$e^{0.7} = 2$

$e^{2 \cdot 0.7} = e^{1.4} = 2^2 = 2 \cdot 2 = 4$

$e^{-1.4} = \frac{1}{4}$

☆ know log rules for likelihood

Old final

4/27/16

1.)

	number seen			
number	0	1	2	3
of year	1	12	5	2
• expected	5			

a.) It's a count. If observer spent the same time t each year and rate of seeing warblers is λ each year.

Why not Poisson $\rightarrow$ t might differ between years, λ might differ between years. Likely not independent due to interactions.

b.) $Pr(\text{data}|\text{model}) = \frac{\Lambda^0 e^{-\Lambda}}{0!} \cdot \left(\frac{\Lambda^1 e^{-\Lambda}}{1!}\right)^{12} \cdot \left(\frac{\Lambda^2 e^{-\Lambda}}{2!}\right)^{5} \cdot \left(\frac{\Lambda^3 e^{-\Lambda}}{3!}\right)^{2} = \mathcal{L}(\Lambda)$

c.) $(12 \cdot 1) + (5 \cdot 2) + (3 \cdot 2) = \frac{28 \text{ warblers}}{20 \text{ years}} = 1.4 \frac{\text{warblers}}{\text{yr}}$

$$\mathcal{L}(\Lambda) = \frac{\Lambda^{28} e^{-20\Lambda}}{u} \longrightarrow S(\Lambda) = \ln(\mathcal{L}(\Lambda)) = \ln\left(\frac{\Lambda^{28} e^{-20\Lambda}}{u}\right)$$

$$= \ln(\Lambda^{28}) + \ln(e^{-20\Lambda}) - \ln(u)$$

$$= 28 \ln(\Lambda) - 20(\Lambda) - \ln(u)$$

$$\frac{ds}{d\Lambda} = \frac{d}{d\Lambda}\left(28 \ln(\Lambda) - 20\Lambda - \ln(u)\right)$$

$$= \frac{28}{\Lambda} - 20 = 0 \longrightarrow \frac{28}{\Lambda} = 20 \longrightarrow 28 = 20\Lambda$$

$$\hat{\Lambda} = \frac{28}{20} = 1.4$$

d.) [The expected distrib. is how many 0 years we would get w/ $\Lambda = 1.4$, how many yrs, etc.

$$Pr(0 | \Lambda = 1.4) = e^{-1.4} = \frac{1}{4}$$

In 20 yrs, expect 5 w/ 0 warblers

To find the next value: $20 \cdot Pr(1 | \Lambda = 1.4)$

4/27/16

c.) χ^2! $\sum \frac{(O-E)^2}{E} = \frac{(1-5)^2}{5} + \dots$ could have $E < 5$. That's bad!

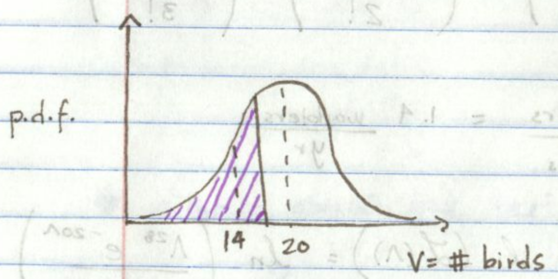
2.) 25 years, avg. of 20 birds/yr.
25 years, avg. of 17 birds/ year

a.) $V \sim N(20, 36)$

$$Pr(V \le 17) = Pr\left(\frac{V-20}{6} \le \frac{17-20}{6}\right)$$

$$= Pr(Z \le -0.5) = \Phi(-0.5)$$

$$= 1 - \Phi(0.5) = 1 - 0.69 = 0.31$$



b.) A = average over 25 years $= \frac{V_1 + V_2 + \dots + V_{25}}{25} = \frac{\sum_{i=1}^{25} V_i}{25}$

$$\boxed{\begin{array}{l} E(A) = E(V) \\ Var(A) = \frac{Var(V)}{n} \end{array}}$$

$$E(A) = E\left(\frac{\sum_{i=1}^{25} V_i}{25}\right) = \frac{1}{25}\sum_{i=1}^{25} E(V_i) = \frac{1}{25}(25 \cdot 20) = \underline{20}$$

$$Var(A) = \frac{Var(V)}{25} = \frac{36}{25}$$

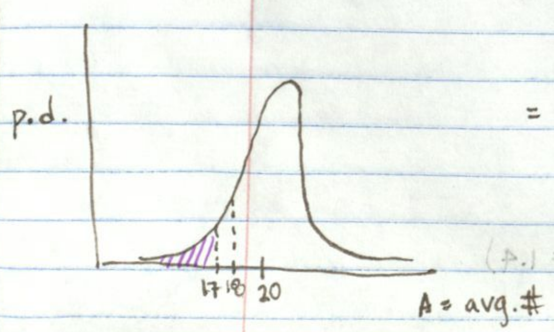
$$Pr(A \le 17) = Pr\left(\frac{A-20}{\sqrt{\frac{36}{25}}} \le \frac{17-20}{\sqrt{36/25}}\right)$$

$$= Pr(Z \le -3/1.2) = Pr(Z \le -2.5)$$

$$= 1 - \Phi(2.5) = 1 - 0.99379$$

$$= \boxed{0.00621}$$

$\boxed{p = 0.006!}$



4/27/16

e.) Use the t-test! → Null hypothesis is that the averages in the two sets of years are the same.

d.) Observer bias: change in observer skill
Correlation between years
Didn't correct for climate change