Academic Presentations

A LaTeX Template Using the `beamer` Class

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Name of the Inviting Institution/Seminar Series

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Outline

Introduction

Introduction 1: Choice of a Reasonable Aspect Ratio

When preparing a presentation, we often do not know whether the native aspect ratio of the projector in the seminar room/lecture hall will be 4 : 3 or 16 : 9 (or 16 : 10).

In this case, it may be a good idea to choose an **intermediate aspect ratio**, see https://github.com/josephwright/beamer/issues/497. The idea behind this recommendation is that it minimizes the average loss of available space.

Hence, these templates include a presentation in the **14 : 9 aspect ratio** (see https://en.wikipedia.org/wiki/14:9_aspect_ratio): while it is imperfect for probably every projector that you will encounter, it is good on average for all of them.

(Please note that $14 : 9 \doteq 1.556$, which is pretty close to the “officially” recommended $20 : 13 \doteq 1.5385$.)

Introduction 2

Great Minds Discuss Ideas.
Average Minds Discuss Events.
Small Minds Discuss People.
—https://quoteinvestigator.com/2014/11/18/great-minds/

Background

- Temporal discounting is key concept in economics.
- Normative model: exponential discounting. However, observed decisions are hard to explain (e.g., Dohmen, Falk, Huffman, and Sunde, 2012).
- One alternative: the “focusing model” by Kőszegi and Szeidl (2013).

Introduction 3

Research Question

- The composition of latex and of typical rubbers is given below.
- Is it true that trees are regularly tapped and the coagulated latex which exudes is collected and worked up into rubber?

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Preview of the Results

- There is no feasible method at present known of preventing the inclusion of the resin of the latex with the rubber during coagulation.

$\Rightarrow$ Although the separation of the resin from the solid caoutchouc by means of solvents is possible, it is not practicable or profitable commercially.

Introduction 4: Beamer `block` Environments

Block title example: 0123456789 äöüß ÄÖÜ Often finding flowers in official fjords

The `block` environment. The `block` environment. The `block` environment. The `block` environment. The `block` environment. Block title example: 0123456789 äöüß ÄÖÜ Often finding flowers in official fjords.

An exemplary example

I am the `exampleblock` environment. Use me for examples.

Summary: Things to remember

The `alertblock` environment. Use this environment for really important stuff. The `alertblock` environment.

Introduction 5: Beamer `block` Environment with Different Colors

A `block` in the default color

The `block` environment. The `block` environment. The `block` environment. The `block` environment. A `block` in the default color.

A `block` in yellow

The `block` environment. The `block` environment. The `block` environment. The `block` environment. A `block` in yellow.

A `block` in the default color

The `block` environment. The `block` environment. The `block` environment. The `block` environment. A `block` in the default color.

Introduction 6: Beamer `definition` and `theorem` Environments

Definition (A Very, Very, Very, Very, Very, Very Long Name of a Concept that Spans Two Lines)

The `definition` environment. Upright.

Theorem (Theorem's mame)

The `theorem` environment. Italic.

Lemma (Lemma's Name)

The `lemma` environment. Italic.

Corollary (Corollary's Name)

The `corollary` environment. Italic.

Proof of Theorem's Name

The `proof` environment. Upright. ■

Study Design

Study Design 1: Design of the Study

- The latex of the best rubber plants furnishes from 20% to 50% of rubber.
- As the removal of the impurities of the latex is one of the essential points to be aimed at, it was thought that the use of a centrifugal machine to separate the caoutchouc as a cream from the watery part of the latex would prove to be a satisfactory process.

Study Design 2: Design of the Study

The watery portion of the latex soaks into the trunk, and the soft spongy rubber which remains is kneaded and pressed into lumps or balls:

$\mathrm{BAL}^{\mathrm{I}}_{1:1}$, $\mathrm{BAL}^{\mathrm{II}}_{1:1}$: Each payment transferred on single day.

$\mathrm{UNBAL}^{\mathrm{I}}_{1:n}$: Earlier payoff concentrated, while later payoff dispersed over $n = 2$, 4, or 8 dates.

$\mathrm{UNBAL}^{\mathrm{II}}_{n:1}$: Earlier payoff dispersed over $n = 2$, 4, or 8 dates, while later payoff concentrated.

Study Design 3: Control Experiment

- Control for alternative explanations.
- Many of the example sentences were taken from http://sentence.yourdictionary.com/latex.

Study Design 4: An Example `enumerate` List

1. First itemtext
    a. First itemtext
        i. First itemtext
        ii. Second itemtext
        iii. Last itemtext
        iv. First itemtext
    b. Second itemtext
    c. Last itemtext
    d. First itemtext
2. Second itemtext
3. Last itemtext
4. First itemtext

Study Design 5: An Example `itemize` List

- First itemtext
  - First itemtext
    - First itemtext
    - Second itemtext
    - Last itemtext
    - First itemtext
  - Second itemtext
  - Last itemtext
  - First itemtext
- Second itemtext
- Last itemtext
- First itemtext

Study Design 6: Some Example Text

Let's include some Greek letters: α, β, σ

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper. α, β, σ

Test: χρστ χρς τ χρσ τ. Math mode, upright: $\mathrm{\sigma}$

Study Design 7: Some Example Formulas

Let's include some additional Greek letters: γ, ϕ, σ_ε, c^α

$$p(R,\phi) \sim \int_{-\infty}^{\infty} \frac{\tilde{W}_n(\gamma)\exp\left[\imath R/a\left(\sqrt{k^2a^2-\gamma^2}\cos\phi\right)\right]}{(k^2a^2-\gamma^2)^{3/4}H_n'^{(1)}\left(\sqrt{k^2a^2-\gamma^2}\right)}\mathrm{d}\gamma$$

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Let's also include some upright Latin letters in math mode: d, e (next slide)

$$\int_a^b f(x)\,\mathrm{d}x = F(b) - F(a)$$

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Let's also include some upright Latin letters in math mode: d, e (next slide)

$$\int_a^b f(x)\,\mathrm{d}x = F(b) - F(a)$$

Let's test the math bold style

$$\boldsymbol{\Sigma} := \mathrm{Cov}(\boldsymbol{X}) = \begin{bmatrix} \mathrm{Var}(X_1) & \cdots & \mathrm{Cov}(X_1, X_n) \\ \vdots & \ddots & \vdots \\ \mathrm{Cov}(X_n, X_1) & \cdots & \mathrm{Var}(X_n) \end{bmatrix}$$

Study Design 8: Additional Example Formulas (with upright π)

Only variables are set in italics according to ISO style—hence, we use upright "d," "e," and "π" (`\mathup{d}`, `\mathup{e}`, and `\mathup{\pi}`, respectively).

Theorem (simplest form of the *Central Limit Theorem*)

Let $X_1, X_2, \cdots$ be a sequence of i.i.d. random variables with mean 0 and variance 1 on a probability space $(\Omega, \mathscr{F}, \mathbb{P})$. Then

$$\mathbb{P}\left(\frac{X_1 + \cdots + X_n}{\sqrt{n}} \leq y\right) \to \mathfrak{N}(y) := \int_{-\infty}^{y} \frac{\mathrm{e}^{-v^2/2}}{\sqrt{2\mathrm{\pi}}}\,\mathrm{d}v \quad \text{as} \quad n \to \infty,$$

or, equivalently, letting $S_n := \sum_1^n X_k$,

$$\mathbb{E}f\left(S_n/\sqrt{n}\right) \to \int_{-\infty}^{\infty} f(v)\frac{\mathrm{e}^{-v^2/2}}{\sqrt{2\mathrm{\pi}}}\,\mathrm{d}v \quad \text{as } n \to \infty, \text{ for every } f \in \mathrm{b}\mathscr{C}(\mathbb{R}).$$

Study Design 9: An siunitx Example Table

Table 1. Overview of the choice lists presented to subjects (adapted from Gerhardt, Schildberg-Hörisch, and Willrodt, 2017).

	Alternative ***A***				Alternative ***B***			
	$c_{\boldsymbol{A},1}$	$p_{\boldsymbol{A},1}$	$c_{\boldsymbol{A},2}$	$p_{\boldsymbol{A},2}$	$c_{\boldsymbol{B},1}$	$p_{\boldsymbol{B},1}$	$c_{\boldsymbol{B},2}$	$p_{\boldsymbol{B},2}$
Choice List I: risky/risky ($x =$ €22.00, $r =$ €7.50, $k =$ €11.50; 25 rows)								
Top row	€ 3.00	50%	€22.00	50%	€ 3.00	50%	€ 7.00	50%
Center row	€ 3.00	50%	€22.00	50%	€ 9.00	50%	€13.00	50%
Row with $m = 0$	€ 3.00	50%	€22.00	50%	€10.50	50%	€14.50	50%
Bottom row	€ 3.00	50%	€22.00	50%	€15.00	50%	€19.00	50%
Choice List II: safe/risky ($x =$ €16.00, $r =$ €5.00, $k =$ €5.00; 19 rows)								
Top row	€11.00	100%			€11.00	50%	€21.00	50%
Center row	€11.00	100%			€ 6.50	50%	€16.50	50%
Row with $m = 0$	€11.00	100%			€ 6.00	50%	€16.00	50%
Bottom row	€11.00	100%			€ 2.00	50%	€12.00	50%
Choice List III: "long shot" ($x =$ €14.00, $r = -$€36.00, $k =$ €7.00; 21 rows)								
Top row	€ 7.00	90%	€50.00	10%	€ 7.00	90%	€10.00	10%
Row with $m = 0$	€ 7.00	90%	€50.00	10%	€11.00	90%	€14.00	10%
Center row	€ 7.00	90%	€50.00	10%	€12.00	90%	€15.00	10%
Bottom row	€ 7.00	90%	€50.00	10%	€17.00	90%	€20.00	10%
Choice List IV: delayed payoffs ($x =$ €18.00, $r =$ €6.00, $k =$ €8.50, paid in one week; 20 rows)								
Top row	€ 9.50	50%	€12.00	50%	€ 9.50	50%	€24.00	50%
Above-center row	€ 9.50	50%	€12.00	50%	€ 5.00	50%	€19.50	50%
Below-center row	€ 9.50	50%	€12.00	50%	€ 4.50	50%	€19.00	50%
Row with $m = 0$	€ 9.50	50%	€12.00	50%	€ 3.50	50%	€18.00	50%
Bottom row	€ 9.50	50%	€12.00	50%	€ 0.00	50%	€14.50	50%

Results

Results 1: Overview

1. As a secondary function we may recognize the power of closing wounds, which results from the rapid coagulation of exuded latex in contact with the air:

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    a. In some cases (Allium, Convolvulaceae, etc.) rows of cells with latex-like contents occur.
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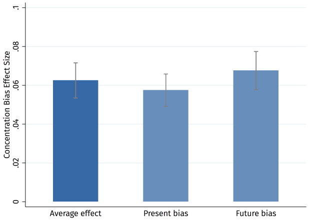
Results 1: Overview

1. As a secondary function we may recognize the power of closing wounds, which results from the rapid coagulation of exuded latex in contact with the air:
   a. In some cases (Allium, Convolvulaceae, etc.) rows of cells with latex-like contents occur.
   b. However, the walls separating the individual cells do not break down.
2. The rows of cells from which the laticiferous vessels are formed can be distinguished (6.3 p.p. vs. 2.6 p.p.; $p < 0.01$).

Results 2: Our Main Results

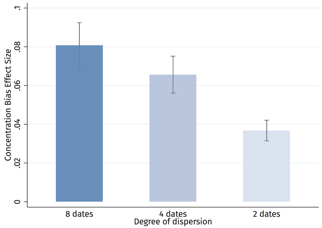
The charts are taken from Dertwinkel-Kalt, Gerhardt, Riener, Schwerter, and Strang (2017).

A **Result 1**



$$\text{BAL}^{\text{I}}_{1:1} - \text{UNBAL}^{\text{I}}_{1:\bullet}$$

B **Result 2**



$$\text{UNBAL}^{\text{II}}_{\bullet:1} - \text{BAL}^{\text{II}}_{1:1}$$

Figure 1. (A) Difference between treatment and control condition. **(B)** Heterogeneity.

Results 3: Main vs. Control Experiment

Rule out some alternative explanations.

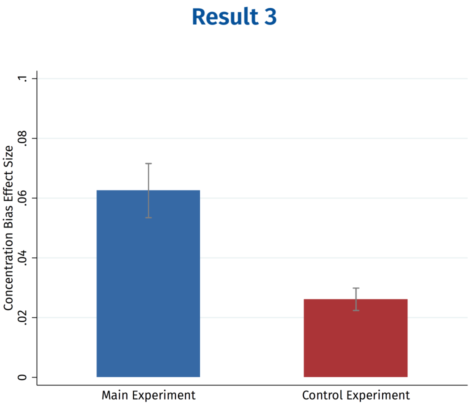


Table 2. Example of a regression table (adapted from Gerhardt, Schildberg-Hörisch, and Willrodt, 2017). Never forget to mention the dependent variable (here, $m_\sim$)!

	(1)	(2)	(3)	(4)	(5)
Treatment	−0.390	−0.228	−0.729*	−0.449*	−0.453**
	(+0.352)	(−0.205)	[+0.377]	[−0.245]	{+0.204}
Female	0.948***	0.061	0.188	0.305	0.385*
	(0.354)	(0.233)	(0.372)	(0.226)	(0.222)
Female × Treatment	0.169	0.251	0.892*	0.454	0.439
	(0.514)	(0.325)	(0.533)	(0.341)	(0.307)
Final high school grade	−0.101	0.013	0.076	0.117	0.039
	(0.198)	(0.144)	(0.224)	(0.146)	(0.133)
Trait self-control	−0.016	0.002	−0.016	−0.000	−0.007
	(0.016)	(0.010)	(0.015)	(0.010)	(0.009)
Constant	2.357***	1.512***	−0.322	2.158***	1.437***
	(0.239)	(0.144)	(0.265)	(0.161)	(0.152)
Observations	303	289	295	304	1191
R^2	0.057	0.008	0.039	0.043	0.024
Treatment × (1 + Female)	−0.221	0.023	0.163	0.004	−0.014
p_F[Treatment × (1 + Female) = 0]	0.327	0.008	0.192	0.000	0.003

Notes: Dependent variable: $m_\sim$. Robust standard errors (cluster-corrected for column 5) in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Missing observations ($N < 308$) due to exclusion of trials in which subjects behaved irrationally (i.e., chose a dominated option). The regressors Final high school grade and Trait self-control are mean-centered.

Results 5: Yet Another `siunitx` Example Table

Table 3. Figure grouping via `siunitx` in a table.

(1)	(2)	(3)
-0.100*	-0.100 01*	-123 456.444***
(2.871)	(2.871 23)	[+50 000.123]

Discussion

Discussion 1

- The latex exhibits a neutral, acid, or alkaline reaction, depending on the plant from which it was obtained.

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  - ⇒ The latex, which is usually coagulated by standing or by heating, is obtained from incisions.

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  ⇒ The latex, which is usually coagulated by standing or by heating, is obtained from incisions.
- See also Dohmen et al. (2012) and Bordalo, Gennaioli, and Shleifer (2013).

Discussion 2: Conclusion

- When exposed to air, the latex gradually undergoes putrefactive changes accompanied by coagulation.
- The addition of a small quantity of ammonia or of formalin to some latices has the effect of preserving them.
- There is, however, reason to believe the following.
- The coagulation of latex into rubber is not mainly of this character.

Discussion 3: An Automated Animation

The automated transition to the next slide (= page in the PDF document) only works in full-screen mode.

- The feature is available in Adobe Acrobat and Acrobat Reader.
- Unfortunately, it is (currently, January 22, 2020) not available in macOS Preview, Skim, and SumatraPDF.

Figure 2. Step 1—Angle: 30.0°

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Figure 2. Step 2—Angle: 60.0°

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Figure 2. Step 3—Angle: 90.0°

Discussion 3: An Automated Animation

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Figure 2. Step 4—Angle: 120.0°

Discussion 3: An Automated Animation

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Figure 2. Step 5—Angle: 150.0°

Discussion 3: An Automated Animation

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Figure 2. Step 6—Angle: 180.0°

Discussion 3: An Automated Animation

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Figure 2. Step 7—Angle: 210.0°

Discussion 3: An Automated Animation

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Figure 2. Step 8—Angle: 240.0°

Discussion 3: An Automated Animation

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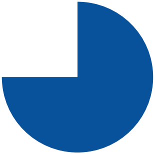

Figure 2. Step 9—Angle: 270.0°

Discussion 3: An Automated Animation

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Figure 2. Step 10—Angle: 300.0°

Discussion 3: An Automated Animation

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Figure 2. Step 11—Angle: 330.0°

Discussion 3: An Automated Animation

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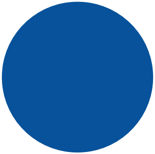

Figure 2. Step 12—Angle: 360.0°

Back to the start

Discussion 4: Testing the `allowframebreaks` option

Let's test automatic numbering with the `allowframebreaks` option.

On this slide, **no** number should be included in the frame title.

Discussion 5: Testing the `allowframebreaks` Option (1/3)

Let's test automatic numbering with the `allowframebreaks` option.

On this slide, "(1/3)" should appear in the frame title.

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

Discussion 6: Testing the `allowframebreaks` Option (2/3)

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

Discussion 7: Testing the `allowframebreaks` Option (3/3)

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

Math “Torture” Test

Math “Torture” Test (1/8)

Most of the following examples are taken from *The TEXbook* (Knuth, 1984, see https://ctan.org/pkg/texbook) and were adapted for LATEX from Karl Berry’s torture test for plain TEX math fonts.

$x + y - z, \quad x + y * z, \quad z * y / z, \quad (x + y)(x - y) = x^2 - y^2,$

$x \times y \cdot z = [x\,y\,z], \quad x \circ y \bullet z, \quad x \cup y \cap z, \quad x \sqcup y \sqcap z,$

$x \vee y \wedge z, \quad x \pm y \mp z, \quad x = y / z, \quad x := y, \quad x \le y \ne z, \quad x \sim y \simeq z\, x \equiv y \not\equiv z, \quad x \subset y \subseteq z$

$\sin 2\theta = 2 \sin\theta \cos\theta, \quad O(n \log n \log n), \quad \Pr(X > x) = \exp(-x/\mu),$

$\bigl(x \in A(n) \bigm| x \in B(n)\bigr), \quad \bigcup_n X_n \bigm\| \bigcap_n Y_n$

In-text matrices $\left(\begin{smallmatrix} 1 & 1 \\ 0 & 1 \end{smallmatrix}\right)$ and $\left(\begin{smallmatrix} a & b & c \\ 1 & m & n \end{smallmatrix}\right)$.

$$a_0 + \cfrac{1}{a_1 + \cfrac{1}{a_2 + \cfrac{1}{a_3 + \cfrac{1}{a_4}}}}$$

$$\binom{p}{2} x^2 y^{p-2} - \frac{1}{1-x}\frac{1}{1-x^2} = \frac{a+1}{b}\bigg/\frac{c+1}{d}.$$

$$\sqrt{1+\sqrt{1+\sqrt{1+\sqrt{1+\sqrt{1+x}}}}}$$

$$\sqrt[n]{1+\sqrt[k]{1+\sqrt[5]{1+\sqrt[4]{1+\sqrt[3]{1+x}}}}}$$

Math "Torture" Test (3/8)

$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right) \left|\varphi(x+iy)\right|^2 = 0$$

$$\pi(n) = \sum_{m=2}^{n} \left\lfloor \left(\sum_{k=1}^{m-1} \lfloor (m/k) \big/ \lceil m/k \rceil \rfloor \right)^{-1} \right\rfloor.$$

$$\int_0^\infty \frac{t - ib}{t^2 + b^2} e^{iat} \, \mathrm{d}t = e^{ab} E_1(ab), \quad a, b > 0.$$

$$\boldsymbol{A} :- \begin{pmatrix} x-\lambda & 1 & 0 \\ 0 & x-\lambda & 1 \\ 0 & 0 & x-\lambda \end{pmatrix}.$$

Math “Torture” Test (4/8)

$$\begin{pmatrix} a & b & c \\ d & e & f \end{pmatrix} \begin{pmatrix} u & x \\ v & y \\ w & z \end{pmatrix}$$

$$\boldsymbol{A} = \begin{pmatrix} a_{11} & a_{12} & \ldots & a_{1n} \\ a_{21} & a_{22} & \ldots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \ldots & a_{mn} \end{pmatrix}$$

$$\boldsymbol{M} = \begin{array}{c} \\ C \\ I \\ C' \end{array} \begin{array}{c} \begin{array}{ccc} C & I & C' \end{array} \\ \begin{pmatrix} 1 & 0 & 0 \\ b & 1-b & 0 \\ 0 & a & 1-a \end{pmatrix} \end{array}$$

Math "Torture" Test (5/8)

$$\sum_{n=0}^{\infty} a_n z^n \quad \text{converges if} \quad |z| < \Bigl(\limsup_{n\to\infty} \sqrt[n]{|a_n|}\Bigr)^{-1}.$$

$$\frac{f(x+\Delta x) - f(x)}{\Delta x} \to f'(x) \qquad \text{as } \Delta x \to 0.$$

$$\|u_i\| = 1, \qquad u_i \cdot u_j = 0 \quad \text{if } i \neq j.$$

$$\text{The confluent image of} \quad \begin{Bmatrix} \text{an arc} \\ \text{a circle} \\ \text{a fan} \end{Bmatrix} \quad \text{is} \quad \begin{Bmatrix} \text{an arc} \\ \text{an arc or a circle} \\ \text{a fan or an arc} \end{Bmatrix}.$$

$$
\begin{aligned}
T(n) \le T(2^{\lceil \lg n \rceil}) \le c(3^{\lceil \lg n \rceil} - 2^{\lceil \lg n \rceil}) \\
&< 3c \cdot 3^{\lg n} \\
&= 3c\, n^{\lg 3}.
\end{aligned}
$$

$$
\begin{aligned}
(x+y)(x-y) &= x^2 - xy + yx - y^2 \\
&= x^2 - y^2 \\
(x+y)^2 &= x^2 + 2xy + y^2.
\end{aligned}
$$

$$\left(\int_{-\infty}^{\infty} e^{-x^2}\,\mathrm{d}x\right)^2 = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} e^{-(x^2+y^2)}\,\mathrm{d}x\,\mathrm{d}y$$
$$= \int_{0}^{2\pi}\int_{0}^{\infty} e^{-r^2}\,\mathrm{d}r\,\mathrm{d}\theta$$
$$= \int_{0}^{2\pi}\left(e^{-\frac{r^2}{2}}\Big|_{r=0}^{r=\infty}\right)\mathrm{d}\theta$$
$$= \pi.$$

Math "Torture" Test (8/8)

$$\prod_{k\geq 0} \frac{1}{(1-q^k z)} = \sum_{n\geq 0} z^n \bigg/ \prod_{1\leq k\leq n} (1-q^k).$$

$$\sum_{\substack{0<i\leq m\\0<j\leq n}} p(i,j) \neq \sum_{i=1}^{p}\sum_{j=1}^{q}\sum_{k=1}^{r} a_{ij}b_{jk}c_{ki} \neq \sum_{\substack{1\leq i\leq p\\1\leq j\leq q\\1\leq k\leq r}} a_{ij}b_{jk}c_{ki}$$

$$\max_{1\leq n\leq m} \log_2 P_n \quad \text{and} \quad \lim_{x\to 0} \frac{\sin x}{x} = 1$$

$$p_1(n) = \lim_{m\to\infty} \sum_{\nu=0}^{\infty} \left(1-\cos^{2m}(\nu!^n \pi/n)\right)$$

References

References

Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer. 2013. "Salience and Consumer Choice." *Journal of Political Economy* 121 (5): 803–43. DOI: 10.1086/673885. [PDF pp. 32–34]

Dertwinkel-Kalt, Markus, Holger Gerhardt, Gerhard Riener, Frederik Schwerter, and Louis Strang. 2017. "Concentration Bias in Intertemporal Choice." Working paper. Bonn, Germany, et al.: University of Bonn et al. URL: https://www.dropbox.com/s/dv20mcu0qkygmjz/Concentration_Bias_in_Intertemporal_Choice.pdf. [PDF p. 27]

Dohmen, Thomas, Armin Falk, David Huffman, and Uwe Sunde. 2012. "Interpreting Time Horizon Effects in Inter-Temporal Choice." IZA Discussion Paper 6385. Maastricht University et al. URL: http://ftp.iza.org/dp6385.pdf. [PDF pp. 5, 32–34]

Gerhardt, Holger, Hannah Schildberg-Hörisch, and Jana Willrodt. 2017. "Does self-control depletion affect risk attitudes?" *European Economic Review* 100 (November): 463–87. DOI: 10.1016/j.euroecorev.2017.09.004. [PDF pp. 22, 29]

Knuth, Donald E. 1984. *The TeXbook*. Reading, MA, USA: Addison-Wesley, 483. [PDF p. 53]

Kőszegi, Botond, and Adam Szeidl. 2013. "A Model of Focusing in Economic Choice." *Quarterly Journal of Economics* 128 (1): 53–104. DOI: 10.1093/qje/qjs049. [PDF pp. 5, 32–34, 64]

Appendix

Appendix: Modeling Concentration Bias

Subjects consider a sequences of consequences $\boldsymbol{c}$ from choice set $\boldsymbol{C}$.

- **Standard discounted utility:** Suppose that the instantaneous utility function u satisfies $u' > 0$ and $u'' \leq 0$, and that earlier consequences are preferred over later consequences of the same magnitude, i.e., $D(t) \leq 1$:

  $U(\boldsymbol{c}\quad) := \sum_{t=1}^{T} \quad D(t)\, u(c_t), \quad$ where, e.g., $\quad D(t) = \delta^t$ or $D(t) = \frac{1}{1+k\,t}$.

- **Focusing model (Kőszegi and Szeidl, 2013):**

  $\tilde{U}(\boldsymbol{c}, \boldsymbol{C}) := \sum_{t=1}^{T} g_t\, D(t)\, u(c_t), \quad$ where

  $g_t \equiv g[\max_{\boldsymbol{c}' \in \boldsymbol{C}} u(c'_t) - \min_{\boldsymbol{c}' \in \boldsymbol{C}} u(c'_t)]$

  - Weighting function $g[\cdot]$ increases in difference of maximum and minimum possible utility at a point in time.
  - Subjects overweight intertemporal consequences with a greater range.