Things They Don't Teach You in Graduate School

Ces choses qu'on ne vous enseigne pas aux études supérieures

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Sixième congrès canadien des étudiants en statistique
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Already | Déjà

Things They Don't Teach You in Graduate School[1]

James A Hanley

McGill University

Abstract

Much of what statisticians teach and use in practice is learnt 'on the job.' I recount here some of my early statistical experiences, and the lessons we might learn from them. They are aimed at those of you starting out in the profession today, and at the teachers who train you. I stress the importance of communication.

Key Words

communication; communication; communication.

Fred Mosteller, Mentor '77-'80

Steve Lagakos, Colleague '73-'80

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[1] An expansion on some after-dinner remarks made at the Conference of Applied Statisticians of Ireland, held in Killarney, May 17-19, 2006. The article is dedicated to two former colleagues – and superb communicators – Fred Mosteller and Steve Lagakos, who are no longer with us.

Lake | lac Ontario
entre 1975 et 1977

http://www.biostat.mcgill.ca/hanley/SailingLakeOntario.mov

Lagakos, interviewed by a biostatistics student as part of a Harvard course

http://www.biostat.mcgill.ca/hanley/Lagakos/leadershipInterviewTamarSofer.pdf

http://www.biostat.mcgill.ca/hanley/Lagakos/SteveLagakosInterview.WAV

Mentor | Mentor

[Reprinted from RADIOLOGY, Vol. 143, No. 1, Pages 29–36, April, 1982.]

The Meaning and Use of the Area under a Receiver Operating Characteristic (ROC) Curve[1]

James A. Hanley, Ph.D.
Barbara J. McNeil, M.D., Ph.D.

Mentor | Mentor

HARVARD gazette

HSPH's Marvin Zelen dies at 87

Was considered a 'tremendous force' in biostatistics

November 19, 2014 | Editor's Pick

Photo by Shaina Andelman

Harvard Professor Marvin Zelen was noted for developing the statistical methods and study designs that are used in clinical cancer trials, in which experimental drugs are tested for toxicity, effectiveness, and proper dosage.

HSPH Communications

Professor Marvin Zelen of the Department of Biostatistics at the Harvard T.H. Chan School of Public Health

Topics in that piece | Les sujets dans cette partie

- Statistical Lineage, and Statistical History
- Green
- Jokes, and Other Teaching Tools
- 1st On-The-Job Lesson: Exact vs. Approx.
- **Communication**
- Errors of Type III and Beyond
- **Communication, Part II**
- Not in the Clinical Trials Textbooks
- **The Ten-Minute Consultation**
- Not the Usual Delta
- The Bigger Picture, and Other **Media**
- Sharing our statistical methods
- Tell Them What You Said

`http://www.biostat.mcgill.ca/hanley/Reprints/ThingsTheyDontTeachYou-JHanley.pdf`

Outline

- **Selected** items from that piece
- STATISTICAL LEARNING
- STATISTICAL PRACTICE

Plan

- Sujets **choisis** de cette partie
- L'APPRENTISSAGE DE LA STATISTIQUE
- LA PRATIQUE DE LA STATISTIQUE

Classroom and Platform Performance
Frederick Mosteller
The American Statistician
Vol. 34, No. 1 (Feb., 1980), pp. 11-17

- http://www.biostat.mcgill.ca/hanley/communicationCommunicationCommunication/MostellerClassoomPlatform.pdf
- https://www.umass.edu/wsp/resources/tales/mosteller.html
- https://www.tandfonline.com/doi/abs/10.1080/00031305.1962.10479594
- https://goo.gl/images/Ee4NCF

Mentor | Mentor

Maurice McGregor, MD

https://muhc.ca/newsroom/article/dr-maurice-mcgregor-faculté-médecine-l?université-président-l?unité-d?évaluation-technologie

http://www.cardiomuhc.ca/maurice-mcgregor

How long did their hearts go on? A *Titanic* study

James A Hanley, Elizabeth Turner, Carine Bellera, Dana Teltsch

Several studies have examined post-traumatic stress in people who survive disasters but few have looked at longevity. The 1997 film *Titanic* followed one character, apparently fictional, but the longevity of the actual survivors, as a group, has not been studied. Did the survivors of the sinking of the *Titanic* have shortened life spans? Or did they outlive those for whom 14-15 April 1912 was a less personal night to remember?

Subjects, methods, and results

We limited our study to passengers. We used data from biographies listed in Encyclopedia Titanica, a website that claims to have "among the most accurate passenger and crew lists ever compiled."[1] Of the 500 passengers listed as survivors, 435 have been traced. We calculated the proportion alive at each anniversary of the sinking.

Hazardous journeys

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Dana Teltsch
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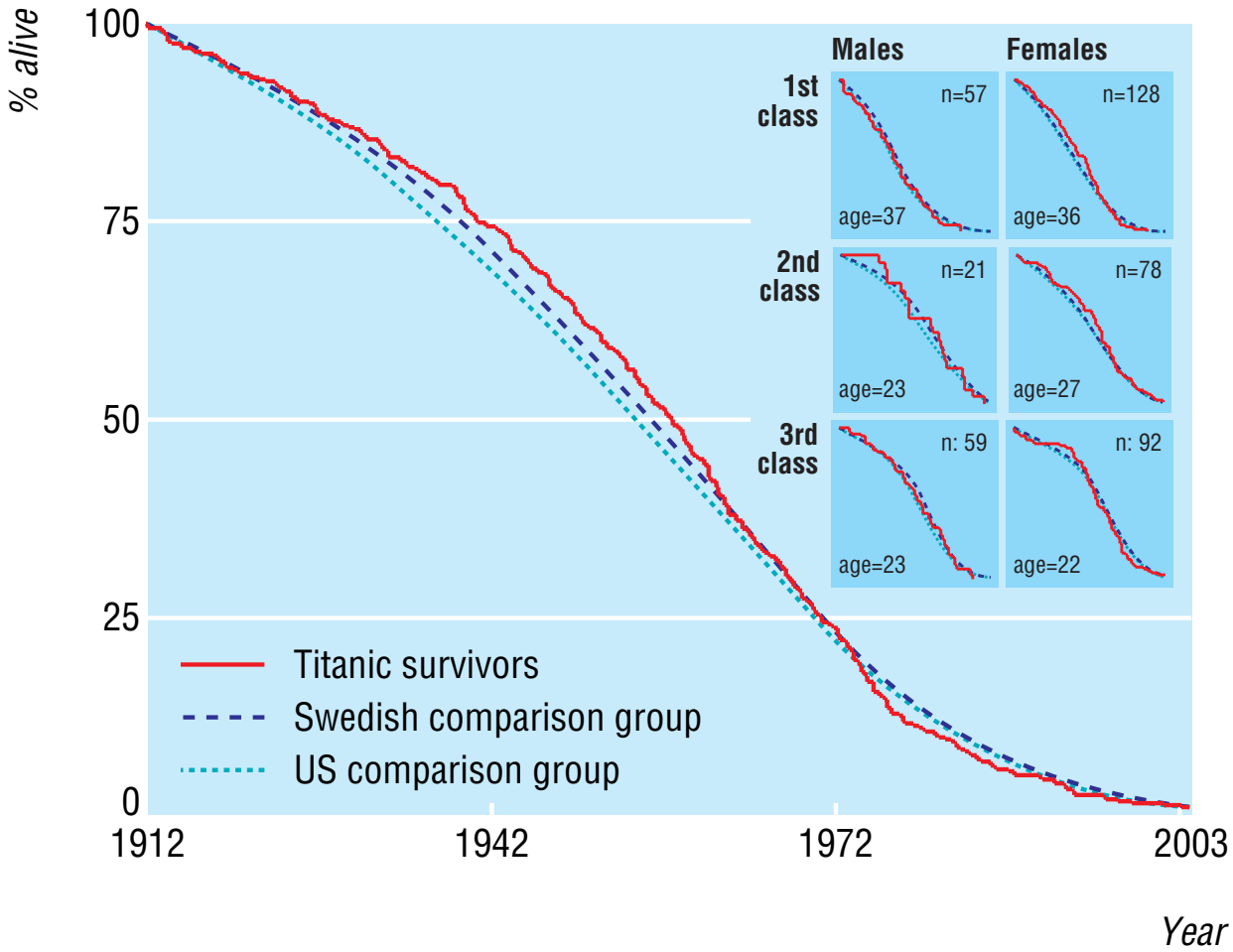
Department of Mathematics and Statistics, McGill University

Elizabeth Turner
graduate student



Percentage still alive on each anniversary of sinking of *Titanic* among 435 survivors and Swedish and white American comparison groups matched for age and sex. Inset: analysis by sex and class of travel (n=No of passengers; age=median age in 1912)

media

http://www.biostat.mcgill.ca/hanley/bios602/b-d-II-ch-1-2-3/InterviewGlobalTV.mov

http://www.biostat.mcgill.ca/hanley/bios602/b-d-II-ch-1-2-3/radioCanadaInternational.mp3

Hazardous journeys

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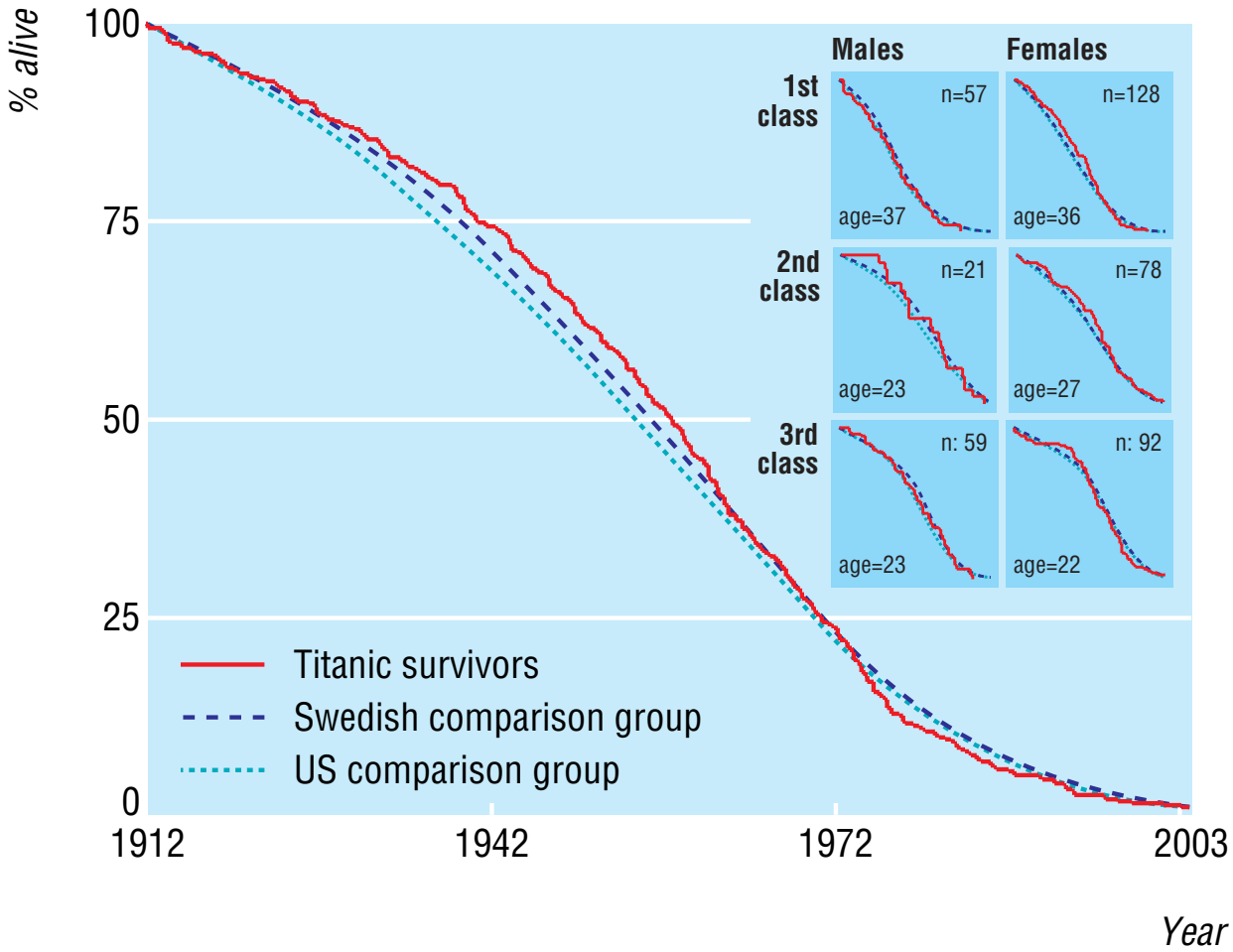

Percentage still alive on each anniversary of sinking of *Titanic* among 435 survivors and Swedish and white American comparison groups matched for age and sex. Inset: analysis by sex and class of travel (n=No of passengers; age=median age in 1912)

The Gazette

MONTREAL SATURDAY, DECEMBER 20, 2003 QUEBEC'S OLDEST DAILY SINCE 1778 FIRST EDITION

The world was introduced to the Freedom Tower yesterday, but the "world's highest" building, to replace the World Trade Centre buildings, is actually 12 metres shorter than Toronto's CN Tower. **Page A25**

INDEX

Carl Napoleon, manager of the Rogers cell-phone shop across the street.

Please see SNOW, Page A4

Titanic survivors led long lives

Trauma didn't affect lifespan, study finds

AARON DERFEL
GAZETTE HEALTH REPORTER

Yes, their hearts did go on.

McGill University researchers have discovered that most survivors of the sinking of the Titanic ended up living long, full lives after the 1912 tragedy.

In fact, most slightly outlived average Americans of their time who were never involved in a disaster.

The findings – published in yesterday's British Medical Journal – contradict assumptions that post-traumatic stress disorder might have cut short their lives.

Please see TITANIC, Page A4

RICHARD ARLESS JR. THE GAZETTE

On Ste. Catherine St. near Peel St. yesterday: The one million people who pass through the city's centre are slipping, sliding and almost double-lutzing their way to the office or Christmas shopping.

Cintec's latest controversy

Waste-management firm blames probes of Salvadoran landfill on bare-knuckles politics

DON MacDONALD
THE GAZETTE

Money laundering, drug trafficking, municipal corruption: the allegations and innuendo hanging over Montreal waste-management company Cintec Group could hardly be more serious.

Cintec operates the largest landfill in the tiny Central American country of El Salvador. For a year, the company and the landfill project have been bombarded by dozens of damaging headlines in Salvadoran newspapers and been made the subject of no fewer than three official investigations.

Please see GARBAGE, Page A2
Paper tried to dig up dirt, Page A3

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QUOTE

Terrible is the temptation to be good.
Bertolt Brecht

WEATHER

Sunny breaks
High -7° Low -13° Page C7

$2 | Beyond metropolitan area $2.30

…ccepting too many
That's up by 15 per
…ts
…rians continue to
feel that there are
…mmigrants coming
…4 per cent, up from
…n a June survey)."

immigration system" plank in the recent election.

The Conservative platform promised to bring "good people into Ontario while keeping bad people out." The document also slammed the federal government, which has jurisdiction

saying about the right number of immigrants were entering the country.

Residents of British Columbia and the territories were most inclined to see immigration levels as being about right (46 per cent, down from 50 per cent). That

ly than men (42 versus 34 per cent, respectively) to feel that "too many" immigrants come to Canada, particularly those over 35 years of age.

Also consistent with previous findings is that Canadians with a higher level of education are less

amount fell to 38 per cent from 47 per cent.

The national poll of 1,675 Canadians was conducted Sept. 2-7 by Pollara and is considered accurate within 2.4 percentage points, 19 times out of 20.

OTTAWA CITIZEN

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…really bad, it's hard
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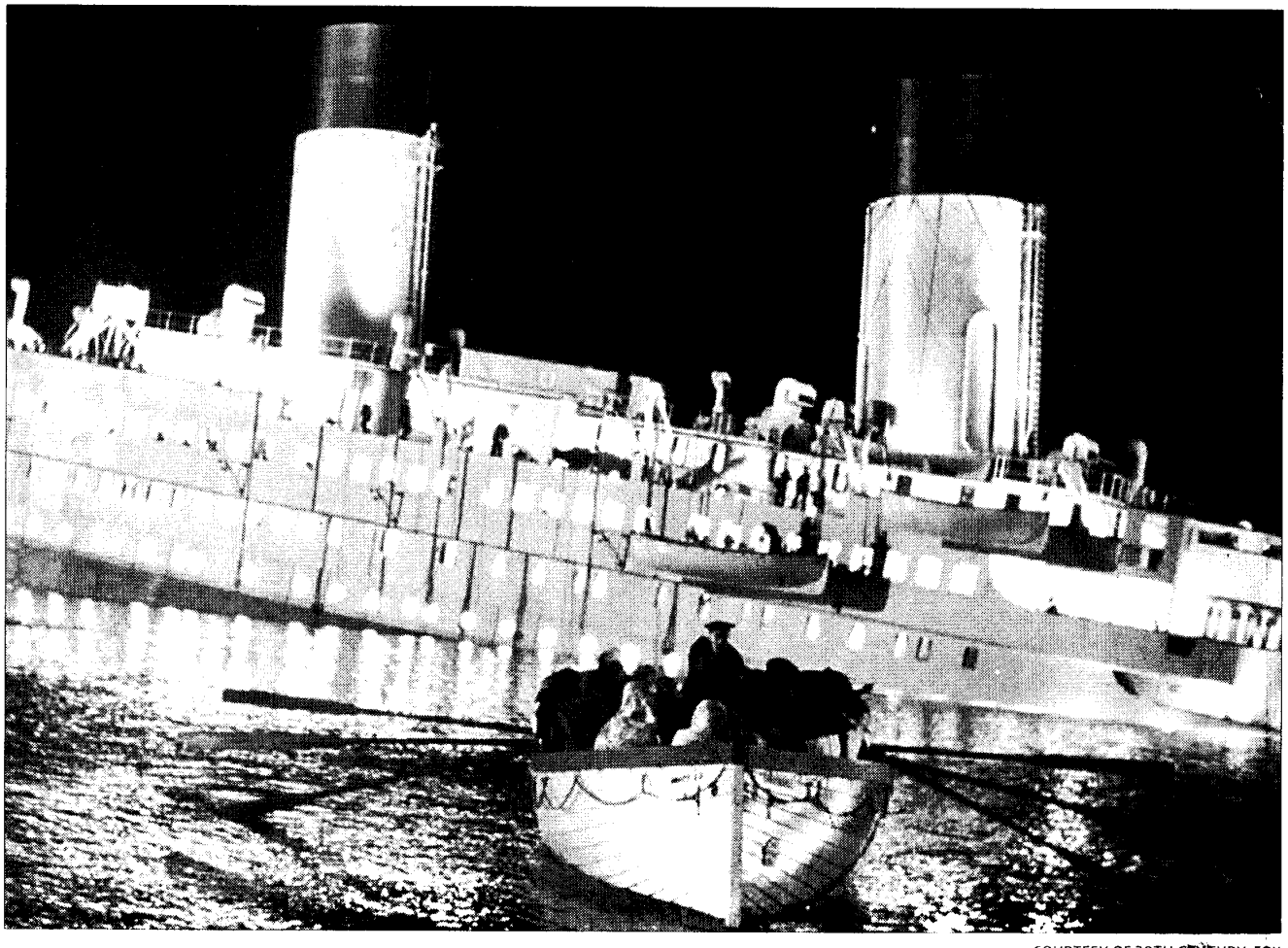

COURTESY OF 20TH CENTURY-FOX

A scene from the 1998 movie Titanic. Taking a cue from the blockbuster, researchers studied the longevity of first-, second- and third-class passengers, and their findings fly in the face of conventional wisdom that the privileged lead longer lives.

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week because of the
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Paradis, a Montreal
p. spokesperson.
orities were getting
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transit services for
leisure trips.
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dverse driving con-
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s and disruptions.
d 211 buses on Lake-
n Beaconsfield were
of St. Charles Blvd.,
l. "There was no salt
vas a skating rink."
ighter side, the sub-
was busier than usu-
ne of year, she said.
t snow in the métro,
e fewer delays."

Titanic | 'This was a survival of the fittest'

CONTINUED FROM A1

Taking a cue from Titanic, the 1997 movie blockbuster starring Leonardo DiCaprio and Kate Winslet, researchers also examined the longevity of first-, second- and third-class passengers. Again, the findings fly in the face of conventional wisdom that the privileged lead longer lives.

Whether a Titanic passenger sailed steerage – like Jack Dawson, the fictional film character portrayed by DiCaprio – or sipped champagne – like Winslet's young socialite, Rose De Witt Bukater – survivors in all classes ended up living just as long.

James Hanley, a statistician in McGill's department of epidemiology and biostatistics, said the lives of Titanic survivors have been investigated so thoroughly, they are ideal candidates for a longevity study.

"Did the experience they have – would it mean they're so hardened and so lucky and so thankful that they're going to live forever, like the song says?" Hanley asked.

He was referring to the film's treacly power ballad, My Heart Will Go On, performed by Quebec's chest-thumping chanteuse, Céline Dion.

"Or," Hanley continued, "were they so traumatized and the men so guilt-ridden" they would die prematurely?

To answer those questions, he and three graduate students pored through a trove of biographical data in the Encyclopedia Titanica, a Web site claiming to have "among the most accurate passenger and crew lists ever compiled" of the voyage.

The researchers compared the longevity of 435 of the 500 survivors with control groups in the United States and Sweden.

The study showed that, on average, a Titanic survivor lived 1.7 years longer than someone in the general population in the United States at the time of the sinking and half a year longer than a member of a similar group in Sweden.

More than half of the survivors lived well into their 70s – roughly equal to the longevity of the comparison groups.

Five people lived past 100, and the three remaining survivors are now in their 90s. They're all female – to be expected, given that women have a higher life expectancy than men. Two sailed in third class, one in second.

Hanley, who sailed on the Queen Elizabeth II from New York to London in 1999, said the results suggest the tragedy was consistent with the Darwinian theory of survival of the fittest.

"These are lucky people who were going to live a long time, who were going to value their lives and were going to be doubly careful," he explained.

"Some people have said this was a survival of the fittest, and that, of course, the survivors were going to do well."

The study also turned on its head the notion that the affluent – who can afford the best health care and who eat better than the underprivileged – live longer.

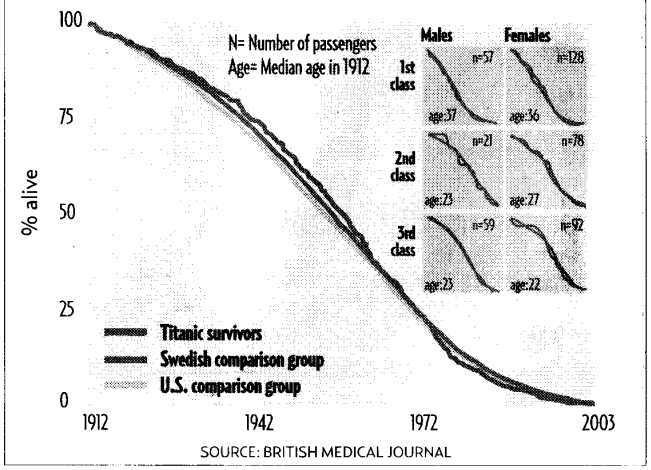
"We immediately thought the survivors of first and second class would do very well because they are so privileged," Hanley said. "The upshot is that this first-class team wasn't very first class."

The study was published in the journal's end-of-the year edition, reserved for offbeat research papers.

aderfel@
thegazette.canwest.com

TITANIC SURVIVORS DIE AT NORMAL RATE

Percentage still alive on each anniversary of the sinking of the Titanic among 435 survivors, and Swedish and white American comparison groups matched for age and sex.



SOURCE: BRITISH MEDICAL JOURNAL

THE GAZETTE

re doesn't seem to be any pattern, any plan,' cop says

le street. Parker de
h structure – more
de most banks were
passable to all but
pattern or any plan. You'll walk
about one block and it looks as
though no one had touched it.

In reaction to the city's apparent lethargy, local merchants have started to mobilize their own personnel to at least clear the patch
route an ambulance down Ste. Catherine St."

Emergency vehicles might have had a difficult time of it this
bination of heavy snowfall, freezing rain and sudden freezes since Monday.

But for people like Parker, who

ACTUALITÉS

Les survivants du *Titanic* s'en sont bien sortis

MATHIEU PERREAULT

Quand il a vu le film *Titanic*, avec Leonardo di Caprio et Kate Winslet, James Hanley s'est demandé de quelle manière la catastrophe avait marqué les survivants du naufrage. Son réflexe est bien normal : M. Hanley est professeur d'épidémiologie à l'Université McGill.

Quelques années plus tard, il a trouvé le moyen d'élucider la question. Il a trouvé, sur Internet, une liste de biographies de la presque totalité des passagers du Titanic. Il a ensuite posé une question à ses étudiants : en raison du traumatisme du naufrage, les survivants du *Titanic* ont-ils vécu moins longtemps que la population moyenne ?

La réponse a surpris M. Hanley : la catastrophe ne semble pas avoir affecté la longévité des passagers. « On pourrait s'attendre à ce que la mort de membres de la famille, l'attente dans l'eau glacée, ou le sentiment de culpabilité à l'idée d'avoir eu la chance d'échapper au sort horrible des noyés, affecte la vie, et donc la longévité, des survivants. Mais nos calculs montrent que non. Ça amène de l'eau au moulin des gens qui disent que le concept de stress post-traumatique n'entraîne pas de conséquences à long terme. »

Recherches plus légères...

L'épidémiologiste et ses étudiants publient leur étude dans le dernier numéro du *British Medical Journal*, une prestigieuse revue médicale qui consacre ses numéros de Noël à des recherches plus légères. Le numéro de cette année comporte notamment une étude des panneaux routiers indiquant les zones où vivent de nombreuses personnes âgées.

L'analyse des données du site Encyclopedia Titanica n'est pas terminée. « Je veux vérifier si la longévité est la même pour les survivants ayant perdu des membres de leur famille, et si le survivant était enfant ou adulte en 1912 », dit M. Hanley, qui a un grand intérêt pour l'océan et les paquebots depuis son enfance sur une île irlandaise. Une analyse de la classe sociale des survivants laisse déjà entrevoir que plus le survivant est riche, plus il est affecté par le traumatisme : les survivants de première classe ont la même longévité que ceux de troisième, alors qu'on pourrait s'attendre à ce que les riches de cette époque vivent plus longtemps que les pauvres.

L'étude de l'impact de certains événements sur la longévité est un champ de l'épidémiologie qui gagne en importance. « Il y a notamment un épidémiologiste torontois, Don Redelmeier, qui a étudié l'impact de gagner un Oscar et celui d'être le président d'une classe de médecine, dit M. Hanley. Les gagnants des Oscars vivent quatre ans plus vieux que ceux qui n'avaient eu qu'une nomination ; dans le deuxième cas, la charge de président a un effet négatif, elle enlève deux ans à l'espérance de vie. »

Ce domaine pointu n'est pas exempt de controverses. « Redelmeier a dit à Discovery Channel que mon étude n'est pas valable parce que mon analyse exclut 17 % des survivants, pour lesquels on n'a pas de données, indique M. Hanley. Je suis d'accord qu'il faut affiner les analyses, mais je pense que notre article est pertinent. »

STATISTICAL LEARNING

- Minimalist
- Real-life props
- Simulations/Animations
- Unity/Logic
- Curiosity

L'APPRENTISSAGE DE LA STATISTIQUE

- Minimaliste
- Accessoires dans la vraie vie
- Simulations/Animations
- Unité/Logique
- Curiosité

Minimalist... examples

- $E\left[\frac{\sum(y-\bar{y})^2}{n}\right] = \frac{n-1}{n}\sigma^2$

  $n = 2; y \in (0,1)$ or $(1,2,3)$

  `http://www.biostat.mcgill.ca/hanley/c607/ch01/mm_ch_01.pdf` page 4

- Structure of $\hat{\beta}$ & $Var[\hat{\beta}]$ when fitting $E[Y|X] = \beta X$ using various criteria

  Fit Model with 1 para to dataset with n = 2

y	x
2	1
8	2

  `http://www.biostat.mcgill.ca/hanley/2DatapointsAndaModel/`

- GEE: heights(y) of $n = 3$ children in 2 families

  `http://www.biostat.mcgill.ca/hanley/Reprints/aje_gee_orientation.pdf`

Minimaliste... exemples

- $E\left[\frac{\sum(y-\bar{y})^2}{n}\right] = \frac{n-1}{n}\sigma^2$

  $n = 2; y \in (0,1)$ où $(1,2,3)$

  `http://www.biostat.mcgill.ca/hanley/c607/ch01/mm_ch_01.pdf` page 4

- Structure de $\hat{\beta}$ & $Var[\hat{\beta}]$ lors de l'ajustement de $E[Y|X] = \beta X$ en utilisant divers critères

  Ajuster Modèle avec 1 para au jeu de données avec n = 2

y	x
2	1
8	2

  `http://www.biostat.mcgill.ca/hanley/2DatapointsAndaModel/`

- GEE: Taille(y) de $n = 3$ enfants de 2 familles

  `http://www.biostat.mcgill.ca/hanley/Reprints/aje_gee_orientation.pdf`

Real-life props / Visualizations

- Elevators
  (L_1 *vs.* L_2 norm, CLT)
  `http://www.medicine.mcgill.ca/epidemiology/hanley/elevator.html`
- Travel times/distances
  (CLT, Gamma $\leftrightarrow$ Poisson)
  `http://www.biostat.mcgill.ca/hanley/bios601/Mean-Quantile/clt_in_action_1.gif`
  `http://www.biostat.mcgill.ca/hanley/bios601/Mean-Quantile/EnoughTires.html`
- Ages/recency of books
  MPG $\leftrightarrow$ litres/100Km
  °F $\leftrightarrow$ °C
  (Change of Scale, Jacobians)
  `http://www.biostat.mcgill.ca/hanley/Reprints/jh_dt_tas_2006.pdf`

Accessoires dans la vraie vie / Visualisations

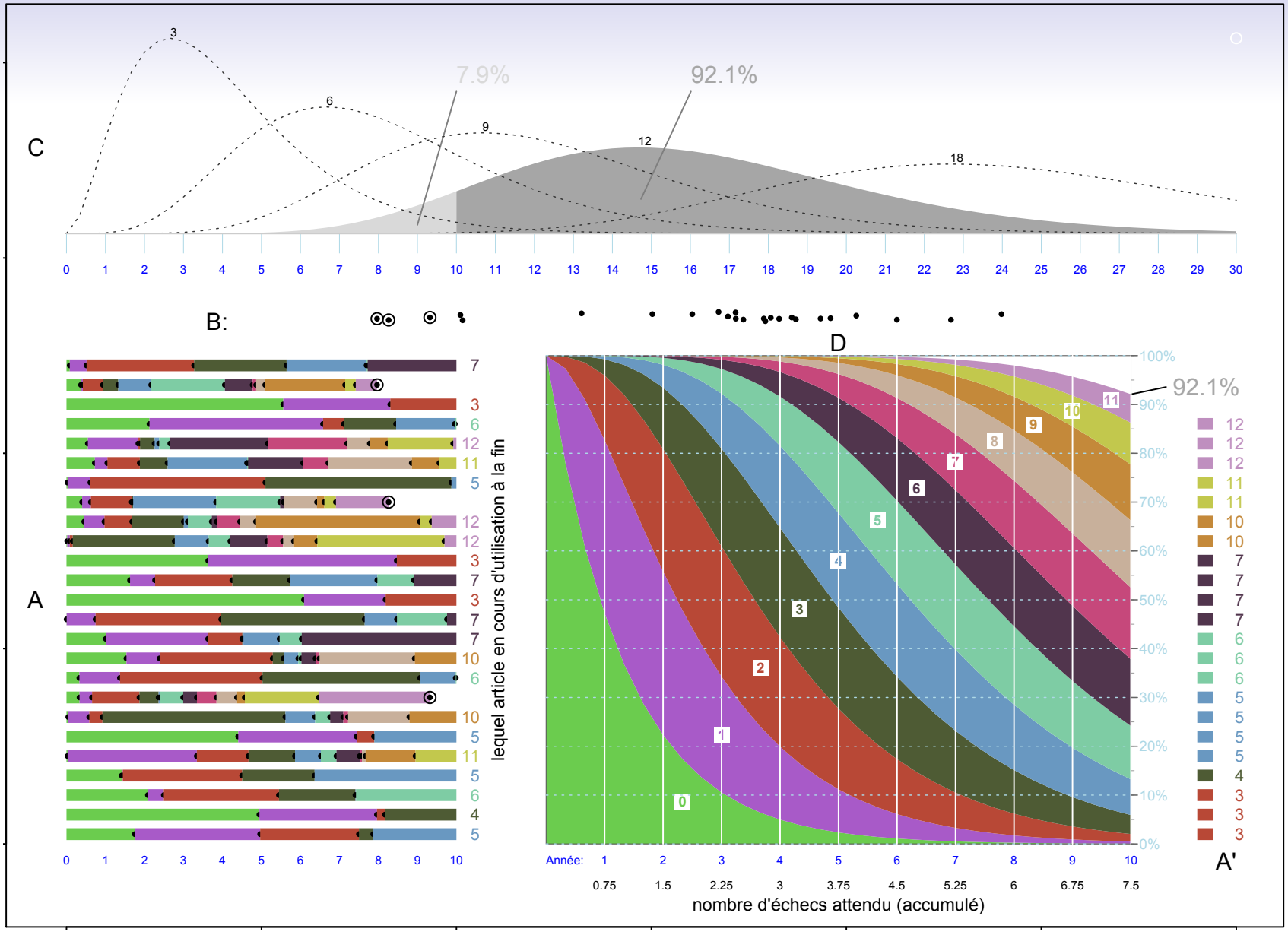
- Ascenseurs
  (norme L_1 *vs.* L_2, TCL)
  `http://www.medicine.mcgill.ca/epidemiology/hanley/elevator.html`
- Temps de déplacements/distances
  (TCL, Gamma $\leftrightarrow$ Poisson)
  `http://www.biostat.mcgill.ca/hanley/bios601/Mean-Quantile/clt_in_action_1.gif`
  `http://www.biostat.mcgill.ca/hanley/bios601/Mean-Quantile/EnoughTires.html`
- Âges/récence des livres
  MPG $\leftrightarrow$ litres/100Km
  °F $\leftrightarrow$ °C
  (Changement d'échelle, Jacobiens)
  `http://www.biostat.mcgill.ca/hanley/Reprints/jh_dt_tas_2006.pdf`

Real-life props / Visualizations

- Words in Text
  (Length-bias)
  http://www.biostat.mcgill.ca/hanley/bios601/Surveys/newsweek.pdf
- % and depth of ocean
  (CLT, CDF^{-1} sampling)
  http://www.biostat.mcgill.ca/hanley/Reprints/HowDeepIsTheOcean.pdf
  http://www.biostat.mcgill.ca/hanley/bios601/Surveys/Oceanography/
- Lotteries
  (E, V, multiplicity, ...)
  http://www.biostat.mcgill.ca/hanley/Reprints/jumping_to_coincidences.pdf
- N(·,·): $s^2 \sim$ Gamma (Fisher)
  http://www.biostat.mcgill.ca/hanley/Student/HanleyEtAlStudent-FishersDerivation.pdf

Accessoires dans la vraie vie / Visualisations

- Mots en Texte
  (Biais de longueur)
  http://www.biostat.mcgill.ca/hanley/bios601/Surveys/newsweek.pdf
- % et profondeur de l'océan
  (TCL, échantillonnage FR^{-1})
  http://www.biostat.mcgill.ca/hanley/Reprints/HowDeepIsTheOcean.pdf
  http://www.biostat.mcgill.ca/hanley/bios601/Surveys/Oceanography/
- Loteries
  (E, V, multiplicité, ...)
  http://www.biostat.mcgill.ca/hanley/Reprints/jumping_to_coincidences.pdf
- N(·,·): $s^2 \sim$ Gamma (Fisher)
  http://www.biostat.mcgill.ca/hanley/Student/HanleyEtAlStudent-FishersDerivation.pdf



http://www.biostat.mcgill.ca/hanley/Reprints/Accromath-2015-1-4.pdf

http://www.biostat.mcgill.ca/hanley/bios601/Mean-Quantile/forAccromathBackTranslate.pdf

Simulations/Animations

- Cell Occupancy
  http://www.biostat.mcgill.ca/hanley/bios601/Intensity-Rate/ Randomly selected visits to 1000 cells
- Epidemics, Cards, Gambling, Lotteries
  http://www.biostat.mcgill.ca/hanley/c323/
- Chevalier de Méré
  http://www.biostat.mcgill.ca/hanley/bios601/Proportion/ChevalierDeMere.R.txt
- Bridge of Life
  http://www.biostat.mcgill.ca/hanley/BridgeOfLife/
- Cancer Screening
  http://www.biostat.mcgill.ca/hanley/screening/ bottom of page

Simulations/Animations

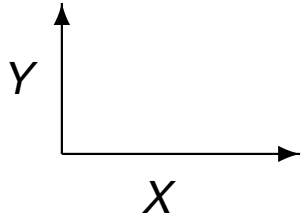
- Occupation des cellules
  http://www.biostat.mcgill.ca/hanley/bios601/Intensity-Rate/ Visites choisies au hasard à 1000 cellules
- Épidemies, cartes, paris, loteries
  http://www.biostat.mcgill.ca/hanley/c323/
- Chevalier de Méré
  http://www.biostat.mcgill.ca/hanley/bios601/Proportion/ChevalierDeMere.R.txt
- Le pont de la vie
  http://www.biostat.mcgill.ca/hanley/BridgeOfLife/
- Dépistage du cancer
  http://www.biostat.mcgill.ca/hanley/screening/ au bas de la page

Unity/Logic

- $\widehat{Var}[\hat{\mu}] = \frac{s^2}{n}$; $\widehat{Var}[p] = \frac{p(1-p)}{n}$
- Sample size
  power considerations
  `http://www.biostat.mcgill.ca/hanley/Reprints/UniversalSampleSize.pdf`
- Mother of all regressions

$$g(E[y]) \sim 1$$

- Survival analysis $\neq$ special topic
  (esp. if one uses ML to fit models)
- Info. (I) rather than $Var = I^{-1}$
- X is not a r.v. ; Y is.

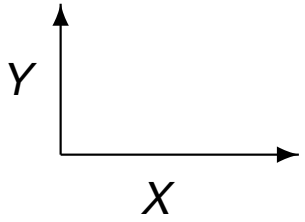


Unité/Logique

- $\widehat{Var}[\hat{\mu}] = \frac{s^2}{n}$; $\widehat{Var}[p] = \frac{p(1-p)}{n}$
- Considérations pour la taille
  d'échantillon/puissance
  `http://www.biostat.mcgill.ca/hanley/Reprints/UniversalSampleSize.pdf`
- Mère de toutes les régressions

$$g(E[y]) \sim 1$$

- Analyse de survie $\neq$ sujet spécial
  (spéc. si on utilise MV pour ajuster modèles)
- Info. (I) au lieu de $Var = I^{-1}$
- X n'est pas une v.a. ; Y l'est.



Curiosity

- Measurement Errors:

$$F = 32 + \frac{9}{5}C$$

`http://www.biostat.mcgill.ca/hanley/bios601/Surveys/ErrorsInXAnimation.R.txt`

- 1.08 $\times$ Woman (Galton)

`http://www.biostat.mcgill.ca/hanley/galton/`

- History

`http://www.biostat.mcgill.ca/hanley/`
`http://www.biostat.mcgill.ca/hanley/anniversaries/`

Curiosité

- Erreurs de mesure:

$$F = 32 + \frac{9}{5}C$$

`http://www.biostat.mcgill.ca/hanley/bios601/Surveys/ErrorsInXAnimation.R.txt`

- 1.08 $\times$ Femme (Galton)

`http://www.biostat.mcgill.ca/hanley/galton/`

- Histoire

`http://www.biostat.mcgill.ca/hanley/`
`http://www.biostat.mcgill.ca/hanley/anniversaries/`

RATE OF REGRESSION IN HEREDITARY STATURE.

Fig. (a)

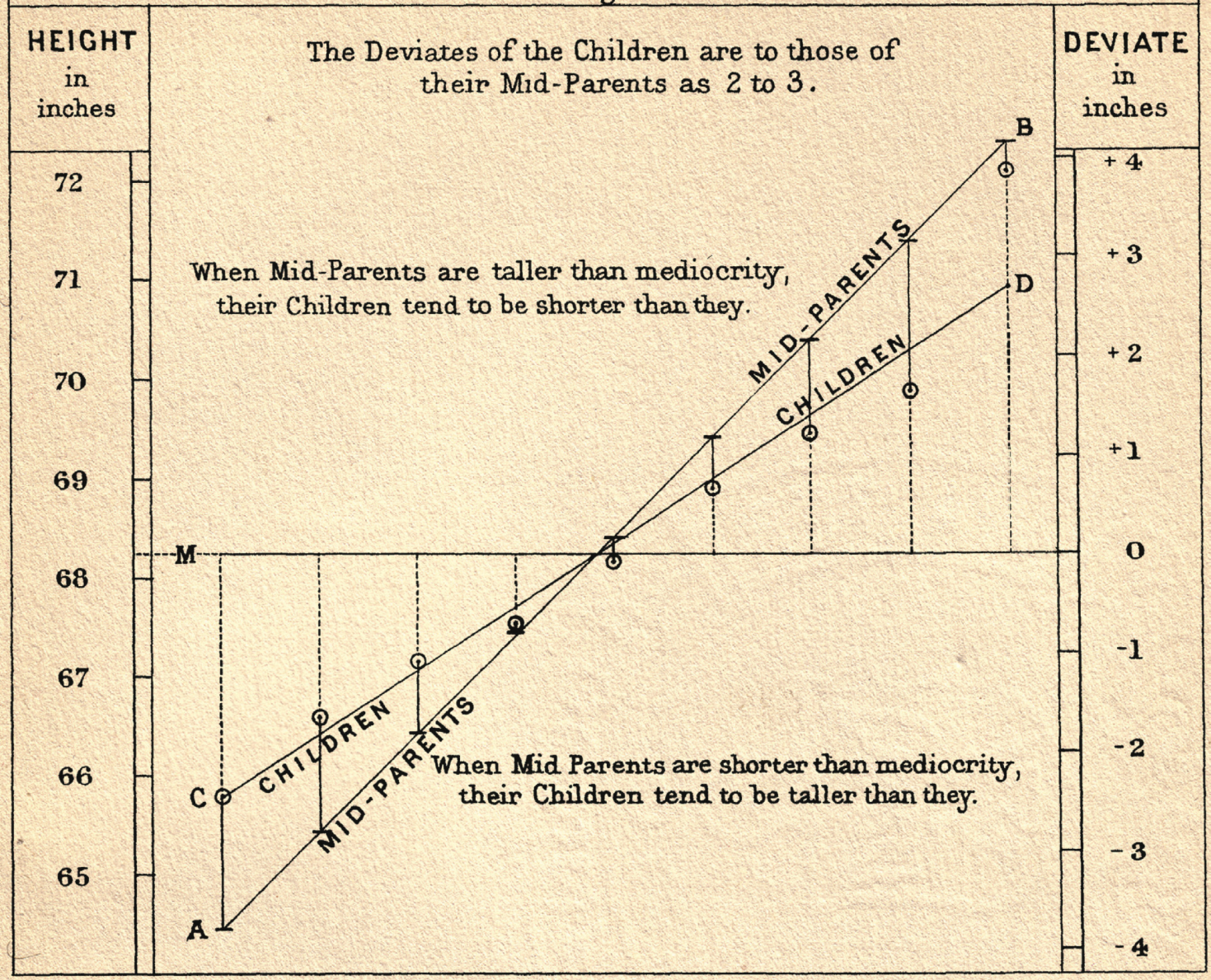


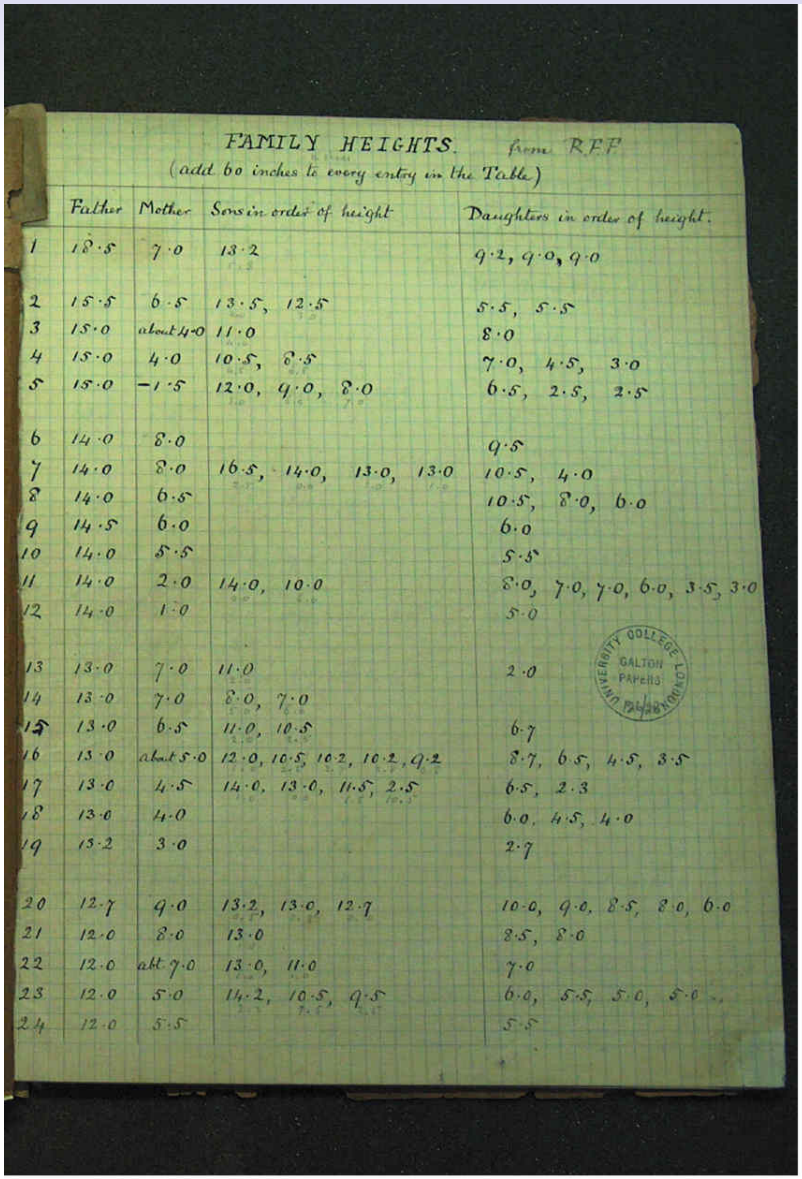
TABLE I.

NUMBER OF ADULT CHILDREN OF VARIOUS STATURES BORN OF 205 MID-PARENTS OF VARIOUS STATURES.

(All Female heights have been multiplied by 1·08).

Heights of the Mid-parents in inches.	Heights of the Adult Children.													Total Number of		Medians.
	Below	62·2	63·2	64·2	65·2	66·2	67·2	68·2	69·2	70·2	71·2	72·2	73·2	Above	Adult Children.	Mid-parents.	
Above ..	..	..	..	..	..	..	..	..	..	..	..	1	3	..	4	5	..
72·5	..	..	..	..	..	..	..	1	2	1	2	7	2	4	19	6	72·2
71·5	..	..	..	..	1	3	4	3	5	10	4	9	2	2	43	11	69·9
70·5	1	..	1	..	1	1	3	12	18	14	7	4	3	3	68	22	69·5
69·5	..	..	1	16	4	17	27	20	33	25	20	11	4	5	183	41	68·9
68·5	1	..	7	11	16	25	31	34	48	21	18	4	3	..	219	49	68·2
67·5	..	3	5	14	15	36	38	28	38	19	11	4	..	..	211	33	67·6
66·5	..	3	3	5	2	17	17	14	13	4	..	..	..	..	78	20	67·2
65·5	1	..	9	5	7	11	11	7	7	5	2	1	..	..	66	12	66·7
64·5	1	1	4	4	1	5	5	..	2	..	..	..	..	..	23	5	65·8
Below ..	1	..	2	4	1	2	2	1	1	..	..	..	..	..	14	1	..
Totals ..	5	7	32	59	48	117	138	120	167	99	64	41	17	14	928	205	..
Medians ..	..	..	66·3	67·8	67·9	67·7	67·9	68·3	68·5	69·0	69·0	70·0	..	..	..	..	..

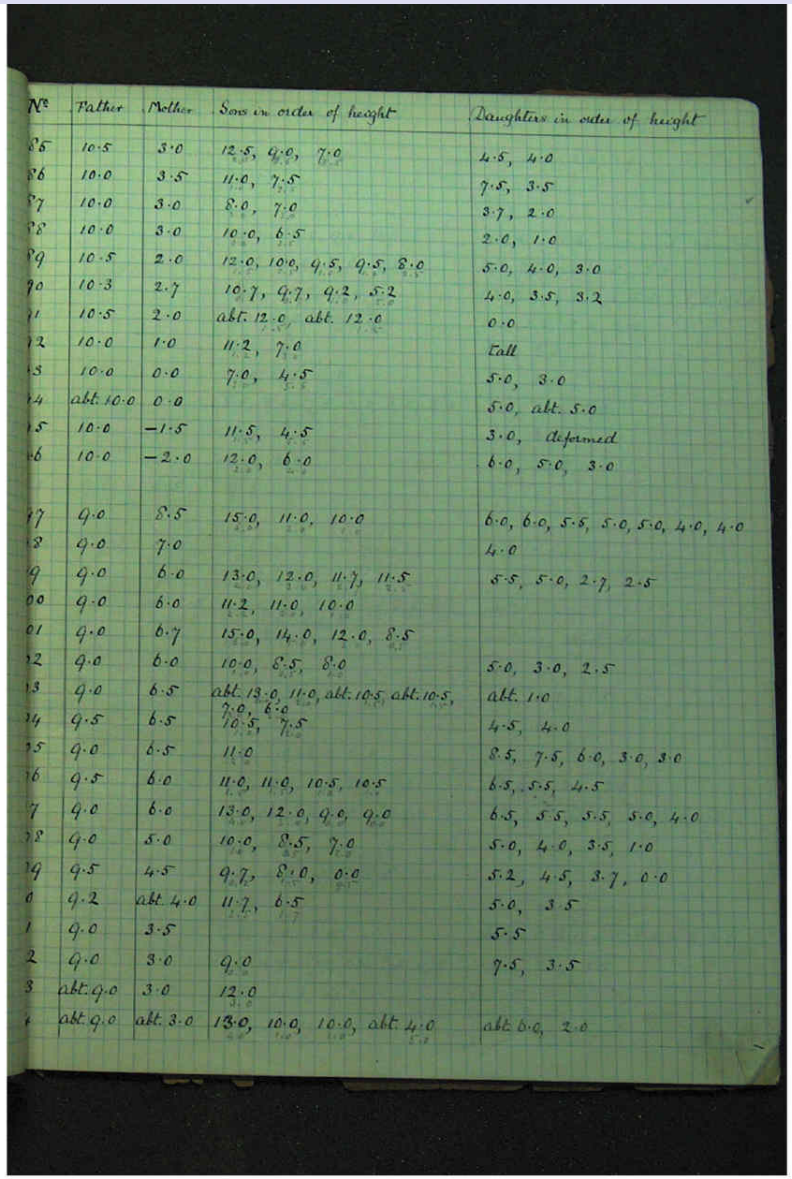
NOTE.—In calculating the Medians, the entries have been taken as referring to the middle of the squares in which they stand. The reason why the headings run 62·2, 63·2, &c., instead of 62·5, 63·5, &c., is that the observations are unequally distributed between 62 and 63, 63 and 64, &c., there being a strong bias in favour of integral inches. After careful consideration, I concluded that the headings, as adopted, best satisfied the conditions. This inequality was not apparent in the case of the Mid-parents.



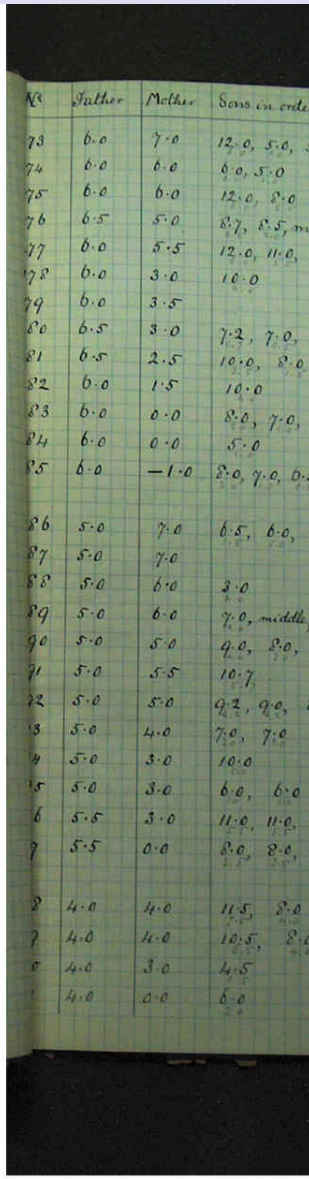
FAMILY HEIGHTS. from R.F.F

(add 60 inches to every entry in the Table)

	Father	Mother	Sons in order of height	Daughters in order of height.
1	18·5	7·0	13·2	9·2, 9·0, 9·0
2	15·5	6·5	13·5, 12·5	5·5, 5·5
3	15·0	about 4·0	11·0	8·0
4	15·0	4·0	10·5, 8·5	7·0, 4·5, 3·0
5	15·0	−1·5	12·0, 9·0, 8·0	6·5, 2·5, 2·5
6	14·0	8·0		9·5
7	14·0	8·0	16·5, 14·0, 13·0, 13·0	10·5, 4·0
8	14·0	6·5		10·5, 8·0, 6·0
9	14·5	6·0		6·0
10	14·0	5·5		5·5
11	14·0	2·0	14·0, 10·0	8·0, 7·0, 7·0, 6·0, 3·5, 3·0
12	14·0	1·0		5·0
13	13·0	7·0	11·0	2·0
14	13·0	7·0	8·0, 7·0	
15	13·0	6·5	11·0, 10·5	6·7
16	13·0	about 5·0	12·0, 10·5, 10·2, 10·2, 9·2	8·7, 6·5, 4·5, 3·5
17	13·0	4·5	14·0, 13·0, 11·5, 2·5	6·5, 2·3
18	13·0	4·0		6·0, 4·5, 4·0
19	13·2	3·0		2·7
20	12·7	9·0	13·2, 13·0, 12·7	10·0, 9·0, 8·5, 8·0, 6·0
21	12·0	8·0	13·0	8·5, 8·0
22	12·0	abt 7·0	13·0, 11·0	7·0
23	12·0	5·0	14·2, 10·5, 9·5	6·0, 5·5, 5·0, 5·0
24	12·0	5·5		5·5



№	Father	Mother	Sons in order of height	Daughters in order of height
85	10·5	3·0	12·5, 9·0, 7·0	4·5, 4·0
86	10·0	3·5	11·0, 7·5	7·5, 3·5
87	10·0	3·0	8·0, 7·0	3·7, 2·0
88	10·0	3·0	10·0, 6·5	2·0, 1·0
89	10·5	2·0	12·0, 10·0, 9·5, 9·5, 8·0	5·0, 4·0, 3·0
90	10·3	2·7	10·7, 9·7, 9·2, 5·2	4·0, 3·5, 3·2
91	10·5	2·0	abt. 12·0, abt. 12·0	0·0
92	10·0	1·0	11·2, 7·0	Tall
93	10·0	0·0	7·0, 4·5	5·0, 3·0
94	abt. 10·0	0·0		5·0, abt. 5·0
95	10·0	−1·5	11·5, 4·5	3·0, deformed
96	10·0	−2·0	12·0, 6·0	6·0, 5·0, 3·0
97	9·0	8·5	15·0, 11·0, 10·0	6·0, 6·0, 5·5, 5·0, 5·0, 4·0, 4·0
98	9·0	7·0		4·0
99	9·0	6·0	13·0, 12·0, 11·7, 11·5	5·5, 5·0, 2·7, 2·5
00	9·0	6·0	11·2, 11·0, 10·0	
01	9·0	6·7	15·0, 14·0, 12·0, 8·5	
02	9·0	6·0	10·0, 8·5, 8·0	5·0, 3·0, 2·5
03	9·0	6·5	abt. 13·0, 11·0, abt. 10·5, abt. 10·5, 7·0, 6·0	abt. 1·0
04	9·5	6·5	10·5, 7·5	4·5, 4·0
05	9·0	6·5	11·0	8·5, 7·5, 6·0, 3·0, 3·0
06	9·5	6·0	11·0, 11·0, 10·5, 10·5	6·5, 5·5, 4·5
07	9·0	6·0	13·0, 12·0, 9·0, 9·0	6·5, 5·5, 5·5, 5·0, 4·0
08	9·0	5·0	10·0, 8·5, 7·0	5·0, 4·0, 3·5, 1·0
09	9·5	4·5	9·7, 8·0, 0·0	5·2, 4·5, 3·7, 0·0
10	9·2	abt. 4·0	11·7, 6·5	5·0, 3·5
11	9·0	3·5		5·5
12	9·0	3·0	9·0	7·5, 3·5
13	abt. 9·0	3·0	12·0	
14	abt. 9·0	abt. 3·0	13·0, 10·0, 10·0, abt. 4·0	abt. 6·0, 2·0



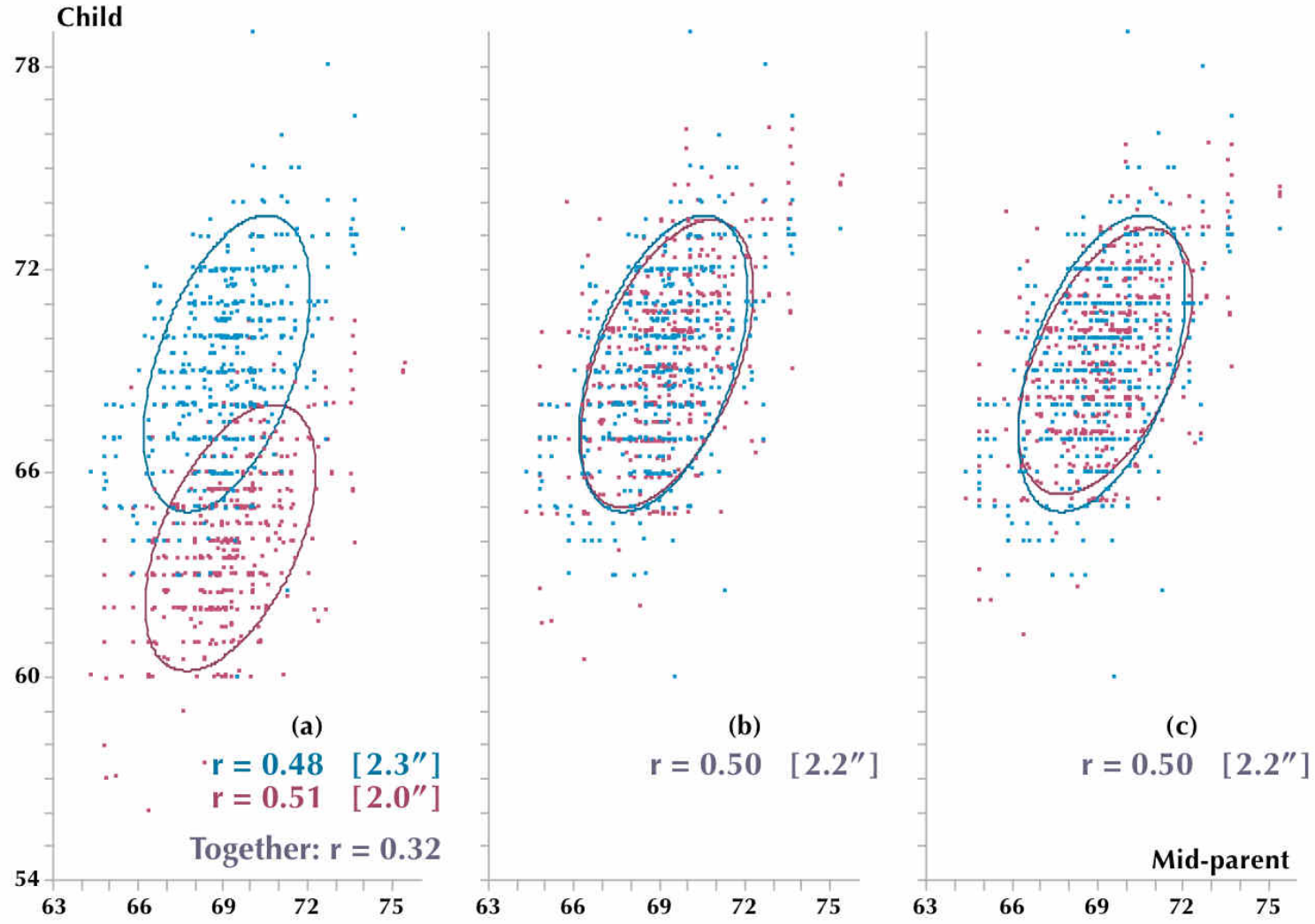
№	Father	Mother	Sons in orde
73	6·0	7·0	12·0, 5·0,
74	6·0	6·0	6·0, 5·0
75	6·0	6·0	12·0, 8·0
76	6·5	5·0	8·7, 8·5, m
77	6·0	5·5	12·0, 11·0,
78	6·0	3·0	10·0
79	6·0	3·5	
80	6·5	3·0	7·2, 7·0,
81	6·5	2·5	10·0, 8·0
82	6·0	1·5	10·0
83	6·0	0·0	8·0, 7·0,
84	6·0	0·0	5·0
85	6·0	−1·0	8·0, 7·0, 0·
86	5·0	7·0	6·5, 6·0,
87	5·0	7·0	
88	5·0	6·0	3·0
89	5·0	6·0	7·0, middl
90	5·0	5·0	9·0, 8·0,
91	5·0	5·5	10·7
92	5·0	5·0	9·2, 9·0,
93	5·0	4·0	7·0, 7·0
94	5·0	3·0	10·0
95	5·0	3·0	6·0, 6·0
96	5·5	3·0	11·0, 11·0,
97	5·5	0·0	8·0, 8·0,
98	4·0	4·0	11·5, 8·0
99	4·0	4·0	10·5, 8·
00	4·0	3·0	4·5
01	4·0	0·0	6·0

http://www.biostat.mcgill.ca/hanley/galton/


82
The Gazett


The Gaze
CHALLENG

"Transmuting" of Female Heights



Heights (in inches) of adult children in relation to their mid-parent height. **(a)** each daughter's height 'as is' **(b)** daughter's height multiplied by 1.08 **(c)** 5.2 inches added to daughter's height. Daughters' heights are shown in pink, and sons' in blue, symbols. Ellipses (75%) are drawn based on the observed means and covariances.

In all three panels, and in analyses for "Do Residuals Segregate along Family Lines?", the mid-parent height is calculated as (father's height + 1.08 x mother's height) / 2.

[Average Residual, in inches]

STATISTICAL PRACTICE

- Be professional
- Communicate well
- Don’t be dazzled by big data/money
- Think for yourself
- Put thinking before techniques

LA PRATIQUE DE LA STATISTIQUE

- Être professionnel
- Bien communiquer
- Ne pas être ébloui par les mégadonnées/l’argent
- Penser par soi-même
- Mettre la réflexion avant les techniques

LINKS | LIENS

http://www.biostat.mcgill.ca/hanley

→ Publications, Presentations, Interviews, etc.