# Errors and Corrections

R. Kass, May 12, 2021

p. 26, below the definition of standard deviation, ($s = .134$ s) should be ($s = .134$ seconds).

p. 40, conditional probability, $P(B > 0)$ should be $P(B) > 0$.

p. 42, middle of page, sum should be product

p. 61, prior to the last paragraph there should be an additional paragraph giving the derivation of the pdf from the hazard function:

$$\begin{aligned}\lambda(x) &= -\frac{d}{dx}\log(1 - F(x)) \\ &\implies \log(1 - F(x)) = -\int_{-\infty}^{x} \lambda(u)du \\ &\implies F(x) = 1 - e^{-\int_{-\infty}^{x} \lambda(u)du} \\ &\implies f(x) = \lambda(x)e^{-\int_{-\infty}^{x} \lambda(u)du}.\end{aligned}$$

p. 84, after "In the discrete case we have", on the right-hand side of first two lines $P(X^{(1)} = x)$ should be $P(Y^{(1)} = y)$

p. 91, after (4.26) "generalize" should be "are the same as"

p. 94, three text lines below (4.30) the equation number after "multiplicative form of" should be (4.30)

p. 102, in lines 7 and 8 the subscript $k$ should be $i$

p. 117, end of page, last sentence should end "and usually when applied to data, where the sample mean $\bar{x}$ and standard deviation $s$ replace $\mu$ and $\sigma$.

p. 120, in the theorem "A random variable" should be "A continuous random variable"

p. 122, top, the first two equations are missing the "/" sign, so should read

$$F(x) = 1 - \lambda_0/f(x)$$

and

$$f(x) = -\lambda_0/f'(x)$$

p. 124, top, "in the Section" should be "in Section"

p. 126, the whole page after the first line needs to be replaced with the following:

The inverse Gaussian arises as the theoretical interspike interval (ISI) distribution for integrate-and-fire neurons under simplifying assumptions. The essential idea begins with excitatory and inhibitory post-synaptic potentials, EPSPs and IPSPs, considered to arrive in a sequence of time bins of length $\Delta t$, taken to be sufficiently small that at most one post-synaptic potential arrives in any particular time bin. Though the theory is more general, for simplicity let us here assume that each EPSP and IPSP contributes a voltage increment of $v$ or $-v$, respectively; and that for any given time step the probability of an EPSP or IPSP arriving is $p$ or $q$, with $p+q<1$. Letting $X_i$ be the resulting voltage contribution at the $i$th time step, we have $p = P(X_i = v)$, $q = P(X_i = -v)$ and $1-p-q = P(X_i = 0)$ and, assuming we begin with the resting potential $V_0 = V_{rest}$ at time $t = 0$, the voltage $V_t$ at time $t$ is

$$V_t = V_{rest} + S_n,$$

where $S_n = X_1 + X_2 + \cdots + X_n$, and there are a total of $n = n(t)$ time steps up to time $t$ of width $\Delta t = t/n$. The variable $S_n$ is said to follow a generalized *random walk* (confer page 530; a simple random walk takes $v = 1$ and $q = 1-p$). If $p > q$ then there is an upward "drift" toward positive voltages, and an action potential occurs when $V_t$ exceeds a particular threshold value $V_{thresh}$. The process then resets to time $t = 0$ and the voltage returns to $V_{rest}$. The behavior of a theoretical integrate-and-fire neuron based on such a random walk process is illustrated in Figure 5.5. The continuous-time stochastic process known as *Brownian motion*, with drift, results from letting $n \to \infty$, so that $\Delta t \to 0$, while $p = \lambda_E \Delta t$ and $q = \lambda_I \Delta t$ (for some positive $\lambda_E$ and $\lambda_I$), so that, for any $t$, the mean and variance converge to constants and, as $\Delta t \to 0$, the excitatory and inhibitory inputs become Poisson processes with intensities $\lambda_E$ and $\lambda_I$ (see Section19.2.1). By the CLT, $S_n$ is approximately Gaussian, which is a basic property of the Brownian motion approximation to $V_t$. The distribution of "first passage time," meaning the time it takes for the drifting Brownian motion to cross a boundary, is inverse Gaussian. (See Whitmore and Seshadri, 1987; and Mudhulkar and Tian, 2002.) The rate of drift toward the spiking threshold $V_{thresh}$, from the resting potential $V_{rest}$, is determined by $\lambda_E - \lambda_I$. Let us write $N_v = (V_{thresh} - V_{rest})/v$, which can be interpreted as the number of excess excitatory steps needed to reach threshold. Then the mean of the inverse Gaussian ISI distribution becomes

$$\mu = \frac{N_v}{\lambda_E - \lambda_I}$$

and the coefficient of variation is

$$\text{CV} = \sqrt{\frac{\lambda_E + \lambda_I}{N_v(\lambda_E - \lambda_I)}}.$$

See Tuckwell (1988, Section 9.6, Equations (9.107)-(9.108)). Thus, when $\lambda_E - \lambda_I \approx (\lambda_E + \lambda_I)/N_v$, the coefficient of variation gets close to 1 and the neuron fires with Poisson-like irregularity.

**NOTE: this last formula is Equation (5.17)**

p. 131, just before the details, "This arises in" should be "Such cases occur in"

p. 133, in the theorem, after "$m$-dimensional multivariate normal," insert "where $m = m_1 + m_2$ and $\Sigma$ is positive definite,"

p. 133, a period is needed at the end of the proof.

p. 137, second paragraph, “is scalar” should be “is a scalar”

p. 142, two lines above the definition at the bottom of the page, $P(Y = c) = 1$ should be $P(X = c) = 1$

p. 146, the statement in the box should read as follows:

*Roughly speaking,* if $X_1, X_2, \ldots, X_n$ are independent random variables, possibly having different distributions, but with all individual $X_i$ variables making relatively small contributions to the variance of the mean $\bar{X}$, then for n sufficiently large, the distribution of $\bar{X}$ is approximately normal with mean $E(\bar{X})$ and standard deviation $\sqrt{V(\bar{X})}$.

p. 146, just after the box (see the correction immediately above), the phrase “no dominant contribution” should be “relatively small contributions”

p. 147, Section 6.3.2, lines 5 and 6, to avoid confusion the subscript $k$ should be replaced by $l$

p. 148, in the statement of the Multivariate Central Limit Theorem, the vector $w$ must be a unit vector

p. 222, bottom, “about any quantities computed from the data” should be ”attached to quantities computed from the data”

p. 250, second to last sentence in second paragraph, a reference to Section 5.4.4 should be included

p. 261, middle of page, equation after “then”, the numerator does not need parentheses

p. 261, before Example 1.4, the remark about z-score should be removed (because z-score more commonly refers to a standardization of the data using standard deviation)

p. 294, end of section 11.5.5, parentheses missing from 1998

p. 297, bottom, and references, reference needed for Fisher’s book

p. 298, top, a little earlier the null hypothesis should be interpreted as corresponding to lack of ability to tell apart the two conditions

p. 341, before equation (12.55), a reference should be give to Section A.7, p. 616

p. 350, line 4 of second paragraph of Section 12.5.5, the reference should be to Section A.7

p. 352, line 2, “length” should be “the length”

p. 359, line 9, the reference should be to Section 12.4.4

p. 400, footnote 4 should include a reference to Stigler (1986) concerning Fechner

p. 403, above equation (14.10) $B(\lambda)$ should be $B(\theta)$

p. 404, footnote, “must correspond to values that are possible” should be “must produce MLEs that are possible values of $\mu$”

p. 411, equation (14.21), comma missing before $y(t)$

p. 449, bottom, period should be removed from last equation

p. 523, middle, period should be inside the parenthesis after 2000

p. 526, legend of Figure 18.4, the word “body” should be removed

p. 546, in “Details,” “L’Hopital’s” should be “L’Hôpital’s”

p. 547, legend to Figure 18.12, the word “curve” should not be italicized

p. 559, line 4, “simple” should be “straightforward”

p. 582, prior to (19.16) the definition of conditional intensity should be

$$\lambda(t|H_t) = \lim_{\Delta t \to 0} \frac{E(\Delta N_{(t,t+\Delta t]}|H_t)}{\Delta t}$$

p. 594, end of Section 19.3.4 “scope” should be “scope of”

p. 597, caption of Figure 19.11 should read “... distribution of intervals shown in Fig. 19.10 after rescaling, based on the fit of the conditional intensity in Equation (19.28).”

p. 597, Example 19.5 the use of “Dr.” in “Dr. Mark Stopfer” is not consistent with rest of book (should be checked throughout)

p. 600, middle, “(19.38) vanishes” should be “(19.38) diverges”

p. 602, bottom, last equation, in the exponent $x_u$ should be $X_u$

p. 623 MISSING REFERENCES, Anderson (1993, 2007)

p. 625 MISSING REFERENCE, Ebbinghaus (1885)

p. 626, punctuation wrong in Fisher (1935)

p. 642 MISSING INDEX ENTRY, Fechner, p. 400

p. 648, $Z_{ons}$ should be $z_{obs}$ and for $z$-score the page should be 117

# Layout Issues (caused by publisher)

p. 32 space missing before Example 2.4

p. 34 space missing at end of “Details”

p. 38 space missing before Axioms

p. 39 space missing before 3’

p. 97 space missing at end of Example 4.5

p. 98 space missing before Bayes Theorem for Random Vectors

p. 108, top, “and effective” should be on same line

p. 296, title of Example 11.1 AND example index, space missing between retinal and ganglion (and example is missing from index)

p. 304, top line, spaces missing before and after “for all”

p. 305, before equation (11.27) space missing before “False”

p. 541, line 4 of Example 18.3, space missing between “method” and “as”

p. 561, footnote, the reference should be to page 560 rather than 559

p. 571, in the proof of the theorem $(i-1)^{st}$ should be $(i-1)$st

# Omissions

p. 61, at end, should include this derivation:

$$\begin{aligned} & \lambda(x) = -\frac{d}{dx}\log(1-F(x)) \\ \implies & \log(1-F(x)) = -\int_{-\infty}^{x}\lambda(u)du \\ \implies & F(x) = 1-\exp\{-\int_{-\infty}^{x}\lambda(u)du\} \\ \implies & f(x) = \lambda(x)\exp\{-\int_{-\infty}^{x}\lambda(u)du\} \end{aligned}$$

Figure 4.2 should have better figure, axes same scale, etc.

Figure 4.3 should have better axes

Figure 8.1 the dots should be more consistent

Appendix A.3 should include a definition of integral and the fundamental theorem of calculus

(new) Section 7.2.3 Identifiability

(new) Section 10.4.10 and Section 11.2.3 Pivotal statistics and p-values under the alternative

(new) Section 16.3.5 large-scale testing and FDR and replication

(new) Section 16.4 Nonparametric Bayes

(new) Section 17.5 Graphs and networks; include causal inference

(new) Section 18.5.4 Non-stationary processes