

(i) Given random variable X & Y. Show covanance is zero ie cov (X,y) = 0.

If X & I are independent, then they are incorrelated. cov(x,y)=

Given :

$$Cov(Xy) = E(X,EX)(Y-ET)$$

$$= E(X-(Y-ET)-EX(Y-ET))$$

Therefore COV G(y) = E(XY) - EXEY

For independent variable  $X \not Y$   $E(XY) = E(X) \cdot E(Y)$  $= E(X) \cdot E(Y)$ 

Hence

= 0

Therefore this proves that given one-dimensional random Variables X & Y and they are independent, their covanance is zero

$$\frac{\text{Cov}(X,Y)}{6} = 0$$

Questión 2 P Total Orgages limes Apples 10 red (r) 3 0.2 green (g) 10 05 3 4 blue (b) 0.3 2 3 Probability of selecting an apple p(a) = p(randa) or p(g anda) or p(b anda) = p(randa) = p(r) and p(a)  $= 0.2 \times 0.3$ = p(g and a) = p(g). p(a) 05×0.3 = 0.15 = P(b and a) = p(b) and p(a) 03 x 1/3 = 3/10 × 1/3 = 1/10 p(a) =Therefore 0.06+0.15+0.1 0.31 Therefore, the probability of selecting an apple 031

(11) Probability than an orange came from the green box.

$$P(g|g) = p(0|g) \cdot p(g) \quad \text{Baye's rule}$$

$$P(0) = p(0|g) = 3/0 = 0.3$$

$$= p(g) = 0.5$$

$$= p(0) = p(0 \text{ and } g) \quad \text{or} \quad p(0 \text{ and } b) \quad \text{or} \quad p(0 \text{ and } g)$$

$$P(0 \text{ and } r) = 4/10 \times 3/10 = 0.388$$

$$P(0 \text{ and } g) = 3/10 \times 3/10 = 0.15$$

$$P(0) = 0.08 + 0.2 + 0.15$$

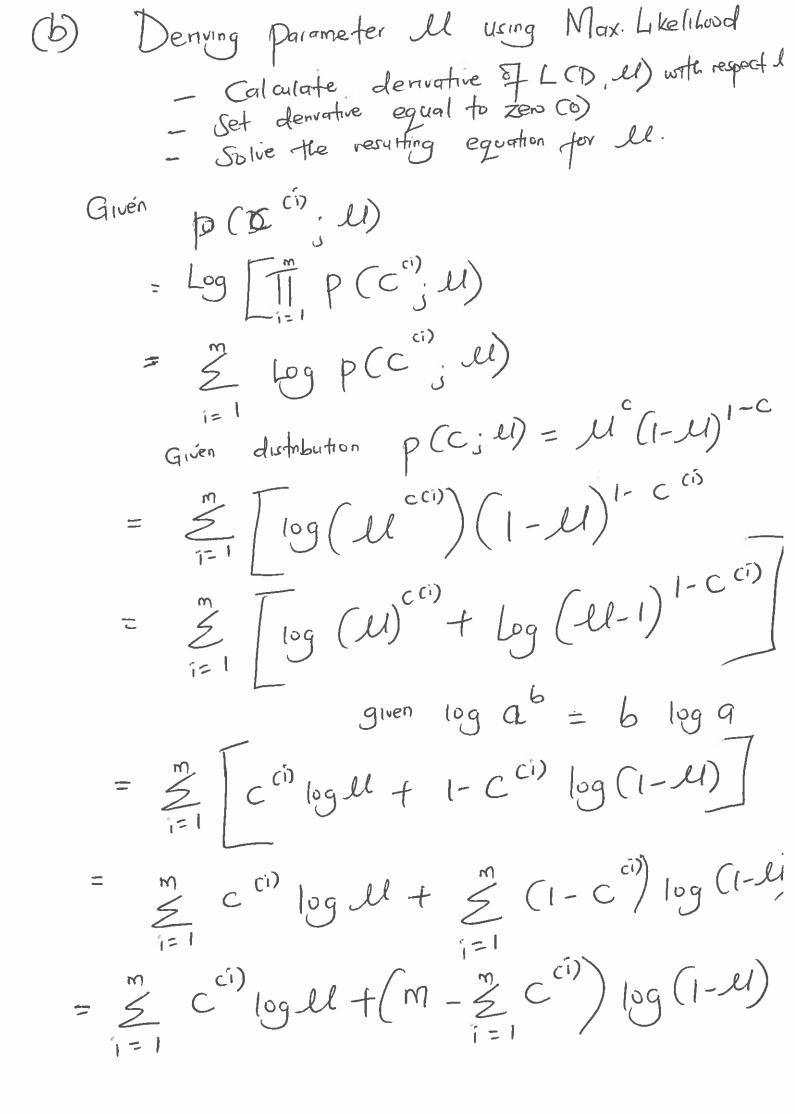
$$= 0.43$$
Hence
$$= 0.3 \times 0.5$$

$$0.43$$

$$= 0.35$$

Therefore; probability that a relected fruit orange came from the green box is 0.35

Question 3 Klating the likelihood function Given  $D = \{C(i), C(m)\}$ C € 20,14 M times flip and ci) clenating 1th flip than: Estimate II p (Ci) U) - Wotation.  $= \prod_{i=1}^{m} \left( \mathcal{U}^{(i)} \left( 1 - \mathcal{U} \right)^{1 - C(i)} \right)$  $= \mathcal{U}^{(ci)}_{(1-\mathcal{U})}^{(1-cci)} \times \mathcal{U}^{(cci)}_{(1-\mathcal{U})}^{(1-\mathcal{U})}^{(1-ccc)}$   $---- \mathcal{U}^{(ccm)}_{(1-\mathcal{U})}^{(1-\mathcal{U})}^{(1-\mathcal{U})}^{(1-ccm)}$  $=\mathcal{U}^{\frac{m}{2}}C^{(i)}\left(1-\mathcal{U}\right)^{m-\frac{m}{2}}C^{(i)}$ given & C ci) can be rewritten as ll (1-ll) m-H Therefore the likelihood function or the probability of  $P(D; \mathcal{U}) = |\mathcal{U}| (1-\mathcal{U})^{m-H}$ 



Hence
$$\frac{d}{du} \log u = |_{u} \text{ and}$$

$$\frac{d}{du} \log (1-u) = \frac{1}{u-1}$$

$$\frac{d}{du} \log (1-u) = \frac{1}{$$

Denving the analytical expression of parameter U using MAD estimation. Pastenor = Likelihood X Prior Endence p(OD) = p(DD) p(O) Q = qig max p(O/D) & p(D/O) p(O) Given : Likelihood function: p(D; M) = MH (1-M) m-H
Dnor p(M; a) = 1/2 Ma-1 (1-M) a-1 M = M (1-W) m-H . 1/2 M 9-1 (1-M) 9-1 where  $u^* = arg max p(u|b) \propto p(b|u) p(u)$ = MH+a-1. 1/2 ((-W) m-H+Ca-1) = log [ = 10] [ = 10] [ -10] m-H+(a-1) = \frac{1}{2} \left[ \log (U + 4 a-1) \] + \log (1-U) \( m - H + \alpha - 1) \]  $\frac{1}{2} \left[ \frac{H+(q-1)}{2} + \frac{m-H+(q-1)}{2} \right] = 0$ 

$$2 \times \frac{1}{2} \left( \frac{H + (a-1)}{2} + \frac{(m-H) + (a-1)}{2(1-1)} \right) = 0 \times 2$$

$$= \frac{H + a-1}{2} + \frac{m-H}{2} + \frac{a-1}{2} = 0$$

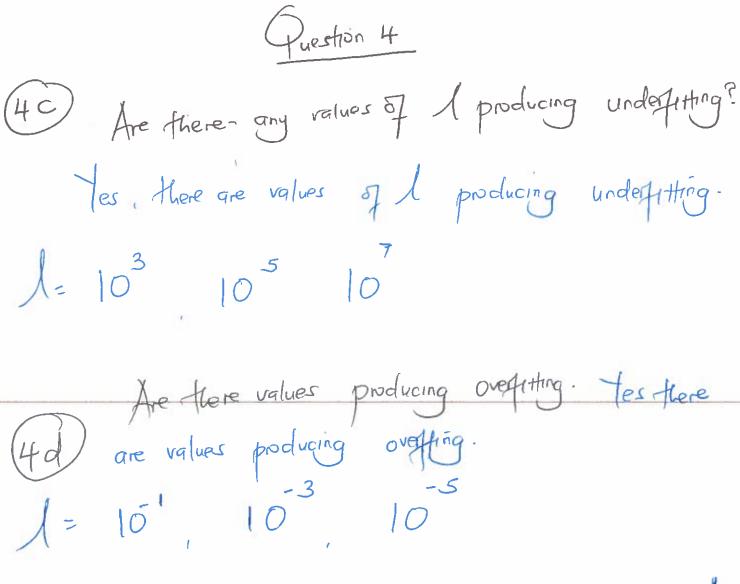
$$= 2 \times \frac{1}{2} \left( \frac{H + a-1}{2} + \frac{1}{2} + \frac{1}$$

 $\hat{M}_{MAP} = \frac{H+9-1}{M+29-2}$ 

Interpreted as the:

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Imaginary examples where the larger the a is the more controlled we are about the prior and the less the a is the less controlled or sure we are about the prior.



(4e) 62 (4) produces more overfitting compared to 6 (2x)

(2(x) which is achieved by plotting the quadratic model

produces more overfitting compared to 6(x) as it fends to

produce more reliance on the training data than 6(x).

les, cross-validation score a good predictor of performance on the test data. This is because it holds out part of the data for testing (x text and 1-test) and texts class multiple times by providing different combinations of training and text data each time.