♭	♮	♯	⌣	⌢	
´14x	ℓ	*a*	*b*	*c*	*d*	*e*	*f*	*g*	″6x
´15x	*h*	*i*	*j*	*k*	*l*	*m*	*n*	*o*	
´16x	*p*	*q*	*r*	*s*	*t*	*u*	*v*	*w*	″7x
´17x	*x*	*y*	*z*	*ı*	*ȷ*	ı	ȷ		

m1tii

´20x		α	β	γ	δ	ϵ	ζ	η	″8x
´21x	θ	ι	κ	λ	μ	ν	ξ	π	
´22x	ρ	σ	τ	υ	ϕ	χ	ψ	ω	″9x
´23x	ε	ϑ	ϖ	ϱ	ς	φ	ϰ	ƛ	
´24x	ϐ	∂	Γ	Δ	Θ	Λ	Ξ	Π	″Ax
´25x	Σ	ϒ	Φ	Ψ	Ω	Υ	ϴ	∇	
´30x		α	β	γ	δ	ϵ	ζ	η	″Cx
´31x	θ	ι	κ	λ	μ	ν	ξ	π	
´32x	ρ	σ	τ	υ	ϕ	χ	ψ	ω	″Dx
´33x	ε	ϑ	ϖ	ϱ	ς	φ	ϰ	ƛ	
´34x	ϐ	∂	Γ	Δ	Θ	Λ	Ξ	Π	″Ex
´35x	Σ	ϒ	Φ	Ψ	Ω	Υ	ϴ	∇	
	″8	″9	″A	″B	″C	″D	″E	″F	

m1tiw

	´0	´1	´2	´3	´4	´5	´6	´7	
´02x			**F**	**J**	**P**	**T**	**U**	**V**	″1x
´03x	**W**	**Y**	**d**	**f**	**r**	**v**	**w**	**y**	
´04x		†	‡	§	¶	℘	***v***	***w***	″2x
´05x	↼	↽	⇀	⇁	ʿ	ʾ	(	)	
´06x	.	,	:	;	(	)	[	]	″3x
´07x	{	}	.	,	<	/	>	⋆	
´10x		***A***	***B***	***C***	***D***	***E***	***F***	***G***	″4x
´11x	***H***	***I***	***J***	***K***	***L***	***M***	***N***	***O***	
´12x	***P***	***Q***	***R***	***S***	***T***	***U***	***V***	***W***	″5x
´13x	***X***	***Y***	***Z***	♭	♮	♯	⌣	⌢	
´14x	ℓ	***a***	***b***	***c***	***d***	***e***	***f***	***g***	″6x
´15x	***h***	***i***	***j***	***k***	***l***	***m***	***n***	***o***	
´16x	***p***	***q***	***r***	***s***	***t***	***u***	***v***	***w***	″7x
´17x	***x***	***y***	***z***	***ı***	***ȷ***	**ı**	**ȷ**		

m1tiw

´20x		α	β	γ	δ	ϵ	ζ	η	″8x
´21x	θ	ι	κ	λ	μ	ν	ξ	π	
´22x	ρ	σ	τ	υ	ϕ	χ	ψ	ω	″9x
´23x	ε	ϑ	ϖ	ϱ	ς	φ	ϰ	ƛ	
´24x	ϐ	∂	Γ	Δ	Θ	Λ	Ξ	Π	″Ax
´25x	Σ	ϒ	Φ	Ψ	Ω	Υ	ϴ	∇	
´30x		α	β	γ	δ	ϵ	ζ	η	″Cx
´31x	θ	ι	κ	λ	μ	ν	ξ	π	
´32x	ρ	σ	τ	υ	ϕ	χ	ψ	ω	″Dx
´33x	ε	ϑ	ϖ	ϱ	ς	φ	ϰ	ƛ	
´34x	ϐ	∂	Γ	Δ	Θ	Λ	Ξ	Π	″Ex
´35x	Σ	ϒ	Φ	Ψ	Ω	Υ	ϴ	∇	
	″8	″9	″A	″B	″C	″D	″E	″F	

- What to do to make such a font?
  - Adjust delimiters in the basic font; reencode into (in our case) TEXNANSI
  - Produce small caps fonts if not available
  - From a set of templates with various versions of Greek regarding “condensedness” and “boldness” find an appropriate match
  - Run a script to merge bits and pieces that should go into the M1-type font
- And now the hard part ...
  - Adjust sidebearings in italic characters (they control the position of subscripts)
  - Construct the companion “K1-font” whose right sidebearings are in positions that TeX math mode uses to set the next character

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  - Find somehow 4–8 hours of free time; make sure your mouse-bearing hand is properly relaxed and in the best possible shape; get down to work on kerning
  - In the first next window of opportunity (just and hour or so) run and carefully inspect the math accent test for the new font

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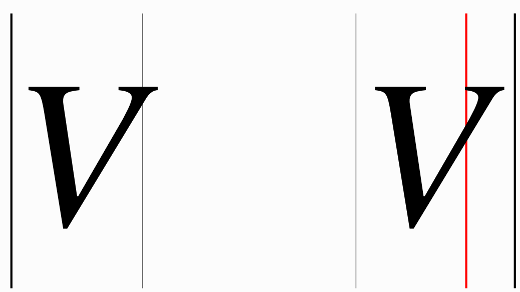

$$\bar{J}_{-50}\ \bar{J}_{-25}\ \bar{J}_{0}\ \bar{J}_{25}\ \bar{J}_{50}\ \bar{J}_{75}\ \bar{J}_{100}\ \bar{J}_{125}\ \bar{J}_{150}\ \bar{J}_{175}\ \bar{J}_{200}$$
$$\tilde{J}_{-50}\ \tilde{J}_{-25}\ \tilde{J}_{0}\ \tilde{J}_{25}\ \tilde{J}_{50}\ \tilde{J}_{75}\ \tilde{J}_{100}\ \tilde{J}_{125}\ \tilde{J}_{150}\ \tilde{J}_{175}\ \tilde{J}_{200}$$
$$\hat{J}_{-50}\ \hat{J}_{-25}\ \hat{J}_{0}\ \hat{J}_{25}\ \hat{J}_{50}\ \hat{J}_{75}\ \hat{J}_{100}\ \hat{J}_{125}\ \hat{J}_{150}\ \hat{J}_{175}\ \hat{J}_{200}$$
$$\dot{J}_{-50}\ \dot{J}_{-25}\ \dot{J}_{0}\ \dot{J}_{25}\ \dot{J}_{50}\ \dot{J}_{75}\ \dot{J}_{100}\ \dot{J}_{125}\ \dot{J}_{150}\ \dot{J}_{175}\ \dot{J}_{200}$$

$$\bar{f}_{-50}\ \bar{f}_{-25}\ \bar{f}_{0}\ \bar{f}_{25}\ \bar{f}_{50}\ \bar{f}_{75}\ \bar{f}_{100}\ \bar{f}_{125}\ \bar{f}_{150}\ \bar{f}_{175}\ \bar{f}_{200}$$
$$\tilde{f}_{-50}\ \tilde{f}_{-25}\ \tilde{f}_{0}\ \tilde{f}_{25}\ \tilde{f}_{50}\ \tilde{f}_{75}\ \tilde{f}_{100}\ \tilde{f}_{125}\ \tilde{f}_{150}\ \tilde{f}_{175}\ \tilde{f}_{200}$$
$$\hat{f}_{-50}\ \hat{f}_{-25}\ \hat{f}_{0}\ \hat{f}_{25}\ \hat{f}_{50}\ \hat{f}_{75}\ \hat{f}_{100}\ \hat{f}_{125}\ \hat{f}_{150}\ \hat{f}_{175}\ \hat{f}_{200}$$
$$\dot{f}_{-50}\ \dot{f}_{-25}\ \dot{f}_{0}\ \dot{f}_{25}\ \dot{f}_{50}\ \dot{f}_{75}\ \dot{f}_{100}\ \dot{f}_{125}\ \dot{f}_{150}\ \dot{f}_{175}\ \dot{f}_{200}$$

$$\bar{L}_{-50}\ \bar{L}_{-25}\ \bar{L}_{0}\ \bar{L}_{25}\ \bar{L}_{50}\ \bar{L}_{75}\ \bar{L}_{100}\ \bar{L}_{125}\ \bar{L}_{150}\ \bar{L}_{175}\ \bar{L}_{200}$$
$$\tilde{L}_{-50}\ \tilde{L}_{-25}\ \tilde{L}_{0}\ \tilde{L}_{25}\ \tilde{L}_{50}\ \tilde{L}_{75}\ \tilde{L}_{100}\ \tilde{L}_{125}\ \tilde{L}_{150}\ \tilde{L}_{175}\ \tilde{L}_{200}$$
$$\hat{L}_{-50}\ \hat{L}_{-25}\ \hat{L}_{0}\ \hat{L}_{25}\ \hat{L}_{50}\ \hat{L}_{75}\ \hat{L}_{100}\ \hat{L}_{125}\ \hat{L}_{150}\ \hat{L}_{175}\ \hat{L}_{200}$$
$$\dot{L}_{-50}\ \dot{L}_{-25}\ \dot{L}_{0}\ \dot{L}_{25}\ \dot{L}_{50}\ \dot{L}_{75}\ \dot{L}_{100}\ \dot{L}_{125}\ \dot{L}_{150}\ \dot{L}_{175}\ \dot{L}_{200}$$

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\DeclareMathSymbol{\SLalpha}{\mathord}{letters}{129}
\DeclareMathSymbol{\SLbeta}{\mathord}{letters}{130}
\DeclareMathSymbol{\SLGamma}{\mathord}{letters}{162}
\DeclareMathSymbol{\SLDelta}{\mathord}{letters}{163}
%
\DeclareMathSymbol{\UPalpha}{\mathord}{letters}{193}
\DeclareMathSymbol{\UPbeta}{\mathord}{letters}{194}
\DeclareMathSymbol{\UPGamma}{\mathord}{letters}{226}
\DeclareMathSymbol{\UPDelta}{\mathord}{letters}{227}
%
\DeclareMathSymbol{\BFSLalpha}{\mathord}{bletters}{129}
\DeclareMathSymbol{\BFSLbeta}{\mathord}{bletters}{130}
\DeclareMathSymbol{\BFSLGamma}{\mathord}{bletters}{162}
\DeclareMathSymbol{\BFSLDelta}{\mathord}{bletters}{163}
%
\DeclareMathSymbol{\BFUPalpha}{\mathord}{bletters}{193}
\DeclareMathSymbol{\BFUPbeta}{\mathord}{bletters}{194}
\DeclareMathSymbol{\BFUPGamma}{\mathord}{bletters}{226}
\DeclareMathSymbol{\BFUPDelta}{\mathord}{bletters}{227}
%
```

```
%
% Options for Greek:
% greeknls, greeknlu, greeknus, greeknuu
% greekbls, greekblu, greekbus, greekbuu
%
\if@greeknls
%%% Greek normal lowercase slanted = nls
  \let\alpha\SLalpha
  \let\beta\SLbeta
...
%%% Greek normal lowercase upright = nlu
  \let\alpha\UPalpha
  \let\beta\UPbeta
...
\if@greekbus
...
\else
%%% Greek bold uppercase upright = buu
  \let\BFGamma\BFUPGamma
  \let\BFDelta\BFUPDelta
```

m2-n101

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x		·	×	∗	÷	⋄	±	∓	″0x
´01x	⊕			⊘	⊙		∘	∙	
´02x	≍	≡	⊆	⊇	≤	≥	⪯	⪰	″1x
´03x	∼	≈	⊂	⊃	≪	≫	≺	≻	
´04x		→	↑	↓	↔	↗	↘	≃	″2x
´05x	⇐	⇒	⇑	⇓	⇔	↖	↙	∝	
´06x	′	∞	∈	∋	△	▽	/	ǀ	″3x
´07x	∀	∃	¬	∅	ℜ	ℑ	⊤	⊥	
´10x	ℵ	⌢	∘	+	=	→	▹	◃	″4x
´11x	=	;	`	´	ˇ	˘	¯	^	
´12x	˙	˜	¨	‾	[	]	:	!	″5x
´13x	∖	⌣	⌢	∪	∩	⊎	∧	∨	
´14x	⊢	⊣	⌊	⌋	⌈	⌉	{	}	″6x
´15x	⟨	⟩	∣	‖	↕	⇕	\	≀	
´16x	√	⨿	∇	∫	⊔	⊓	⊑	⊒	″7x
´17x	♧	∉	♤	∌	♣	♢	♡		

m2-n101

´20x		♠	√	−	←	⊖	⊗	◯	″8x
´21x	∞	(	)	[	]	{	}	⌊	
´22x	⌋	⌈	⌉	⟨	⟩	⟦	⟧	∣	″9x
´23x	‖	∅	·	·	·	·	∘	∘	
´24x	∘	•	•	●	●	●	●	∸	″Ax
´25x	⨬	⨫	∺	≐	⩦	→	⟶	⟶	
´26x	¯	¯	˙	¨	⃛	⃜	˜	˜	″Bx
´27x	˜	^	^	^	′	′	⋉	⋊	
´30x	⋈	◇	∼	⇝	⊏	⊐	⪝	⪞	″Cx
´31x	⋝	⋜	⩕	⊴	⊵	⋬	⋭	⋎	
´32x	⋏	⦵	⦶	⫝	⊛	⦶	⦸	⊚	″Dx
´33x	⧆	◫	⊡	⧄	⧅	⧇	⧈	□	
´34x	□	⋪	⋬	△	◁	⊴	▷	⊵	″Ex
´35x	≲	≳	≋	∅	⫫	≢	≭	≉	
´36x	⫇	⫈	∝	≍	∼	≈	≃	⫺	″Fx
´37x	⫹	↩	↪	≅					
	″8	″9	″A	″B	″C	″D	″E	″F	

$$\bar{V}, \bar{V}, \overline{V}, \overline{V}, \bar{P}, \bar{P}, \overline{P}, \overline{P},$$

$$\tilde{V}, \widetilde{V}, \widetilde{V}, \widetilde{V}, \tilde{P}, \widetilde{P}, \widetilde{P}, \widetilde{P},$$

$$|M^{t_2}_{H_1}| = |M^{t_2}_{H_1}|$$

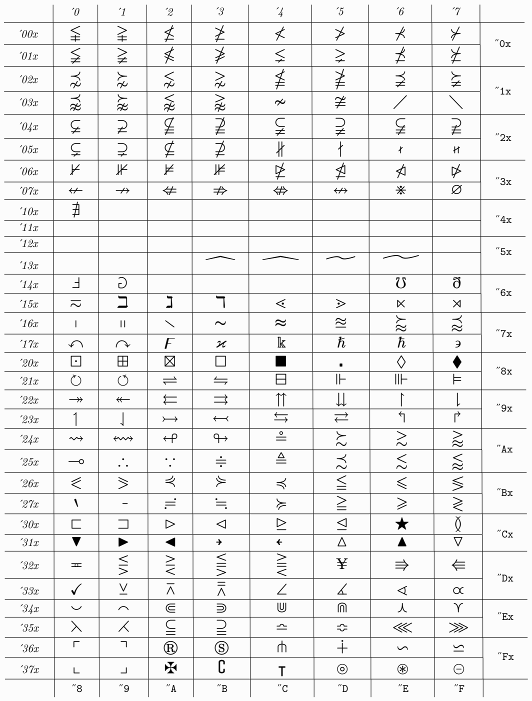
m4-101

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x		$\mathbb{A}$	$\mathbb{B}$	$\mathbb{C}$	$\mathbb{D}$	$\mathbb{E}$	$\mathbb{F}$	$\mathbb{G}$	˝0x
´01x	$\mathbb{H}$	$\mathbb{I}$	$\mathbb{J}$	$\mathbb{K}$	$\mathbb{L}$	$\mathbb{M}$	$\mathbb{N}$	$\mathbb{O}$	
´02x	$\mathbb{P}$	$\mathbb{Q}$	$\mathbb{R}$	$\mathbb{S}$	$\mathbb{T}$	$\mathbb{U}$	$\mathbb{V}$	$\mathbb{W}$	˝1x
´03x	$\mathbb{X}$	$\mathbb{Y}$	$\mathbb{Z}$	0	1	2	3	4	
´04x		$\mathfrak{A}$	$\mathfrak{B}$	$\mathfrak{C}$	$\mathfrak{D}$	$\mathfrak{E}$	$\mathfrak{F}$	$\mathfrak{G}$	˝2x
´05x	$\mathfrak{H}$	$\mathfrak{I}$	$\mathfrak{J}$	$\mathfrak{K}$	$\mathfrak{L}$	$\mathfrak{M}$	$\mathfrak{N}$	$\mathfrak{O}$	
´06x	$\mathfrak{P}$	$\mathfrak{Q}$	$\mathfrak{R}$	$\mathfrak{S}$	$\mathfrak{T}$	$\mathfrak{U}$	$\mathfrak{V}$	$\mathfrak{W}$	˝3x
´07x	$\mathfrak{X}$	$\mathfrak{Y}$	$\mathfrak{Z}$	5	6	7	8	9	
´10x	|	$\mathscr{A}$	$\mathscr{B}$	$\mathscr{C}$	$\mathscr{D}$	$\mathscr{E}$	$\mathscr{F}$	$\mathscr{G}$	˝4x
´11x	$\mathscr{H}$	$\mathscr{I}$	$\mathscr{J}$	$\mathscr{K}$	$\mathscr{L}$	$\mathscr{M}$	$\mathscr{N}$	$\mathscr{O}$	
´12x	$\mathscr{P}$	$\mathscr{Q}$	$\mathscr{R}$	$\mathscr{S}$	$\mathscr{T}$	$\mathscr{U}$	$\mathscr{V}$	$\mathscr{W}$	˝5x
´13x	$\mathscr{X}$	$\mathscr{Y}$	$\mathscr{Z}$						
´14x		a	b	c	d	e	f	g	˝6x
´15x	h	i	j	k	l	m	n	o	
´16x	p	q	r	s	t	u	v	w	˝7x
´17x	x	y	z						

m4-101

´20x		$\mathfrak{a}$	$\mathfrak{b}$	$\mathfrak{c}$	$\mathfrak{d}$	$\mathfrak{e}$	$\mathfrak{f}$	$\mathfrak{g}$	˝8x
´21x	$\mathfrak{h}$	$\mathfrak{i}$	$\mathfrak{j}$	$\mathfrak{k}$	$\mathfrak{l}$	$\mathfrak{m}$	$\mathfrak{n}$	$\mathfrak{o}$	
´22x	$\mathfrak{p}$	$\mathfrak{q}$	$\mathfrak{r}$	$\mathfrak{s}$	$\mathfrak{t}$	$\mathfrak{u}$	$\mathfrak{v}$	$\mathfrak{w}$	˝9x
´23x	$\mathfrak{x}$	$\mathfrak{y}$	$\mathfrak{z}$						
´24x		$\mathcal{A}$	$\mathcal{B}$	$\mathcal{C}$	$\mathcal{D}$	$\mathcal{E}$	$\mathcal{F}$	$\mathcal{G}$	˝Ax
´25x	$\mathcal{H}$	$\mathcal{I}$	$\mathcal{J}$	$\mathcal{K}$	$\mathcal{L}$	$\mathcal{M}$	$\mathcal{N}$	$\mathcal{O}$	
´26x	$\mathcal{P}$	$\mathcal{Q}$	$\mathcal{R}$	$\mathcal{S}$	$\mathcal{T}$	$\mathcal{U}$	$\mathcal{V}$	$\mathcal{W}$	˝Bx
´27x	$\mathcal{X}$	$\mathcal{Y}$	$\mathcal{Z}$						
´30x		$\boldsymbol{\mathcal{A}}$	$\boldsymbol{\mathcal{B}}$	$\boldsymbol{\mathcal{C}}$	$\boldsymbol{\mathcal{D}}$	$\boldsymbol{\mathcal{E}}$	$\boldsymbol{\mathcal{F}}$	$\boldsymbol{\mathcal{G}}$	˝Cx
´31x	$\boldsymbol{\mathcal{H}}$	$\boldsymbol{\mathcal{I}}$	$\boldsymbol{\mathcal{J}}$	$\boldsymbol{\mathcal{K}}$	$\boldsymbol{\mathcal{L}}$	$\boldsymbol{\mathcal{M}}$	$\boldsymbol{\mathcal{N}}$	$\boldsymbol{\mathcal{O}}$	
´32x	$\boldsymbol{\mathcal{P}}$	$\boldsymbol{\mathcal{Q}}$	$\boldsymbol{\mathcal{R}}$	$\boldsymbol{\mathcal{S}}$	$\boldsymbol{\mathcal{T}}$	$\boldsymbol{\mathcal{U}}$	$\boldsymbol{\mathcal{V}}$	$\boldsymbol{\mathcal{W}}$	˝Dx
´33x	$\boldsymbol{\mathcal{X}}$	$\boldsymbol{\mathcal{Y}}$	$\boldsymbol{\mathcal{Z}}$						
´34x		$\mathbb{A}$	$\mathbb{B}$	$\mathbb{C}$	$\mathbb{D}$	$\mathbb{E}$	$\mathbb{F}$	$\mathbb{G}$	˝Ex
´35x	$\mathbb{H}$	$\mathbb{I}$	$\mathbb{J}$	$\mathbb{K}$	$\mathbb{L}$	$\mathbb{M}$	$\mathbb{N}$	$\mathbb{O}$	
´36x	$\mathbb{P}$	$\mathbb{Q}$	$\mathbb{R}$	$\mathbb{S}$	$\mathbb{T}$	$\mathbb{U}$	$\mathbb{V}$	$\mathbb{W}$	˝Fx
´37x	$\mathbb{X}$	$\mathbb{Y}$	$\mathbb{Z}$						
	˝8	˝9	˝A	˝B	˝C	˝D	˝E	˝F	

m5-n101



```
%% THIS FONT MUST BE HERE!!! It is for special purposes and needs low-level
%% TeX character coding
\DeclareSymbolFont{extraa}{U}{extra}{m}{n}%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

\DeclareSymbolFont{operators}{LY1}{tir}{m}{n}%    redeclare!
\DeclareSymbolFont{letters}{LM1}{mjm}{m}{it}%     redeclare!
\DeclareSymbolFont{symbols}{LM2}{mjm}{m}{n}%      redeclare!
\DeclareSymbolFont{largesymbols}{MY3}{mjm}{m}{n}% redeclare!
\DeclareSymbolFont{boperators}{LY1}{tir}{b}{n}%   mathfam "boperators" LY1
\DeclareSymbolFont{bletters}{LM1}{mjm}{b}{it}%    mathfam "bletters" LM1b
\DeclareSymbolFont{bsymbols}{LM2}{mjm}{b}{n}%     mathfam "bsymbols" LM2b
\DeclareSymbolFont{bbbcal}{U}{mjmd}{m}{n}%        mathfam "bbbcal"   LM4
\DeclareSymbolFont{symii}{U}{mjme}{m}{n}%         mathfam "symii"    LM5n
%%%\DeclareSymbolFont{bfsymii}{U}{mjme}{b}{n}%    mathfam "bfsymii"  LM5b
\DeclareSymbolFont{sfoperators}{LY1}{hel}{m}{n}%  mathfam "sfoperators" LY1
\DeclareSymbolFont{bsfoperators}{LY1}{hel}{b}{n}% mathfam "bsfoperators" LY1
```

```
% Defaults for undeclared math sizes - to be used only exceptionally
\def\defaultscriptratio{.65}%%%{.76}
\def\defaultscriptscriptratio{.5}%%%{.6}
%
% MJ version of math sizes (add more if necessary)
\def\MJMathSizes{\def\@vpt{5}\def\@vipt{6}\def\@viipt{7}\def\@viiipt{8}%
 \def\@ixpt{9}\def\@xpt{10}\def\@xipt{11}\def\@xiipt{12}\def\@xivpt{14}%
 \def\@xviipt{17}\def\@xxpt{20}\def\@xxvpt{25}%
 \DeclareMathSizes{6.0}{6.0}{5.0}{5.0}%
 \DeclareMathSizes{7.0}{7.0}{5.0}{5.0}%
 \DeclareMathSizes{8.0}{8.0}{5.0}{5.0}%
 \DeclareMathSizes{9.0}{9.0}{6.0}{5.0}%
 \DeclareMathSizes{10.0}{10.0}{6.5}{5.0}%
 \DeclareMathSizes{11.0}{11.0}{7.0}{6.0}%
 \DeclareMathSizes{12.0}{12.0}{8.0}{6.0}%
 \DeclareMathSizes{24.0}{24.0}{16.0}{12.0}%
}
%
```

```
%
\DeclareRobustCommand\HELB{%
  \mathversion{normal}%
  \let\rm=\SFbf
  \let\it=\SFbi
  \let\bf=\SFbf
  \let\bi=\SFbi
  \sffamily\bfseries\upshape\selectfont}
%
\DeclareRobustCommand\HC{%
  \mathversion{mhc}%
  \let\rm=\SFCrm
  \let\it=\SFCit
  \let\bf=\SFCbf
  \let\bi=\SFCbi
  \let\sc=\SFCrmsc
  \fontfamily{helc}\mdseries\upshape\selectfont
}
%
\DeclareRobustCommand\HCB{%
  \mhcmath
  \let\rm=\SFCbf
  \let\it=\SFCbi
  \let\bf=\SFCbf
  \let\bi=\SFCbi
  \let\sc=\SFCbfsc
  \fontfamily{helc}\bfseries\upshape\selectfont}
%
```

```
\def\SerifItalicPunct{%
\mathcode`\.="0411\mathcode`\,="0412\mathcode`\:="0413\mathcode`\;="0414
\mathcode`(="4415\mathcode`)="5416\mathcode`[="4417\mathcode`]="5418
\def\lbrace{\delimiter"4419308 }\let\{=\lbrace
\def\rbrace{\delimiter"541A309 }\let\}=\rbrace
\mathcode`\!="541B\mathcode`\?="541C\mathcode`\*="241D\mathcode`\+="241E
\mathcode`\-="241F
\delcode`(="415300\delcode`)="416301
\delcode`[="417302\delcode`]="418303
}
%
\def\SerifBoldItalicPunct{%
\mathcode`\.="0421\mathcode`\,="0422\mathcode`\:="0423\mathcode`\;="0424
\mathcode`(="4425\mathcode`)="5426\mathcode`[="4427\mathcode`]="5428
\def\lbrace{\delimiter"4429308 }\let\{=\lbrace
\def\rbrace{\delimiter"542A309 }\let\}=\rbrace
\mathcode`\!="542B\mathcode`\?="542C\mathcode`\*="242D\mathcode`\+="242E
\mathcode`\-="242F
\delcode`(="425300\delcode`)="426301
\delcode`[="427302\delcode`]="428303
}
%
\def\SansSerifItalicPunct{%
\mathcode`\.="0431\mathcode`\,="0432\mathcode`\:="0433\mathcode`\;="0434
```

- There is a twist in the usual style for theorem-like environments: Digits, delimiters and “tall” punctuation should be upright . . .
- *... as in case (assuming* $(a, b) \neq (c, d)$*) when ...*
- So, along with “it” we have “thit” . . .
- Again, relax your arm, . . . *(*you want it to look right, don’t you*)*?

jmtii

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x					/	˙	˝	˛	˝0x
´01x	ﬂ				ﬁ				
´02x	ı		`	´	ˇ	˘	¯	˚	˝1x
´03x	¸	ß	æ	œ	ø	Æ	Œ	Ø	
´04x		!	"	#	$	%	&	’	˝2x
´05x	(	)	*	+	,	-	.	/	
´06x	0	1	2	3	4	5	6	7	˝3x
´07x	8	9	:	;	<	=	>	?	
´10x	@	A	B	C	D	E	F	G	˝4x
´11x	H	I	J	K	L	M	N	O	
´12x	P	Q	R	S	T	U	V	W	˝5x
´13x	X	Y	Z	[	\	]	ˆ	_	
´14x	‘	a	b	c	d	e	f	g	˝6x
´15x	h	i	j	k	l	m	n	o	
´16x	p	q	r	s	t	u	v	w	˝7x
´17x	x	y	z	{	|	}	˜	¨	

jmtiih

	´0	´1	´2	´3	´4	´5	´6	´7	
´00x					/	˙	˝	˛	˝0x
´01x	ﬂ				ﬁ				
´02x	ı		`	´	ˇ	˘	¯	˚	˝1x
´03x	¸	ß	æ	œ	ø	Æ	Œ	Ø	
´04x		!	"	#	$	%	&	’	˝2x
´05x	(	)	*	+	,	-	.	/	
´06x	0	1	2	3	4	5	6	7	˝3x
´07x	8	9	:	;	<	=	>	?	
´10x	@	A	B	C	D	E	F	G	˝4x
´11x	H	I	J	K	L	M	N	O	
´12x	P	Q	R	S	T	U	V	W	˝5x
´13x	X	Y	Z	[	\	]	ˆ	_	
´14x	‘	a	b	c	d	e	f	g	˝6x
´15x	h	i	j	k	l	m	n	o	
´16x	p	q	r	s	t	u	v	w	˝7x
´17x	x	y	z	{	|	}	˜	¨	

resources in the firm's environment (Pfeffer 1972, Pfeffer and Salancik 1978).

The latter role is particularly important

The latter role is particularly important

The latter role is particularly important

[redacted]

to entrepreneurial firms (Daily and Dalton 1992, 1993) for which establishing ties with other entities in their environment is typically more difficult than for estab-

Proposition 7. *When the quality of directors' information is low (i.e., α is close to 1/2),*[7] *directors' reputations do not affect the equilibrium. In the model with reputable directors, if $I/A \geq \beta$, $R \geq \underline{W}(0)$, and $R \geq r$, a separating equilibrium exists. In this equilibrium: (i) good new ventures hire directors and pay them wage of $W^* = r$, (ii) bad new ventures do not hire directors, and (iii) stakeholders sign on only with good new ventures.*

Straightforward comparative static analysis of the equilibrium conditions reveals that

$$dP^*/dr = 1/[1+\underline{W}'(P^*)] \geq 0 \quad \textbf{and}$$

$$dW^*/dr = \underline{W}'(P^*)/[1+W'(P^*)] \geq 0,$$

where $\underline{W}'(P^*) = d\underline{W}(P^*)/dP^*$. Therefore, as the profitability of bad firms approaches that of good ones, good firms must employ directors with higher reputations and pay them more.

ISAAC NEWTON

THE *PRINCIPIA*

Mathematical Principles of Natural Philosophy

A New Translation
by I. Bernard Cohen and Anne Whitman
assisted by Julia Budenz

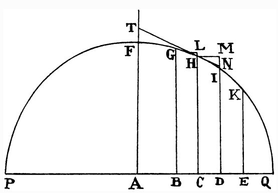
Preceded by

A GUIDE TO NEWTON'S *PRINCIPIA*
by I. Bernard Cohen

Our translation	*Tait's version*
For if the action of an agent is reckoned by its force and velocity jointly, and if, similarly, the reaction of a resistant is reckoned jointly by the velocities of its individual parts and the forces of resistance arising from their friction, cohesion, weight, and acceleration, the action and reaction will always be equal to each other in all examples of using devices or machines.	Work done on any system of bodies has its equivalent in the form of work done against friction, molecular forces or gravity, if there be no acceleration; but if there be acceleration, part of the work is expended in overcoming resistance to acceleration, and the additional kinetic energy developed is equivalent to the work so spent.

It is certainly true that Newton's "force and velocity jointly" can be translated out of context into its post-Newtonian equivalent of "rate of doing work" since $F\frac{ds}{dt} = \frac{d(F \times s)}{dt}$ for constant F. Nevertheless, the concept of work as a useful physical entity for rational mechanics was developed only long after the *Principia* was published, and the reckoning of "action" by "force and velocity jointly" is

Now for the abscissas CB, CD, and CE write $-o$, o, and $2o$. For the ordinate CH write P, and for MI write any series $Qo + Ro^2 + So^3 + \cdots$. And all the terms of the series after the first, namely $Ro^2 + So^3 + \cdots$, will be NI, and the ordinates DI, EK, and BG will be $P - Qo - Ro^2 - So^3 - \cdots$, $P - 2Qo - 4Ro^2 - 8So^3 - \cdots$, and $P + Qo - Ro^2 + So^3 - \cdots$ respectively. And by squaring the differences of the ordinates BG − CH and CH − DI and by adding to the resulting squares the squares of BC and CD, there will result the squares of the arcs GH and HI: $o^2 + Q^2o^2 - 2QRo^3 + \cdots$ and $o^2 + Q^2o^2 + 2QRo^3 + \cdots$. The roots of these, $o\sqrt{(1+Q^2)} - \frac{QRo^2}{\sqrt{(1+Q^2)}}$ and $o\sqrt{(1+Q^2)} + \frac{QRo^2}{\sqrt{(1+Q^2)}}$, are the arcs GH and HI. Furthermore, if from ordinate CH half the sum of ordinates BG and DI is subtracted, and from ordinate DI half the sum of ordinates CH and EK is subtracted, the remainders will be the sagittas Ro^2 and $Ro^2 + 3So^3$ of arcs GI and HK. And these are proportional to the line-elements LH and NI, and thus as the squares of the infinitely small times T and t; and hence the ratio $\frac{t}{T}$ is $\frac{R + 3So}{R}$ or $\frac{R + \frac{3}{2}So}{R}$; and if the values just found of $\frac{t}{T}$, GH, HI, MI, and NI are substituted in $\frac{t \times GH}{T} - HI + \frac{2MI \times NI}{HI}$, the result will be $\frac{3So^2}{2R}\sqrt{(1+Q^2)}$. And since 2NI is $2Ro^2$, the resistance will now be to the gravity as $\frac{3So^2}{2R}\sqrt{(1+Q^2)}$ to $2Ro^2$, that is, as $3S\sqrt{(1+Q^2)}$ to $4R^2$.



And the velocity is that with which a body going forth from any place

$7^h 39^m$ mean [*lit.* equated] time. And the places calculated from Flamsteed's observations and compared with the places calculated by the theory are shown in the following table.

1682 Apparent time	*Place of the sun*	*Calculated longitude of the comet*	*Calculated latitude north*	*Observed longitude of the comet*	*Observed latitude north*	*Difference in longitude*	*Difference in latitude*
d h m	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	′ ″	′ ″
Aug. 19 16 38	♍ 7 0 7	♌ 18 14 28	25 50 7	♌ 18 14 40	25 49 55	−0 12	+0 12
20 15 38	7 55 52	24 46 23	26 14 42	24 46 22	26 12 52	+0 1	+1 50
21 8 21	8 36 14	29 37 15	26 20 3	29 38 2	26 17 37	−0 47	+2 26
22 8 8	9 33 55	♍ 6 29 53	26 8 42	♍ 6 30 3	26 7 12	−0 10	+1 30
29 8 20	16 22 40	♎ 12 37 54	18 37 47	♎ 12 37 49	18 34 5	+0 5	+3 42
30 7 45	17 19 41	15 36 1	17 26 43	15 35 18	17 27 17	+0 43	−0 34
Sept. 1 7 33	19 16 9	20 30 53	15 13 0	20 27 4	15 9 49	+3 49	+3 11
4 7 22	22 11 28	25 42 0	12 23 48	25 40 58	12 22 0	+1 2	+1 48
5 7 32	23 10 29	27 0 46	11 33 8	26 59 24	11 33 51	+1 22	−0 43
8 7 16	26 5 58	29 58 44	9 26 46	29 58 45	9 26 43	−0 1	+0 3
9 7 26	27 5 9	♏ 0 44 10	8 49 10	♏ 0 44 4	8 48 25	+0 6	+0 45

we get

$$k\Delta u = -k\frac{\delta}{\delta\xi}\{\Delta D\}$$
$$= -k\frac{\delta}{\delta\xi}\left\{\tfrac{5}{3}P^3 A\frac{\delta^2\frac{1}{\rho}}{\delta\xi^2} + \tfrac{5}{3}P^3 B\frac{\delta^2\frac{1}{\rho}}{\delta\eta^2} + \cdots\right\}.$$

---

and, in accordance with this,

$$V = c\,\frac{\delta^2\rho}{\delta\xi^3} + b\frac{\delta^2\frac{1}{\rho}}{\delta\xi^2} + \frac{a}{2}\left[\xi^2 - \frac{\eta^2}{2} - \frac{\zeta^2}{2}\right]$$ [3]

and

$$u' = -2c\frac{\delta\frac{1}{\delta}}{\delta\xi}, \quad v' = 0, \quad w' = 0,$$ [4]

then the constants a, b, c can be determined such that $u = v = w = 0$ for $\rho = P$. By superposing three such solutions, we get the solution given in equations (5) and (5a).

α is then to be considered as the angle between the velocities v and w. After a simple calculation we obtain

$$U = \frac{\sqrt{(v^2 + w^2 + 2vw\cos\alpha) - \left(\frac{vw\sin\alpha}{V}\right)^2}}{1 + \frac{vw\cos\alpha}{V^2}}.$$

It is worth noting that v and w enter into the expression for the resultant velocity in a symmetrical manner. If w also has the direction of the X-axis (Ξ-axis), we get

$$U = \frac{v + w}{1 + \frac{vw}{V^2}}.$$

$\int \epsilon X dx$. Since the electron is supposed to accelerate slowly, and consequently cannot emit any energy in the form of radiation, the energy taken from the electrostatic field must be equated to the kinetic energy W of the electron. Bearing in mind that the first of equations (A) holds throughout the entire process of motion, we obtain

$$W = \int \epsilon X\,dx = \int_0^v \beta^3 v\,dv = \mu V^2\left\{\frac{1}{\sqrt{1 - \left(\frac{v}{V}\right)^2}} - 1\right\}.$$

Thus, W becomes infinitely large when $v = V$. As is the case for our previous results, superluminal velocities are not possible.