Ralph's responsibility assignment

This is a continuation of Demski's problem 19 in chapter 16 (16-19).

In attempting to decide whether to evaluate the manager's business unit as a cost center or a cost and revenue center, Ralph and the manager are faced with recognizing or identifying the information structure. Recall cost is either 1 or 2 and revenue is either 4 or 5. Ralph believes if the manager supplies input L then, on average, cost equals 1.7. On the other hand, if the manager supplies input H then, on average, cost equals 1.1, revenue, on average, equals 4.5, and importantly, the product of cost and revenue, on average, equals 4.99.[1] The latter quantity acknowledges the idea that encouraging the manager to chase low costs solely may prove detrimental to revenues even if the manager has no direct control over revenues.[2] The manager shares these expected value assessments.

$$\text{Expected value assessments}$$
$$E\left[c \mid L\right] = \left(p_{14|L} + p_{15|L}\right)1 + \left(p_{24|L} + p_{25|L}\right)2 = 1.7$$
$$E\left[c \mid H\right] = \left(p_{14|H} + p_{15|H}\right)1 + \left(p_{24|H} + p_{25|H}\right)2 = 1.1$$
$$E\left[r \mid H\right] = \left(p_{14|H} + p_{24|H}\right)4 + \left(p_{15|H} + p_{25|H}\right)5 = 4.5$$
$$E\left[c \cdot r \mid H\right] = p_{14|H}\left(1 \cdot 4\right) + p_{15|H}\left(1 \cdot 5\right) + p_{24|H}\left(2 \cdot 4\right) + p_{25|H}\left(2 \cdot 5\right) = 4.99$$

Hence, these common assessments lead to common knowledge (maximum entropy) probability assignments.

Required:

1. Using maximum entropy probability assignment (see Ralph's probability assignment), identify the joint probability assignment for cost and revenue given the manager supplies input L. That is, determine $p_{14|L}$, $p_{15|L}$, $p_{24|L}$, and $p_{25|L}$.

2. Using maximum entropy probability assignment, identify the joint probability assignment for cost and revenue given the manager supplies input H. That is, determine $p_{14|H}$, $p_{15|H}$, $p_{24|H}$, and $p_{25|H}$.

3. Do you expect Ralph to evaluate the manager's business unit as a cost center or cost and revenue center? Is revenue conditionally informative given the cost measure?

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[1] This latter knowledge could be described (or scaled) in terms of covariance, or equivalently, correlation and standard deviations.

[2] It may be instructive to think of a manager of a service center, for instance.