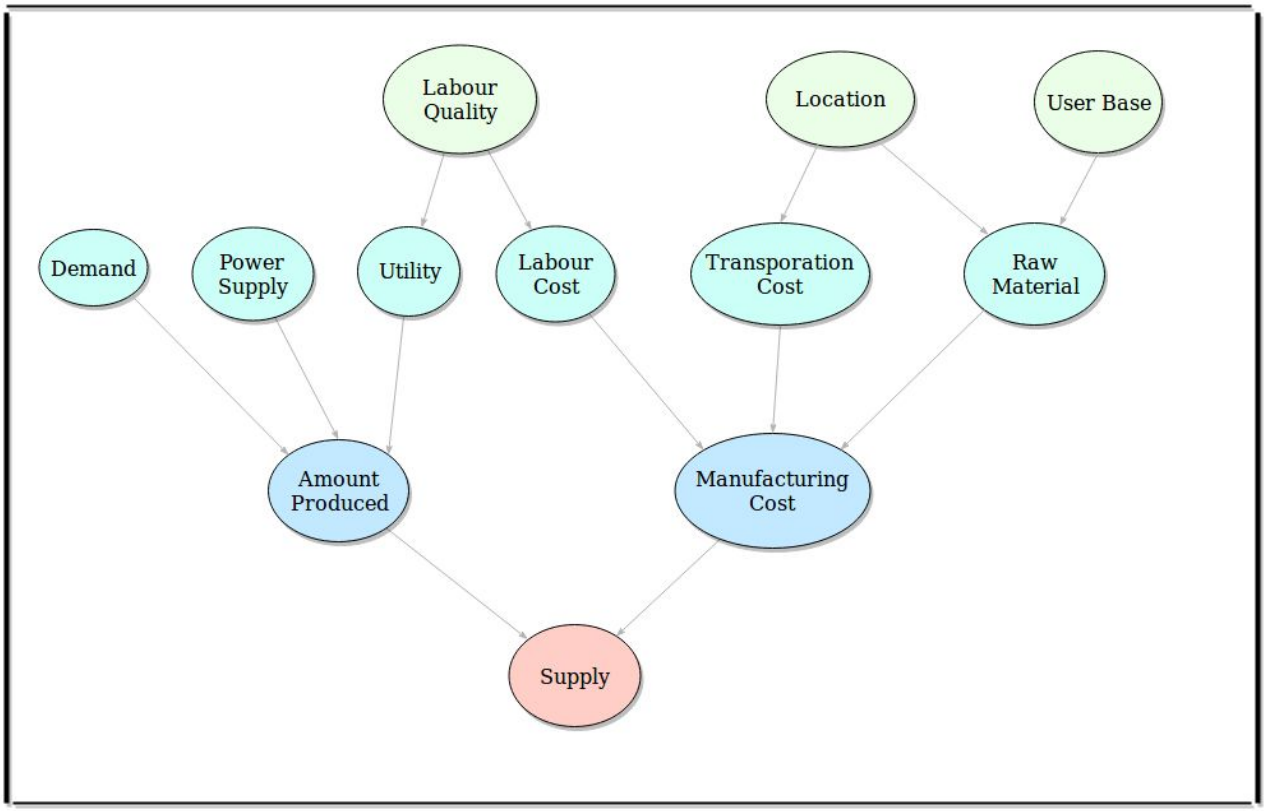
BAYESIAN BELIEF NETWORK

-20161094

-20161093



Key

LQ	Labour Quality	Low, Medium, High
D	Demand	Low, Medium, High
Loc	Location	Region 1, Region 2, Region 3

UB	Userbase	Less, More
PS	Power Supply	Regular, Non-Regular
U	Utility	Less, More
LC	Labour Cost	Low, Medium, High
TC	Transportation Cost	Low, Medium, High
R	Raw Material	Cotton, Wool, Silk
A	Amount Produced	2, 4, 7 (in millions)
MC	Manufacturing Cost	Low, Medium, High
S	Supply	Regular, Non-regular

Conditional Probability Tables

Labour Quality

LQ	Low	Medium	High
P(LQ)	0.3	0.4	0.3

Demand

D	Low	Medium	High
P(D)	0.3	0.4	0.3

Location

Loc	Region 1	Region 2	Region 3
P(Loc)	0.35	0.35	0.3

Userbase

UB	Less	More
P(UB)	0.5	0.5

Power Supply

PS	Regular	Non-Regular
P(PS)	0.5	0.5

Utility

LQ	U.Low	U.Medium	U.High
Low	0.8	0.2	0
Medium	0.3	0.6	0.1
High	0	0.2	0.8

Labour Cost

LQ	LC.Low	LC.Medium	LC.High
Low	0.8	0.2	0
Medium	0.3	0.6	0.1
High	0	0.2	0.8

Transportation Cost

Loc	TC.Low	TC.Medium	TC.High
Region 1	0.5	0.3	0.2
Region 2	0.2	0.6	0.2
Region 3	0.1	0.3	0.6

Raw Material

Loc	R.Cotton	R.Wool	R.Silk
Region 1	0.9	0	0.1
Region 2	0.1	0.1	0.8
Region 3	0	0.95	0.05

Amount Produced

U	PS	D	A.2	A.4	A.7
Less	Non-Regular	Low	0.8	0.2	0
Less	Non-Regular	Medium	0.6	0.3	0.1
Less	Non-Regular	High	0.5	0.4	0.1
Less	Regular	Low	0.5	0.4	0.1
Less	Regular	Medium	0.3	0.5	0.2
Less	Regular	High	0.2	0.5	0.3
More	Non-Regular	Low	0.4	0.5	0.1
More	Non-Regular	Medium	0.3	0.5	0.2
More	Non-Regular	High	0.2	0.4	0.4
More	Regular	Low	0.2	0.5	0.3
More	Regular	Medium	0.2	0.3	0.5
More	Regular	High	0.1	0.2	0.7

Manufacturing Cost

LC	R	TC	MC.Low	MC.Medium	MC.High
Low	Cotton	Low	0.9	0.1	0
Low	Cotton	Medium	0.8	0.2	0
Low	Cotton	High	0.6	0.3	0.1
Low	Wool	Low	0.7	0.2	0.1
Low	Wool	Medium	0.6	0.3	0.1
Low	Wool	High	0.4	0.4	0.2
Low	Silk	Low	0.5	0.4	0.1
Low	Silk	Medium	0.4	0.3	0.3
Low	Silk	High	0.2	0.3	0.5
Medium	Cotton	Low	0.8	0.2	0
Medium	Cotton	Medium	0.6	0.2	0.2
Medium	Cotton	High	0.5	0.3	0.2
Medium	Wool	Low	0.5	0.4	0.1
Medium	Wool	Medium	0.4	0.4	0.2
Medium	Wool	High	0.3	0.3	0.4
Medium	Silk	Low	0.2	0.5	0.3

Medium	Silk	Medium	0.1	0.5	0.4
Medium	Silk	High	0	0.3	0.7
High	Cotton	Low	0.6	0.4	0
High	Cotton	Medium	0.4	0.4	0.2
High	Cotton	High	0.3	0.4	0.3
High	Wool	Low	0.3	0.4	0.3
High	Wool	Medium	0.2	0.5	0.3
High	Wool	High	0.1	0.4	0.5
High	Silk	Low	0	0.3	0.7
High	Silk	Medium	0	0.15	0.85
High	Silk	High	0	0	1

Supply

AP	MC	S.Regular	S.Non-Regular
2	Low	0.4	0.6
2	Medium	0.3	0.7
2	High	0.2	0.8
4	Low	0.7	0.3
4	Medium	0.5	0.5

4	High	0.4	0.6
7	Low	0.9	0.1
7	Medium	0.7	0.3
7	High	0.5	0.5

JUSTIFICATIONS

- The **transportation cost** is dependent upon the region in which transportation is to be done, in our Bayes net Region 1 is thought to be the cheapest while Region 3 the most expensive.

- **Raw Materials** available for production is dependent on the location of production, in our Bayes net it is assumed that Region 1 contains maximum cotton, Region 2 contains maximum wool and Region 3 contains maximum silk.

- The **amount of textile** produced is dependent on the **demand**, **utility** and **power supply**. Values of probabilities are assigned assuming that improvement in any of these would improve the probability of a better amount of production.

- The **manufacturing cost** is dependent upon labour cost, transportation cost, and raw material. The CPT is made assuming maximum effect due to raw material being used followed by **labour cost** and **transportation cost**.

- **Supply** is dependent upon Manufacturing cost and Amount of textile produced, as the amount increases or the manufacturing cost decreases the probability of having a regular supply increases.

QUERY

Form : P(X | p(X), p(p(X)))

Query : P(MC = High | R = Silk, Loc = Region 2)

```
P(MC = High | R = Silk, Loc = Region 2) = (P(MC = High | R = Silk, TC = Low) *
                                           P(TC = Low | Loc = Region 2)) +

                                          (P(MC = High | R = Silk, TC = Medium) *
                                          P(TC = Medium | Loc = Region 2)) +

                                          (P(MC = High | R = Silk, TC = High) *
                                          P(TC = High | Loc = Region 2))
```

```
P(LC = Low)       = P(LQ = Low) * 0.8 + P(LQ = Medium) * 0.3 + P(LQ = High) * 0
                  = 0.3*0.8 + 0.4*0.3 + 0.3*0
                  = 0.36

P(LC = Medium)    = P(LQ = Low) * 0.2 + P(LQ = Medium) * 0.6 + P(LQ = High) * 0.2
                  = 0.3*0.2 + 0.4*0.6 + 0.3*0.2
                  = 0.36

P(LC = High)      = P(LQ = Low) * 0 + P(LQ = Medium) * 0.1 + P(LQ = High) * 0.8
                  = 0.3*0 + 0.4*0.1 + 0.3*0.8
                  =  0.28
```

```
P(MC = High | R = Silk, TC = Low)   =     P(LC = Low) * 0.1 +
                                          P(LC = Medium) * 0.3 +
                                          P(LC = High) * 0.7
                                    = 0.36 * 0.1 + 0.36 * 0.3 + 0.28 * 0.7
                                    = 0.34

P(TC = Low | Loc = Region 2) = 0.2
```

```
P(MC = High | R = Silk, TC = Medium) =    P(LC = Low) * 0.3 +
                                          P(LC = Medium) * 0.4 +
                                          P(LC = High) * 0.85
                                     = 0.36 * 0.3 + 0.36 * 0.4+ 0.28 * 0.85
                                     = 0.49

P(TC = Medium | Loc = Region 2) = 0.6
```

```
P(MC = High | R = Silk, TC = High)  =     P(LC = Low) * 0.5 +
                                          P(LC = Medium) * 0.7 +
                                          P(LC = High) * 1
                                     = 0.36 * 0.5 + 0.36*0.7 + 0.28 * 1
                                     = 0.712

P(TC = High | Loc = Region 2) = 0.2
```

FINAL ANSWER

```
P(MC = High | R = Silk, Loc = Region 2) = (P(MC = High | R = Silk, TC = Low) *
                                          P(TC = Low | Loc = Region 2)) +

                                          (P(MC = High | R = Silk, TC = Medium) *
                                          P(TC = Medium | Loc = Region 2)) +

                                          (P(MC = High | R = Silk, TC = High) *
                                          P(TC = High | Loc = Region 2))

P(MC = High | R = Silk, Loc = Region 2)   = 0.34 * 0.2 + 0.49 * 0.6 + 0.712 * 0.2
                                          = 0.5044
```