562 - Assignment 5

Q.1) $v_{rocky} = v_R = 2$ km/h

$v_{sandy} = v_S = 3$ km/h

$v_{smooth} = v_{Sm} = 5$ km/h

		Probabilities		
Routes	length	Sandy	Smooth	Rocky
Route 1	2 km	20%	30%	50%
Route 2	1.8 km	40%	20%	40%
Route 3	3.1 km	50%	40%	10%

Expect travel time for a route:

$$E(R) = \sum \frac{P_{env} \times L_{Route}}{v_{env}}, \text{ where } P_{env} = \text{Probability of a terrain}$$

L_R = length of route

v_{env} = velocity on that terrain

$$E(R_1) = \frac{P_R \times L_{R1}}{v_R} + \frac{P_S \times L_{R1}}{v_S} + \frac{P_{Sm} \times L_{R1}}{v_{Sm}}$$

$$= L_{R1}\left(\frac{P_R}{v_R} + \frac{P_S}{v_S} + \frac{P_{Sm}}{v_{Sm}}\right) = 2\text{km}\left(\frac{0.5}{2\frac{\text{km}}{\text{h}}} + \frac{0.2}{3\frac{\text{km}}{\text{h}}} + \frac{0.3}{5\frac{\text{km}}{\text{h}}}\right)$$

$E(R_1) = 2 \times (0.25 + 0.067 + 0.06)$

$= 0.754$ hours

$$E(R_2) = 1.8 \times \left(\frac{0.4}{2} + \frac{0.4}{3} + \frac{0.2}{5}\right) = 0.672 \text{ hours}$$

$$E(R_3) = 3.1 \times \left(\frac{0.1}{2} + \frac{0.5}{3} + \frac{0.4}{5}\right) = 0.920 \text{ hours}$$

Route 2 is the best route as it has the lowest expected travel time

Q.2) $P_{damaged} = 30\%$, $T_{damaged} = 0.75$ hours

$$E(R_1)^* = E(R_1) + (P_{damaged} \times T_{damaged}) + (P'_{damaged} \times T'_{damaged})$$

$= 0.754\text{h} + (0.3 \times 0.75) + (0.7 \times 0)$

$= 0.979\text{h}$

(2.2) Route 2:

$P_{damaged} = 0.6$, $T_{damaged} = 1\,h$

$E(R_2)^* = E(R_2) + (P_{damaged} \times T_{damaged})$

$= 0.672 + (0.6 \times 1)$

$= 1.272$

Route	R_1'	R_2'	R_3
$E(R)$	0.979 h	1.272 h	0.920 h

With this new information, R_3 is the best route.

(2.3) Current expected travel time:

$E(R_3) = 0.920\,h$

Need to find Value of Information

VoI = Time saved if terrain is smooth

$E(R_{3\,satellite}) = \frac{P_{sm} \times LR_3}{V_{sm}} + P'_{sm} \times \left(\frac{LR_3}{V_R} + \frac{LR_3}{V_S} \right)$

$= \frac{0.4 \times 3.1}{5} + 0.6 \times \left(\frac{3.1}{2} + \frac{3.1}{3} \right)$

$VoI = E(R_3) - E(R_{3\,satellite})$

$E(R_{3\,satellite}) = \frac{P_{sm} \times LR_3}{V_{sm}} + \left(E(R_{3\,not\,smooth}) \times P'_{sm} \right)$

$E(R_{3\,not\,smooth}) = P_S \times \frac{LR_3}{V_S} + P_H \times \frac{LR_3}{V_H} = 3.1 \left(\frac{0.5}{3} + \frac{0.1}{82} \right)$

$= 0.672\,h$

$E(R_{3\,satellite}) = \frac{0.4 \times 3.1}{5} + 0.6 \times 0.672$

$= 0.248 + 0.4032 = 0.6512\,h$

So, $VoI = 0.920\,h - 0.6512 = 0.2688\,h$

VoI = 16 minutes