EPI 513-607 Mid-term exam, May 31, 1990 SOLUTIONS

Q1 (a) yes, shifts it upwards. (b) no

Q2 (ii) adding three numbers that are right on the mean leaves the numerator unchanged, but increases the denominator by 3.

Q3 (i), otherwise, i.e., if (ii) or (iii), the standard deviation would reflect negative distances.

Q4 Need (a) 1 head and 1 tail, (b) 50 heads and 50 tails [(a) is a 3-point distribution, (b) is a 101-point distribution].
(a) has more chance of occuring: 2/4 vs $\binom{100}{50}(1/2)^{100}$ for (b), which is a lot smaller.

Q5 a. If π of women has been increasing then it doesn't satisfy the Binomial assumptions.
b. Yes c. Yes d. Not binomial; the π is certain in some months and very rare in others.

Q6 SD(sum) = √n SD(individuals) = √100 (25) = 250 lbs. E(sum) = $n\mu$ = (100)(150) = 15 000
15 500 is 500 or 2SD(sum) above 15 000, i.e., there is a $2\frac{1}{2}$ % chance of getting > 15 500.

Q7 $\bar{x} \pm t_{24}$ SD/√25 = 299 789.2 ± 2.0639 x 12/5 = (299784.25, 299794.15)

Q8 Yes you can: can invoke central limit theorem if *n* is reasonably large, e.g., binomial with large *n* and reasonably central value of π is Gaussian enough.

Q9 SD(individual) = 6000, SE(mean) = SD(mean of 225) = 6000/√225 = 400
(a) False. The statement is about individual institutions but uses 2SE(mean).
(b) True.
(c) True. This is just stating (b) in words, and it views the CI as a procedure whose <u>average</u> correct performance is 95%.

Q10 H_0: choosing at random, so $E(\bar{x}) = \mu$.
H_{alt}: choosing not at random, so possibly $E(\bar{x}) \neq \mu$ [there are several other ways of being non random, e.g., someone could pull out half from the lower quartile and half from the upper quartile and still get $E(\bar{x}) = \mu$]. Here it sounds (post-hoc) like H_{alt}: $E(\bar{x}) > \mu$
$P(\bar{x} > 33 \mid \mu = 30, \sigma = 5) = P(z \geq \frac{33-30}{5/5}) = P(z \geq 3) = 0.0013$.

Q11 (i) Better to say <u>chance alone</u> (there is some chance fluctuation in all variations, even in systematic or clear differences).

Q12 (i) Paired t-test. Deals only with pre-post differences in the treated group.
Mean change is 5.3, so 95%CI: ± t_{32} SE(average change) = ±3.3.
1 SE = 3.3/ t_{32} ≈ 1.6. $t = \frac{5.3 - 0}{\text{SE(ave change)}}$ = 5.3/1.6 = 3.31.
(ii) ± t_{64} SE(difference in average change) = $\pm 1.9977\sqrt{1.6^2 + 2.2^2}$ = ±5.43.

Q13 (i) 1- If test each part separately (not recommended)
— compute: average(clench) – average(tourniquet) for each person just from data in figure 1 (upper panel) and use paired t-test with *n* = 4, *df* = 3.
— same for lower panel.
The problem is the interpretation of 2 significance tests.
2- Recommended: Compute corresponding difference for the corresponding times in Figure 1 (lower panel), i.e., the "placebo" effect. Then compute the difference of the 2 differences, i.e., subtract "effect" measured in lower panel (very little anyway) from effect in upper panel, to produce 1 single number per subject, and 1 significance test on the *n* = 4 subjects.

Q14 <u>Sleep-Wake schedules:</u>
(i) SE(Mean) = SD(individual)/√n SD(individual) = √n SE(Mean).
(ii) Nights within same subject are not independent.
(iii) Independent samples t-test (mostly different men in the 2 groups, but with small overlap).
(iv) There probably is some covariance between the 2.

<u>Circadian Phase:</u>
(i) Paired t-test with *n* = 5.
(ii) Independent samples t-test with *n* = 5 vs (mostly) another *n* = 5.

EPI 513-607 Mid-term exam, May 31, 1990 SOLUTIONS